Recovery Implementation Program

San Juan River Basin

Fiscal Year 2004 Annual Budget and Work Plan

Approved August 26, 2003

Amended November 20, 2003

San Juan River Basin Recovery Implementation Program

FY 2004 Work Plan

Approved August 26, 2003
Amended November 20, 2003

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Principal Investigators: David L. Propst and Amber L. Kingsbury
New Mexico Department of Game and Fish

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Miller Ecological Consultants

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Utah Division of Wildlife Resources

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Bureau of Indian Affairs

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U.S. Bureau of Reclamation

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U.S. Bureau of Reclamation

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A. Monitoring						
A-1	Adult/Juvenile Fish Community Monitoring	FWS, GJ	$ 84,604		$ 84,604	B
A-6	YOY/Small Bodied Fish Monitoring	NMDGF	$ 63,545		$ 63,545	B
A-11	Larval Colorado Pikeminnow Survey	UNM, NMDGF	$ 45,425		$ 45,425	B
A-17	Larval Razorback Sucker Survey	UNM, NMDGF	$ 50,310		$ 50,310	B
A-25	Specimen Curation/Identification	UNM	$ 28,980		$ 28,980	B
A-29	Channel Morphology	KB	$ 124,641		$ 124,641	B
A-33	Habitat Mapping	KB/ERI	$ 89,771		$ 89,771	B
A-36	Water Temperature Monitoring	KB	$ 8,810		$ 8,810	B
A-38	Water Quality Monitoring	KB	$ 30,924		$ 30,924	B
A-42	Update and Maintenance of GIS Database	UNM/KB	$ 65,205		$ 65,205	B
A-47	Publication of Supplemental Update to Larval Sucker Guide	CSU-Larval Fish Lab	$ 5,864	$10,000	$ 15,864	B
	Subtotal		**$ 598,079**	**$ 10,000**	**$ 608,079**	

Page #	Title	Agency	Program	Other Direct	Total	Base or Capital
B. Peer Review						
B-1	Peer Review	BIO-WEST	$ 22,000		$ 22,000	B
	Subtotal		**$ 22,000**		**subtotal $ 22,000**	
C. Research Activities						
C-1	Population Model Maintenance	MEC/ERI	$ 38,425		$ 38,425	B
C-4	Assessment of Fish Movement at Hogback	FWS, Abq.	$ 26,112		$ 26,112	B
C-9	Trophic Relationships Among Colorado Pikeminnow and Its Prey in the San Juan River	NMDG&F KSU	$ 51,000		$ 51,000	B
C-23	Assessment of Colorado Pikeminnow Augmentation	BIO-WEST, NMDG&F UNM	$144,561	$ 10,112	$ 154,673	B
C-37	Development of Stocking Protocols for Colorado Pikeminnow	BIO-WEST, FWS	$ 22,000			B
	Subtotal		**$ 282,098**	**$ 10,112**	**Subtotal $ 292,210**	

Page #	Title	Agency	Program	Other Direct	Total	Base or Capital
D. Recovery Efforts						
D-1	Nonnative Species Control, PNM to Shiprock	FWS, Abq	$ 147,382		$ 147,382	B
D-7	Nonnative Species Control - Lower San Juan	UDWR and others	$ 112,220		$ 112,220	B
D-11	Razorback Sucker Augmentation and Monitoring	FWS, G.J.	$ 143,100		$ 143,100	B (12,000 C)
D-18	Colorado Pikeminnow Fingerling Production	FWS/DNF HTC	$ 68,344		$ 68,344	B
D-22	Stocking of Fingerling Colorado Pikeminnow	FWS, G.J.	$ 15,144		$ 15,144	B
D-25	Interim Holding Facility for Larval Razorback Sucker	UNM	$ 18,400		$ 18,400	B
D-30	Razorback Sucker Pond Limnological Study	ERI/BIA	$ 34,660		$ 34,660	B
	Subtotal		**$ 539,250**	**$ 0**	**subtotal $ 539,250**	

Page #	Title	Agency	Program	Other Direct	Total	Base or Capital
E. Hydrology Committee						
E-1	Completion of 3rd Generation Model and Documentation	BR	$ 91,000		$ 91,000	B
E-3	Maintenance & Operation of Model	BR	$ 53,774		$ 53,774	B
E-6	Improve Stream Gaging	BR	$ 5,500		$ 5,500	B
	Subtotal		**$ 150,274**		**subtotal $ 150,274**	
F. Program Coordination and Management						
F-1	Program Coordination	FWS, Abq	$ 145,680		$ 145,680	B
F-4	Program Management	BR	$ 56,400		$ 56,400	B
	Subtotal		**$ 202,080**	**$ 0**	**subtotal $ 202,080**	
G. Capital Projects and Management						
G- 1	Capital Projects Management	BR	$ 58,100		$ 58,100	C
G-5	Operation of PNM Fish Passage/Ponds	Navajo Nation	$ 66,315		$ 66,315	B
	Rearing Ponds					
	Subtotal		**$ 124,415**	**$ 0**	**Subtotal $ 124,415**	

Summary

Category	Program Base Funds	Program Capital Funds	Other Funds	Total Funds
A. Monitoring	$ 598,079		$ 10,000	$ 608,079
B. Peer Review	$ 22,000			$ 22,000
C. Research Activities	$ 282,098		$ 10,112	$ 292,210
D. Recovery Efforts	$ 527,250	$ 12,000		$ 539,250
E. Hydrology	$ 150,274			$ 150,274
F. Program Coordination and Management	$ 202,080			$ 202,080
G. Capital Projects	$ 66,315	$ 58,100		$ 124,415
Total Program Budget	**$ 1,848,096**	**$ 70,100**	**$ 20,112**	**$1,938,308**

MONITORING CHAPTER

2004 WORK PLAN

Adult/Juvenile Fish Community Monitoring
Fiscal Year 2004 Project Proposal
Updated 4 June 2003

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Background:

Studies performed before 1991 documented a native San Juan River fish fauna of eight species, including Colorado pikeminnow (previously known as Colorado squawfish), razorback sucker, and roundtail chub and provided baseline information on distribution and abundance of native and introduced fish species in the San Juan River. Main channel fish community monitoring studies (known as "adult monitoring") performed from 1991 to 2002 refined this baseline data and provided data on specific habitat usage by rare fish species. Adult monitoring proved to be a highly effective tool for monitoring populations of stocked razorback sucker and Colorado pikeminnow. Information gathered during adult monitoring also aided in the selection of specific sites for detailed hydrologic measurements and larval drift sampling. Integration of adult monitoring data with data from Colorado pikeminnow macrohabitat studies, razorback sucker experimental stocking studies, tributary and secondary channel studies, fish health studies, contaminants studies, habitat mapping studies, and non-native species interaction studies, helped provide data to make flow recommendations for reoperation of Navajo Reservoir.

Intensive electrofishing surveys conducted from 1991 to 2002 greatly expanded our knowledge on the distribution and abundance of the San Juan River fish community. As of October 2002, nineteen wild Colorado pikeminnow (two juveniles and 17 adults) have been collected and PIT-tagged; 13 of the 19 Colorado pikeminnow were radio-tagged. In addition, 39 adult and over 200 juvenile stocked Colorado pikeminnow have been recaptured (95 of these fish were captured on the October 1998 adult monitoring trip). Thirty-four roundtail chub were collected, 25 of these were PIT-tagged. No wild razorback sucker were collected, however over 100 recaptures (including multiple recaptures of individual fish) have occurred with stocked razorback sucker during adult monitoring trips. The 2003 adult monitoring trip is scheduled for late September through early October 2003. This trip is already funded via FY-2003 funds.

The need for a long-term, standardized monitoring program, such as the adult monitoring study, is addressed in objective 5.7.1, a Milestone in the San Juan River Long Range Plan. Additionally, future monitoring will help determine fish community response to reoperation flows from Navajo Dam (objective 5.2.10), as well as monitoring both wild and augmented populations of Colorado pikeminnow and razorback sucker (objective 5.3.9).

Adult monitoring will continue with one trip in fall 2003, to measure fish community response to reoperation flows from Navajo Dam, monitor populations of stocked Colorado pikeminnow and razorback sucker, and assess the impacts of management actions (e.g., nonnative fish removal efforts) on native fish species. In support of objective #3 below, nonnative fish removal will continue to be done on adult monitoring trips. The study design for adult monitoring is based upon the criteria for long-term monitoring of the San Juan River main channel fish community. These criteria were accepted as final by the San Juan River Biology Committee on 31 March 2000.

Description of Study Area:

The study area for adult monitoring extends from river mile (RM) 180.0 (Animas River confluence) in Farmington, New Mexico, downstream to RM 2.9 (Clay Hills Landing) just above Lake Powell in Utah. The entire reach of river from RM 180.0 to RM 2.9 will be sampled in the fall of every year (sampling to begin in the second to third week of September).

Objectives:

1.) Monitor the San Juan River's main channel fish community, specifically the large-bodied fish species, to identify shifts in fish community structure, species abundance and distribution, and length/weight frequencies that are occurring corresponding to management actions that are being implemented by the San Juan River Recovery Implementation Program. These include (but may not be limited to) the following:

a) reoperation of water releases from Navajo Reservoir
b) mechanical removal of nonnative fishes
c) modification or removal of instream water diversion structures
d) augmentation efforts for both federally-listed endangered fish species - Colorado pikeminnow and razorback sucker

2.) Monitor population trends (e.g., distribution and abundance, habitat use, spawning and staging areas, growth rates, recruitment) of the rare San Juan River fish species - Colorado pikeminnow, razorback sucker, and roundtail chub (both wild and stocked fish).

3.) Remove nonnative fish species which prey upon and compete with native fish species in the San Juan River.

Methods:

Objectives 1-3: One adult monitoring trip will take place in fall 2004. This trip will sample from the Animas River confluence in New Mexico (RM 180.0) to Clay Hills Landing in Utah (RM 2.9). Electrofishing will be the primary sampling technique, although seining and trammel netting may also be employed.

Two oar-powered rafts, with one netter each, will electrofish in a continuous downstream fashion, with one raft on each shoreline. No outboard motors will be used. Sampling crews will consist of approximately 8-9 people (4 for electrofishing, 2 for baggage rafts, and 2-3 for other research elements that are being done simultaneously with our sampling). Electrofishing will sample two out of every three miles (approximately 120 total sampled miles). All fish collected will be enumerated by species and life stage every sampled mile. Every fifth sampled mile (known as a "designated mile" or DM), all fish collected will be weighed and measured. All native fish collected will be returned alive to the river. All nonnative fish collected will be removed from the river. All nonnative predatory fishes (i.e. - walleye, striped bass, largemouth bass, and smallmouth bass) collected will be weighed, measured, and have stomach contents taken, before being removed from the river. Tag numbers, total length, and weight will be recorded on all recaptured, FLOY-tagged fish (both native and nonnative), as well as any rare fish collected.

Colorado pikeminnow, razorback sucker, and roundtail chub greater than 200 mm TL will be implanted with PIT (Passive Integrated Transponder) tags. Notes will be kept on any parasites and/or abnormalities observed on collected fishes.

Electrofishing will follow the methods set forth above and in the long-term monitoring plan. Seining and trammel netting may be done where suitable habitat is available at the sampling crews' discretion. The Service will have the lead for adult monitoring trips and other cooperating agencies will provide personnel and equipment as needed. Costs for cooperating agencies are included in this budget.

Products:

An interim progress report for adult monitoring data collected during 2004 is scheduled to be available by 31 March 2005. The "draft final" of this interim progress report which incorporates comments received, is scheduled to be completed by 1 June 2005. DBASE IV files containing information on total catch and length/weight data gathered on adult monitoring trips will be submitted to the University of New Mexico's Museum of Southwestern Biology (Division of Fishes) for inclusion on the San Juan River Recovery Implementation Program integrated database CD-ROM and web page by 31 March 2005.

Fiscal Year 2004 Budget:

Personnel	
Objectives 1-3 (110 man days): logistics, electrofishing, removal of nonnative fish	$23,750
Subtotal	$23,750
Travel and Per Diem (32 days)	$ 6,950
Coordination, meeting attendance, data input, data analysis, report writing (55 days)	$17,770
Subtotal	$24,720
Office Support	
Project Leader (2 weeks) and Administrative Officer (2 weeks)	$ 6,200
Office supplies (telephone, Copier lease, paper, misc supplies, postage, software)	$ 2,000
Subtotal	$ 8,200
Equipment and Supplies--i.e., fuel, vehicle maintenance, and repair/replacement/maintenance of field equipment, including: dip nets, oar-blades, PIT tag gear, rafts, raft trailer, generators, electrofishing equipment, life jackets, camping equipment, etc. ***	$ 5,500
Total	$62,170
Service Administrative Overhead (20.00%)	$12,434
U.S. Fish and Wildlife-CRFP Total	$74,604
Funding for participation of other agencies:	
New Mexico Dept. of Game and Fish-Santa Fe	$ 3,000
U.S. Fish and Wildlife Service-Albuquerque	$ 3,000
Utah Division of Wildlife Resources-Moab	$ 4,000
Subtotal	$10,000
GRAND TOTAL	**$84,604**

*** The 'Equipment and Supplies' costs listed here represent the costs anticipated to be incurred by CRFP in FY-2004 for performing our own field work as well as providing equipment for other agencies (UDWR-Moab and USFWS-Albuquerque) with whom we are cooperating on approved SJRIP projects. Our total anticipated cost for 'Equipment and Supplies' in FY-2004 (i.e. $11,000) has been distributed across two CRFP workplans, of which this workplan is one.

Previous Years' Funding:

Fiscal Year 1998	$50,000
Fiscal Year 1999	$43,900
Fiscal Year 2000	$43,900
Fiscal Year 2001	$54,400
Fiscal Year 2002	$58,000
Fiscal Year 2003	$59,740

Estimated Outyear Funding (based on an annual 5% increase as agreed upon by the SJRIP Biology Committee at their 21 May 2002 meeting):

Fiscal Year 2005	$ 88,800
Fiscal Year 2006	$ 93,240
Fiscal Year 2007	$ 97,900
Fiscal Year 2008	$102,800

YOY/Small Bodied Fish Monitoring
Fiscal Year 2004 Project Proposal

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Background:

As set forth in Section 5.7 of the San Juan River Basin Recovery Implementation Program (SJRIP) Long-Range Plan, a long-term monitoring program "to identify changes in the endangered and other native species populations, status, distributions and habitat conditions" was to be developed by the SJRIP Biology Committee. The ichthyofaunal monitoring portion of the San Juan River Monitoring Plan and Protocols (Propst, et al., 2000) was divided into four primary areas, larval fish (drift sampling), larval fish (seining), young-of-year/small bodies, and subadult and adult/large-bodied fishes. The portion of the San Juan River to be monitored extends from the confluence of the Animas and San Juan rivers (Farmington) to Lake Powell (Clay Hills Crossing). The following work proposal for 2004 is to conduct the young-of-year/small-bodied fishes monitoring effort per protocols set forth in the San Juan River Monitoring Plan and Protocols (SJRMPP). Beginning in 2004, specimens collected from each mesohabitat will be preserved separately, data will be recorded in database by mesohabitat, and annual reporting will include summary of species occurrences by mesohabitat.

In addition to accomplishing work (field, laboratory, data analysis, and report writing) specific to the young-of-year/small-bodied fish monitoring effort, NMGF personnel participate in telemetry studies, native-nonnative interactions study, Colorado pikeminnow augmentation evaluation, and larval fish sampling of the San Juan River Basin Recovery Implementation Program. This work and budgeting for NMGF participation in these activities is included with Scopes of Work for each activity and submitted by Principal Investigator(s) for each.

Study Area:

The study area for YOY/small bodied fish monitoring extends from river mile RM 180.0 (Animas River confluence) in Farmington, New Mexico, downstream to RM 2.9 (Clay Hills Crossing) just above Lake Powell in Utah.

Collections:

Specimens collected will be inspected to determine if any rare fishes (Colorado pikeminnow, roundtail chub, and razorback sucker) are present in a sample or collection. All identifiable rare fish and all large- bodied native fish (i.e., flannelmouth and bluehead suckers)>150 mm TL will be released. Specimens from each sampled mesohabitat will be preserved separately. All other specimens will be preserved in 10% formalin and returned to the New Mexico Department of Game and Fish Laboratory for identification, enumeration, and measurement (total length and mass).

Objectives:

The objectives of this portion of the San Juan River monitoring effort are to obtain data that will aid in the evaluation of the response (e.g., reproduction, recruitment, and growth) of native and nonnative fishes to different flow regimes and other management actions (e.g., impediment modification), track trends in species populations (e.g., abundance and relative condition) and characterize patterns of habitat use. The data will also be available to all researchers and may be used in conjunction with data obtained in other studies to evaluate future management activities.

Methods:

The study reach (Farmington to Clay Hills Crossing) includes geomorphic reaches 6 through 1, with Reach 1 being the most downstream. As stated in SJRMPP, sampling will occur every third mile within the study reach. Secondary channels are defined as channels having less than 25% of the volume of flow at the time of sampling and are at least 300 m in length. Inflow at the top of a channel is not necessary for it to be classified as a secondary channel. If any portion of a secondary channel (except mouth) is within a designated sample mile, the secondary channel will be sampled. Young-of-year/small-bodies fish monitoring will occur in conjunction with the large-bodied fish monitoring effort. All secondary channels in each third-mile will be sampled. Primary channel shoreline habitats will be sampled in 3-mile increments. Field work will be accomplished in autumn (late-September through mid-October) and involves one foray through each of three macro-reaches (Farmington-Shiprock, Shiprock-Four Corners, and Four Corners-Cray Hills Crossing).

Primary channel and secondary channel sampling sites will be within the same river mile. In addition to structured primary channel sampling, all backwaters and embayments (>25 m^2) associated with the primary channel within each third-mile will be sampled.

Sample sites within secondary channels will be a sufficient distance from the inflow to and outflow from the secondary channel to minimize primary channel faunal and physiochemical influences. Secondary channel sample sites will be at least 100 and not more than 200 m in length. All mesohabitats (e.g., pool, riffle, riffle-eddy, and shoal) within the site will be sampled in approximate proportion to their availability within the site; typically, at least five mesohabitat types will be sampled in each secondary channel. Each mesohabitat will be sampled separately

with 3.2 x. 1.6 m (4 mm mesh) drag seines. Each secondary channel sampling effort will be a minimum of 5 seine hauls. The number of seine hauls, total area (m^2) seined, and types of mesohabitats sampled will be recorded on standard field forms. Specimens collected in each mesohabitat will be inspected to determine if any rare fishes (Colorado pikeminnow, roundtail chub, and razorback sucker) are present in the seine. If a rare fish is captured, it will be identified, total length (±1.0 mm) and mass (±1.0g) determined, and released. Any rare fish >150 mm TL will be scanned to determine presence of a PIT tag. If none is present, the specimen will be implanted with a PIT tag having a unique alphanumeric code. All pertinent data (i.e., total and standard lengths, mass, PIT tag code, mesohabitat, water depth, substrate, and cover) on rare fish captured will be recorded. All large-bodied native fish (i.e., flannelmouth and bluehead suckers) will be weighed, measured, and released. All other specimens will be preserved separately by mesohabitat in 10% formalin and returned to the New Mexico Department of Game and Fish Laboratory for identification, enumeration, and measurement (total length and mass). Field collection number, habitat number, and river mile will be recorded on a water-proof label and placed in each specimen container. Location of site (UTM) will be determined with a GPS unit. Identification of all retained rare fishes will be confirmed by personnel of the Museum of Southwestern Biology. Preserved specimens will be accessioned to the New Mexico Department of Game and Fish Collection of Fishes or the University of New Mexico Museum of Southwestern Biology.

Within each third-mile, shoreline habitats of the primary channel will be sampled. At each designated mile, all mesohabitats (e.g., riffle, debris pool, and shoal) along 200 m (near center of mile) of shoreline will be sampled. All mesohabitats present will be sampled in approximate proportion to their availability within the site. Regardless of the number of mesohabitats present at a primary channel site, at least 5 seine hauls will be made with a drag seine (3.2 x 1.6 m, 4mm mesh). The shoreline (river right or left) sampled will be dependent upon accessibility of the shoreline. Where more than one shoreline is accessible (and can be seined efficiently), that with greater diversity/complexity will be sampled. Location (UTM) will be determined with a GPS unit. Specimen and habitat data will be obtained and recorded as required for secondary channel sampling. All retained specimens from primary channel sampling will be preserved separately from the adjacent secondary channel collection. All retained specimens will be accessioned to the New Mexico Department of Game and Fish Collection of Fishes or the University of New Mexico Museum of Southwestern Biology.

Backwaters and embayments (>25 m^2) not located within structured primary channel sampling sites also will be sampled. During periods of low flow, secondary channel mouths frequently function as backwaters or embayments. In this monitoring effort, secondary channel mouths without surface inflow from upstream will be treated as backwater/embayment habitat. The maximum number of backwaters or embayments sampled will be one per mile. Three seine hauls will be made in each backwater or embayment sampled. All specimens collected, except rare fishes, will be retained and returned to the laboratory for identification and enumeration. All rare fish will be measured and released; those >150 mm will be PIT tagged. Data collection and recording of relevant information (including GPS determined location) will be the same as for secondary and primary channels.

Ambient temperature and water quality data (water temperature, dissolved oxygen, conductivity, and salinity) will be measured in each sampled secondary channel, at primary channel sites and in backwaters/embayments. Secondary channel water quality data will be obtained a sufficient distance from the inflow to the secondary channel to minimize primary channel influences. All water quality data for each sample will be recorded on standard field forms.

Products:

Data collected during the 2004 monitoring effort will be summarized by geomorphic reaches. Minimally, the annual report will report density per species (number/m^2) per geomorphic reach (primary and secondary channels and backwaters) and rare fishes and the mesohabitats each was found in. Data obtained from secondary and primary channel sampling will be reported separately. Community-comparison metrics, such as the Shannon-Wiener Index and Morisita's Index of Diversity, will be used for longitudinal and annual comparisons. River discharge data (Four Corners gage) will be used to assess the effect of discharge volume on species density estimates. All data obtained during 2004 monitoring activities will be electronically recorded in a format to be determined by the SJRIP Biology Committee. The annual report (including electronic database) will be submitted to the SJRIP Biology Committed by 31 March 2004.

Literature Cited:

Propst, D.L., S. P. Platania, D.W. Ryden, and R. Bliesner. 2000. San Juan River Monitoring Plan and Protocols. San Juan Basin Recovery Implementation Program. U.S. Fish and Wildlife Service, Albuquerque, NM.

Budget[1]:

Young-of-year/small-bodied Monitoring (Field)		
	Personnel (36 staff days)	$ 9,450
	Travel and per diem	3,150
Specimen sorting and identification, specimen curation, and data compilation		
	Personnel (84 staff days)	22,050
Annual small-bodies/YOY data synthesis, analysis, and report preparation		
	Personnel (55 staff days)	14,450
	Administrative Support (10 man days)	2,100
	Subtotal	$51,200
Report reviews and integration (e.g., annual & Long Range Plan) and meeting attendance (per diem only)		
	Personnel (15 staff days)	3,940
	Travel and Per Diem	1,575
	Administrative Support (5 staff days)	1,050
	Subtotal	$ 6,565
	TOTAL	$57,765
	Indirect Costs (10%)	5,780
GRAND TOTAL		**$63,545**

[1]Budget does not include in-kind contributions of about $25,000 per year in salary and benefits. In-kind includes field time, data analysis and report preparation, meeting attendance, and administration.

Outyear Funding (based on 5% annual cost of living increases):

Fiscal Year 2000	$57,200
Fiscal Year 2001	51,700
Fiscal Year 2002	51,700
Fiscal Year 2003	49,775
Fiscal Year 2004	63,545
Fiscal Year 2005	66,725
Fiscal Year 2006	70,060
Fiscal Year 2007	73,560

San Juan River Larval Colorado Pikeminnow Survey
Fiscal Year 2004 Project Proposal

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Background:

Beginning in spring 1995, personnel from the Division of Fishes, Museum of Southwestern Biology (MSB), at the University of New Mexico assumed responsibility for the San Juan River larval fish passive drift-netting study. This project, formerly conducted by the Utah Division of Wildlife Resources, continued with only minor changes in sampling protocol. Data collected from this research activity provided several discrete types of information on the fishes of the San Juan River. Data that can be obtained on the endangered fishes of the river include determining approximate spawning period, identifying approximate location of spawning sites, and assessing effects of annual hydrology (and temperature) on their reproductive activities. Similar data could also be obtained for other members of the ichthyofaunal community and contrasted with previous drift-net sampling to assess the effects of that year's flow regime on fish reproduction. Samples collected during this research program were and will continue to be processed and curated by Fish Division personnel at the University of New Mexico.

Between 1993-2001, a total of six larval Colorado pikeminnow have been collected. The two YOY Colorado pikeminnow collected in 1993 (at Mexican Hat) were the same length (9.2 mm TL; MSB 18098, 18099) and were taken on consecutive days in late July (26-27). From these two individuals, we determined the date of spawning to be about 8-9 July 1995.

Two larval Colorado pikeminnow were taken at Mexican Hat during the 1995 larval fish passive drift-netting study. The first specimen, 9.5 mm TL mesolarvae (MSB 26187) was taken between 2114-2310 hours on 2 August 1995. The next morning (3 August 1995) between 0531-0800 hours, a second Colorado pikeminnow, 9.0 mm TL mesolarvae (MSB 26191) was collected. The

similar size and developmental stage of these two individuals, in combination with the fact that the two fish were collected within 12 hours of each other, strongly suggest that they were cohorts from a single spawning event. From these two individuals, a spawning date (between 15-17 July) was determined.

A single YOY Colorado pikeminnow was collected in 1996. That specimen was an 8.6 mm TL yolked-mesolarvae taken on 2 August 1996 in a drift net at the Mixer sampling locality (RM 128.0). The 1996 back-calculated spawning date for Colorado pikeminnow (18 July 1996) was similar to that predicted in 1995 despite considerable difference in spring peak discharge (1995 - 12,100 cfs; 1996 - 3,450 cfs) and total annual discharge. The 1997-2000 drift netting samples did not yield any Colorado pikeminnow.

A single larval Colorado pikeminnow was collected in 2001 at the Mixer sampling locality (RM 128.0). The specimen was collected on 1 August 2001, and was an 8.9mm yolked mesolarvae. From this specimen a spawning date between 17-18 July was determined.

Table 1. Summary of larval and YOY Colorado pikeminnow collected in the San Juan River during larval drift-netting (1993-2001) and back-calculated dates of spawning.

Field Number	MSB Catalog Number	Number specimen.	Total Length	Date Collected	Date Spawned	River Mile	Sample Method
MH72693-2	18098	1	9.2	26 Jul 93	08 Jul 93	53.0	drift netting
MH72793-2	18099	1	9.2	27 Jul 93	09 Jul 93	53.0	drift netting
JPS95-205	26187	1	9.2	02 Aug 95	15 Jul 95	53.0	drift netting
JPS95-207	26191	1	9.0	03 Aug 95	17 Jul 95	53.0	drift netting
WHB96-037	29717	1	8.6	02 Aug 96	18 Jul 96	128.0	drift netting
FC01-054	Not yet assigned	1	8.9	01 Aug 01	18 Jul 01	128.0	drift netting
TOTAL		**6**					

The specimen collected in 2001 represents the first non-stocked larval Colorado pikeminnow collected in the drift since August 1996. In 2001, less than 1,000 specimens were collected during a year replete with intense summer rainstorm events. These flushing flows transported considerable detritus into the river and overwhelmed drift collecting gear with debris. This excessive amount of debris required over a year of processing before fish could be separated from all samples and identified. The sampling conducted in 1999 occurred during an extremely low flow year, which was reflected in the collection of a very limited number of drifting larval

fish (only 84 at Four Corners and 79 at Mexican Hat). Conversely, 2000 was a Amore normal@ flow year resulting in the collection of over 2,100 specimens (1,370 at Four Corners and 768 at Mexican Hat). No Colorado pikeminnow were collected in drift studies during these years (1998-2000).

The limited number of wild adult San Juan River Colorado pikeminnow (versus stocked individuals) is reflected in the extremely low catch rate of larval Colorado pikeminnow. However, numerous adult and sub-adult pikeminnow have been stocked into the San Juan River over the last five years in an effort to augment the diminished population. The Colorado pikeminnow augmentation plan calls for continued stocking efforts in the San Juan River over the next 10 years. The San Juan River Biology Committee expects, as was documented with stocked razorback sucker, that reproduction among stock pikeminnow will occur and can be documented through the sampling of larval fish. There are no means to differentiate between native versus stocked larval Colorado pikeminnow.

As the number of adult (reproductively mature) Colorado pikeminnow in the San Juan River increases (due to both stocking and recruitment), so does the probability of elevated levels of spawning by this species. The San Juan River Biology Committee charged us with exploring the possibility of expanding the sampling effort for larval Colorado pikeminnow in fiscal year 2003. One means of accomplishing this task was to include an additional sampling site in (increasing from two to three sites). Another suggestion for FY 2003 Colorado pikeminnow studies was to perform targeted sampling for Colorado pikeminnow similar to that being performed for larval razorback sucker. Collections targeting larval Colorado pikeminnow could be accomplished either by expanding the duration of the current larval razorback sucker survey (April-June) or through development of a discrete (new) project.

These and other items were considered and evaluated during the February 2002 San Juan Biology Committee meeting. The team recommended the immediate expansion of the larval razorback sucker survey (April-June) to encompass the months of June, July, and August with seining efforts to target sampling for Colorado pikeminnow. This change in sampling protocol required deviation from the FY 2002 Scope of Work and was initiated July 2002 (using FY 2002 funds), and is proposed again for FY 2004.

Approval for this change in sampling was acquired at the 19-21 February 2002 San Juan Biology Committee meeting in Farmington, New Mexico. This new sampling protocol resulted in the collection of over 95,000 specimens for the Colorado pikeminnow larval survey in 2002. Unfortunately, no Colorado pikeminnow were collected.

The objectives of this specific monitoring effort are identified in the aforementioned document (1a, 3a, 3b) and listed below.

Study Area:

The principal sampling area for this study will be the San Juan River between Cudei Diversion Dam (near RM 142) and the Clay Hills boat landing (ca. RM 3) just above Lake Powell Utah. This study will include acquiring collections in reaches of the San Juan River under the jurisdiction of the National Park Service.

Objectives:

1.) Determine the relative annual reproductive success of Colorado pikeminnow (1a)
2.) Provide annual summaries of monitoring results (3a)
3.) Provide detailed analysis of data collected to determine progress towards endangered species recovery in three years and thence every five years (3b)
4.) Provide comparative analysis of the reproductive success of he San Juan River fishes
5.) Attempt to validate presumed spawning period of Colorado pikeminnow

Methods:

Sampling for Colorado pikeminnow larvae will be conducted in the San Juan River between Cudei (Rm 142) and Clay Hills (RM 2.9) from early July through mid-September using sampling techniques that will provide sufficient numbers of individual fish necessary to meet study objectives. Access to the river will be gained through the use of inflatable rafts. Sampling efforts for larval fish will be concentrated in low velocity habitats. Samples in those habitats will be collected with small mesh seines and light-traps.

Meso-habitat type, length, maximum and minimum depths, water clarity, and substrate will be recorded for each sampling locality. Digital photos as well as GPS coordinates will also be taken at each of the sampling localities. For seine samples, the length and number of hauls made will be recorded. The aforementioned habitat conditions will be recorded for all light-trap samples taken as well as time of placement and retrieval. Catch per unit effort for seine samples will be recorded as the number of fish per m^2 and number of fish per hour for specimens collected in light-traps.

Catch rate date will be compared across and within site by species. In addition, catch rate between and within site will be compared temporally. Specimens will be distinguished and compared by residence status (native versus non-native) and catch rate over-laid with the annual hydrograph.

Products:

Draft reports for the 2004 larval sampling activities and collection efforts will be prepared and distributed by 31 March 2005 to the San Juan River Biology Committee for review. Upon receipt of written comments, that report will be finalization and disseminated to members of the

San Juan River Biology Committee by 1 June 2005. Fish collected from those studies will be curated in the Division of Fishes, Museum of Southwestern Biology (MSB), Department of Biology, at the University of New Mexico. Original field notes will be retained in the Division of Fishes and collection information will be electronically stored in a permanent MSB database program where the geo-referenced collection information will be maintained in a consistent database and GIS format. These data and any maps generated from them will be available to the San Juan River Biology Committee via hard-copy reports and electronically. Electronic copies of the field and collection data will be transferred to the San Juan River database manager following the successful protocol previously employed.

Budget FY-2004:

Personnel		
Field Research Associate (40 staff-days) (sampling activities, collection management supervision, data entry)	$	12,000
Field Research Technicians (64 staff-days) (sampling activities, collection processing)	$	16,000
Subtotal	$	28,000
Travel and per diem		
Travel (mileage-4WD-Alb to sites)	$	2,600
Field per diem (90 staff-days)	$	4,600
Subtotal	$	7,200
Equipment and Supplies		
Equipment upkeep (trailer, raft)	$	1,500
Sampling/Field Gear (seines, GPS units, storage materials)	$	2,000
Laboratory Equipment/supplies (fixatives, jars, stereoscope, dissecting tools)	$	800
Subtotal	$	4,300
Total	$	39,500
Administrative Overhead	$	5,925
GRAND TOTAL	**$**	**45,425**

Out year Funding (based on 5% COLA increases):

Fiscal Year 2005	$	47,393
Fiscal Year 2006	$	49,763
Fiscal Year 2007	$	52,521

San Juan River Larval Razorback Sucker Survey
Fiscal Year 2004 Project Proposal

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Background:

In 1994, the first series of razorback sucker (n=672) were stocked in the San Juan River between Bluff, Utah and Hogback, New Mexico. Mean length and mass of those individuals, at the time of stocking, was about 400 mm TL and 710 g, respectively. In 1995, 13 of the recaptured razorback sucker were tuberculate males and six of those individuals were ripe. Four recaptured 1995-razorback sucker were determined to be female but, unlike the males, none were sexually mature. In their 1995 report of activities, Ryden and Pfeifer (1996) suggested that the majority of the experimentally stocked San Juan River razorback sucker reached sexual maturity in 1995-96 and that spawning of these individuals might begin in the next two years.

The UNM-NMGF larval fish drift study, whose primary focus was determining spawning period, identifying approximate location of spawning sites, and assessing effects of annual hydrology (and temperature) on Colorado pikeminnow reproductive activities, provided similar information for other members of the ichthyofaunal community. At the November 1996 San Juan River Biology Committee integration meeting, it was suggested that a portion of the larval fish drift study be expanded to allow for documentation of razorback sucker spawning. However, because reproduction by razorback sucker (March-May) occurred considerably earlier than Colorado pikeminnow (June-July), separate investigations of spawning periodicity and magnitude were necessary for each species.

The most significant potential difference identified between the two studies, besides temporal differences in spawning, was that we were attempting to provide the first documentation of reproduction by individuals (razorback sucker) whose spawning potential had not been

determined. Sampling for larval razorback sucker was being conducted with no assurance that the stocked population of adult razorback sucker would spawn in this system. Conversely, we knew from previous studies that Colorado pikeminnow reproduction had and was still occurring in the San Juan River and, because of this certainty, our larval fish sampling efforts for this minnow could be different than those for razorback sucker.
Numerous Upper Colorado River basin researchers had reported light-traps as one of the best means of collecting larval razorback sucker, we too elected to use that sampling procedure during the first year (calendar year 1997) of sampling. The only previous San Juan River fish investigation that employed light-traps was in 1994-1995 (conducted by the National Park Service) near the San Juan River-Lake Powell confluence. The 1994 sampling effort produced an extremely large number of larval fish (ca. 25,000) from a modest number of samples (n=20), of which over 99% were red shiner. Similar sampling in 1995 yielded 25,455 specimens in 47 light-traps samples and as in 1994, red shiner numerically dominated the catch. No Colorado pikeminnow or razorback suckers were taken in the 1994-1995 light-trap sampling efforts.

During the 1997 razorback sucker larval fish survey, light traps were set nightly in low-velocity habitats between Aneth and Mexican Hat from late March through mid-June 1997. The traps were distributed at dusk and retrieved about four hours later. Fish taken in those samples were preserved in the field. Sampling success during the 1997 razorback sucker larval fish study was quite poor. While there were over 200 light-trap sets, those sampling efforts produced only 297 fish. Of those, about 200 (66%) were larval suckers (either flannelmouth sucker or bluehead sucker). Larval razorback sucker were not present in the 1997 sampling survey. While there were probably several factors to account for the poor light trap catch rate, a principal factor was the limited access to suitable habitats. Light traps are most effective when set in habitats with little or no water velocity. During our driving survey of riverine habitats in the region (March 1997), we identified numerous locations that appeared to be suitable sites for light trap sampling. However, we found that high flow in the San Juan River eliminated virtually all previously identified low velocity habitats. Further driving reconnaissance failed to yield additional locations to set light traps. Being tied to specific collecting sites was not the most efficient means of collecting large numbers of individuals.

In 1998 we modified our sampling technique to allow for the sampling of a greater portion of the San Juan River and the collection of a significantly larger number of larval fish over a wider reach of the river. We conducted sampling forays (n=6) at approximately bi-weekly intervals from 17 April (first trip - no larval suckers) to 6 June 1998 between the Four Corners drift-net station (RM 128) and Bluff (RM 80) and used both active and passive sampling techniques to collect larval fish. The primary sampling method was a fine mesh larval seine (in 1998, we collected more larval sucker in a single seine sample than in all of the 1997 light trap samples). Passive sampling techniques were both drift-netting and the use of light-traps. Drift-nets were set periodically to determine if larval sucker comprised a significant portion of the drift community while light-traps were set adjacent to campsites if appropriate aquatic mesohabitats could be located. An inflatable raft was used to traverse this river reach and allowed investigators the opportunity to sample habitats that were either not formerly accessible or observable under the constraints of the previous sampling protocol.

The 1998 sampling protocol resulted in 183 collections and 13,000 specimens between river miles 68.7 and 126.1. The majority of these individuals (n=9,960) were larval catostomids. This 43-fold increase in number of specimens, as compared with 1997, provided substantially better resolution of spawning periodicity of the sucker community. In addition, the 1998 samples produced enough individuals for investigators to determine, with a high degree of confidence, if razorback sucker reproduction occurred in the San Juan River during that period. None of the aforementioned information was obtainable from 1997 light-trap samples. In 1998, two larval razorback suckers were collected. These specimens provide verification of spawning by the re-established population.

In 1999, the study area was expanded to include the San Juan River from near Four Corners (River Mile 128) to near Clay Hills (River Mile 4.9). The scope of work for that year included at least one collecting effort between Sand Island and Clay Hills. A total of 174 fish collections were made in 1999 producing over 20,000 fishes. Over 37% of these individuals were sucker larvae (n=7,635). Seven larval razorback sucker were collected in 1999 between 4 May and 14 June. The seven larvae (razorback) were taken in backwaters or low velocity habitats located between river miles 96.2 and 11.5. Almost half (n=3) of these individuals were in the new-downstream reach first sampled in 1999.

There was no substantive change in the sampling protocol or methodology for this project in 2000. A total of 210 collections were made between 4 April and 23 June 2000. These collections yielded 11,316 specimens of which 7,587 (67%) were larval sucker. There was a marked increase in the number of larval razorback sucker taken in 2000 as compared with 1999 and 1998. Identifications of individuals revealed 129 larval razorback sucker in 24 separate collections. Individuals were collected in low velocity habitats between river miles 124.8 and 8.1. The lowest-most sampling location that yielded larval razorback sucker (RM 8.1) produced over 85 individuals in a single sample (26 May 2000). Conversely, the uppermost collection of larval razorback sucker was less than four river miles downstream of the upper boundary of the study area on 1 June 2000.

In 2001 the study area was expanded once more to include an additional 14 miles upstream, to Cudei NM. There was a substantial increase in the number of fish collected in 2001. A total of 206 collections were made between 10 April 2001 and 14 June 2001 yielding 95,628 specimens. The majority of these fishes were represented by non-native larval cyprinids accounting for 94% of the total number of fish collected in 2001. Catostomids comprised only 8.4% of the total catch. There was a decline in the overall catch of larval razorback in 2001 (n=50). The decreased number in 2001 compared with 2000 (n=129) is within the normal boundaries of sample variation that would be experienced in annual fish collections of such a magnitude. Razorback sucker were collected at 15 sites, two of which produced more than 10 individuals, and for the first time since 1999, larval razorback (n=2) were collected in light-traps.

The results in 2002 produced informative and interesting data. A total of 152 fish collections were made between river mile 141.6 and 2.8 from 15 April 2002- 29 June 2002. A total of 812

larval and juvenile razorback sucker was collected during 2002, the largest number taken to date. Twenty collections contained >10 individual razorback sucker and five samples contained >50 individuals. In 2002 razorback sucker exhibited a more uniform longitudinal distribution compared to previous years. The most upstream larval razorback sucker collection was RM 134.5 (Reach 5) while the most downstream site of collection was Clay Hills, Utah (RM 2.8). Reaches 3 and 4 produced the greatest number of razorback sucker (n=312 and n=320 respectively). Much larger juveniles were collected in 2002 than in previous years. The largest juvenile razorback sucker collected was 54.4 mm TL as compared to 28.8 mm TL for the largest specimen collected prior to 2002. Juvenile razorback sucker comprised 15.9% of all razorback sucker collected in 2002 and were taken throughout the study area.

The results of this investigation continues to provide unequivocal documentation of reproduction in the San Juan River by members of a razorback sucker cohort that had been stocked as part of the San Juan River Basin Recovery Implementation Program. Excluding 2001, there has been a logarithmic increase in the number of individuals collected and there is no reason to assume that this trend will not continue in 2003 and FY2004. The sampling process has proven an extremely effective means of monitoring this ontogenetic stage of razorback sucker.

This work is being conducted as required by the San Juan River Basin Recovery Implementation Program Monitoring Plan and Protocol dated 31 March 2000. The objectives of this specific monitoring effort are identified in the aforementioned document (1a, 3a, 3b) and listed below.

Study Area:

The principal sampling area for this study will be the San Juan River between Cudei (near RM 142) and the Clay Hills boat landing (ca. RM 3) just above Lake Powell in Utah. A spring 2000 collection of larval razorback sucker at RM 124.8 indicated the need to expand the upstream boundary of the study area (formerly RM 128). Beginning in 2001, sampling included an additional 14 river miles of the San Juan River (the reach between Cudei and RM 128). As in all post 1999 sampling efforts, the study will include making collections in reaches of the San Juan River under the jurisdiction of the National Park Service.

Objectives:

1.) Determine the spawning periodicity of catostomids between mid-April and early June and examine potential correlation with temperature and discharge.

2.) Attempt to validate presumed spawning period of San Juan River catostomids using data from the razorback sucker and Colorado pikeminnow larval fish studies.

3.) Determine if reproduction by razorback sucker occurred in the San Juan River (upstream of Mexican Hat, UT)

4.) Provide comparative analysis of the reproductive effort of catostomids.

5.) Determine the relative annual reproductive success of razorback sucker (1a).

6.) Provide annual summaries of monitoring results (3a).

7.) Provide detailed analysis of data collected to determine progress towards endangered species recovery in three years and thence every five years (3b).

Methods:

Sampling for razorback sucker larvae will be conducted in the San Juan River between Cudei (RM 142) and Clay Hills (RM 2.9) from early April through early June using sampling techniques that will provide sufficient number of individual fish necessary to meet study objectives. GPS readings and digital photos will be taken at each sampling locality, and researchers will record UTM coordinates and zone corresponding with each field number as agreed upon at the May, 2001 meeting of the San Juan River Biological Committee. Access to the river shall be acquired through the use of an inflatable raft. The tentative sampling schedule will be once a month and encompass the entire study area (Cudei to Clay Hills).

As previous San Juan River investigations have clearly demonstrated, larval fish most frequently occur and are most abundant in low velocity habitats (i.e., isolated pools, backwaters, and secondary channels), sampling efforts will be concentrated in these mesohabitats. Small mesh seines (1 m x 1 m x 0.8 mm) will be the primary means of collecting larval fish from low-velocity habitats. In addition, light-traps will be employed when appropriate aquatic low-velocity mesohabitats can be located adjacent to that evening's campsite. Meso-habitat type, length, maximum depth, and substrate will be recorded for each sample. For seine samples, the length of each seine haul will be determined in addition to the number of seine hauls per site. The aforementioned habitat conditions will also be recorded at light-trap sampling sites in addition to the time of placement, time of retrieval, and duration of the light-trap sample.

All retained specimens will be placed in plastic bags containing a solution of 5% buffered formalin and a tag inscribed with unique alpha-numeric code that will also be recorded on the field data sheet. River Mile, standardized for the San Juan River Basin Recovery Implementation Program, will be the primary descriptor used to designate the location of sampling sites. Global Positioning System (GPS) readings (the principal numeric descriptor) will be taken at each sampling locality as stipulated at the May, 2001 meeting of the San Juan River Biological Committee. Universal Transverse Mercator (UTM) coordinates and zone will be determined with a Garmin Navigation Geographic Positioning System Instrument for each sampling locality and recorded on a field data sheet whose unique alpha-numeric code matches that of the tag in the retained sample.

Preserved collections will be returned to the laboratory where they will be sorted, specimens identified to species, enumerated, measured (minimum and maximum size [mm SL] for each species at each site), transferred to 70% ethyl alcohol, and catalogued in the Division of Fishes

of the Museum of Southwestern Biology (MSB) at the University of New Mexico (UNM). Specimens whose species-specific identity is dubious or merit additional verification will be forwarded to Darrel E. Snyder (Larval Fish Laboratory, Colorado State University) for review.

Catch per unit effort (CPUE), for each seine sample, will be determined as the number of fish per m^2 of water sampled. The number of fish collected per hour that light-traps are set will be presented as CPUE for this collecting methodology. The annual 2003 razorback sucker survey report will present, in summarized tabular form, fish catch rate (per species) for the entire study period as well by river reach. In addition, catch rate between and within reaches will be compared temporally. Detailed collection information (i.e., catch methodology, species composition of the sample, mesohabitat description, physical-chemical habitat characteristics, length and developmental stage of razorback sucker specimens) will be provided for samples that contain larval razorback sucker.

Community-comparison metrics, such as the Shannon-Wiener Index and Morisita's Index of Diversity, will be used for longitudinal and annual comparisons. Specimens will be distinguished and compared by residence status (native versus non-native) and catch rate over-laid with the annual hydrograph. Mean daily discharge data during the study period will be obtained from U.S. Geological Survey Gauges at Shiprock (# 09368000), New Mexico and Four Corners (#09371010), Colorado. These river discharge data will be used to assess the effect of discharge volume on species density estimates.

For reporting purposes, pre-2003 larval razorback sucker data were separated into upper and lower reaches with the former including collections between RM 141.6 and Bluff and the latter containing collections from Bluff downstream to Clay Hills Crossing (RM 2.9). A new protocol for reporting on annual monitoring activities was agreed to by the San Juan River Basin Biology Committee and initiated beginning with 2002 reports. One component of the new reporting was that data were to be resented and analyzed along the predesignated San Juan River Reaches. This change in reporting did not work well for the larval San Juan River razorback sucker survey project as that investigation was not conducted in the same format as the other monitoring activities (i.e., small bodied fish, adult monitoring, habitat, etc). In those other, well established monitoring programs, sampling of the entire river was done during a single uninterrupted effort which allowed for meaningful between-reach comparisons. Conversely, the larval San Juan River razorback sucker survey project does not attempt to sample the entire study area under a single, continuous sample event. Instead, the river was divided into functional reaches (upper and lower) based solely on the distance that could be sampled in five to seven days and points of access. The period between sampling events of the upper and lower reaches of the San Juan River (under this study) were often one to two weeks. This sampling protocol allowed for a more efficient sampling of the San Juan River, especially given that the larval San Juan River razorback sucker survey project was still functioning primarily as a "search and capture" versus "monitoring" project.

Given the marked increase in the number of razorback sucker taken in 2002 and the need to formalize the sampling protocol of this project with the other monitoring surveys, beginning in

2003, the entire larval razorback sucker study area will be sampled during each individual (continuous) sampling trip.

Products:

A draft report for the 2004 razorback sucker sampling activities will be prepared and distributed to the San Juan River Biology Committee for review by 31 March 2005. Upon receipt of written comments, that report will be finalized and disseminated to members of the San Juan River Biology Committee by 1 June 2005. Fish collected from this study will be curated in the Division of Fishes, Museum of Southwestern Biology (MSB), Department of Biology, at the University of New Mexico. Original field notes will be retained in the Division of Fishes and collection information will be electronically stored in a permanent MSB database program where the geo-referenced collection information will be maintained in a consistent database and GIS format. These data and any maps generated from them will be available to the San Juan River Biology Committee via hard-copy reports and electronically. Electronic copies of the field and collection data will be transferred to the San Juan River database manager.

Budget FY-2004:

Personnel

Field Research Associate (65 staff-days) (sampling activities, collection management supervision, data entry, sample processing)	$	19,500
Field Research Technicians (60 staff-days) (sampling activities, collection processing)	$	15,000
Subtotal	$	24,500

Travel and per diem

Travel (mileage-4WD-Alb to sites)	$	3,000
Field per diem (33 staff-days)	$	1,500
Non-Field per diem (10 staff-days)	$	750
Subtotal	$	5,250

Equipment and Supplies

Equipment upkeep (trailer, raft)	$	2,000
Sampling/Field Gear (seines, GPS units, storage materials)	$	1,000
Laboratory Equipment/supplies (fixatives, jars, vials, dissecting tools)	$	1,000
Subtotal	$	4,000
Total	$	43,750
Administrative Overhead	$	6,560
GRAND TOTAL	**$**	**50,310**

Out-year funding (based on 5% increases):

Fiscal Year 2005	$	52,850
Fiscal Year 2006	$	55,500
Fiscal Year 2007	$	58,275

San Juan River Specimen Curation
Fiscal Year 2004 Project Proposal

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Background:

Personnel from the Division of Fishes, Museum of Southwestern Biology (MSB), at the University of New Mexico are responsible for two inter-related programs on the San Juan River. The Fish Division is the repository for specimens collected and retained by researchers. Fish taken under these programs are initially sorted by the principal investigator, held until they have submitted their yearly-progress report, and then received by MSB personnel. The collection is accessioned, specimens transferred from formalin to alcohol, identifications verified, individuals enumerated, length ranges recorded (largest and smallest specimen in a collection), collection data verified and transferred to wet labels, and incorporated into a database. It is standard policy at all major Natural History museums (i.e., Smithsonian Institution, Carnegie Museum, University of Michigan Museum of Zoology) that, prior to incorporation into the collection, all specimens be examined by qualified personnel (in that particular field of study) in an effort to verify the original identification and collection information. This system provides a final check (safeguard mechanism) to minimize the likelihood of misidentification of San Juan River fish species with particular attention on Colorado pikeminnow and razorback sucker. Any changes in species identifications that are detected are noted and returned to the principal investigator along with the entire data set (listing of collection locality, collectors, date, original field number, species, number of specimens, length ranges, and museum catalog number).

In addition to performing duties associated with collections curation, we are also responsible for complete processing (sorting, identifying, counting, curating, and reporting) of selected San Juan River collections (Colorado pikeminnow larval fish sampling and razorback sucker larval fish sampling). The samples generated by the aforementioned studies resulted in the collection of over 20,000 larval fish during 1999, 15,000 during 2000, and 96,000 during 2001. In 1999 and 2001, we processed almost 200,000 larval and juvenile fishes collected by the New Mexico Department of Game and Fish and Utah Division of Wildlife Resources. As in the past, deviations in the identifications of those samples have been noted and forwarded to the principal investigators. All of the non-MSB samples from calendar year 2001 have been received and are being processed by MSB personnel.

The number of fish processed by the MSB Division of Fishes under the San Juan River Basin Recovery Program can fluctuate greatly between years. One reason for the vacillation in number of specimens is because the samples sent to MSB by non-MSB researchers are not processed until almost one year following their collection. This lag between time of collection and MSB processing is necessary as individual researchers must perform the preliminary sort and require the specimens for preparation of their reports. Other factors such as annual variability of sampling conditions and initiation of new or completion of old projects has resulted in marked changes in the number of samples and specimens (As occurred between 2001 and 2002 when drift sampling for larval Colorado pikeminnow was eliminated in favor of seine sampling).

Discussion of this issue with the San Juan River Biology Committee resulted in the recommendation that the annual budget for the San Juan River Specimen Curation and Larval Fish Identification reflect an "average" year of sample processing. The Biology Committee recognized that some years would require more effort from MSB than budgeted while other years might not require the same high level of activity. A relatively stable budget allowed for uninterrupted processing of samples and was sufficient to allow the processing of backlogged samples generated during years of exceptionally high fish capture. To date, over 750,000 specimens (along with associated locality and ecological data) have been curated into the MSB Division of Fish Collection and are available to researchers.

Almost all MSB-San Juan River Basin archived samples are the result of collections made under the San Juan River Basin Recovery Implementation Program Monitoring Plan and Protocol. In addition, a component of New Mexico Department of Game and Fish collecting permits is the disposition of all retained specimens in the Museum of Southwestern Biology for curation.

Study Area:

This project does not involve the collection of specimens but instead the processing and curation of samples gathered by the different research components of the San Juan River Research program. The collective sampling area for other researchers will be the San Juan River between the outfall of Navajo Reservoir and the Clay Hills boat landing (RM 2.9) just above Lake Powell in Utah.

Objectives:

1.) Provide a permanent repository for San Juan River fish collections, field notes, and associated data
2.) Verify species identifications, enumerate specimens, and report to principal investigators
3.) Maintain a GIS reference database for current material
4.) Assist principal investigators with secondary collection sorting and identifications as time and resources permit

Methods:

The primary task to be completed under this project is the processing and curation of fish specimens generated by research projects executed under the auspices of the San Juan River Basin Recovery Implementation Program. Samples are transferred to the Division of Fishes, by the principal investigator of a project, once that individual has completed their work and prepared the necessary reports. (This usually infers a lag-time of one year between collection of specimens and transference to the Division of Fishes). Collections are matched with the appropriate data-sheet, transferred from formalin to alcohol, stored in museum quality jars, re-identified, counted, measured (range), labeled, and catalogued into the permanent MSB Fish Division collection and placed on the shelves in the light and temperature controlled collection room. All data associated with the specimens are entered into the database of the Division of Fishes and subsequently copied to the San Juan River database.

In addition to the aforementioned responsibilities, the Division of Fishes is available and has frequently assisted principal investigators by taking on the added responsibility of processing (a limited number) of their unsorted collections (without requesting additional funding). Specimens are sorted, identified, counted, measured, catalogued, and data submitted to the principal investigator for inclusion in reports. In cases where the amount of backlogged material in the possession of the principal investigator was beyond our capabilities, supplemental funds have been sought so that additional personnel can be hired (under the supervision of the permanent staff) to process the excess material.

Products:

A draft report of the 2004 San Juan River specimen curation and larval fish identification sampling activities will be prepared and distributed by 31 March 2005 to the San Juan River Biology Committee for review. Upon receipt of written comments, that report will be finalized and disseminated to members of the San Juan River Biology Committee by 1 June 2005. Fish collected from this study will be curated in the Division of Fishes, Museum of Southwestern Biology (MSB), Department of Biology, at the University of New Mexico. Original field notes will be retained in the Division of Fishes and collection information will be electronically stored in a permanent MSB database program. Electronic copies of the field and collection data will be transferred to the San Juan River database manager following the successful protocol previously employed.

Budget FY-2004:

Personnel

Research Associate (40 staff-days) (final verification of all specimens, data compilation, data entry and management, supervision)	$	14,000
Laboratory Technician (36 staff-days) (fluid and jar transfer, specimen enumeration)	$	7,200
Subtotal	$	21,200

Travel and per diem

Travel (two trips)	$	800
Per diem (6 staff-days)	$	600
Subtotal	$	1,400

Equipment and Supplies

Laboratory Equipment/supplies (vials, jars, alcohol, acid-free labels)	$	2,000
Computer supplies/maintenance	$	600
Subtotal	$	2,600
Total	$	25,200
Administrative Overhead	$	3,780
GRAND TOTAL	**$**	**28,980**

Out-year funding (based on 5% increases):

Fiscal Year 2005	$	30,429
Fiscal Year 2006	$	31,950
Fiscal Year 2007	$	33,550

Long Term Monitoring - Channel Morphology
Fiscal Year 2004 Project Proposal

Principal Investigator: Ron Bliesner
Keller-Bliesner Engineering
78 East Center, Logan, UT 84321
(435) 753-5651 bliesner@kelbli.com

Study Area:

The study area consists of the San Juan River and its flood plain from RM 180 (Farmington, NM) to RM 3 (Clay Hills Crossing).

Collections:

There are no collections associated with this study.

Background:

There are presently 25 river transects that have been established between RM 180 and RM 3 in the San Juan River for purposes of measuring channel scour and deposition. Additionally, substrate composition (sand or cobble/gravel) has been identified during each survey. These cross-sections have been surveyed before and after runoff since 1992. The data from these surveys was used to examine channel scour and deposition, determine change in channel capacity and track change in substrate material. Flow statistics for 8,000 cfs flows were based, in part, on these data.

Maintenance of cobble bars with open interstitial space has been determined to be important for spawning of Colorado Pikeminnow. Four of the sites (RM 173.7, 168.4, 132, 131) that have been identified in the San Juan River as having characteristics suitable for spawning have been monitored since 1995. The results of the surveys at this site were used as part of the basis of the flow recommendation at 8,000 cfs. To verify or adjust this recommendation, these sites will continue to be monitored.

The flow-habitat area model for backwaters is based on the ability of the channel to clean sediment from the system and the rate at which the sediment accumulates in the backwaters after runoff. The amount of perturbation (loss of habitat) due to summer and fall storms has been estimated based on analysis of habitat area data collected before and after storm events. Equivalent data on change in depth of backwaters and depth of sediment have not been analyzed. It is proposed that sediment depth and water depth be measured in backwaters twice yearly at the end of runoff in late July or early August and again in October to assess change. The second sampling will be completed during the fall habitat mapping exercise.

Objectives:

1.) River Geometry Monitoring. Determine short term and long term change in river cross sections at key locations and the relationship of this change to spring runoff and summer/fall storm events.

2.) Cobble Bar Monitoring. Determine short term and long term change in cobble bar characteristics in response to spring runoff and summer/fall storm events.

3.) Backwater Perturbation Monitoring. Monitor effect of spring runoff and summer/fall storm events on sediment accumulation in backwaters and backwater depth.

Methods:

1.) River Geometry Monitoring. The 14 cross-sections identified in 1999 as part of the long term monitoring plan will be surveyed pre- and post-runoff for analysis of annual change and compared to previous surveys to determine trends. Analysis of the change in cross-section geometry and substrate in relation to hydrographic conditions will be completed to monitor response of the system to flow recommendations.

2.) Suspended Sediment Analysis. Continuous turbidity monitors are installed at Shiprock, New Mexico and Montezuma Creek Bridge, Utah. The data will be used to qualitatively assess sediment transport in relation to the flow regime, in addition to identification of storm events.

3.) Cobble Bar Monitoring. Maintenance of cobble bars with open interstitial space has been determined to be important for spawning of Colorado Pikeminnow. Four sites (RM 173.7, 168.4, 132, 131) have been identified in the San Juan River as having characteristics suitable for spawning. These sites have been monitored since 1995. The results of the surveys at this site were used as part of the basis of the flow recommendation at 8,000 cfs. To verify or adjust this recommendation, these sites will continue to be monitored per the long range monitoring plan.

Topographic surveys will be completed for each of the sites utilizing total station or gps survey equipment with control provided by the established bench marks at each site. Surveys will be completed as soon as practical after spring runoff, usually during the end of July or early August. The same area will be surveyed each year to allow comparison to previous years.

At the same time, the structure of the bar will be assessed by completing point counts of the surface bed material (n=200 per sample or more) at each bar. Particles will be selected by the point count method over the full extent of the bar within the survey boundary. Size is determined by placing the rocks through a square hole in an aluminum plate, cut to represent an equivalent screen size from 1 cm through 10 cm at 1 cm

increments, then 2 cm increments through 20 cm. Those larger than 20 cm are recorded as greater than 20 cm. Interstitial material smaller than 1 cm is not recorded.

Depth of open interstitial space (depth to embeddedness) will be measured on a 5 or 10-ft grid over the extend of the bar. Measurement will be made by working a hand between rocks until the fingers touch the sand embedded depth. The depth of penetration below the average top of cobble immediately adjacent to the sample point will be measured and recorded as the depth of open interstitial space.

Change in bar morphology will be determined by producing three-dimensional plots of the surveyed surface and subtracting the resulting surface from the surface generated from the previous survey. The amount of change will be correlated to the flow conditions for the year.

The size distribution of cobble at each bar is computed and the D_{16}, D_{50} and D_{84} sizes reported and compared to previous years. Depth of open interstitial space will be computed as actual depth and multiples of mean cobble diameter.

4.) Backwater Perturbation Monitoring. To characterize the relative quality of backwaters, five representative backwaters within each geomorphic reach will be measured for water and sediment depth. Measurements will be made annually between September 15 and Nov 1 per the long term monitoring plan. These sites will remain the same from year-to-year to the extent possible. If a backwater is "lost," another will be selected for sampling and retained in the sampling regime until it is lost. Depth of sediment will be measured and recorded for "lost" backwaters. All measurements will be made at flows between 500 and 1,000 cfs, if possible, and at the same flow from year-to-year, if possible. Sediment and water depths will be measured at three points in each backwater (mouth, 1/3 and 2/3 of length). The backwaters sampled will be marked on digital aerial imagery.

Storm events will be determined by changes in flow and turbidity at USGS gages located near Shiprock and Montezuma Creek.

The annual report will include a summary of backwater measurement data for each site, including site location, water and sediment depth, flow at sampling, flow and turbidity data. Every five years the runoff/storm event/backwater habitat relationships will be analyzed.

Products:

An annual report and data files for inclusion in the GIS database will be produced under this task. The annual report will include a summary of backwater measurement data for each site, including site location, water and sediment depth, flow at sampling, flow and turbidity data. The draft progress report and data submittal to the database are due 31 March 2005. Final report is due 1 June 2005.

Budget FY-2004:

Category	Staff-Days		Cost
Personnel:			
Coordination & report	38	$	28,840
Cross-section survey	37	$	28,244
Spawning bar monitoring	34	$	25,460
Backwater perturbation monitoring	31	$	21,571
Subtotal	140	$	104,115
Travel/per diem:			
Data analysis & report	0	$	0
Cross-section survey	30	$	3,100
Spawning bar monitoring	18	$	4,050
Backwater perturbation monitoring	21	$	4,500
Subtotal	69	$	11,650
Equipment Rental (boats, survey inst.)		$	1,430
Misc. supplies, copies, etc.		$	2,052
Overhead (10% of subcontract)		$	1,631
NM gross receipts tax (5% of NM costs)			3,763
Grand Total		**$**	**124,641**

This is a monitoring function and is expected to continue through 2007. Out year funding is expected to increase by approximately 5% annually due to inflation.

Habitat Mapping
Fiscal Year 2004 Project Proposal

Principal Investigator: Ron Bliesner
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(435) 753-5651 bliesner@kelbli.com

and

Principal Investigator: Vince Lamarra
Ecosystems Research Institute
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(435) 752-2580 vincel@ecosysres.com

Study Area:

The study area consists of the San Juan River from RM 180 (Farmington, NM) to RM 3 (Clay Hills Crossing).

Collections:

There are no collections associated with this study.

Background:

Habitat mapping completed during the period 1992 - 1997 has been used to develop flow/habitat relationships used in the flow recommendation process. To verify and refine these relationships and examine long term trends, habitat mapping will be continued on an annual basis during the low flow period in the fall per the long range plan.

Objectives:

1.) Main River Habitat Mapping. Map San Juan River habitat from RM 180 to RM 0 during September-October. This objective is a continuation of the 2000 work as described in the long term monitoring program.

2.) Digitize and process data utilizing GIS. Habitat mapping data will be digitized and entered into the ArcCAD system.

Methods:

1.) Habitat mapping (San Juan River). One flight to collect digital aerial photography or videography will be completed for the San Juan River from RM 180 to RM 0 and printed at an approximate scale of 200 ft/inch. Thirty-eight categories of aquatic habitat will be mapped in the field utilizing the digital imagery as a base map. The flights and mapping will be completed as soon after runoff as flows reach 1,000 cfs or less and weather will allow. Field mapping will be completed at flows between 500 and 1,000 cfs if possible.

Two of every three miles will be mapped through the full reach, corresponding with the miles designated for sampling under the other long term monitoring plans.

2.) Digitize and process data utilizing GIS. Upon completion of each habitat mapping program (Objectives 1 and 2), the field maps will be rectified and digitized into ArcCAD.

Products:

An annual report and GIS coverages for inclusion in the GIS database will be produced under this task. The annual report and coverages will be for the 2003 mapping. Reporting for the 2004 mapping will be in the 2005 budget. The draft progress report and data submittal to the database are due 31 March 2005. Final report is due 1 June 2005.

Budget FY-2004:

Category	Staff-Days		Cost
Personnel:			
Field Mapping & interpretation	58	$	30,545
Digitizing & data processing	46	$	25,320
Data Analysis	19	$	13,290
Subtotal	123	$	69,155
Travel/per diem:			
Field Mapping & interpretation	26	$	3,250
Digitizing & data processing	0	$	0
Subtotal	26	$	3,250
Equipment Rental (boats, equipment)		$	800
Videography flight (USBR)			9,000
Map prints, binders, misc. supplies		$	1,200
Overhead (10% of subcontract)		$	4,454
NM gross receipts tax (5% of NM costs)			1,912
Grand Total		**$**	**89,771**

This is a monitoring function and is expected to continue through 2007. Out year funding is expected to increase by approximately 5% annually due to inflation.

Water Temperature Monitoring
Fiscal Year 2004 Project Proposal

Principal Investigator: Ron Bliesner
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(435) 753-5651 bliesner@kelbli.com

Study Area:

Temperature recorders are installed from RM 224 (Navajo Dam) to RM 92.5 (Montezuma Creek Bridge).

Collections:

None.

Background:

Water temperature recorders were installed in 1992. This work element is a continuation of the original work, with station servicing and data extraction.

Objective:

Collect Water Temperature Data at 7 locations

Methods:

Collect Water Temperature Data at 7 locations. Temperature recorders are located at Navajo Dam, Archuleta, Farmington, Shiprock, Four Corners and Montezuma Creek and on the Animas River at Farmington. These recorders will be serviced twice and the data extracted and plotted for the annual report.

Products:

An annual report and data files for inclusion in the GIS database will be produced under this task. The draft progress report and data submittal to the database are due 31 March 2005. Final report is due 1 June 2005.

Budget FY-2002:

Category	Staff-Days	Cost
Personnel:		
Data Collection	4	$ 3,030
Data Analysis	6	$ 4,860
Subtotal	10	$ 7,890
Travel/per diem:	2	$ 270
Data logging Equipment Rental		$ 200
Misc. supplies		$ 300
Overhead (10% of subcontract)		$ 0
NM gross receipts tax (5% of NM costs)		150
Grand Total		**$ 8,810**

This is a monitoring function and is expected to continue through 2007. Out year funding is expected to increase by approximately 5% annually due to inflation.

Water Quality Monitoring
Fiscal Year 2004 Project Proposal

Principal Investigator: Ron Bliesner
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(435) 753-5651 bliesner@kelbli.com

Study Area:

Water samples will be taken at 12 locations along the San Juan River or tributaries between RM 219 (Archuleta) and RM 52 (Mexican Hat).

Collections:

Water samples only

Background:

Monthly water samples during 1991-1998 have been collected at about 30 different sites in the San Juan River and its tributaries within the study area. The results of the water-quality analyses have shown that most concentrations are replicated between months and among nearby stations. The results of these analyses were used to identify the stations, set the timing and parameters of analysis.

Objective:

Collect Quarterly Water Samples at 12 Locations.

Methods:

Collect Quarterly Water Samples at 12 Locations. Depth integrated water samples will be collected at the 12 locations listed in Table 1. Samples will be taken quarterly in February, May, August and November of each year near mid-month. The chemical analyses most relevant to the long-term monitoring goals are listed in Table 2. The concentration of the parameters listed in the first column will be determined every sampling period. In addition field measurements of temperature, pH, redox potential, electrical conductivity and dissolved oxygen will be taken. Annually, during low flow periods in February, the water samples should analyzed for all the parameters listed in Table 2. Field data collection and laboratory analysis will be completed by standard EPA methods, where applicable.

Table 1. Proposed Sampling Stations along San Juan River between Navajo Dam and Mexican Hat.

Station Name	Station ID	USGS Sampling In Period	BIA Sampling Period
SAN JUAN RIVER NR ARCHULETA BRIDGE	9355500	1958-1984	1991-1998
GALLEGOS CANYON NR FARMINGTON, NM	9357255	1979-1981	1991-1998
ANIMAS RIVER AT FARMINGTON, NM	9364500	1958-1992	1991-1998
SAN JUAN RIVER AT FARMINGTON, NM	9365000	1974-1991	1991-1998
LA PLATA RIVER NR FARMINGTON, NM	9367500	1977-1991	1994-1998
OJO AMARILLO CANYON	9367536		1993-1998
SAN JUAN RIVER AT SHIPROCK, NM	9368000	1958-1992	1991-1998
MANCOS RIVER NR FOUR CORNERS	9371005		1991-1998
SAN JUAN RIVER AT FOUR CORNERS, CO	9371010	1977-1990	1991-1998
SAN JUAN RIVER AT MONTEZUMA CREEK BRIDGE	9378610		1991-1998
SAN JUAN RIVER AT BLUFF BRIDGE (HIGHWAY 191)	9379495		1991-1998
SAN JUAN RIVER NR BLUFF, UT (AT MEXICAN HAT)	9379500	1974-1993	1991-1998

Table 2. Water quality parameters for analysis

Quarterly	Annually
Arsenic (total and dissolved)	Aluminum (total and dissolved)
Calcium (dissolved)	Barium (total and dissolved)
Copper (total and dissolved)	Manganese (total and dissolved)
Lead (total and dissolved)	Nickel (total and dissolved)
Magnesium (dissolved)	Potassium (total and dissolved)
Mercury (total and dissolved)	Strontium (total and dissolved)
Sodium (dissolved)	
Selenium (total, dissolved, total recoverable)	
Zinc (total and dissolved)	Chloride (dissolved)
	Ammonia (dissolved)
Alkalinity(HCO_3)	Nitrate (dissolved)
Hardness	Nitrite (dissolved)
TDS	Silica (total and dissolved)
TSS	Sulfate (dissolved)
Turbidity	Orthophosphate (dissolved)

Products:

An annual report and data files for inclusion in the GIS database will be produced under this task. The draft progress report and data submittal to the database are due 31 March 2005. Final report is due 1 June 2005.

Budget FY-2004:

Category	Staff-Days	Cost
Personnel:		
Data collection and analysis	7	$ 5,544
Travel/per diem:	7	$ 1,000
Equipment cost (sampling equipment rental)		$ 1,000
Laboratory analysis		$ 21,000
Overhead (10% of subcontract)		$ 2,100
NM gross receipts tax (5% of NM costs)		280
Grand Total		**$ 30,924**

This is a monitoring function and is expected to continue through 2007. Out year funding is expected to increase by approximately 5% annually due to inflation.

Update and Maintenance of San Juan River Basin Recovery Implementation Program GIS Database and Development of a Web-Based Interactive Interface
Fiscal Year 2004 Project Proposal

Principal Investigators: Sara J. Gottlieb and Alexandra M. Snyder
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Background:

San Juan River research efforts that preceded the establishment of the San Juan River Basin Recovery Implementation Program (SJRBRIP), in combination with those that have subsequently resulted from that program, form the basis of the suite of decisions already made and those to be made regarding biologic and hydrologic issues. An immense amount of information has been gathered through the San Juan River research activities that have been conducted over the last 15 years. Most of this information has been synthesized and made available in the form of reports or publications. For example, in 1999 and 2000 researchers consolidated and analyzed data from their individual long-term research projects and presented it as summary reports of seven years of research (1991-1998). Likewise, the flow recommendation report released in 1999 represented a synthesis between biological, hydrological, and habitat research activates.

Preparation of the aforementioned summary reports was facilitated by the existence of the SJRBRIP database. Individual researchers are responsible for submitting raw data for incorporation to the integrated database. This project was both initiated and maintained by Keller-Bliesner Engineering, LLC (Keller-Bliesner) in Logan, Utah in cooperation with the U.S. Fish and Wildlife Service's - Region 2 Albuquerque Office. Keller-Bliesner provided coordination of updates, maintenance, and distribution (via CD's) of the database.

There have been numerous important advances during the past five years in GIS and database technologies that now allow for expansion of the electronic capabilities of the database and its associated information. Since many current San Juan River researchers do not have the expertise needed to use the GIS database in its present format, increase in the ease of use was identified as a principal need for future versions of the database. This modification is necessary to make the information available to more researchers within the program. Development of a user-friendly, web-based interface will decrease the time between distribution of updated versions of the database and enable researchers to access their own and other researchers' data in their analyses and reports. Decisions regarding authorization of access to the web-based interface are currently

under discussion in the SJRBRIP Biology Committee and will be finalized under consultation with the SJRBRIP Coordination Committee.

Over the lifetime of the SJRBRIP, several sets of hard-copy river mile maps based on aerial photos have been produced and used by researchers in the Program. Minor differences and errors in these maps have resulted in inconsistencies in the data sets incorporated into the existing database. The use of Geographic Positioning System (GPS) units and GIS software allows a high level of positional accuracy in data that are currently being acquired by the researchers. It is important that the level of data quality be maintained at a high level and that existing data be brought up to the current standards as much as possible.

The purpose of this proposal is to fund this effort with the goal of developing a user-friendly web-based interface to SJRBRIP's GIS Database. Another important objective of this proposal is to provide for the generation of distribution maps that result from user-initiated queries. In addition, continuation of funds to cover the cost of maintenance and distribution of the database are being requested.

Study Area:

This project will initially encompass the San Juan River Basin downstream of Navajo Reservoir but should ultimately be expanded to include the entire San Juan River Basin.

Objectives (continued from FY2003, with completion projected for out years):

1.) Maintain and incorporate researchers' comments into the web-based interface to the San Juan River Recovery Implementation Program's GIS Database.
2.) Maintain, perform Quality Control, annually update, and distribute current San Juan River Recovery Implementation Program GIS researcher database using appropriate format.
3.) Establish electronic archives of the aforementioned database at the ultimate repository for this information (U.S. Fish and Wildlife Service Region 2 Office, Albuquerque, New Mexico).
4.) Generate for distribution and maintain a standardized set of hard-copy aerial photos with river mile, 10^{th} of mile, and appropriate landmarks connoted.

Methods:

1.) Maintain a web-based interface to the GIS Database.
In 2003, a web page interface is being developed which authorized researchers can use to access and analyze the data geographically. The interface will provide the ability to create custom multiple-parameter queries within the researchers' datasets and result in generation of maps and data reports that can be used in analysis as well as reporting activities. A prototype of the interface will be provided to the researchers in 2004 and their comments solicited. These comments will be incorporated, as appropriate, in future versions of the interface.

2.) Update and Maintain GIS Database.
In 2003, the existing GIS Database, which has been maintained by Keller-Bliesner since its inception, was transferred to MSB/USFWS. The database format is being modified (under consultation and coordination with Keller-Bliesner) to better integrate with the data program being prepared for GIS interface application. Starting in 2003, MSB has assumed responsibility for tracking and acquisition of annual datasets to be submitted by 31 March of each year by individual researchers. New data will be incorporated with the existing San Juan River Recovery Implementation Program's GIS Database. Existing data will be checked for Quality Control and updated as necessary.

3.) Coordinate Database Updates and Maintenance with FWS-Region 2. The close proximity of MSB to the U.S. Fish and Wildlife Service's - Region 2 Albuquerque Office provides for extensive coordination of updates, maintenance, and development of the database. The MSB staff will consult and coordinate closely with appropriate staff (including the San Juan River Program Coordinator and San Juan River Program Assistant) in the FWS-Region 2 office in all aspects of the work. This effort will result in the collaborative production of the database and web-based interface.

4.) Contact and coordinate with appropriate personnel in the Upper Colorado River Basin and Glen Canyon Environmental Studies offices to investigate the feasibility of linkage of the proposed San Juan River Recovery Implementation Database with other regional fish databases.

5.) Generate and Maintain standardized and customized maps. Appropriate base layers, including Digital Orthophoto Quarter Quadrangles (DOQQs) will be obtained and additional layers, including 10th of mile designations will be generated in order to provide researchers with a standardized set of hard copy aerial photo maps for use in the field. These standardized maps will allow for seamless integration of field data with the GIS database. In addition, at researchers' request, customized maps will be generated for use in reports and presentations.

Products:

The database and associated documentation will be disseminated via a password-protected project web page. Standardized hard copy aerial photo maps with river mile and 10th of mile designations will be generated and distributed to the researchers in paper and electronic (CD) format. The database and interface will reside with Region 2 (Albuquerque) of the U.S. Fish and Wildlife Service, the designated repository for the data, and on a MSB server. A draft report that describes the results and progress of the FY 2004 efforts will be distributed by 31 March 2005. Upon receipt of written comments, that report will be finalized and disseminated to members of the San Juan River Biology Committee by 1 June 2005.

Budget FY-2004:

Personnel		
Database Manager (40 staff-days) (programming, data compilation, data management, supervision)	$	24,300
Database Technician (60 staff-days) (data entry, data query)	$	25,000
Programming Consultation (10 staff-days) (provide assistance with complex programming)	$	2,000
Subtotal	$	51,300
Travel and per diem		
Travel (mileage – attend two SJR meetings)	$	800
Per diem (6 staff-days)	$	600
Subtotal	$	1,400
Equipment and Supplies		
Laboratory Equipment/supplies (CD's, office supplies)	$	2,000
Computer supplies/maintenance (hardware and software upgrades)	$	2,000
Subtotal	$	4,000
Total	$	56,700
Administrative Overhead	$	8,505
GRAND TOTAL	**$**	**65,205**

Out-year funding (based on 5% increases):
Fiscal Year 2005 * $ * 39,280

* The anticipated reduction in cost reflects completion of interactive database portion of the study and reflects a change in duties to that primarily of database management.

COLORADO RIVER RECOVERY PROGRAM
SAN JUAN RIVER RECOVERY IMPLEMENATION PROGRAM Project No.:
FY-2004–2005 PROPOSED SCOPE OF WORK for:
Publication of Supplemental Update to Larval Sucker Guide

Lead Agency: Larval Fish Laboratory, Colorado State University
Submitted by: Kevin R. Bestgen, Project Manager
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Date: 30 April 2003, modified 15 May 2003

Category:

	Expected Funding Source:
_ Ongoing project	x Annual funds
_ Ongoing-revised project	_ Capital funds
_ Requested new project	x Other (CDOW possible co-sponsor)
x Unsolicited proposal	

I. Title of Proposal:

Publication of Supplemental Update to Larval and Early Juvenile Sucker Guide by Snyder and Muth, CDOW Technical Publication 38, 1990.

II. **Relationship to RIPRAP:**

General Recovery Program Support Action Plan item V.C–develop and enhance scientific techniques required to complete recovery actions.

III. **Study Background/Rationale and Hypotheses**:

Collections of the early life stages of fish are essential to research on and monitoring of razorback sucker (or other sucker) spawning sites and seasons, larval production, transport, distribution, nursery habitat, and survival, and other aspects of early life history. Such research cannot proceed effectively without accurate identification of at least razorback sucker or other target species among collected

specimens. Morphological identification requires knowledge of the appearance of not only the target species but all similar species in the waters sampled and the diagnostic criteria for segregating them. For the early life stages of many species, including the suckers and minnows of the Upper Colorado River Basin (UCRB), morphological criteria for identification change dramatically as the fish grow and develop, making diagnosis especially difficult and complicated. Descriptive information and diagnostic criteria must be well founded, sufficiently detailed, and documented in such a way that they are retrievable, usable, and verifiable by any interested researcher.

The (draft) final report for Recovery Project 112 constitutes, with minor modifications, a manuscript for publication of a supplemental update and expansion of the descriptions and keys in the Colorado Division of Wildlife (CDOW) guide to UCRB sucker larvae and early juveniles (Snyder and Muth 1990). The manuscript includes a listing of corrections and descriptive updates (character range extensions, replacement drawings), description of longnose sucker larvae and juveniles (only sucker not covered by the 1990 publication, an updated and expanded comparative summary, and an updated and expanded replacement for the printed keys–a computer-interactive key on CD and available over the internet.

This proposed scope of work provides for formal publication of the manuscript as either a supplemental update to the 1990 guide with a limited reprint of that guide or, preferably, an integrated portion of a new edition of the guide. The former option would necessitate manual update of the user's copy of the 1990 guide and use of both it and the supplement with the interactive key. The latter option would be a much nicer product and more convenient and desirable for the user (updates, the revised comparative summary, the introduction and instructions for the computer-interactive key, and the new species account for longnose sucker would be cleanly integrated with the old guide and the former 60-page printed key deleted). The supplemental update could be published without a reprint of the 1990 guide, but that publication's original print run of 1,200 copies has been exhausted (out-of-print) since the mid-1990's. Accordingly, that less costly option has been dismissed.

Although unpublished copies of the final report and key for Recovery Project 112, when used with existing copies of the 1990 guide, will facilitate more certain identification of razorback sucker and other larval and early juvenile suckers collected in the UCRB, formal publication will provide for much broader recognition, distribution, and use of the descriptive information and computer-interactive key. In addition to the UCRB, the proposed publication will be useful wherever the covered species may occur in Colorado, the Southwest, and North America. Still other biologists will find it valuable as a model and proof of concept for the application of computer-interactive keys to identification of closely related or very similar fish larvae.

IV. **Study Goals, Objectives, End Product:**

The goal is to make more readily available the updated and new descriptive information and new taxonomic tool constituting the final report for Recovery Project 112 to facilitate easier and more accurate identification larval and early juvenile suckers collected in the UCRB or wherever the covered species might occur. Also to promote use of the computer-interactive key as a model and proof-of-concept for preparation of other keys to early life stages of fish.

The objective is to accomplish these goals and complete Part 1 of a Comprehensive Guide to the Larvae and Early Juveniles of Cypriniform Fishes in Western Colorado and the UCRB by formal publication of a modification of the final report as a supplemental update to the 1990 guide, with a limited reprint of that guide, or as an integral part of a new edition of that 1990 guide.

Assuming CDOW is willing to serve as the publication outlet (to be negotiated), the end product would be either publication of 1,000 or 1,500 copies of a supplemental update to the 1990 guide as a CDOW Special Report, with a 500 or 1000-copy reprint of the 1990 guide (CDOW Technical Publication 38), or, preferably, publication of 1,500 copies of a new edition of the guide as a CDOW Technical Publication. If FY 2003 funds can be made available, publication could be concluded this summer in time for analysis of 2003 collections. If CDOW is not willing to serve as the publication outlet, other recognized serial publication outlets will need to be considered and the budget adjusted accordingly.

V. **Study area:** UCRB

VI. **Study Methods/Approach:**

If publishing the supplemental update with a reprint of the original guide through CDOW, I would make the appropriate minor modifications to my Recovery Project 112 Final Report and submit it as a manuscript to the CDOW editor, currently publication specialist Nancy Wild. The editor would complete formatting and otherwise finalize an electronic document for the printer. Fortunately, the CDOW contractor for printing of the original 1990 guide still has the negative plates for that publication.

If publishing instead a new edition of guide, I would specify any necessary additional changes the original guide and work with the editor to integrate the content of the supplemental update in the guide. The printing contractor will work with the editor (and me if necessary) on integrating replacement and new sections with existing negatives for unchanged (except for page numbers) or easily modified (e.g., range extension in a species account table, reversal of illustrations) sections. If published as the proposed CDOW publications, most distribution and requests for copies would be

handled by CDOW with a supply of copies provided to both the Recovery Program and Larval Fish Laboratory for internal and additional distribution.

VII. **Task Description and Schedule:**

Publication–as soon as possible, preferably this summer if the project can be funded with FY 2003 Recovery Program funds and/or CDOW.

VIII. **FY-2003 or 2004 Work Deliverables/Due Dates:**

Deliverables, assuming publication through CDOW, would be publication of "Computer-Interactive Key to Eggs, Larvae, and Early Juveniles of Catostomid Larvae in the Upper Colorado River Basin with Description of Longnose Sucker (Supplemental Update to Colorado Division of Wildlife Technical Publication 38)" by Darrel E. Snyder as a CDOW Special Report, with reprint of CDOW Technical Publication 38, or "Catostomid Fish Larvae and Early Juveniles of the Upper Colorado River Basin–Morphological Description, Comparison, and Computer-Interactive Key (Updated and Expanded Edition of Colorado Division of Wildlife Technical Publication 38 and Part I of a Comprehensive Guide to the Cypriniform Fish Larvae and Early Juveniles of Western Colorado and the Upper Colorado River Basin)" by Darrel E. Snyder and Robert T. Muth as a CDOW Technical Publication.

CDOW would handle subsequent distribution and requests, as well as provide an as sufficient number of copies (e.g, 100) to the Recovery Program and LFL for internal and other distribution. Publication would be scheduled for summer 2003 if FY 2003 funds can be made available, or fall 2003 if covered by FY 2004 funds.

Budget:

Preferred Option: 1,500-copy publication of updated edition (124 pp) of 1990 guide, CDOW Tech. Publ. 38.[a]

	RP	CDOW	Total
- Labor: PI ($5341/mo; 3 wks) [b]	$3,700		$3,700
- Other: Printer–printing & assembly [c]	7,195	or 7,195	7,195
Printer–stripping charges	300	or 300	300
Optional color covers	500	or 500	500
CDs (1.40 each)	2,100	or 2,100	2,100
- Total Direct Costs:			13,795
Indirect Costs (15% TDC) [d]			2,069
Total Direct & Indirect Costs [e]			**15,864**

[a] Assumes publication will be through CDOW and CDOW will cover at least internal costs for such publication, including that of its publication specialist or editor. If not, budget will need to be revised to reflect costs via another publication outlet. Printer costs were provided through CDOW publication specialist Nancy Wild. Costs for CD duplication with labels and sleeves were provided by Kinko's of Fort Collins.

[b] Includes fringe benefits.

[c] Includes spiral binding, b&w covers, CD pocket on inside back cover.

[d] Assumes MOU in which the University covers remainder of standard 45% indirect costs rate. If all costs but PI salary and benefits are paid directly by CDOW or the Recovery Program to the printing contractor, indirect costs would be $555 and total costs $14,350 for the preferred option with comparable savings for the other options.

[e] Reducing publication run from 1,500 to 1,000 copies would reduce total costs to $12,760 ($11,651 if printer paid directly).

Alternative Option 1: 1,500-copy publication of supplemental update (64 pp) to 1990 guide, with 1,000-copy reprint of that guide, CDOW Tech. Publ. 38 (160 pp).[a]

	RP	CDOW	Total
- Labor: PI ($5341/mo; 1 wks)[b]	$1,233		$1,233
- Other: Printer–printing & assembly [c]			
Supplemental update	4,193	or 4,193	4,193
Optional color covers	500	or 500	500
Reprint of 1990 guide	6,045	or 6,045	6,045
Optional color covers	400	or 400	400
CDs (1.40 each)	2,100	or 2,100	2,100
- Total Direct Costs:			14,471
Indirect Cost (15% TDC)[d]			2,171
Total Direct & Indirect Costs			16,642

Footnotes as above.

Alternative Option 2: 1,000-copy publication of supplemental update (64 pp) to 1990 guide, with 500-copy reprint of that guide, CDOW Tech. Publ. 38 (160 pp).[a]

		RP	CDOW	Total
-	Labor: PI ($5341/mo; 1 wks)[b]	$1,233		$1,233
-	Other: Printer–printing & assembly [c]			
	Supplemental update	3,080	or 3,080	3,080
	Optional color covers	400	or 400	400
	Reprint of 1990 guide	3,750	or 3,750	3,750
	Optional color covers	300	or 300	300
	CDs (1.50 each)	1,500	or 1,500	1,500
-	Total Direct Costs:			10,263
Indirect Cost (15% TDC) [d]				1,539
Total Direct & Indirect Costs				11,802

Footnotes as above.

IX. **Budget Summary**

FY-2003 or 2004:

Preferred Option–	$15,864
Alternative Option 1–	$16,642
Alternative Option 2–	$11,802

X. **Reviewers:**

Tom Czapla via coordinator's review of draft final report for Recovery Project 112. Copy was also forwarded to Tom Nesler for CDOW consideration. No comments or suggestions had been received from either party prior to submission of this proposal to the Recovery Program.

XI. References:

Snyder, D. E. 2003. Computer-interactive key to sucker larvae and early juveniles of the Upper Colorado River Basin with description of longnose sucker. (Draft) Final report of Colorado State University Larval Fish Laboratory to Upper Colorado River Endangered Fish Recovery Program, U.S. Department of the Interior Fish and Wildlife Service, Lakewood, Colorado.

Snyder, D. E., and R. T. Muth. 1990. Description and identification of razorback, flannelmouth, white, Utah, bluehead, and mountain sucker larvae and early juveniles. Colorado Division of Wildlife Technical Publication 38.

PEER REVIEW CHAPTER

2004 WORK PLAN

Peer Review for 2004
Fiscal Year 2004 Project Proposal

Principal Investigator: Paul B. Holden
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Jicarilla-Apache Nation
(435) 752-4202 pholden@bio-west.com

Background:

A Peer Review Panel was established in 1997 to assist the SJRIP with reports and plans for future studies.The four members of the panel participated in meetings in 1997 where the flow recommendations were discussed, and continued involvement in the flow recommendation report process by commenting on the pre-draft report and attending a Biology Committee meeting to discuss the pre-draft report in 1998. They also met with the Biology Committee in 1999 to discuss the draft flow recommendation report that the Biology Committee sent to the Coordination Committee for review. In addition, in 1999 the Peer Review Panel reviewed the draft Monitoring Plan, and initial drafts of the final research reports.

In 2000 and 2001, the Peer Review Panel reviewed and commented on the final research reports, the long term monitoring plan, and the Program Evaluation Report.

In 2002, the Peer Review Panel was changed somewhat. Drs. Ron Ryel and David Galat were retained from the existing panel and two new members were added. Dr. John Pitlick from the University of Colorado was selected as the geomorphologist and Dr. Stephen Ross from the University of Southern Mississippi was selected as the fishery ecologist after a lengthy selection process. During 2003 the Peer Review Panel participated in subcommittee and Biology Committee meetings related to integration of 1999-2002 monitoring data, as well as attending Biology Committee meetings related to the Work Plan. Dr. Galat resigned from the panel and the Biology Committee selected Dr. Wayne Hubert, U.S. Geological Survey, University of Wyoming, to fill that position as a river aquatic ecologist for the Panel. Dr. Hubert resigned in late 2003 and Dr. Mel Warren was selected to replace him on the panel.

This proposal provides for funding for the Peer Review Panel activities during 2004. It is anticipated that the Panel will meet with the Biology Committee at two meetings during the year, the February, 2004 summary meeting and another meeting typically in May to discuss Scopes of Work for 2005.

Goal:

The goal of peer review is to provide additional scientific oversight over San Juan River Recovery Implementation Program technical studies and reporting. The Peer Review Panel will work with the Biology Committee to produce scientific credible documents and will assist the Biology Committee in maintaining a highly scientific direction to the Program.

Methods:

The Peer Review Panel will meet with the Biology Committee in 2004 two times to review monitoring and research progress and to discuss scopes of work for2004. They will provide verbal input during the meetings and provide written reviews of the progress of the Program. Their reviews will be provided to the Biology Committee through Dr. Paul Holden in letter form, and through discussions at the Biology Committee meetings. Biology Committee researchers may call Peer Review Panel members to ask for advice, and Peer Review Panel members may call Biology Committee researchers if they have questions concerning Program activities. All correspondence between the Biology Committee and the Peer Review Panel will be coordinated through Dr. Paul Holden, who will maintain a record of these coordination activities for the Program.

Products:

Peer review participation at 2 Biology Committee meeting, letter reports from each peer reviewer.

Primary Contact: Dr. Paul Holden
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Phone:435-752-4202
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Personnel:	
Dr. John Pitlik Department of Geology Univeristy of Colorado Boulder, CO 80309-0260 Phone: 303-492-5906 email: pitlick@spot.colorado.edu	Dr. Stephen Ross Department of Biological Sciences University of Southern Mississippi Hattiesburg, MS 39406-5018 Phone: 601-266-4928 FAX: 601-266-5797 email: stephen.ross@usm.edu
Dr. Mel Warren, Jr. Team Leader and Research Biologist Center for Bottomland Hardwoods Research Southern Research Station, USDA Forest Service 1000 Front Street Oxford, MS 38655 Phone: 662-234-2744, ext. 246 FAX: 662-234-8318 email: mwarren01@fs.fed.us	Dr. Ron Ryel Department of Forest, Range, and Wildlife Utah State University 5230 Old Main Hill Logan, UT 84322-5230 Phone: 435-797-8119 FAX: 435-797-3796 email: ron.ryel@usu.edu

Budget FY-04:

Payment for serving on the Peer Review Panel includes expenses for travel to and from meetings, and an hourly rate for services. It is anticipated that Panel Members will spend approximately 6 days each in 2003.

Salaries:	$	14,000	
Travel:	$	8,000	
Total	$	22,000	

Future use of the Peer Review Panel is not known but they likely will be used each year to provide guidance to the Biology Committee.

Estimated Outyear Funding:

2005	**$25,000**
2006	**$25,000**
2007	**$50,000**

RESEARCH CHAPTER
2004 WORK PLAN

San Juan River Population Model Maintenance,
Development of User Interface and
Population Model Runs
Fiscal Year 2004 Project Proposal

Principle Investigator: Bill Miller
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and

Principle Investigator: Vince Lamarra
Ecosystems Research Institute Research Institute
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Background:

A modeling effort to construct a conceptual framework for the fish community and endangered fishes in the San Juan River began in 1998. This effort relates to Sections 5.1; 5.1.1; 5.1.2; 5.1.3.; 5.1.4 of the Long Range Plan. These models have helped direct a focused field effort with the intent of using key site specific data to determine the carrying capacity of Colorado pikeminnow and razorback sucker in the river. A mechanistic population model has been constructed from the original conceptual model.

The San Juan River population model includes bioenergetics, population, and trophic components. Data for fish populations by age class and habitats as well as other trophic components are required as model parameters. The intent of the FY2004 program is to refine the structural and functional components of the mechanistic model, develop a user interface and run-time version of the model to distribute to the Biology Committee members and make additional model runs with updated input data from the first years of monitoring in the San Juan River.

Objectives:

1.) Maintain Stella model software for the San Juan population model, which includes updating the model parameters with new information from the monitoring program.

2) Develop a user interface and run-time version of the model to distribute to the Biology Committee.

3.) Make model additional model runs that incorporate the information from the integration of the first years of monitoring data to evaluate meeting recovery goals of Colorado pikeminnow and razorback sucker.

Methods:

The model will be updated with current data on species distributions and abundance from population estimates and the standardized monitoring program. Model simulations will be made to evaluate the change in population dynamics as a result of stocking Colorado pikeminnow and razorback sucker. Model simulations will be conducted for Colorado pikeminnow stocked as young of the year and stocked as 150 mm size classes. A maximum of 10 different stocking rates for each species is proposed for model simulations.

The current model does not have a user interface and requires a full copy of Stella software to run the model. The second task for FY 2004 is to develop a user interface and run-time version of the model that can be distributed and run with the full modeling software.

Schedule:

Model maintenance will be concurrent with model simulations. Model maintenance will consist of updating the model with new model parameters based on new information and updating the model software as needed. Model maintenance will begin with the notice that funding has been secured. Completion of the user interface and model simulations and documentation of maintenance activities is scheduled for June 1, 2004.

Products:

A brief report will be prepared that documents the model maintenance and model runs. Summary tables of model simulations will be produced for each model run. A summary of model maintenance activities will be completed and submitted to the standardized data base. A user manual will be distributed with the run-time version of the software.

Budget FY-2004:

All funding for FY 2004 activities are requested from the recovery program. Total funding requested is shown in the following table.

	Miller Ecological Consultants	Ecosystems/ Keller-Bliesner	Total Cost
Labor	$26,120.00	$8,000.00	$34,120.00 (55 Staff days)
Travel	$1,905.00	$1,000.00	$2,905.00
Equipment			
Supplies	$500.00		$500.00
Overhead	$6,418.00	$900.00	$7,318.00
Total	$28,525.00	$ 9,900.00	**$ 38,425.00**

Assessment of Fish Movement Through the Non-Selective Fish Ladder at Hogback Diversion, New Mexico
FY 2004 Workplan Proposal

Principal Investigators - Jason E. Davis, Stephanie Coleman and James E. Brooks
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Background:

Diversion structures on the San Juan River have been the subject of previous evaluations regarding effects on movement of fishes (Masslich and Holden 1996, Ryden 2000). These diversion structures can effect fish communities by impeding fish movement, entrainment, and disturbance in both benthic and fish communities during routine repair and reconstruction periods. Field measurements of movement patterns for tagged fishes in reaches 5 and 6 by Ryden (2000) indicated that fish could move upstream of diversion structures at Cudei (142.0), Hogback (RM 158.6), APS (RM 163.3), PNM (RM 166.6), and Fruitland (RM 178.5). Upstream movements were detected for channel catfish *Ictaluras punctatus*, common carp *Cyprinus carpio*, and flannelmouth *Catostomus latipinnis* and bluehead suckers *Catostomus discobolus.*

A study to assess fish passage utilization through the Redlands Diversion structure on the Gunnison River, Colorado from 1996-2000 indicated heavy use of the fish ladder with over 43,000 individuals passing during the study period (Burdick 2001). This structure is a selective fish passage with all native fishes collected transferred above the diversion and all non-natives removed. Data indicated that the majority of channel catfish utilized the fish ladder from June-August of each year. In order to adequately evaluate the efficacy of mechanical removal in decreasing distribution and abundance of large bodied non-native fishes in discreet river reaches, a better understanding of diversion structures that include non-selective fish passage structures and the role they play in fish movement is needed. Mechanical removal of large channel catfish (>500 mm) and subsequent availability of habitat may encourage movement from downstream reaches to occupy these now vacant territories. In addition, the upstream movement of striped bass *Morone saxatilis* from Lake Powell and documented occurrence within Reach 6 downstream of PNM Weir could increase and further impact the native fish community.

In 2001, Cudei was removed and replaced by a sub-surface syphon which has no visible impediment to fish movement. This structure may now make an additional 16.6 RM (Hogback Diversion at 158.6 to Cudei at 142.0) readily accessible to both native and non-native fish movement. Hogback Diversion was rebuilt, and included construction of a non-selective fish passage structure. Although this structure has made an additional eight river miles accessible to native fishes including the endangered Colorado pikeminnow, *Ptychocheilus lucius*, and

razorback sucker, *Xyrauchen texanus*, its construction does not limit movement solely to native fishes.

Prior to completion of Hogback reconstruction, the diversion structure likely limited upstream movement of fishes and the new fish ladder has lessened that impediment. As a response to this concern, the last mechanical removal effort during 2001 (early November) and the last during pre-spring runoff in 2002 (early April) included one additional sampling day each to capture, implant with numbered dangler (FLOY) tags, and release channel catfish the first 5.5 river miles downstream of Hogback Diversion

During 2001, mechanical removal efforts targeting channel catfish in a sub-portion of Reach 6 (PNM downstream to Hogback) continued and a total of ten sampling efforts removed 4,024 individuals. Declining trends in abundance and distribution of channel catfish removed (n = 1340) were observed over eight sampling trips prior to spring runoff. In the four remaining sampling efforts (July, August, September, November) the number of channel catfish removed doubled (n = 2,689). Possible explanations for the increased catch of channel catfish included warmer water temperatures and associated activity level of fish during late summer/autumn and low, clear flow conditions during the last four sampling efforts. An additional explanation may be the completion of the non-selective fish passage structure at Hogback and resulting upstream movement of channel catfish during spring runoff and throughout summer.

Removal efforts upstream of Hogback Diversion continued in 2002 and saw similar trends in seasonal distribution and abundance of channel catfish. Capture rates increased from 1.16 channel catfish/hour of electrofishing in April to over 54 channel catfish/hour of electrofishing in June. A total of eight tagged fish were recaptured above the diversion during the June sampling. The large increase in numbers of channel catfish collected and the recapture of tagged fish may indicate movement of large numbers of channel catfish during early summer months.

Prior to 2003, 725 channel catfish were tagged in the 5.5 river miles below Hogback Diversion. Of these fish, 23 were recaptured during removal efforts upstream of the diversion indicating use of the ladder by this species. Currently, over 1,500 fish have been tagged and include channel catfish (n = 927), common carp (n= 508), and flannelmouth (n = 70) and bluehead suckers (n = 12) with two more tagging trips remaining. To date, only channel catfish have been documented to utilize the non-selective fish ladder at Hogback.

This scope of work proposes to continue the evaluation of upstream movment of the four most common large-bodied fishes in the San Juan River (channel catfish, common carp, and flannelmouth and bluehead suckers) past Hogback Diversion. While other diversion structures modified for fish passage in the Upper Colorado River Basin have been evaluated for movement (Cavalli, 2000), the structurally different and non-selective fish ladder at Hogback has not and the ability to allow upstream movement should be verified. Similar to studies by Ryden (2000), fishes will be tagged using numbered and distinctly colored dangler tags and released from below Hogback Diversion. Tagging and monitoring efforts will be combined with and added to existing non-native mechanical removal efforts. In addition, monitoring and evaluation of fish

movement upstream of APS Weir will be characterized, if fish tagged below Hogback Diversion move upstream through both diversion structures.

Study Area:

The study area for assessing use of the non-selective fish ladder at Hogback Diversion is from PNM Weir (RM 166.6) downstream to approximately 5.5 river miles downstream of Hogback Diversion (RM 153.0).

Objectives:

1.) Determine utilization of the non-selective fish ladder at Hogback Diversion by channel catfish, common carp, and flannelmouth and bluehead suckers.

2.) Determine and evaluate fish movement above APS Weir.

3.) Relate non-selective fish passage results to attainment of non-native removal target objectives.

4.) Relate results towards future recommendations regarding fish ladder design at other diversion structures on the San Juan River.

Methods:

A minimum of four (4) sampling trips will be conducted and all channel catfish, common carp, and flannelmouth and bluehead suckers will be tagged in the study area prior to spring high flow conditions. Fish will be collected using a raft-mounted electrofishing unit. During these sampling efforts, all non-native fishes collected will be measured for total and standard lengths (nearest 1mm), weighed (nearest 5g) and equipped below the dorsal fin with a visual dangler tag. Dangler tags will be blue in color and will have a unique numeric code preceded by the initials SJR. These tags will be identical to those used in previous channel catfish tagging studies (Brooks et al. 2000) Data taken will be separated by river mile and reach and effort (hours electrofishing) will be recorded to calculate catch per unit effort (number fish per hour electrofishing). Rare fish collected will be identified, measured for total and standard lengths, weighed, checked for the presence of a PIT or radio tag, appropriate fish tagged, and immediately released. Specific river mile of capture and comments on relative condition of the fish will also be recorded.

Tagging and monitoring movement of tagged fish will be accomplished in conjunction with non-native mechanical removal trips performed by the U.S.F.W.S., New Mexico Fishery Resources Office and cooperators (U.S.F.W.S - Grand Junction, U.S. Bureau of Indian Affairs, State of New Mexico, State of Utah). Fish recaptured above the diversion will be measured for total and standard lengths, weighed and tag number recorded. Location of recapture, to the nearest 0.1 RM will be recorded and all non-native fish will be removed. In addition to tagging efforts below Hogback Diversion, native fish collected between APS Weir and Hogback

Diversion during removal efforts will be tagged to characterize movement. Additional monitoring of tagged fish movement will occur during the fall main channel standardized monitoring trip.

In addition to tagging trips, four separate sampling efforts will be conducted at the fish ladder to determine presence/absence of tagged fish within the fish ladder. A block net will be placed at the downstream end of the ladder and backpack electrofishing (Smith-Root Type 11 backpack shocker) will be used to capture stunned fish. A total of three passes will be conducted to ensure the capture of fish present. Native fish species collected will be placed upstream of the diversion and all non-natives will be removed from the river.

During all sampling efforts, temperature (Celsius), dissolved oxygen (mg/l), salinity (ppt), turbidity (uohms), and secchi disk depth (nearest 0.1 m) will be recorded and related to fish sampling results. In addition, stream discharge as reported by USGS gauging station #09365000 (2.3 miles upstream of the La Plata confluence) will be recorded to evaluate discharge influences on fish movement through the Hogback fish ladder.

Deliverables:

A final summary report detailing findings will be completed in draft by 31 March 2005 for SJRIP Biology Committee review and finalized by 1 June 2005. An electronic data file will be provided for inclusion in the centralized database by 31 March 2005.

Literature Cited

Brooks, J.E., M. J. Buntjer, and J.R. Smith. 2000. Non-native species interactions: management implications to aid in recoveery of the Colorado pikeminnow and razorback sucker in tthe San Juan River. San Juan River Basin Recovery Implementation Program, USFWS, Albuquerque,New Mexico.

Burdick, B.D. 2001. Five-year evaluation of fish passage at the Redlands Diversion Dam on the Gunnision River near Grand Junction, Colorado: 1996-2000. Recovery Program Project Number CAP-4b. Final Report prepared for the Recovery Implementation Program for Endangered Fishes in the Upper Colorado River Basin. U.S. Fish and Wildlife Service, Colorado River Fishery Project, Grand Junction, CO.

Cavalli, P.A. 2000. An Evaluation of the Effects of Tusher Wash Diversion Dam on Movement and Survival of Juvenile and Subadult Native Fish. Utah Division of Wildlife Resources. Publication Number 01-1.

Masslich, W. and P.B. Holden. 1996. Expanding distribution of Colorado squawfish in the San Juan River. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM.

Ryden, D.W. 2000. Adult fish community monitoring on the San Juan River, 1991-1997. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM.

Budget:

Personnel:		
Collection and tagging (20 staff days)	$	6,242
Monitoring (10 staff days)	$	2,500
Reporting/data management (40 staff days)	$	10,000
Subtotal	$	18,742
Travel/per diem:		
Collection/tagging	$	1,500
Reporting/data management	$	200
Subtotal	$	1,700
Equipment and supplies		
Collection/tagging	$	1,000
Miscellaneous	$	500
Subtotal	$	1,500
T0TAL	$	21,942
Administrative Overhead (19%)	$	4,170
GRAND TOTAL	**$**	**26,112**

Outyear Funding (an increase of 5% included):

Fiscal Year 2003	$	24,840
Fiscal Year 2004	**$**	**26,112**

TROPHIC RELATIONSHIPS AMONG COLORADO PIKEMINNOW (*PTYCHOCHEILUS LUCIUS*) AND ITS PREY IN THE SAN JUAN RIVER (Scope of Work for FY 2004)

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AND

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Activities for FY 2004: The scope of work (SOW) and budget for FY 2004 are within this study plan for the entire study. Work to be accomplished during FY 2004 corresponds to Year 2 of the Study Plan. In FY 2004, we will conduct experiments that address Objectives 3 and 4, listed on page 6. The total budget of $51,000 for FY 2004 is detailed on page C-19.

BACKGROUND An essential element of restoration or recovery of an endangered species, such as Colorado pikeminnow (*Ptychocheilus lucius*), is a thorough understanding of the relative importance of factors that have contributed to its decline. Various studies (e.g., Holden and Wick 1992, U.S. Fish and Wildlife Service 1990, Platania et al. 1991) have demonstrated that altered flow regimes, habitat modifications, range fragmentation, and establishment of numerous nonnative fish species have contributed to the imperiled status of Colorado pikeminnow. To enhance survival of the species, efforts have been made to remove or ameliorate factors identified as causing its decline. In addition, augmentation of extant populations by stocking hatchery-reared fishes has been undertaken in the San Juan River. All efforts to improve the status of Colorado pikeminnow by increasing its abundance implicitly assume there is an adequate prey base. However, considering the dramatic changes to the prey assemblages in this system, there is no clear evidence that adequate prey is available.

In the San Juan River, the historical prey base of Colorado pikeminnow was composed mainly of soft-rayed cyprinids and catostomids; other fishes such as mottled sculpin (*Cottus bairdi*) and cutthroat trout *(Oncorhynchus clarki*) occurred mainly in habitats upstream of those

occupied by Colorado pikeminnow. Based upon their current distribution throughout warmwater reaches of the San Juan River and their high abundance (Gido et al. 1997, Gido and Propst 1999, Propst and Hobbes 2000), speckled dace (*Rhinichthys osculus*), flannelmouth sucker (*Catostomus latipinnis*), and bluehead sucker (*Catostomus discobolus*) were likely important prey for Colorado pikeminnow. Although currently rare in the San Juan River, roundtail chub (*Gila robusta*) and razorback sucker (*Xyrauchen texanus*) were more common historically (Tyus et al. 1982) and thus potential prey of Colorado pikeminnow. In the past 100 years, over 20 nonnative fishes have become established in the San Juan River; some are common and generally distributed, but others are rare (Bestgen 2000). Common and widespread nonnative fishes include red shiner (*Cyprinella lutrensis*), common carp (*Cyprinus carpio*), fathead minnow (*Pimephales promelas*), and channel catfish (*Ictalurus punctatus*). Although other ictalurids (e.g., *Ameiuus* spp.), in addition to channel catfish, and centrarchids are established in the San Juan River, none are common (Propst and Hobbes 2000, Ryden 2000).

Colorado pikeminnow begin to consume fish at an early age and small size (Vanicek and Kramer 1969). As an individual increases in size, its potential prey likewise increases in size. To some extent, prey availability is mediated by the habitat occupied by different life stages of Colorado pikeminnow. Young (<1 yr) and small (<100 mm TL) individuals that primarily inhabit low-velocity habitats, such as backwaters, prey largely upon syntopic species such as larvae or young of large-bodied species (e.g., roundtail chub and flannelmouth sucker). As Colorado pikeminnow grow, and move from low-velocity into main channel habitats, the size range and variety of prey likely increase, typical of piscivorous fishes (Gerking 1994). At this point, an individual's gape dimensions and where it forages are major factors limiting prey size and variety. In primary channel habitats typically occupied by adult Colorado pikeminnow, its primary prey species historically were speckled dace and sub-adults and adults of roundtail chub, flannelmouth sucker, bluehead sucker, and razorback sucker. Although speckled dace, flannelmouth sucker, and bluehead sucker are currently common in the San Juan River, historical data are insufficient to determine whether abundance of any, or all, have declined, increased, or remained constant. Roundtail chub and razorback sucker, however, are now less common than historically (Tyus et al. 1982, Platania et al. 1991).

Three factors probably were major determinants of prey consumed by Colorado pikeminnow: habitat occupied, gape dimensions, and prey encountered. To the extent that habitat of a potential prey species differed from that typically occupied by Colorado pikeminnow, the less likely it was to be preyed upon. For example, because speckled dace occurred mainly in riffles and adult Colorado pikeminnow typically occupied deeper and less turbulent habitats, dace were not likely primary prey items of pikeminnow. For sub-adult Colorado pikeminnow, however, speckled dace may have been an important prey species. In addition, the small-bodied speckled dace (adult size <120 mm TL) are presumably more energetically costly than larger prey species because of the large number necessary to maintain basal metabolic demands. Moreover, prey items of Colorado pikeminnow may be dependent on its hunting tactics. If it is an ambush predator, habitat occupied largely determined what it would most likely encounter and therefore consume. Alternatively, if it stalks or actively hunts prey and moves among habitats, diversity of prey likely increased.

Introduction and establishment of nonnative fish species, both caused the decline of native fish species (via competitive interactions or predation by nonnatives) and the addition of potential prey items for native predators. Whereas these nonnative fishes may serve as prey for Colorado pikeminnow, they may be better adapted to escape predation than native prey species because they evolved in eastern systems with higher densities of predators. Thus, it is unclear what effect the establishment of nonnative species and decline of native prey species had or will have on populations of Colorado pikeminnow. Has the introduction of nonnative species increased, decreased, or had no effect on the forage base? Or, as assemblage structure and composition changed, has Colorado pikeminnow foraging success declined, increased, or remained the same? *A key question is whether changes in prey base affected viability of Colorado pikeminnow in the San Juan River and if these changes are likely to impair success of augmentation efforts?*

We propose a series of field experiments, using recently developed stable isotope tracer technology, to evaluate relative use of native and nonnative prey species by Colorado pikeminnow. This study will quantify the dietary importance of commonly occurring species (e.g., native flannelmouth sucker, bluehead sucker, and speckled dace and nonnative common carp, red shiner, fathead minnow, and channel catfish) under controlled and existing "natural" conditions. In addition, roundtail chub will be used in experiments to determine if Colorado pikeminnow preferably forage on this species, which was once abundant in the San Juan River. Finally, our results will complement existing bioenergetics models (Lamarra and Miller) by quantifying relative importance and caloric content of different tropic levels.

Recent developments in mass spectrometry have enabled the use of naturally occurring stable isotopes of nitrogen (^{15}N) and carbon (^{13}C) to determine trophic position and trace pathways to determine ultimate energy sources. Ratios of $^{15}N/^{14}N$ are typically low in naturally occurring elements. Stable isotopes of nitrogen (^{15}N) are particularly helpful in evaluating trophic position of organisms because individuals that feed high in the food web (i.e., predators) tend to be enriched with heavy ^{15}N, which accumulates during protein synthesis at a faster rate than the lighter ^{14}N isotope. Stable isotopes also provide information on the source(s) of energy. For example, Cherel et al. (2000) were able to establish the breeding origins of seabirds by analyzing stable isotope signatures in feathers. McCarthy and Waldron (2000) were able to differentiate freshwater-resident and sea-run migratory brown trout based on changes in stable isotopes of N and C in their tissues. Martinez et al. (2001) characterized the isotope ratios of fishes in the Colorado River basin and suggested that isotopes may be helpful in determining if off-channel ponds were the source of nonnative fishes. Thus, naturally occurring stable isotope ratios can be used to determine the origin of energy assimilated by organisms, which compliments traditional food habits studies that only give a snap-shot of food items consumed at a particular moment. In addition, components of natural systems can be enriched with ^{15}N and then those molecules can be followed through the system to quantify energy transfer (e.g., Dodds et al. 2000). We propose to use this technology combined with a series of field experiments to evaluate the relative contribution of potential prey, including roundtail chub, to Colorado pikeminnow in the San Juan River.

Below, we describe a series of field and laboratory studies and experiments to examine the relative importance of common native and nonnative fishes in the diet of Colorado pikeminnow. The first phase of the proposed study will be to identify caloric content and signatures of stable isotopes of N and C at all trophic levels in the San Juan River (organic sediments through "top" predator) in each geomorphic reach of the river (Farmington to Lake Powell). The next phase of the study will quantify differences in prey behavior among native and nonnative species and vulnerability of these species to consumption by Colorado pikeminnow using a combination of artificial streams and field experiments. We also will use ^{15}N tracers during these experiments to positively identify native prey species of Colorado pikeminnow.

The overarching goal of this study is to *assess the capability of current San Juan River prey base for maintenance of viable Colorado pikeminnow populations*. Specific objectives/goals of the study are:

1) Characterize prey base of Colorado pikeminnow and linkages with lower tropic levels by determining stable isotope signatures ($\delta^{15}N$ and $\delta^{13}C$) of the biotic assemblages in the San Juan River for six geomorphic reaches of the river (Farmington to Lake Powell).

2) Work in conjunction with Lamarra and Miller to incorporate prey suitability, trophic relationships, and caloric content of lower trophic groups into bioenergetics models. Quantify caloric content for different trophic levels in the San Juan River by reach to parameterize bioenergetics models for Colorado pikeminnow.

3) Determine if Colorado pikeminnow use nonnative prey as efficiently as native prey by conducting foraging experiments in artificial streams located at the Konza Prairie Biological Station (KPBS), Kansas and in field enclosures in secondary channels of the San Juan River.

4) Quantify the use of specific prey items by Colorado pikeminnow by using $\delta^{15}N$ labeled roundtail chub or other fish species in field enclosure experiments.

STUDY DESIGN

Stable isotope signatures and caloric content—To establish baseline data on carbon and nitrogen isotope signatures of the fish assemblage in the San Juan River, we will collect and analyze samples from fishes and potential prey items from the six geomorphic reaches of the San Juan River from Farmington to Lake Powell beginning in 2003. In addition, we will analyze these samples for caloric content. Both the stable isotope analysis and the caloric data will help quantify the feeding relationship and energy requirements of Colorado pikeminnow and its prey. This aspect of the study will complement the bioenergetics modeling of Lamara and Miller and thus, we will work to coordinate our sampling and analysis to accommodate those models.

Collections of fish tissue will be made in conjunction with ongoing monitoring programs to facilitate capture of fishes. Small-bodied fishes will be collected whole, whereas tissue plugs or fin clips will be taken from large-bodied native and nonnative fishes. This information will allow us to characterize trophic position of each species in the assemblage and possibly determine specific prey items of native (Colorado pikeminnow) and nonnative (channel catfish) predators. These data also will provide essential information on naturally occurring levels of these isotopes to compare with the experiments described below.

Tissue samples from fishes and other organisms from lower trophic levels will be frozen in the field and brought to the laboratory, thawed, dried at 50^{o}C for 48hr and ground to a powder with a mortar and pestle. Ground samples will be analyzed in the Stable Isotope Mass Spectrometry Laboratory (SIMSL) in the Division of Biology at Kansas State University (KSU) using a ThermoFinnigan Delta Plus mass spectrometer. Stable isotope ratios will be calculated in the standard notation:

$$\delta^{15}N = [^{15}N/^{14}N_{sample}/^{15}N/^{14}N_{standard}) - 1 \times 1000$$

$$\delta^{13}C = [^{13}C/^{12}C_{sample}/^{13}C/^{12}C_{standard}) - 1 \times 1000$$

Values will be expressed on a per mil (‰) basis. Because carbonates are known to bias isotope ratios of carbon, a separate aliquot will be taken from each sample, acidified to remove carbonates and then analyzed for carbon isotope ratios as described above. A pilot study, in which samples from the San Juan River community were taken in October 2001 demonstrated our ability to process samples necessary to complete the proposed experiments using the facilities at KSU. Although we did not collected samples from adult native fishes, preliminary results suggest a high degree of overlap in energy

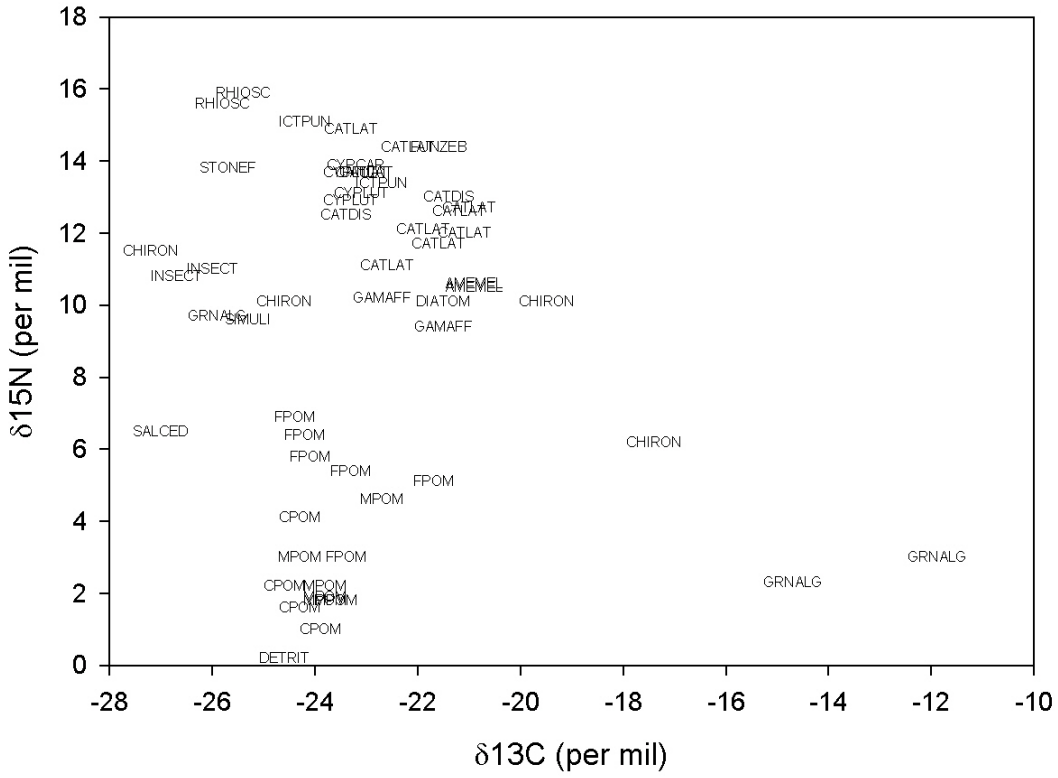

Figure 1. Stable isotope signatures for various components of the aquatic community in the San Juan River between RM 120 and RM 90. Abbreviations are as follows: Labels for fishes include the first three letters for the genus plus the first three letters of the specific epithet; FPOM, MPOM, and CPOM = fine, medium, and coarse particulate organic matter, respectively; CHIRON = chironomid; STONEFL = Stoneflies; GRNALG = green algae; SIMULI = Simulids; DETRIT = Detritus; SALCED = Salt Cedar; INSECT = various insects.

acquisition between juvenile natives and adult nonnative fishes (Figure 1). In addition, spatial variation in $\delta^{13}C$ signatures between backwaters (Green algae and chironomids) and main-channel habitats suggest a high potential to determine the relative importance of different habitats on consumer species.

Caloric content of fish, invertebrate, and plant material will allow us to evaluate the potential quality of different resources bases for Colorado pikeminnow. Measurements will be made with a Parr semi-microbomb calorimeter. For fishes, only muscle tissue from the dorsal region will be used. All samples will be homogenized as described as above and pressed into a pellet for combustion in the calorimeter.

Artificial stream experiments

A combination of artificial streams and field enclosures will be used to quantify the importance of native and nonnative fishes as prey by Colorado pikeminnow. Artificial streams are located at the KPBS in Kansas and have been designed to match the stream units that have been

successfully used in previous experiments at the University of Oklahoma (Gido et al. 1999, Gido and Matthews 2001, Matthews et al. 2001). Each stream will be configured to have two pools connected by a riffle (Figure 2) and mimic natural pool and riffle habitats. These systems should provide sufficient structural heterogeneity to provide cover for experimental fishes. Substrate will be a mixture of cobble, gravel, sand, and silt to match conditions in the San Juan River (i.e., predominately sand and cobble substrate). This experiment will examine changes in behavior of the various prey fishes when in the presence of a caged Colorado pikeminnow. In addition, we will release the pikeminnow and determine its foraging efficiency on the different prey species. Our working hypothesis is that nonnative species will alter their behavior more than native species in the presence of Colorado pikeminnow and also be less vulnerable to predation than the native species.

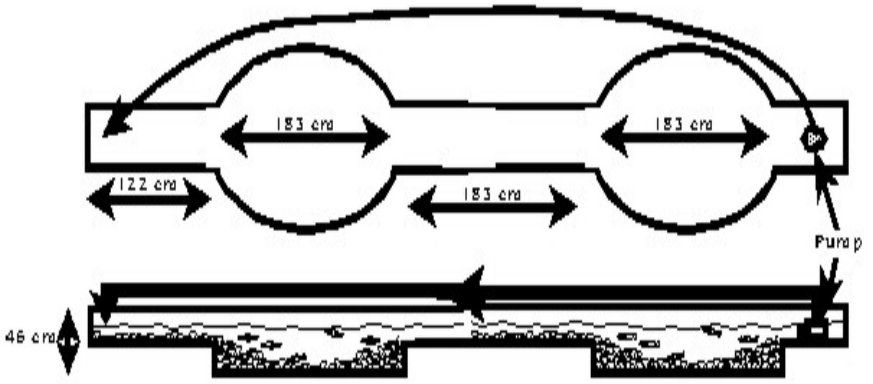

Figure 2. Configuration of artificial stream to be used to test prey response to and foraging efficiency of Colorado pikeminnow.

Prey behavior trials –In this experiment we will monitor the behavior of three native species (speckled dace, flannelmouth sucker, and roundtail chub) and two nonnative species (red shiner and fathead minnow) before and after the introduction of a caged pikeminnow into the streams. Five replicate trials will be run for each species using different fishes. The prey fish will be stocked at moderate densities (sensu Gido and Propst 1999) in the streams, 24 hr before the introduction of the pikeminnow, to allow them time to "adjust" to the system. After this period, habitat use of each individual will be characterized. Next, one caged pikeminnow will be placed into a randomly selected pool. Habitat use of the prey species will be measured one hour after the introduction of the pikeminnow. Habitat use measurements will include location in the water column (surface, bottom, etc.), mesohabitat (pool or riffle), proximity to caged predator, and activity rates (e.g., feeding, swimming, resting).

Predation efficiency - Additional experiments will be conducted to determine the relative predation efficiency of pikeminnow on the various prey species. Stream configuration, stocking densities, and acclimation period will be the same as above. However, in these trials, the pikeminnow will be released and allowed to forage on the various prey species. The

pikeminnow will be removed after 24 hours and all fish will be seined from the streams to determine the number consumed by the pikeminnow. Pikeminnow will be starved for 48 hr prior to the foraging efficiency experiment.

For all experiments, the fishes will be kept at a holding facility at Kansas State University and facilities will be modified to preclude accidental escape of San Juan fishes in the Kansas River system. For this experiment and those described below, all the appropriate permits necessary to work with endangered species and the transfer of nonindigenous fishes will be obtained beforehand.

Field experiment

Results from the experimental stream studies will be complimented with field enclosure experiments to evaluate our ability to scale our results up to natural systems. Field enclosures will allow us to recapture Colorado pikeminnow, prey species, and nonnative predators at the end of the experiment. For these experiments, 10 mm-mesh plastic netting will be used to block six ca.100-m reaches in a secondary channel of the San Juan River. Previous studies (e.g., Gido et al. 1997, Gido and Propst 1999) found that 100m reaches of San Juan River secondary channels contained a diverse array of habitats including pools, riffles, eddies and backwaters. Thus, these reaches should adequately represent major habitats available to pikeminnow and their prey. Reaches will be selected to have similar physical habitat features (e.g., depth, flow and large woody debris). Each reach will be sufficiently long (100 m) so that fishes behave normally and predation rates by Colorado pikeminnow will not be artificially high. After block nets (constructed of wire mesh and secured to the substrate with rebar) are in place, each reach will be sampled with three or more passes of a seine and DC-pulsed backpack electrofisher to quantify species present in the experimental reaches. All captured fish will be identified, counted, and released back into the reach from which they were captured. Muscle plugs will be taken from 30 to 50 individuals of each species for isotope characterization. If there are major differences in assemblage structure among enclosed reaches, we will remove or add fish to facilitate comparisons among reaches. After fish are sampled, three of the six reaches will be stocked with 5 sub-adult pikeminnow (200 to 350 mm TL). Prior to stocking, these individuals will be marked with a PIT tag and a tissue plug will be taken for isotope analysis. By monitoring changes in abundance of all species relative to enclosures without Colorado pikeminnow, we will be able to quantify changes in mortality rates

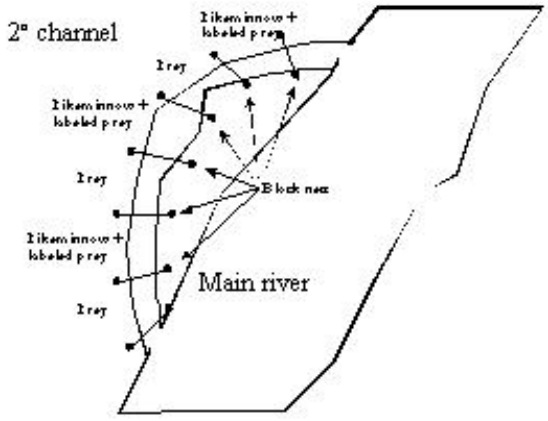

Figure 3. Design of field enclosure experiments to be conducted in San Juan River secondary channels.

of nonnative prey species as well. Captive-reared and nitrogen –labeled roundtail chub will be placed in one exclosure during each trial.

We will attempt to run the experiment twice a year for two years to account for temporal variation in abiotic and biotic conditions. The length of each experimental run will be approximately two weeks, assuming this will be adequate time to uptake sufficient ^{15}N for detection, as determined from laboratory experiments (see below). A field crew consisting of at least two individuals will be on site during each experiment to monitor field conditions and clean debris and maintain block nets. At the end of the experiment, a combination of seining and DC-pulsed backpack electrofishing will be used to capture all stocked fishes from each reach. A sample of dorsal muscle tissue will be taken from each pikeminnow, frozen and returned to the laboratory for analysis. Channel catfish and any other predators captured during this study will be sacrificed for tissue samples and analysis of stomach contents. All other fishes captured will be identified, measured, and released, with the exception of labeled prey species, which will be preserved in 10% formalin and returned to the laboratory to characterize growth during the experiment.

During Year 1 of this study, we will construct block nets on one secondary channel to evaluate the feasibility of the field experiments. If we are able to contain fishes for two weeks, we will proceed with the experiments the following year.

Field trials will be conducted from cessation of spring runoff (late June-early July) through early autumn (late September) during summer 2004 and 2005. The two field experiments will be conducted within a six week period; the second experiment will occur two weeks after completion of first experiment. Information and insights gained during the first run will be considered in making changes to the experimental design in subsequent trials.

Probability of success will depend on the frequency of flood events that may destroy or damage exclosures. An evaluation of historic flows from the USGS gauging station at the Four Corners Bridge indicates we have a very high likelihood of success. We selected a likely starting date of 1 July and examined previous discharge records between 1978 and 2000 to determine how many years there would have been a significant flow event during a two week period after 1 July. In three of the 23 years examined, the flow in the river doubled in the two weeks following 1 July, suggesting a 13% chance that our experiment would be ruined. However, if we attempt these experiments during two years, or twice each year, the chances of a flood of sufficient magnitude to destroy or damage exclosures drops to 1.7 % or less. Moreover, we will closely monitor weather forecasts to increase our chances of success.

Laboratory study to evaluate use of $\delta^{15}N$ as a tracer

In conjunction with the artificial stream and field experiments, we will evaluate the feasibility of using ^{15}N labeled prey items to confirm consumption of particular prey species by a predator. This will allow us to separate losses of prey items to natural mortality from those consumed by pikeminnow. Brine shrimp cultures will be reared at KSU and their tissue will be ^{15}N enriched by feeding them algae grown in ^{15}N labeled ammonium chloride. The ^{15}N labeled shrimp will be

stockpiled in a freezer and used to enrich the tissues of captive native San Juan fishes (roundtail chub, speckled dace, and flannelmouth sucker). To evaluate the uptake efficiency and tissue enrichment of the ^{15}N in the prey, tissue samples from five individuals of each species will be taken one, two, and three weeks after the initiation of a ^{15}N enriched brine shrimp diet and analyzed for ^{15}N using procedures described above. To further evaluate the ability of the ^{15}N label in minnows and suckers to be transferred to a predator, we will feed the ^{15}N enriched fish to pikeminnow at a rate of one individual per day for one, two, and three week periods and measure ^{15}N accumulation in pikeminnow muscle tissue from five individuals after different feeding durations. We will use the results from this study to adjust the amount of time necessary to feed prey fishes a ^{15}N labeled diet and the number of ^{15}N labeled prey fishes that are necessary for the pikeminnow to consume to detect their consumption in the field. In addition, this will allow us to assess our ability to use ^{15}N concentration in pikeminnow tissue to quantify the biomass of prey consumed. That is, individuals that consume a greater quantity of enriched prey should have higher concentrations of ^{15}N in their tissue.

Data analysis

Differences in isotope signatures among geomorphic reaches will first be assessed using biplots of $\delta^{15}N$ and $\delta^{13}C$ signatures. Significant differences among reaches for each species will be assessed using Analysis of Variance (ANOVA) with post hoc corrections for multiple comparisons. ANOVA also will be used to evaluate difference in prey behavior and prey mortality rates in the presence or absence of Colorado pikeminnow in artificial stream and field experiments. Because the field experiments will be repeated over time (i.e., two years), year of experiment will be included as a blocking variable. Finally, paired t-tests will be used to evaluate differences in $\delta^{15}N$ in Colorado pikeminnow tissue before and after field experiments stocked with enriched native fishes. This will allow us to confirm the consumption of different prey species under natural conditions.

SIGNIFICANCE OF PROPOSED RESEARCH

Recovery of endangered species often depends on maintaining important linkages of imperiled species with other components of the ecosystem. Hydrology and fish assemblage structure has been drastically altered in the San Juan River. Thus, recovery efforts to increase populations of Colorado pikeminnow may depend on restoring both a natural hydrology and other native species populations, such as roundtail chub. The proposed research will quantify the use of both native and nonnative prey species in the diet of Colorado pikeminnow. In addition, we will generate energy density information that can be used to refine bioenergetics models that estimate carrying capacity of the system. This information will strongly influence management decisions to either supplement native prey species or eradicate nonnative species. Moreover, by examining the consumption of prey items by nonnative predators (e.g., channel catfish), we can evaluate the potential competitive interactions among these fishes. This proposed study, if conducted, will provide information necessary to achieve SJRRIP Long Range Plan Objectives 4.4, 5.3.6, and 5.4.3. The use of manipulative field experiments will build upon existing correlative data (e.g., monitoring programs and carrying-capacity modeling efforts) to characterize the interactions of Colorado pikeminnow with native and nonnative fishes in the

San Juan River, and to provide information that enables implementation of adaptive management strategies to recover Colorado pikeminnow in the San Juan River.

SCHEDULE

The first year of the proposed research will focus on collecting tissue samples for isotope signatures and caloric content. This information will help define the trophic interaction of Colorado pikeminnow and its prey resources. In addition, we will conduct several pilot experiments to assess the feasibility of the proposed field experiments. Thus, at the end of the first year, we will evaluate the likelihood that forthcoming experiments will be successful. If it is determined, based on pilot projects, that the experiments have a low probability of success we will either modify the proposed activities accordingly, or terminate the experiments and spend a second year finalizing a written report of the first year's results.

Timeline

June 2003 – May 2004: Collect samples from six geomorphic reaches of the San Juan River to characterize stable isotope signatures and caloric content of fishes and resource bases to evaluate sources of energy. Conduct pilot laboratory experiments at KSU, capture and rear fish to be ^{15}N enriched, select study secondary channel.
Conduct pilot experiments to evaluate and refine the feasibility of using blocked sections of secondary channels as replicates for field experiments.

Jul. 2004 – Sep. 2004: Conduct first year of field experiments (two trials).

Oct. 2004 – Nov. 2004 Conduct prey behavior and predator consumption experiments in artificial streams

Nov. 2004 – July 2005: Laboratory and data analyses

Jul. 2005 – Sept 2005: Conduct second year of field experiments (two trials).

Oct. 2005 – Nov. 2005: Conduct second year of prey behavior and predator consumption experiments in artificial stream.

Nov. 2005 – Dec. 2006: Complete data analysis and synthesis. Draft and complete project completion report.

Facilities and Equipment available at Kansas State University

Artificial Stream system located at Konza Prairie Biological Station (12 riffle/pool units are currently in place and another 12 units are expected to be running by December 2002)

Wet lab (1100 ft^2) with fiberglass holding tanks and carbon filter water conditioning system

ThermoFinnigan Delta Plus mass spectrometer

Parr semi-microbomb calorimeter w/2 bombs

Large capacity drying oven

Ohaus digital analytical balance

Compound and dissecting microscopes

BUDGET

2003 – 2004 (YR1):	Personnel	
	KSU (research technician, 1 month summer salary for Gido, undergraduate assistant to run calorimeter)	30,000
	NMDG&F	5,000
	Per diem and travel	3,000
	Equipment and supplies (Chemicals, seines, block nets, isotope and bomb analysis, etc.)	7,000
	Overhead (20% of KSU budget)	8,000
	Total FY 2003	53,000
2004 – 2005 (YR2)	**Personnel**	
	KSU (research technician, 1 month summer salary for Gido)	**25,000**
	NMDG&F	**10,000**
	Per diem and travel	**5,000**
	Equipment and supplies (Chemicals, seines, block nets, isotope analysis, etc.)	**5,000**
	Overhead (20% of KSU budget)	**6,000**
	Total FY 2004	**$51,000**

2005 – 2006 (YR3)	Personnel	
	KSU (research technician, 1 month summer salary for Gido)	25,000
	NMDG&F	10,000
	Per diem and travel	5,000
	Equipment and supplies	5,000
	Overhead (20% of KSU budget)	6,000
	Total FY 2005	**51,000**
	Grand Total Budget	**$155,000**

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Assessment of Colorado Pikeminnow Augmentation in the San Juan River
Scope of work for FY 2004

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Background:

In 1996 and again in 1997, approximately 100,000 young-of-year (YOY) Colorado pikeminnow were stocked in the San Juan River to characterize growth and retention in the river and quantify

and characterize nursery habitat used by stocked fish (Trammel and Archer 2000). This experiment showed that habitat for young Colorado pikeminnow was available and reasonably common in the San Juan River, that YOY survived for at least 2 years, grew up to 250 mm TL, and that a large proportion remained in the river, rather than dispersing to Lake Powell. Differences in survival and retention observed between sampling trips and years were attributed to storm events and flow patterns. Storm events and runoff events tended to reduce survival and move the fish downstream. Fish in the lower river tended to be more susceptible to flow-induced changes in retention than fish in the upper river.

Based on the success of this experimental study, the SJRIP stocked 100,000 pikeminnow above the Fruitland Diversion in Farmington, NM, and another 100,000 at the Shiprock bridge in Shiprock, NM, on October 24, 2002. The SJRIP also funded BIO-WEST, the New Mexico Department of Game and Fish, and the University of New Mexico to follow the progress of the stocked pikeminnow seasonally through 2002-2003. The overall goal of the study was to characterize retention of stocked Colorado pikeminnow and what, if any, changes should be made to the augmentation program to increase retention. In addition, an important objective of the current augmentation program is to establish Colorado pikeminnow in the area above Shiprock, especially the area above the PNM Weir. The adult Colorado pikeminnow recovery goals (USFWS 2002) were based on the assumption that Colorado pikeminnow could be expanded into this area to utilize the abundant available forage (native suckers and dace). Therefore, determining whether the area upstream of PNM weir could retain stocked pikeminnow was an important objective of the pikeminnow monitoring project in 2002-2003.

Results of the December 2002 and March 2003 samplings showed that retention above the Hogback Diversion appears to have been poor, and few if any pikeminnow appear to have moved upstream from the Farmington stocking site. Only 12 pikeminnow were collected in approximately 14 miles of sampling between the Farmington stocking site and the Hogback Diversion in December 2002. By the March 2003 sampling, only 1 pikeminnow was found in 9 miles of river sampled between the Farmington stocking site and the Hogback Diversion. Below the Hogback Diversion retention seems to have been better. In December 2002, 111 pikeminnow were captured in 29 miles of river sampled between the Shiprock Bridge and Sand Island. In March 2003, 96 pikeminnow were collected in the 29 miles sampled between the Shiprock Bridge and Sand Island. All of these catches are lower than similar sampling after the 1996 and 1997 experimental stockings by the Utah Division of Wildlife Resources (UDWR), even though more pikeminnow (4 times more in this area) were stocked in 2002.

Stocking Colorado pikeminnow into the San Juan River is expected to continue annually (Ryden 2003) with the intent of developing an adult population capable of sustaining itself in the river and meeting the recovery goals of 800/1,000 adult Colorado pikeminnow (USFWS 2002). At least 300,000 YOY pikeminnow are scheduled for stocking in October or November 2003. Some of the 2003 fish will be stocked over several miles of river at each stocking area, rather than in only two locations (Dale Ryden, USFWS, personal communication).

In this scope of work, we propose continuing the YOY Colorado pikeminnow monitoring that was initiated in 2002. This includes monitoring fish that will be stocked in 2003 and any

pikeminnow remaining in the study area from the 2002 stocking. This monitoring will help to more clearly understand factors affecting pikeminnow growth and retention in the San Juan River.

The study will also continue to help refine augmentation protocols. Due to the low retention from the 2002 stocking, two additions to the 2004 scope of work have been recommended by the Biology Committee. The first addition is adding monitoring stations to the study in the lower San Juan River (below RM 75). This area was not included in 2002-2003 sampling due to logistical concerns (this area is in a canyon and must be accessed by floating through the entire canyon) and, hence, relatively high cost. However, the UDWR found several large juvenile and adult Colorado pikeminnow in the canyon reach in 2002 sampling, potentially survivors from the 1996 or 1997 stockings, suggesting that pikeminnow may be using this area more than previous studies had shown (Jackson 2003). This prompted the request to add stations in the lower 50 miles of the San Juan River to our 2004 scope of work. Results from April 2003 razorback sucker larval monitoring, where 22 of the stocked YOY pikeminnow were captured below RM 50 (H. Brandenburg, University of New Mexico, personal communication), lend additional support for adding stations in the lower river. Therefore, we propose to continue the studies initiated in fiscal year 2003 and add three more stations in the lower river. The UDWR is conducting nonnative studies in the canyon reach below Mexican Hat and we will work with them to access the Reach 1 and 2 stations.

The second addition to the study involves experimenting with stocking protocols. The reasons for the reduced retention of pikeminnow from the 2002 stocking are unclear. The vast majority of the stocked fish apparently moved downstream within a few days and out of the river. One potential explanation is that the YOY pikeminnow had difficulty finding low velocity habitats suitable for their survival as they dispersed from the stocking site. This could be due to a lack of available habitat, or to behavioral characteristics of the fish after being introduced into a foreign environment. While Trammell and Archer (2000) found that nursery habitat was available for fish in 1996 and 1997, the amount of low velocity habitats, and more specifically backwaters, has declined over the past few years and was at its lowest known level in fall and early winter 2002-2003 (V. Lamarra, Ecosystems Research Institute, personal communication). The changes in the flow regime of the San Juan River between the stocking periods is partially responsible for the decline in backwater habitat. The San Juan River, like most of the rivers in the southwest, is in the midst of a multiple year drought, so flows were lower throughout 2002, and early 2003 than those seen in 1996-1997 and 1997-1998. Nursery habitat availability in the San Juan is dependent on flow level (Trammell 2000). The drought has also appeared to reduce the number of flow events required to maintain backwater habitats, so both the quality and quantity of nursery habitats available to stocked pikeminnow were probably reduced in 2002-2003.

Reintroduction efforts for native Colorado River fishes have had chronic problems with downstream drift of the stocked fish (Marsh and Langhorst 1988, Burdick and Bonar 1987, Marsh and Brooks 1989, Masslich and Holden 1996, Burdick 2003). In the San Juan River, Dudley and Platania (2000) found that protolarval Colorado pikeminnow stocked below the Hogback Diversion (RM 159) could drift to Clay Hills (RM 3) in as little as three days. In follow-up monitoring of the 500,000 protolarval Colorado pikeminnow stocked for the drift

study, none were found in three sampling trips from Hogback to Clay Hills (Trammell 2000). Jackson (2001) found 4 protolarval Colorado pikeminnow immediately after over 100,000 fish were stocked below Cudei Diversion, but none were captured in subsequent monitoring. Trammell (2000) and Jackson (2001) concluded that massive transport of larvae to Lake Powell, variable flows changing nursery habitat, and predation were probably responsible for the poor retention of the stocked pikeminnow larvae. Masslich and Holden (1996) summarized a number of studies that showed stocked pikeminnow drifted long distances downstream. Young pikeminnow (50-100mm) were stocked in the Colorado River several times in the early 1980s. The young pikeminnow generally dispersed from the stocking area within 30 days and were found 17 miles downstream within 6 days. Eventually some of the stocked fish were found up to 100 miles downstream. Therefore, behavioral characteristics may be a major issue behind stocked pikeminnow retention.

During the December 2002 monitoring pikeminnow seemed clumped in very specific habitats with near zero velocity and debris piles (usually tree limbs) for cover. One backwater above the Four Corners Bridge contained 78% (87 of the 111) of the pikeminnow caught below Shiprock. Conversely, in March 2003 pikeminnow were distributed throughout the area below Shiprock, and found in a variety of low velocity habitats. Colder water temperatures may have resulted in pikeminnow clumping in very specific habitats during the December sampling. However, if backwater habitats with cover are important during this time of year, the availability of those habitats was limited in December 2002.

Stocking of 200,000 or more YOY Colorado pikeminnow into the San Juan River is expected to continue annually (Ryden 2003) with the intent of developing an adult population capable of sustaining itself in the river and meeting the recovery goals of 800/1,000 adult Colorado pikeminnow (USFWS 2002). The poor retention of pikeminnow from the 2002 stocking, especially in the area above Hogback Diversion, led some members of the SJRIP Biology Committee to speculate that instead of stocking more fish, improving retention through new stocking techniques and habitat improvements should be investigated.

Stocking the YOY pikeminnow directly into low velocity habitats spread throughout larger sections of river, instead of stocking at one or two stocking sites has been approved for 2003 (Dale Ryden, USFWS, 2003 Scope of Work). Stocking in this manner may reduce the amount of downstream drift by eliminating the need for pikeminnow to find suitable habitat while drifting in the current. Other changes in stocking protocol may also help increase the retention of stocked pikeminnow throughout the river. The December 2002 sampling trip showed that pikeminnow seem restricted to certain habitats when river temperatures are cold. Stocking pikeminnow when water temperatures are warmer may reduce dispersal, because YOY pikeminnow may utilize a wider variety of habitats above a certain critical temperature. This appeared to be the case in March 2003 when stocked fish were much more dispersed than during December 2002. River temperatures were generally 3-5°C during the December sampling and 7-14°C during the March trip.

Acclimating fish to the river environment may also be a useful tool in improving retention. One of the common suggestions for improving the retention of stocked endangered fishes in the

Colorado River system has been to acclimate the fish to their new environment before releasing them (Marsh and Brooks 1989, Minckley et al. 1991, Ryden and Pfeifer 1996, Burdick 2003). Acclimation of hatchery-reared razorback sucker juveniles prior to stocking has been attempted several times in the Colorado River and its reservoirs (Mueller and Marsh 1998, Mueller and Foster 1999, Mueller et al. 2003). In these studies a subset of the razorback suckers to be stocked was held in net pens or backwaters prior to their release. The behavior of these acclimated fish was then compared with the behavior of fish that were not acclimated before release. No significant differences in dispersal of site-acclimated versus non-acclimated fish was observed in any of the studies. However, in two of the studies it appeared that site-acclimated fish did not travel as far, or disperse as fast, as non-acclimated fish (Mueller and Marsh 1998, Mueller and Foster 1999). Mueller et al. (2003) found that hatchery fish preconditioned to flow showed significantly less downstream dispersal than fish reared in ponds.

While some acclimation studies have been conducted with juvenile razorback suckers (~320-440 mm TL), less is known about acclimation of YOY fish, like the Colorado pikeminnow stocked in the San Juan (40-60 mm). Young Colorado pikeminnow (50-100 mm) were held with block nets in several backwaters along the Colorado River prior to release. However, the fish quickly dispersed from these holding areas after the block nets were removed (Chuck McCada, USFWS, personal communication). Whether the acclimation reduced the amount of downstream drift displayed by those fish was not determined since the fish were not marked.

The second addition to the monitoring study includes experiments designed to test different stocking protocols for YOY pikeminnow in the San Juan River. Specifically, we propose to experiment with acclimating stocked fish to the river and adding woody debris (brush piles) to low velocity habitats in 2004. Experiments with stocking at warmer temperatures will be initiated in 2005. These studies would be continued for a minimum of 3 years or until a refined stocking protocol is developed. The objective of these experiments is to improve the retention and survival of stocked pikeminnow throughout the San Juan River, with a special emphasis on the area above the Hogback Diversion. The experiments should help refine augmentation protocols that will maximize the retention of stocked fish. Comparisons of data from the monitoring of stocked Colorado pikeminnow between 2002-2003 and future years will allow us to measure the success of different experiments. This information can then be used to make management decisions regarding how the augmentation plan will help fulfill the recovery goals for the species.

The 2003 and 2004 data will provide a baseline to compare against future years. Continued sampling will allow the SJRIP to judge the success of new stocking protocols and habitat restoration efforts which may be implemented in 2003, and different flow conditions between years, at improving the retention of stocked YOY pikeminnow. This information can be used to make management decisions regarding future augmentation efforts.

Study Area:

The study area will be enlarged from the area studied in 2003 and will encompass the San Juan River from Clay Hills, Utah (RM 3) to near Bloomfield, New Mexico (RM 190). Eleven stations

will be utilized to represent the study area rather than the eight used in 2003, two in Geormorphic Reach 6 near Farmington, two in Reaches 2 and 3, one each in Reaches 1, 4, 5, and 7, and one in the lower Animas River. Reaches 1 and 2 will be sampled for the first time under this scope of work. Within the geomorphic reaches the study stations will remain the same as the 2003 stations to allow for retention comparisons between years. The three new stations will initially be RM 40-45 just below Mexican Hat, RM 20-25 near Johns Canyon in Reach 2, and RM 8-13 near Grand Gulch in Reach 1. RM 8-13 and 20-25 were identified by Trammel and Archer (2000) as nursery areas. A relatively high number of the 2002 stocked Colorado pikeminnow were found in the RM 40-45 area during the April 2003 razorback sucker larval monitoring trip (H. Brandenburg, University of New Mexico, personal communication). Adjustments to these locations may be made during the first sampling trip so the maximum amount of suitable habitat is sampled at each location. Table 1 provides the stations to be sampled, along with their river mile boundaries.

Table 1. Stations to be sampled for the 2003-2004 Colorado pikeminnow monitoring.

Station	River miles
Lower Animas	0-3.5
Upper San Juan	181.5-189.5
Fruitland Diversion to Hatch Trading Post	170-179.4
APS Weir to Hogback Diversion	160-164.7
Shiprock Bridge to Cudei	143-148.9
Drift station to Four Corners Bridge	120.2-128.5
Aneth	97.3-105.2
Bluff	77.5-84.0
Below Mexican Hat	40-45
Johns Canyon	20.0-25.0
Grand Gulch	8.0-13.0

The stocking experiments may expand the upper boundary of the study to RM 190.5. Specific experiments to improve retention will occur in the Upper San Juan Station (RM 190.5-181.5), the below Fruitland Diversion station (RM 179.4-170), from Hogback Diversion to the Shiprock Bridge (RM159-148.9), and the Shiprock to Cudei station (RM 148.9-143).

Objectives:

The objectives of the study are listed below.

1. Characterize growth and retention of 2003 stocked YOY Colorado pikeminnow during the first year after stocking in the San Juan River.

2. Identify factors such as river flow, storm events, and canal locations, with emphasis on the area above the PNM Weir, that are related to high or low retention of stocked YOY Colorado pikeminnow during the first year after stocking.

3. Characterize growth and retention of age 1 stocked YOY Colorado pikeminnow from the 2002 stocking during their second year in the river.

4. Compare growth and retention between 2002 and 2003 stocked fish and relate to changes in stocking protocol, river conditions, habitat improvements, and habitat availability.

5. Compare growth and retention of the 2002 and 2003 stocked fish with historical stockings, and relate to changes in stocking protocol, river conditions, habitat improvements, and habitat availability.

6. Experiment with augmentation protocols for Colorado pikeminnow to improve retention, especially in the upper river.

Methods:

Protocol Experiments - BIO-WEST proposes to study the benefits of site acclimation and increased cover (brush piles) in 2003-2004, in addition to the new stocking methods employed by the USFWS (see below). Studies of stocking fish earlier, at a warmer river temperature, will be planned for 2004-2005 if a suitable marking technique can be developed.

Conducting multiple stocking protocol studies at the same time can be complicated unless fish in the different experiments can be marked or different study areas are used. In October 2003, the USFWS is proposing to use a new stocking protocol by stocking pikeminnow over two 10-12 mile reaches of the San Juan River in October 2003. The YOY pikeminnow will be stocked directly into low velocity habitats throughout the river from the confluence of the Animas (RM 181.5) to the Hatch Trading Post (RM 170), and also from the Hogback Diversion (RM 159) to the Shiprock Bridge (RM 148.9) (D. Ryden, USFWS, personal communication). A GPS location will be taken at each area where pikeminnow are released.
Acclimation studies will occur in the Upper San Juan River above Farmington and the APS Weir to Hogback Diversion stations. Since the USFWS will be stocking fish in all available low velocity habitats from the mouth of the Animas River to Hatch Trading Post, we will stock marked fish in low velocity habitats above and below that area. The habitat available in each reach of river at any given time is largely a function of prevailing flow conditions. Therefore, BIO-WEST will perform a reconnaissance trip through both stations the week prior to the stocking to identify appropriate backwater and side channel habitat available for acclimation studies in October 2003. BIO-WEST may expand the upstream boundary of the Upper San Juan monitoring station to include more preferred habitat. During the reconnaissance trip, BIO-WEST will identify 5-10 low velocity habitats suitable for acclimation in each station. AGPS location will be taken for all acclimation study sites. Prior to pikeminnow introduction, the low velocity habitats will be depletion seined to remove other fishes. Native fish will be placed in alternate habitats, and nonnative fish will be removed. Block nets with < 2 mm mesh will be

used to enclose the low velocity habitat to prevent the escape of introduced pikeminnow and the entrance of other fish. Block nets will be set in place several days prior to stocking to determine any obvious problems with the maintenance of the acclimation study sites.

BIO-WEST personnel will receive a subset of approximately 20,000 fish from Dexter National Fish Hatchery. These fish will be marked with a new batch marking dye (calcein) at Dexter prior to being transferred to the river. (Note: Dexter is presently experimenting with the calcein dye and at this time feels it will work with pikeminnow. If it does not work, an elastomer dye mark will be applied.) The dye will allow identification of those fish that were site-acclimated during the 2003-2004 YOY Colorado pikeminnow monitoring. BIO-WEST will place approximately 1,000 of these marked pikeminnow into each selected acclimation habitat in each of the two study stations. Block nets will be monitored every day for 7 days after the stocking, at which point block nets will be removed. Monitoring of the block nets will involve visiting each acclimation study site at least twice daily over the 7-day period. BIO-WEST will use kayaks to efficiently move about the acclimation study stations.

The December 2002 monitoring data indicated that the presence of cover, in the form of debris piles, may be important in retention of stocked pikeminnow in colder winter months. BIO-WEST proposes to add debris piles to low velocity habitats throughout the Shiprock to Cudei monitoring station prior to the October 2003 stocking. In combination with the reconnaissance trips to identify acclimation study sites, BIO-WEST personnel will also float the Shiprock to Cudei study station the week before the October 2003 stocking. Branches will be removed from the abundant nonnative tree, Russian olive (*Elaeagnus angustifolia*), and placed into appropriate pikeminnow nursery habitats. Care will be taken to remove only a few branches from individual trees, to avoid any visual denudation of the stream bank and damage to the riparian zone. Branches that have already fallen will be used when possible. A GPS location will be taken at all habitats where debris is added.

Data collected during the 2003-2004 YOY Colorado pikeminnow monitoring will be used to judge the success of each of the above methods in increasing the retention of stocked pikeminnow. All pikeminnow captured during monitoring will be scanned for the presence of the calcein dye using a SE-MARK detector device (Western Chemical, Inc.). A comparison of pikeminnow CPE between 2002-2003 and 2003-2004 in the Upper San Juan and APS Weir to Hogback stations will provide information on whether site acclimation studies increased the retention of fish in these stations. Examining all fish captured during the monitoring for calcein marks should provide information on how far site-acclimated fish drifted from their stocking site and whether site acclimated fish had better retention than non-acclimated fish. Comparing CPE of pikeminnow between 2002-2003 and 2003-2004 in the Shiprock to Cudei station should give an indication of whether brush piles increased retention in that station. The CPE of pikeminnow in the Shiprock to Cudei station will also be compared to downstream stations that will not receive debris pile manipulations. Pikeminnow CPE will be compared between 2002-2003 and 2003-2004 in the Fruitland Diversion station to provide information on whether stocking fish into individual habitats increased retention. Finally, comparing the overall pikeminnow CPE between 2002-2003 and 2003-2004 should indicate whether the suite of protocols implemented during the 2003 stocking had an impact on the retention of pikeminnow throughout the river.

Fish data will be transformed to more closely approximate the normal distribution. The statistical program SYSTAT will be used to make the comparisons noted above. Where appropriate, we plan to use parametric tests, such as Analysis of Variance and t-tests, to compare catch per effort between years and stations.

The studies are proposed to run for at least 3 years since different techniques may work better under different flow/habitat/temperature conditions. As noted above, stocking fish earlier when river temperature will be warmer and the fish smaller will be added in the 2005 work plan (for implementation in fall 2004).

Monitoring - Three sampling trips will be made between the 2003 YOY pikeminnow stocking and September 2004. The first trip will be 2 to 4 weeks following stocking, most likely in late October or early November 2003. The second will be post-winter, but pre-runoff, most likely in March 2004. The third trip will be post-runoff, most likely in July or August, 2004. Trips will be scheduled to avoid periods of changing flow conditions.

During each trip, each of the 11 sampling stations will be sampled for one day. Access to the stations will be made with a jon boat, except in Reaches 1 and 2 where a raft will be used. Within each station, as many backwaters, shoals, and other low-velocity habitats available for young Colorado pikeminnow (Trammel and Archer 2000) will be sampled as is practicable in a day. Random sampling between stations will occur in Reaches 1 and 2 as the entire area below Mexican Hat will be floated. Sampling will be conducted using a 4 m x 2 m x 3 mm, 3 m x 2 m x 3 mm or a 9 m x 2 m x 6 mm double-weighted seine. Information collected at each seining location will include: river mile location, GPS location (UTM), habitat type, seine type, water temperature, area sampled (length and width), average depth, maximum depth, and substrate type. All fish collected, except for small larvae, will be identified to species and counted. A minimum of 50 randomly selected individuals of each species will be measured at each station except for Colorado pikeminnow, which will all be measured. This will provide information on the general size and age of the fishes that are collected at each station and during each sampling trip. Native fishes will be returned to the habitat alive, and nonnative fishes will be retained. A separate data sheet will be used for each seine location. Multiple seine hauls may be made in large (>100 m^2) habitats. The emphasis will be to take as many samples as possible rather than to gather detailed information on each fish captured.

Starting in November 2003, a PIT tag reader will be taken on monitoring trips. All pikeminnow over 150 mm captured during monitoring will be scanned for PIT tags and tagged if they do not already have a PIT tag.

It is anticipated that data on stocked Colorado pikeminnow will also be obtained during the annual April-June razorback sucker larval fish and July-September larval Colorado pikeminnow surveys currently being conducted under the SJRIP, as was the case in April, 2003. Additionally, the fall standardized sampling (Propst et al. 2000) should provide some information on pikeminnow retention from the mid-summer sampling trip through October. Since University of New Mexico (UNM) personnel responsible for the two aforementioned

larval fish studies, and the New Mexico Department of Game and Fish (NMGF) personnel responsible for the fall small-bodied fish standardized sampling are the co-principal investigators on this proposal, we expect seamless integration of data between the respective projects.

Data analysis will include an evaluation of changes during the course of the year in YOY Colorado pikeminnow catch rate, size, and location in the river. Information from the razorback sucker spring-summer sampling, as well as the September-October standardized monitoring, will be included in the analysis to provide a complete first year picture of the fate of the stocked fish. As the fish grow, information from the large-bodied fish electrofishing surveys will also be added. Changes in YOY Colorado pikeminnow catch rates will be compared with factors such as flow, river location, presence of canals, and other factors that may influence growth or retention. The results from the first year of the study will be compared with the second year of the study to determine changes in retention and identify potential causes for those changes. Information from earlier pikeminnow stocking efforts and follow-up sampling will be reviewed and compared where appropriate to the 2002 and 2003 information. Fish numbers will be transformed to better approximate a normal distribution. Using the statistical program SYSTAT pikeminnow CPE between stations, seasons, and years will be compared with parametric tests, including t-tests and analysis of variance tests. YOY pikeminnow habitat use will be examined with chi-square analysis. Potential changes to the augmentation program will be suggested based on the results of the study, especially if growth or retention are not within the range of expected results as noted in the Augmentation Plan (Ryden 2003).

Collection information will be compared with physical information such as river flow, storm event timing, and habitat availability that will be obtained from the physical monitoring activities of the SJRIP (Keller-Bliesner Engineering data). This physical information will be compared to the catch information to determine possible reasons for changes in retention between years and between sampling periods. In addition, if habitat improvements are implemented in 2003, the effect of those actions will be evaluated by comparing catch rates between 2002-2003 sampling and 2003-2004 sampling at appropriate stations.

BIO-WEST personnel will have the lead role in the study. Mr. Michael Golden will be the team leader. Personnel from NMGF and UNM will assist with field collection efforts and provide equipment as necessary for the upper eight stations. Personnel and rafts from UDWR will be used to access the lower three stations. A standard field crew of four people is anticipated except in Reaches 1 and 2 (lower three stations) where 3 people will be utilized.

The study is planned for a minimum of 3 more years to allow for an evaluation of the various factors that may be impacting YOY Colorado pikeminnow retention.

Products:

Letter-type trip reports summarizing what was found will be prepared following each trip. These short reports will be sent to the Biology Committee via the listserver once data have been preliminarily analyzed.

BIO-WEST personnel will also attend the annual researchers' meeting in February 2004 and provide a Microsoft Powerpoint presentation of the results of the project.

The annual draft report for 2003-2004 will be prepared and distributed to the SJRIP Biology Committee on or before March 31, 2005. Upon receipt of comments, a final report will be prepared on or before June 1, 2005, and provided to the SJRIP for distribution. All data will be presented in a Microsoft Access database and provided to the SJRIP for inclusion in the standardized database by March 31, 2005.

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Ryden, D.W. and F.K. Pfeifer. 1996. Monitoring of experimental stocked razorback sucker in the San Juan River. 1995 Annual Progress Report. US Fish and Wildlife Service, Colorado River Fishery Project, Grand Junction, Colorado.

Trammell, M. 2000. Evaluation of reintroduction of young of year Colorado pikeminnow into the San Juan River: 1999 annual report. San Juan River Basin Recovery Implementation Program. US Fish and Wildlife Service, Albuquerque, NM. 17p.

Trammel, M. and E. Archer. 2000. Evaluation of reintroduction of young of the year Colorado pikeminnow in the San Juan River 1996-1998. Pages 4-1 to 4-33, *in* Archer, E., T. A. Crowl, and M. Trammel, editors. Age-0 native species abundances and nursery habitat quality and availability in the San Juan River, New Mexico, Colorado, and Utah. Utah Division of Wildlife Resources, Salt Lake City, UT.

U.S. Fish and Wildlife Service. 2002. Colorado pikeminnow (*Ptychocheilus lucius*) recovery goals. Amendment and supplement to the Colorado Squawfish Recovery Plan. US Fish and Wildlife Service, Region 6, Denver, CO

2004 BUDGET:

BIO-WEST

Monitoring:

Labor (1,212 man-hours)		67,480.00
Travel (117 days per diem,4,800 miles, 20 hours plane time)		13,269.00
Equipment and Supplies		3,894.00
	Total	**84,643.00**

Protocol Experiments:

Labor (304 man-hours)		$19,125.00
Travel (30 days per diem, 1,500 miles)		4,070.00
Equipment and Supplies		8,625.00
	Total	**$31,820.00**

NMDGF

Labor (36@ $275/day)		9,900.00
Travel (33 days @$65/day and 3000 miles @ $.50/mile)		3,645.00
Equipment & Supplies		500.00
	Total	14,045.00
Overhead (10%)		1,404.50
	Total	**15,449.50**

UNM

Labor		
Field Research Technician (22 staff-days @ $275/day)		6,050.00
Travel and per diem		
Mileage (will drive with NMGF)		
Field per diem (18 staff-days @ $50/day)		900.00
Equipment & Supplies (will use equipment and supplies funds from existing UNM-SJR projects)		
	Subtotal	6,950.00
Administrative Overhead (15%)		1,042.50
	Total	**7,992.50**

UDWR

Labor (59 man days)		9,407.00
Travel		
Mileage (3 trips)		800.00
Per Diem (15 days)		600.00
	Total Travel	1,400.00
Equipment and Supplies		
Raft and motor		1,000.00
Miscellaneous		500.00
	Total Equipment	1,500.00
Administrative Overhead (20%)		2,461.00
	Total	**14,768.00**
Grand Total of the Project		**$154,672.50**

Funding Contribution from the National Park Service to UDWR	$10,112.00
TOTAL (Program Funds)	**$144,561.00**

Out-year Funding (based on 5% annual increase):

Fiscal Year	
2005	**173,996**
2006	**182,695**
2007	**191,830**

Development of Stocking Protocols for Colorado Pikeminnow in the San Juan River

Scope of work for FY 2004

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Background:

Augmentation of Colorado pikeminnow is a major portion of the recovery strategy for this species in the San Juan River where the wild population is extremely small. The general augmentation strategy is to stock 200,000 to 300,000 young-of-the-year (yoy) pikeminnow in the fall of each year for a number of years, or until certain population goals are met (Ryden 2003). The first stocking occurred in 2002 when approximately 200,000 yoy were stocked by the U.S. Fish and Wildlife Service (USFWS), half at Farmington (RM 180.1) and half at Shiprock (RM 147.9) NM. The fish were reared at Dexter National Fish Hatchery and Technology Center (DNFH) who has had the lead in culturing and propagating Colorado pikeminnow since 1981. BIO-WEST conducted monitoring studies of the stocked fish in 2002 and 2003 to determine overall retention in the river and location of retained fish.

In fall 2003 stocking was conducted on November 6 when the USFWS stocked most of the available fish (175,000 were available in 2003) into low velocity habitats along 20 miles of river; 10 miles near Farmington and about 10 miles between the Hogback Diversion and Shiprock. In addition, BIO-WEST was funded to utilize 20,000 of the total available yoy to study stocking protocols, primarily acclimation of the fish prior to release to the open river. The 20,000 fish for BIO-WEST were marked with calcein, a non-lethal fluorochrome compound that chemically binds with calcium, three days prior to stocking the fish into net pens and netted off backwaters in two areas, above Farmington reach and the APS Weir to Hogback Diversion reach. Fish were

delivered to the river on November 6 in three trucks from DNFH and stocking was initiated in late morning. BIO-WEST monitored their pens and backwaters during the next 7 days.

Monitoring of the young fish for the first 24 hours after stocking showed that they were healthy and doing very well with very few mortalities (less than 10 observed out of 20,000 fish handled). At about 24 hours post stocking, large numbers of fish started showing signs of stress (swimming near the surface erratically and developing a red blush on ventral portion of the fish) and died. About 70 to 80 percent of the fish died during the following 48 hours, after which the remaining live fish appeared to have recovered from the traumatic event and were released on November 12. On November 8 during the mortality period, BIO-WEST crews seined near the APS Weir and caught 6 non-marked pikeminnow that had been stocked by the USFWS near Farmington. Two of those 6 fish showed stress signs similar to the fish being held in the pens and backwaters. At the time the fish were dying (November 9), Paul Holden of BIO-WEST contacted Dr. Ron Goede, a retired Utah Division of Wildlife Resources fish health expert to determine cause and effect for the catostrophic loss. Dr. Goede suggesed that large changes in water hardness and conductivity (salinity) may be a issue. He had noted similar delayed mortality taking cutthroat trout from very hard to very soft water in the past.

Discussions with Manuel Ulibarri began on November 10 and dead fish were sent overnight to DNFH. Autopsies of some of the dead fish were made by Manuel on November 11 and hemorrhaging of the internal organs was noted as the likely cause of death. Based on Manuel's past experience, and information from the literature, as well as a comparison of DNFH and San Juan River water (Table 1), it was generally concluded that taking the fish from DNFH with very hard and saline water, to the San Juan River with low hardness and salinity, was the likely reason for the death of most of the stocked fish. DNFH staff believe the delayed mortality was caused by the fishes internal organs not being able to osmotically adjust to the drastic in water quality. DNFH harvest protocols consist of a seven day cycle that begins with draining one acre rearing ponds over a 48 hour period. During harvest, approximately 50gpm fresh water flow is added to the harvest basin where fish are collected and transported in oxygenated tanks and a 0.5% saline solution to the fish culture building for enumeration and marking. The 2 day harvest time frame and fresh water provides the fish sufficient time to acclimate to well water quality that they will be in for the next 5 days. Over the next two days debris and unwanted invertebrates are removed from the culture tanks, and the fish are netted, weighed, marked and enumerated. Following this process the fish are placed in a 0.5% saline solution to alleviate the handling stress and allowed to rest three days prior to shipping. On the seventh day the fish are netted, and loaded into oxygenated, insulated fiberglass tanks and hauled in a 0.5% saline solution at densities of approximately 100 to150 fish (2#) per gallon of water. It is possible that fish mortalities were incurred due to the extreme difference in water quality of the receiving water, compounded by the week long harvest, handling, marking and shipping scenario. Future work will include spreading out this process to a two week period. Since the stocking protocols used on November 6 were essentially the same ones used since 1996 when yoy Colorado pikeminnow were first stocked in the San Juan River (tempering for temperature at the river lasted approximately a half hour), it is likely that similar large mortality events happened at all previous stockings.

Table 1. Water quality comparison of Dexter National Fish Hatchery and Technology Center wells and the San Juan River near Farmington, NM.

Constituent	DNFH	San Juan River
Hardness	1700-2200 mg/l	180 mg/l
TDS	3950-4800 mg/l	240 mg/l
Alkalinity	188-245 mg/l	110 mg/l
Conductance	3420-5500 umhos/cm	390 umhos/cm

This proposal is the result of discussions between Manuel Ulibarri and Paul Holden during the week of November 10, as well as discussions with the Biology Committee of the SJRIP on November 13. DNFH retained about 2,000 yoy pikeminnow for other studies but those fish can be used to experiment with protocols that will reduce or eliminate the mortalities seen during the recent stocking in the San Juan River.

Study Area:

The study area will be DNFH and the APS Weir to Hogback Diversion reach (RM 163.5-159.0) of the San Juan River.

Objectives:

The objectives of the study are:

1. Determine what factor(s) caused the delayed mortality of stocked Colorado pikeminnow in the San Juan River.

2. Develop protocols for acclimatizing fish prior to stocking that will eliminate the observed mortality.

Methods:

Two types of experiments are proposed. Initial experiments will be conducted at DNFH using San Juan River water to duplicate the mortality scenario. Once the cause of mortality has been determined, experiments with differing levels of tempering of the fish will be conducted at Dexter to determine the optimum length of tempering time necessary prior to stocking. Tempering will involve changing the water the fish are held in from DNFH water to San Juan River water over a specified period of time. Information gained from the DNFH trials will be used when stocking the fish into the San Juan in net pens.

DNFH Experiments - All experiments will have 2 replications. The initial test will compare calcein marked and non-marked fish, as well as stressed and non-stressed fish. Groups of 50 marked and non-marked fish will be subjected to handling procedures similar to those used on November 5 and 6 to load, transport, and stock the fish in the San Juan River. The two groups of fish will be stocked from the simulated DNFH truck tanks and placed in aquaria with San Juan River water at the approximate temperature of the river on November 6 (45 F). A third group of fish will be taken directly from DNFH water to San Juan River water without the added stress of simulated handling procedures. A fourth (control) group of fish will be stressed and placed in DNFH water. The fish will be observed initially every 4 hours for the first 48 hours, and every 8-12 hours as mortalities subside, for the next 5 days to determine mortalities. About 20 percent of the dead fish will be autopsied to determine cause of death. This study will determine if the mortalities seen in the San Juan River can be duplicated, if there is a difference is survivability of calcein marked fish versus non-marked fish, if the handling stress contributed to the mortalities, and the reason for death of the fish.

If mortalities are not seen, additional experiments will be conducted to determine what happened with the river stocking. If the mortalities occur as expected, the second tier of hatchery experiments will be initiated. These experiments will also use paired groups of 50 fish and will test tempering DNFH water with San Juan River water for periods of 12, 24, 36 and 48 hours to achieve essentially pure San Juan River water. Within each experiment, equal amounts of replacement San Juan River water will be mixed with the DNFH water every 4-8 hours. These experiments will also run for 5 days and the fish observed initially every 4 hours.

It is anticipated that these experiments will determine an optimal tempering time for yoy pikeminnow. The final experiments will take what was learned in the lab and test them under field conditions. These experiments will use five sets of paired net pens (6' x 6') in a backwater or side channel that was used for the November 6-12 studies in the San Juan River between the APS Weir and Hogback Diversion. The experiments will compare tempering in the hatchery prior to transport to the stocking location versus tempering the fish at the river just prior to stocking. One set of pens will be used as controls, and use calcein marked fish with no tempering, essentially the same protocol that was used on November 6. One set of pens will be used to test the shortest tempering time determined during the initial DNFH experiments. The fish in this test will be tempered in the hatchery prior to travel to the San Juan River. The remaining three sets of pens will use fish that are hauled to the river in DNFH water, and then tempered for the three shortest tempering times determined during the initial experiments. This experiment will allow for some comparison of real world stocking protocols since very large quantities of water would be needed to temper large numbers of fish at the hatchery. BIO-WEST personnel will assist with the onsite tempering, stock the fish into the cages, and observe the fish every two hours during daylight to determine mortalities and overall condition. Dissolved oxygen and temperature in the study site will be monitored with a Hydrolab. If the river rises during the tests, the cages may need to be moved. After 6 days, the remaining fish will be released into the San Juan River.

Changes in experimental design may occur depending on the results of the various experiments. Additional experiments may be warranted in the fall of 2004 if the results of these experiments

are not satisfactory. The one factor that will not be tested is the effect of handling large numbers (200,000 to 300,000) of you pikeminnow at one time.

Products:

A report detailing the methods used and results of the study will be prepared and presented at the February 2004 Biology Committee meeting. A brief summary of the results of the tests will be posted on the SJRIP Biology Committee listserver as the experiments are in progress.

Study Timing:

Time is of the essence for this study, both to conduct the studies at similar river conditions to November 6, and also to conduct them before winter sets in. Therefore, DNFH personnel will obtain water from the San Juan River with their hatchery trucks the week of November 17. The first set of experiments will be initiated that week, and the appropriate number of fish calcein marked. The second set of experiments will occur during the week of November 24, and the field tests will be initiated the week of December 1, 2003.

Literature Cited:

Ryden, D. W. 2003. Augmentation plan for Colorado pikeminnow for the San Juan River. U.S. Fish and Wildlife Service, Grand Junction, CO.

2004 Budget:

DNFH

Labor costs will be covered by DNFH	
Travel	$ 2,000

BIO-WEST

Labor (384 man-hours)	16,650
Travel (25 days per diem, 1,500 miles, 6 hours airplane)	3,074
Supplies	276
Total	$20,000
Total Budget	**$22,000**

RECOVERY CHAPTER

2004 WORK PLAN

Non-native Species Control, PNM Weir to Shiprock, New Mexico
FY 2004 Workplan Proposal

Principal Investigators – Jason E. Davis, Stephanie Coleman and Jim Brooks
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Background:

During 1991 to 1997, non-native species studies on the San Juan River focused on the identification of impacts to native fishes. Research characterized non-native species distribution and abundance in main channel habitats, seasonal movements of both channel catfish *Ictalurus punctatus* and common carp *Cyprinus carpio*, food habits of non-native predators, overlap of resource use between native and non-native fish species, and the relation of these findings to differing flow regimes. Channel catfish were the single most abundant large non-native in main channel collections (Ryden, 2000). Data indicated that channel catfish occupied a variety of habitats within the main channel, generally exhibited localized movement and at lengths > 450 millimeters preyed upon native fishes (Brooks et al., 2000).

Control of problematic non-native fishes has been identified as a management action to the recovery of Colorado pikeminnow *Ptychocheilus* lucius and razorback sucker *Xyrauchen texanus* (Recovery Goal 5.2.2.3, Mgt. Action C-3; Task C-3.3 C-3.4; U.S. Fish and Wildlife Service, 2002). Beginning in 1999, emphasis on removal of channel catfish and common carp was placed on a portion of Reach 6, PNM Weir to Hogback Diversion (RM 167.5 to 159.0) and was designed to address efficacy of mechanical removal and minimization of the reproductive effort in the upper portion of these species ranges. This sub-reach was selected based on studies conducted from 1991 to 1997 indicating low numbers of both channel catfish and common carp above PNM Weir and channel catfish collected within this reach were almost exclusively large fecund adult fish, > 300 mm (Ryden, 2000).

Intensive removal trips in 2001 began in February. A total of ten (3 day) trips removed 4,024 channel catfish and 3,074 common carp. Declining trends in distribution and abundance of both species were observed over six sampling trips conducted prior to spring runoff. In the four remaining trips (July, August, September and November) the number of channel catfish removed doubled (Davis, 2003). We hypothesized that these increases in catch rates are due to upstream movement through the non-selective fish ladder at Hogback Diversion. In addition to seasonal declines in distribution and abundance, mean total length of channel catfish declined over the ten trips to end with a mean of 396.48 mm. This mean is significantly lower than that observed in sampling conducted during 1999.

In 2002 a total of 3,558 channel catfish and 1,542 common carp were removed. Catch rate data were initially high but declined in subsequent sampling trips. Less than 100 channel catfish were collected on five trips with four of those yielding fewer than 20 fish. The lowest total number of

channel catfish removed during a three day sampling trip occurred in November with only three individuals collected. Over 90% of all channel catfish collected were captured in June, July and August (three trips total).

A continued shift toward smaller channel catfish was also observed to end the year with a mean TL of 384.9 mm. A shift to smaller sized channel catfish is important to the control of this species due to attainment of sexual maturity and increased reproductive potential of larger sizes. Helms (1975) found that 1 of 10 channel catfish were sexually mature at 330 mm TL, producing about 4,500 eggs compared to 5 of 10 at 380 mm TL, producing over 41,000 eggs. In comparison of length data taken in both 1999 and 2002 this shift to smaller individuals is apparent. Channel catfish > 600 mm TL comprised 13% of the catch in 1999 and only 0.1% in 2002. In addition, channel catfish < 400 mm TL comprised only 19% of the catch in 1999 and over 63% in 2002 (Davis, un-published data). These shifts to smaller individuals coupled with declines in seasonal abundance throughout this reach may have long term effects to the channel catfish populations in adjacent downstream reaches.

Data from 2002, coupled with similar results in 2001, indicated an apparent success in decreasing channel catfish abundance seasonally within this sub-reach. Initial results from a project to address movement through the non-selective fish ladder at Hogback (completed during late winter 2001) indicated that the ladder does work and does not serve as a barrier to upstream movement of channel catfish (NMFRO files). Therefore, current removal efforts have shifted to focus sufficient effort upstream of Hogback Diversion, prior to high spring flow conditions, to maintain current accomplishments while initiating removal efforts downstream. By beginning removal efforts in the adjacent downstream sub reach (Hogback to Shiprock, New Mexico) we may be able to minimize upstream emigration and maintain low abundance of channel catfish throughout the upstream sub-reach year round. In addition, channel catfish remain very abundant immediately below Hogback diversion (Dale Ryden, personal communication) and likely contribute much to the channel catfish population in adjacent downstream reaches. By continuing efforts upstream of Hogback Diversion and initiating removal effort downstream, we may be able to suppress the channel catfish population over 20 river miles of the upper San Juan River. It is throughout this reach that current efforts to augment the populations of both razorback sucker and Colorado pikeminnow are currently taking place (both species are stocked immediately below Hogback Diversion).

A study addressing the drift of fishes in the San Juan River from 1991-1997 found that channel catfish was the most abundant drifting larval fish sampled (Platania and Dudley, 2000). By removing large fecund channel catfish from the upper portion of their range in the San Juan River mechanical removal has the potential to affect distribution and abundance of this species in adjacent downstream reaches. Removal efforts on the San Juan River are concentrated on all size classes. Sexually mature channel catfish as well as sexually immature individuals that would contribute to the breeding population in subsequent years are being removed. Theoretically, this non-selective removal would impact the population more rapidly than size selective removal (Smith, 2000).

Given the popularity of channel catfish as a sport fish and the concerns expressed by the public regarding disposal of removed fish, a program to transplant removed fish to isolated fishing

impoundments within the Basin was initiated in 1998 and continues through the present. Channel catfish collected are transported by the New Mexico Department of Game and Fish or the Navajo Nation to closed impoundments. This effort is strongly supported by the State of New Mexico and the local public and expansion of the program is highly recommended

The USFWS has a long standing working relationship with Native American tribes in assisting in various fisheries related issues including non-native recreational fishing programs on tribal lands. The Service has long provided recreational game fish to tribal partners throughout the Southwest with emphasis on rainbow trout, *Oncorhyncus mykiss*, and channel catfish. Due to changes in USFWS priorities many hatchery programs which supplied these fish for tribal use have suffered cutbacks or complete closures causing many tribal programs to suffer. The Southwest Tribal Fisheries Commission (SWTFC), currently seeking charter, was formed to restore and enhance tribal sport fishery resources and may provide additional support for distribution of removed channel catfish..

Objectives:

1. Continue data collection and mechanical removal of large bodied non-native fish during main channel and rare fish monitoring efforts.

2. Evaluate distribution and abundance patterns of non-native species to determine effects of mechanical removal on abundance and distribution patterns.

3. Characterize response of native species in intensive removal reaches.

4. Expand intensive removal efforts to adjacent downstream reaches (Hogback Diversion to Shiprock, NM), while still maintaining sufficient effort to maintain current accomplishments within upstream sub-reaches.

5. Continue and expand transplantation of channel catfish to closed impoundments isolated from the San Juan River with the assistance of New Mexico Department of Game and Fish, Navajo Nation Fish and Wildlife Service and the SWTFC.

6. Characterize the seasonal distribution and abundance of striped bass upstream of Shiprock, NM during removal efforts and continue to document the predative impacts via stomach content analysis.

Methods:

Mechanical removal will continue during the fall main channel monitoring efforts. During these sampling efforts, all non-native species collected will be sacrificed and data recorded for species identification and enumeration, ontogenetic stage (young-of-year, sub-adult, adult) at non-designated miles, and standard and total lengths and weight at designated miles. Data will be summarized by geomorphic reach and sampling will occur two out of every three river miles. Data for recaptured channel catfish and common carp tagged during all studies will be recorded in the field and integrated into existing databases for movement and abundance. Catch rate

(CPUE) will be calculated as number of fish collected per hour electrofishing time and be calculated for the total collection and for each species. Analyses will include comparison of 1998-2003 data summaries.

Initial sampling efforts, minimum of one trip, will be conducted from PNM Weir to Hogback Diversion to monitor and evaluate prior year's effort and to remove fish that remain or have moved upstream of Hogback Diversion. If catch rates remain low (< 5.0 catfish/hour of electrofishing) during initial sampling, removal efforts will shift to the adjacent downstream reach. After high spring/summer flows, sampling efforts again will be shifted to the PNM Weir to Hogback Diversion reach to document any upstream emigration that occurred.

If initial sampling efforts justify a shift to downstream reaches, removal efforts will follow the same sampling protocol utilized during 2001 and 2002. Three day sampling efforts for mechanical removal in the San Juan River between Hogback Diversion and Shiprock, New Mexico will occur throughout 2004. Sampling will be by two electrofishing rafts and captured channel catfish will be measured (nearest 1 mm) for standard and total lengths, weighed (nearest 1 g), and, if not sacrificed for study purposes, transported by hatchery truck to isolated recreational angling impoundments in the Four Corners region. All other nonnative species sampled during these efforts will be removed (lethal) and appropriate data recorded for location, length/weight, and, for lacustrine predators, stomach contents. Total and individual daily catch rates will be calculated to evaluate efforts of short-term suppression efforts to locally deplete non-native species numbers.

If rare species are collected, sampling will be immediately halted and the fish will be weighed, measured, checked for the presence of a radio transmitter or PIT tag and will be released within the general area of collection. Notes on the condition of the fish and location of collection (RM) will be recorded.

In addition historical catch rate data on native fish collected within intensive removal reaches including flannelmouth sucker, *Catostomus latipinnis*, and bluehead sucker, *Catostomus discobolus*, collected during the fall monitoring trips (1991-2003) will be analyzed to determine any effects non-native removal has had on distribution and abundance of these species. Comparisons between capture rate data and length frequency of these two native species prior to and during removal efforts will be analyzed to help clarify the effect non-native removal may have on these populations within the intensive removal sub-reaches.

Striped bass control efforts will be combined with other mechanical removal efforts unless high abundance and distribution patterns observed post spring runoff 2000 are encountered during 2004. If it is determined that abundance is high, specific removal efforts will be employed between Farmington, New Mexico and Bluff, Utah. All non-native fishes will be removed. Lacustrine non-native species (striped bass, walleye, largemouth bass) collected in the San Juan River will be sacrificed for stomach content analysis and gender and reproductive status identified. Stomachs will be removed from each specimen captured and contents will be identified in the field when possible. Otherwise, stomachs will be preserved in 10% formalin for lab analysis.

Deliverables:

An electronic data file will be provided for inclusion in the centralized database by 31 March 2005. A draft summary report detailing findings will be submitted to the San Juan River Implementation Program, Biology Committee, by 31 March 2005. Revisions will be completed and a final summary report will be submitted by 1 June 2005.

Literature Cited:

Brooks, J.E., M.J. Buntjer, and J.R. Smith. 2000. Non-native species interactions: Management implications to aid in recovery of the Colorado pikeminnow *Ptychocheilus lucius* and razorback sucker *Xyrauchen texanus* in the San Juan River, CO-NM-UT. San Juan River Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM.

Davis, J.E. 2003. Non-native species monitoring and control, San Juan River 1999-2001. Progress Report for the San Juan River Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM.

Helms, D.R. 1975. Variations in the abundance of channel catfish year classes in the upper Mississippi River and causative factors. Iowa Conservation Commission, Iowa Fisheries Technical Series 75-1, Des Moines.

Platania, S.P. and R.K. Dudley. 2000. Drift of Fishes in the San Juan River, 1991-1997. San Juan River Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM.

Ryden, D.W. 2000. Adult fish community monitoring on the San Juan River, 1991-1997. San Juan River Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM.

Smith, J.R. 2000. Non-native species monitoring and control, San Juan River 1998-1999. Progress Report for the San Juan River Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM.

U.S. Fish and Wildlife Service. 2002. Razorback sucker (*Xyrauchen texanus*) Recovery Goals: amendment and supplement to the Razorback Sucker Recovery Program Plan. U.S. Fish and Wildlife Service, Mountain-Prairie Region (6), Denver, Colorado.

Budget (FY 2004):

Personnel:		
Nonnative species removal/channel catfish translocation (168 staff days)	$	58,800
Laboratory processing of samples (11 staff days)	$	3,850
Reporting/data management (40 staff days)	$	14,000
Native species response analyses (15 staff days)	$	5,250
Subtotal	$	81,900
Travel/per diem:		
Removal/translocation (113 staff days)	$	8,500
Reporting/data management (12 staff days)	$	900
Subtotal	$	9,400
Equipment and supplies		
Removal/translocation (generator replacement, equipment maintenance)	$	5,000
Miscellaneous (administrative supplies)	$	1,500
Subtotal	$	6,500
T0TAL	$	97,800
Administrative Overhead (19%)	$	18,582
Funding for participation of other agencies:		
New Mexico Department of Game and Fish - Santa Fe	$	10,500
U.S. Fish and Wildlife Service – Fisheries Division - For Distribution Truck and Driver	$	10,000
U.S. Fish and Wildlife Service - Grand Junction	$	5,250
Utah Division of Wildlife Resources - Moab	$	5,250
GRAND TOTAL	**$**	**147,382**

Outyear Funding (with 5% increase included):

Fiscal Year 2001	$ 117,240	Fiscal Year 2002	$ 130,040
Fiscal Year 2003	$ 136,880	**Fiscal Year 2004**	**$ 147,382**
Fiscal Year 2005	$ 154,751	Fiscal Year 2006	$ 162,488
Fiscal Year 2007	$ 170,612		

Nonnative Species Control in the Lower San Juan River
Fiscal Year 2004 Project Proposal

Principal Investigators: Julie A. Jackson and J. Michael Hudson
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Background:

Nonnative fish species prey upon and compete with native fish species, resulting in the decline of the native fish population. Predacious fish introduced as sport fish into reservoirs have increasingly made their way into the riverine habitat that has historically been the domain of native fish. Northern pike, walleye, largemouth bass, and sunfish are some examples of sport fish that have been found in the Green and Colorado rivers.

In 1995, mechanical removal efforts were initiated by the U.S. Fish and Wildlife Service (USFWS) to target nonnative species in the upper San Juan River. Channel catfish were the main focus of these removal efforts, as they occupy a variety of habitats within the main channel, and prey on the native fish community. Data from 1998 to 2000, collected by USFWS, has shown a decline in the abundance of channel catfish > 300 mm TL in the study area, presumably due to removal actions. Removal efforts continue to take place in a nine mile portion of Geomorphic Reach 6 between the Hogback Diversion Dam and the PNM Weir.

Other nonnative species are a concern due to their impact on native species in the San Juan River. Several lacustrine predators are free to move up into the San Juan River from Lake Powell. These include largemouth bass, walleye and striped bass. Lake Powell has a large population of striped bass and their life history patterns suggest that they move out of lakes and into lotic waters to spawn in the spring (Lee et al. 1980). Furthermore, their effectiveness as visual predators is likely increased during clear flowing runoff periods. Since 1995, striped bass movement from Lake Powell into the San Juan River has become a concern of San Juan River researchers. High numbers (approximately 270 individuals) and widespread distribution of striped bass was observed in July 2000 during electrofishing surveys on the San Juan River. Surveys in the fall of 2000 indicated approximately one hundred striped bass still present in the river (Ryden 2001). Stomachs of these striped bass contained many native suckers (unpublished data from San Juan River database). Striped bass and walleye continue to be collected by several researchers throughout the San Juan River. Additionally, during the first year (2002) of this project 34 endangered fish were captured in the lower San Juan River. Striped bass and other nonnative fish predation upon native fish poses a substantial threat to the recovery of endangered species in the San Juan River. The consistent observation of this species in the San Juan River suggests the need for further study and continued removal efforts to aid in the persistence of the native and endangered fish community in the river.

This work plan proposes the continuation of an ongoing study to identify when the majority of striped bass move up into the San Juan River, in addition to actively removing them and other nonnative fish in the lower section of river. This study will serve to determine what time frame will be most effective so that more intensive and specific removal efforts may be employed in the future. Removal efforts in the lower river will aid in current efforts further upstream, and hopefully suppress any negative impacts to the endangered and native fish community. Initial efforts for this study began in 2002 and will continue in 2004, serving as the third year of this project. Additionally, beginning in 2003, channel catfish collected during the first trip of each year will be floy tagged in attempt to obtain a population estimate and further evaluate effects of removal.

Description of Study Area:

The study area for this project includes the San Juan River from Mexican Hat (RM 53) to Clay Hills (RM 2.9), Utah. The river from Mexican Hat to RM 16 is part of Geomorphic Reach 2 and is primarily bedrock confined and dominated by riffle-type habitat. RM 16 down to Clay Hills includes Geomorphic Reach 1 where the river is canyon bound with an active alluvial bed. Habitats within this section are heavily influenced by the shifting thalweg, changing river flow, and reservoir elevations. This section of river has additionally been identified as important nursery habitat for native and endangered fish species.

Objectives:

1.) Determine peak striped bass movement from Lake Powell into the San Juan River in order to refine timing of removal trips.

2.) Continue mechanical removal efforts of large bodied nonnative species in the lower portion of the San Juan River and generate a population estimate of channel catfish by mark/recapture data.

3.) Relate striped bass movement out of Lake Powell into the San Juan River to lake and river conditions (including temperature, flows and turbidity).

4.) Characterize the distribution and abundance of lacustrine predators moving out of Lake Powell into the San Juan River during spring and summer.

Methods/Approach:

Mechanical removal of nonnative species will be conducted from Mexican Hat to Clay Hills, Utah. Sampling effort will be conducted via two raft mounted electrofishing boats. The entire study area will be electrofished in a downstream fashion with one boat on each shoreline. Each boat will have one netter and one rower. A third boat will follow behind to pick up nonnative fish missed by the electrofishing boats. These fish will not be included in catch rate calculations, so that comparisons can be made between trips and years. Ten five day trips with 6 people are anticipated, and timing of sampling will be dependent on 2003 data. Bimonthly trips will be conducted, which will likely translate into every other week sampling from March through

August. The final trip of the year is anticipated in October. In an average water year, this schedule would allow for sampling a variety of habitat conditions, including variable flows, temperatures, and turbidity.

All nonnative fish collected will be identified, enumerated, measured to the nearest mm for total and standard length, weighed to the nearest gram, and removed from the river. Gender and reproductive status of lacustrine species will be determined and approximate location of capture by river mile recorded. Stomach contents of lacustrine species will be examined. Contents needing microscopic identification will be preserved. Any threatened and/or endangered fish encountered will be collected, identified, enumerated, measured to the nearest mm for total and standard length, weighed to the nearest gram, and scanned for a PIT tag. If a PIT tag is not present one will be inserted. General condition of the fish will be recorded in addition to any parasites or abnormalities. All threatened and endangered fish collected will be returned to the river at the location in which they were caught. River mile and GPS coordinates will be recorded at the location in which threatened and endangered fish are collected. Catch rates for all fish will be calculated as number of fish caught per hour. Other native fish will not be netted.

Channel catfish collected during the first trip of the year will receive a floy tag and be returned to the river. Channel catfish collected on subsequent trips will be removed from the river. A Lincoln/Peterson population estimate will be generated for channel catfish captured during the first pass and recaptured in the second pass. Captures of channel catfish during subsequent trips will allow us to monitor ratios of marked to unmarked fish and use these ratios to calculate a rough population estimate thereafter. Ratios of marked fish to unmarked fish will help determine if assumptions of a closed population are being met.

General water quality parameters will be recorded including temperature, conductivity, salinity and dissolved oxygen. Daily river discharge, temperature and turbidity will be compared to catch rates for striped bass to determine the relationship between river conditions and movement of these fish upstream.

Costs for other cooperating agencies that may provide personnel and equipment as needed are included in this budget.

Products/Schedule:

A draft report for the Nonnative Species Control in the Lower San Juan River activities will be prepared and distributed to the San Juan River Biology Committee for review by 31 March, 2004. Historical information on nonnative fish species use of the lower San Juan River will be included, to the extent it is available. Upon receipt of written comments, that report will be finalized and forwarded to members of the San Juan River Biology Committee 1 June 2004. Electronic copies of the field and collection data will be transferred to the San Juan River database manager following the successful protocol previously employed.

Literature Cited:

Lee, David S., C. R. Gilbert, C. H. Hocutt, R.E. Jenkins, D. E. McAllister, J. R. Stauffer, Jr.1980. Atlas of North American Freshwater Fishes. North Carolina State Museum of Natural History.

Ryden, D. W. 2001. Long term monitoring of sub-adult and adult large-bodied fishes in the San Juan River, 2000. Interim Progress Report. U.S. Fish and Wildlife Service. Grand Junction, CO. 61 pp.

Budget FY-2004:

Personnel:			
Biologist (116 total days)		$	22,825
3 Technicians (279 total days)		$	27,900
Project Leader (15 total days)		$	3,375
	Subtotal	$	54,100
Travel / Per Diem:			
Travel (10 trips)		$	4,000
Per Diem (50 days)		$	3,000
	Subtotal	$	7,000
Equipment / Supplies:			
Equipment Maintenance (generators, trailers, rafts)		$	5,000
Miscellaneous		$	1,000
	Subtotal	$	6,000
TOTAL		**$**	**67,100**
Administrative Overhead (20%)		$	13,420
Funding for Participating Agencies:			
U.S. Fish and Wildlife Service- Albuquerque		$	15,850
U.S. Fish and Wildlife Service- Grand Junction		$	11,900
New Mexico Game and Fish- Santa Fe		$	3,950
GRAND TOTAL		***$***	***112,220***

Outyears
FY-2005 - $ 117,050
FY-2006 - $ 122,120
FY-2007 - $ 127,450

Razorback Sucker Augmentation and Monitoring
Fiscal Year 2004 Project Proposal

Updated 4 June 2003
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Background:

Razorback sucker is a federally-listed endangered fish native to the San Juan River. At present this species is rare in the San Juan River. In order to gain information on habitat use, possible spawning areas, and survival and growth rates of hatchery-reared razorback sucker in the wild, it was necessary to experimentally stock a small number of fish. Experimental stocking of razorback sucker into the San Juan River began in 1994, as outlined in An Experimental Stocking Plan For Razorback Sucker In The San Juan River. Between 1994 and 1996, a total of 940 razorback sucker were stocked into the San Juan River by personnel from the U.S. Fish and Wildlife Service's (Service) Colorado River Fishery Project (CRFP) office in Grand Junction, Colorado. All fish were PIT-tagged before release into the wild. Based on the success of this experimental stocking study the decision was made to implement a full-scale augmentation program for razorback sucker in the San Juan River. Information obtained during the evaluation of stocked razorback sucker will help address objectives 5.1 through 5.5 in the San Juan River Long Range Plan.

In August 1997, a Five-Year Augmentation Plan for Razorback Sucker in the San Juan River was finalized. The five-year augmentation plan, recommended the stocking of 73,482 razorback sucker into the San Juan River between 1997 and 2001. Stocking of razorback sucker from various sources into the San Juan River began in early September 1997. However, between 3 September 1997 and 1 November 2001 a total of only 5,896 razorback sucker were stocked into the San Juan River. If razorback sucker stocked as part of the experimental stocking plan (1994-1997) are included, 6,836 razorback sucker have been stocked into the San Juan River since 1994. The 5,896 razorback sucker stocked as part of the five-year augmentation effort represents a shortfall of 67,586 fish when compared to numbers recommended in the five-year augmentation.

The inability to achieve San Juan River razorback sucker augmentation goals has been due to a suite of circumstances all of which ultimately result in a lack of fish. However, the main problem is that rearing facilities outside of the San Juan River Basin lack the capabilities to hold and rear razorback sucker for the San Juan River Recovery Implementation Program (SJRIP). To alleviate this problem, the SJRIP undertook efforts to obtain or build grow-out ponds within the San Juan River basin that would afford a measure of self-sufficiency (for holding/rearing fish) to the San Juan River razorback sucker augmentation program. Beginning in 1997, a series of grow-out ponds were established on NAPI lands southwest of Farmington, New Mexico.

Presently there are about 25 surface acres of grow-out ponds (i.e., nine individual ponds) being used to rear razorback sucker. The San Juan River Biology Committee is currently pursuing the acquisition and/or construction of additional pond acreage.

Another problem when trying to meet target stocking numbers set forth in the augmentation plan is that, in many years, the number of excess razorback sucker available to the SJRIP from Upper Colorado River Basin (UCRB) recovery efforts are not sufficient to make up for shortfalls and achieve the goals prescribed in the augmentation plan. One approach currently being employed to address the problem is to obtain razorback sucker larvae from Willow Beach and Dexter National Fish Hatcheries (NFH). These larval fish are progeny of wild Lake Mohave adults being held at those hatcheries. Since the majority of these larvae are produced in March, they need to be temporarily retained until food availability and water temperatures in ponds are adequate to support them (usually mid- to late-May). Personnel Division of Fishes, Museum of Southwestern Biology (MSB), at the University of New Mexico (UNM) have addressed this concern (under a separate workplan) by establishing temporary holding facilities for larval razorback sucker. The UNM holding facility serves to maintain larvae in the interim (8-10 weeks) between their being obtained from hatchery facilities and a time when water temperatures at grow-out ponds increases to a sufficient level for rearing. These larval fish have been used in past years to stock Hidden Pond and the two Avocet Ponds.

In spring 2003, the 6-Pack grow-out ponds were stocked with approximately 5,800 age-1 (i.e., 100-250 mm TL) razorback sucker obtained from the Service's 24-Road hatchery (n = 5064) and CDOW's Mumma state fish hatchery (n = 800). These razorback sucker were excess fish that were being culled from the UCRB razorback sucker broodstock lots. In subsequent years, larval razorback sucker from various sources (i.e., Dexter NFH, 24-Road hatchery, others) will be used to stock ponds, as they become available.

Because of the large shortfall in numbers of stocked fish during the 1997-2001 augmentation effort, the San Juan River Biology Committee adopted an addendum to the 1997 stocking plan (finalized in February 2003) that extends the intensive stocking period for razorback sucker for an additional eight-year period, beginning in 2004 and continuing through 2011. This addendum calls for stocking a minimum of 11,400 age-2 razorback sucker per year, with the goal of establishing an adult population of 5,800 adult razorback sucker in the San Juan River.

Razorback sucker stocked into the grow-out ponds in spring 2004 (as well as holdover fish from previous years' harvest efforts) will be harvested throughout 2005 (and outyears) for this eight-year augmentation effort.

In the interim between the two augmentation efforts (i.e., during 2002 and 2003), the nine grow-out ponds currently in use will be sampled multiple times and fish $\geq$ 300 mm TL will be selectively removed, PIT-tagged, and stocked into the San Juan River. This selective removal of larger fish from grow-out ponds will allow for accelerated growth of smaller razorback sucker remaining in the grow-out ponds. In addition, razorback sucker stocked in 2002 and 2003 will help boost numbers of adult razorback sucker in the river between the two augmentation efforts.

Because of the large increase in numbers of fish that need to be handled since the 6-Pack ponds came online in 2002 (this tripled the number of ponds to be harvested), it has become necessary to employ increased numbers of fyke-nets and multiple sampling efforts to adequately harvest fish in the grow-out ponds. Because of this, harvest efforts have increased roughly four-fold over previous years.

Description of Study Area:

Razorback sucker will be reared in ponds southwest of Farmington, New Mexico for two full growing seasons (to TL $\geq$ 300 mm), at which time they will be harvested, PIT-tagged, and stocked into the San Juan River at RM 158.6, just downstream of the Hogback Diversion (between Farmington and Shiprock, New Mexico).

The study area for monitoring razorback sucker stocked into the San Juan River extends from RM 158.6 downstream to RM 2.9 (Clay Hills boat landing) just upstream of Lake Powell in Utah.

Objectives:

1.) Obtain, rear, harvest, and stock razorback sucker to fulfill tasks and objectives outlined in the current version of the razorback sucker augmentation plan (*2003 final*).

2.) Monitor stocked razorback sucker in the wild for various parameters, including:
a) Spawning season habitat use and movement patterns
b) Survival and growth rates
c) Determine whether hatchery-reared razorback sucker will recruit into the adult population and successfully spawn in the wild

3.) Remove nonnative fish species which prey upon and compete with native fish species in the San Juan River.

Methods:

USFWS personnel will coordinate the obtaining of larval razorback sucker from Willow Beach and Dexter NFH during March and April 2004. Larval razorback sucker obtained from hatchery facilities will be transferred to the interim rearing facility at MSB with handling and transport following existing U. S. Fish and Wildlife Service protocols. Under a separate workplan, growth and survival will be tracked during the rearing tenure at MSB. CRFP personnel will determine when it is appropriate to transfer larval razorback
sucker from the interim MSB holding facilities to grow-out ponds (presumably late May to early June). This transfer and disposition of larvae will be determined and coordinated by CRFP personnel with the assistance of MSB personnel.

CRFP personnel will coordinate obtaining any excess larval or juvenile razorback sucker that may become available from UCRB recovery efforts (e.g., those from the 24-Road hatchery). CRFP personnel will transport these fish and stock them in the appropriate grow-out pond.

Razorback sucker will be reared in ponds for two full growing seasons. Management of ponds, including maintenance of water level, fertilization, and monitoring of pond water quality, invertebrate, and plant communities will be performed by personnel from Ecosystems Research Institute and BIA-NIIP (under a separate workplan). Once a pond management plan has been developed, long-term management of the grow-out ponds will become the responsibility of the Navajo Department of Fish and Wildlife.

Starting in 2004, the process of rearing razorback sucker will enter a two-step process. In the first step larval razorback sucker will be stocked at high densities into "nursery ponds" that will be intensively managed to maximize growth of these fish in the first year. In the fall of their first growing season, these large, age-0 fish will be harvested out of the nursery ponds and stocked into the larger, existing grow-out ponds, where they will spend their second growing season before being harvested and stocked. This approach should allow fish being stocked into the existing grow-out ponds to escape predation by salamanders due to their larger size and increased mobility, without having to drain and renovate existing grow-out ponds. Fish in nursery ponds will be fed an artificial diet and nursery ponds will be regularly rotated, drained, and renovated to eliminate aquatic predators such as tiger salamanders, which take a heavy toll on stockings of larval fish. Five new, one-acre nursery ponds are scheduled to be constructed in 2004 for this purpose (using capital projects funds). In the meantime, Hidden Pond will be used as a nursery pond. Therefore, by November 2003, all remaining razorback sucker in Hidden Pond will be removed and stocked into the two Avocet Ponds and Hidden Pond will be pumped dry (to eliminate tiger salamanders). Hidden Pond will be refilled again in spring 2004, at which time it will again be stocked with high densities of larval fish to serve as a nursery pond until the new nursery ponds are constructed and come online.

Grow-out ponds will be harvested on at least three occasions during the year.
Ponds will be harvested using fyke nets (6-8 per pond), working a maximum of three grow-out ponds at any one time. During harvest, razorback sucker $\geq$ 300 mm TL will be harvested from ponds, PIT-tagged, and stocked into the San Juan River just downstream of Hogback Diversion (RM 158.6). Razorback sucker < 300 mm TL will be counted, given fin clips, and returned to the grow-out pond. Multiple sampling days with fyke nets will then allow for a population estimate (Petersen or Schnabel) to be performed so that numbers of fish in each pond can be tracked. The first 100 fish harvested from each pond will also be measured and weighed. This will allow for the tracking of fish growth in the ponds.

To monitor fish that have been stocked into the river, CRFP personnel (along with personnel from cooperating agencies) will monitor stocked fish on two electrofishing/netting trips in 2004. One trip will sample RM 158.6-76.4, followed shortly thereafter by the second trip that will sample RM 76.4-2.9. These two sampling trips will occur on the ascending limb of the hydrograph, from late April to late May. Electrofishing along with selective seining and trammel netting will be used to determine dispersal, and survival of stocked fish. The fall 2004 main channel fish community monitoring trip will act as the second "riverwide" pass to monitor

stocked razorback sucker. Survival rates will be determined using either mark-recapture models (e.g., Program CAPTURE, MARK, Petersen, Schnabel) or age/growth curves or a combination of the two. Electrofishing and handling of rare fish species will follow the protocol found in the main channel fish community monitoring workplan, except that only data on rare fish species collected (i.e., razorback sucker, Colorado pikeminnow, and roundtail chub) will be recorded. When rare fish species are collected, PIT tag number, length, weight, reproductive status (if evident), and information about health abnormalities (if any) will be recorded.

In support of Objective 2, up to eight razorback sucker may be implanted with radio transmitters (one-year lifespan) on fall 2003 sampling trips. Razorback sucker that have been in the San Juan River for less than one calendar year will not be implanted with radio tags. Radio-tagged fish will be tracked throughout the suspected 2004 spawning season for razorback sucker in the San Juan River (i.e., late March though mid-June). Tracking trips will be conducted on a monthly basis (a minimum of four trips) from March to June. If spawning aggregations of razorback sucker are identified, trips will be done on a more frequent basis, concentrating on the groups of spawning fish.

Fish contacted in aggregations during suspected spawning seasons will be tracked for a minimum of one hour each. At the end of these contacts, all riverine habitats for 100 meters both up- and downstream of the most up- and downstream fish locations during the contact period will be mapped on hardcopies of aerial videography. All habitats utilized by fish suspected to be spawning will be recorded as well as the amount of time spent in each particular habitat type. Once back from the field, relative percentages of habitats available and habitats used will be determined, so that habitat selection can be determined as in previous razorback sucker telemetry studies on the San Juan River. During these hour-long radiotelemetry contacts, detailed habitat information on substrate, depth, cover, and velocity at the fish's most frequented location will also be recorded. Water quality parameters including dissolved oxygen, water temperature, conductivity, and pH will be measured at each contact location. At the end of a radio telemetry contact, attempts will be made to recapture radiotelemetered fish via trammel netting, seining, or electrofishing. Recapture efforts will be aimed at gaining data on age, growth, and sexual status as well as trying to recapture
any other razorback sucker that might be aggregating with radiotelemetered fish. If spawning aggregations of razorback sucker are identified, crews from other research elements monitoring razorback sucker larval drift (i.e., Steven Platania) and habitat quality and quantity (i.e., Ron Bliesner and Vince Lamarra) will be notified.

In support of objective 3, mechanical removal of nonnative fish species will continue to take place on all razorback sucker monitoring trips.

The Service (CRFP) will have the lead for the razorback sucker monitoring with the Service's New Mexico Fishery Resources Office (NMFRO) providing field personnel and equipment for monitoring trips. Other cooperating agencies may provide personnel and equipment for these trips as needed.

Products:

An interim progress report for razorback sucker monitoring trips conducted in 2004 will be completed by 31 March 2005. A "draft final" incorporating all comments received will be completed by 1 June 2005. DBASE IV files containing information on total catch and length/weight data gathered for rare fish species will be submitted to the University of New Mexico's Museum of Southwestern Biology (Division of Fishes) for inclusion on the SJRIP integrated database CD-ROM and web page by 31 March 2005.

Fiscal Year 2004 Budget:

Personnel	
Objective 1 (112 man days): grow-out pond work	$ 24,200
Objective 2 (40 man days): radio telemetry	$ 8,650
Objective 2 (35 man days): electrofishing	$ 7,600
Subtotal	$ 40,450
Travel and Per Diem (60 days)	$ 13,000
Coordination, meeting attendance, data input, data analysis, and report writing (55 days)	$ 17,800
Subtotal	$ 30,800
Office Support	
Project Leader and Administrative Officer (3 weeks)	$ 9,300
Office supplies (telephone, Copier lease, paper, misc supplies, postage, software)	$ 2,000
Subtotal	$ 11,300
Equipment and Supplies	
1) i.e., fuel, vehicle maintenance, and repair/ replacement/maintenance of field equipment, including: dip nets, oar blades, PIT tag gear, rafts, raft trailer, generators, electrofishing equipment, life jackets, camping equipment, outboard motors, radio receivers, trucks, etc.***	$ 5,500
2) purchase new fyke nets from H. Christian Co.	
a) Four 3/4" mesh, square, #18 fyke net @ $850.00 each (= cost for net + shipping)	$ 3,400
b) Four 1½" mesh, square, #18 fyke net @ $700.00 each (= cost for net + shipping)	$ 2,800
3) cost share with Upper Basin Recovery Program (they are paying for 2/3 of the cost) for replacement of 10-year-old stocking truck. 1/3 of cost to SJRIP	$ 9,000
Subtotal	$ 20,700

CRFP Total	$103,250
Service Administrative Overhead (20.00%)	$ 20,650
U.S. Fish and Wildlife Service-Region 6 Total	$123,900
Funding for assistance from U.S. Fish and Wildlife Service - Albuquerque (NMFRO)	$ 6,000
Funding for Keller-Bliesner Engineering to provide pump, fuel, and manpower for draining Hidden Pond	$ 1,200
PIT Tags (3,000 tags)	$ 12,000
GRAND TOTAL	**$143,100**

*** The 'Equipment and Supplies' costs listed here represent the costs anticipated to be incurred by CRFP in FY-2004 for performing our own field work as well as providing equipment for other agencies (UDWR-Moab and USFWS-Albuquerque) with whom we are cooperating on approved SJRIP projects. Our total anticipated cost for 'Equipment and Supplies' in FY-2004 (i.e. $11,000) has been distributed across two CRFP workplans, of which this workplan is one.

Previous Years' Funding:

Fiscal Year 1997	$ 41,200
Fiscal Year 1998	$ 44,000
Fiscal Year 1999	$ 50,700
Fiscal Year 2000	$ 86,240
Fiscal Year 2001	$ 62,600
Fiscal Year 2002	$ 67,600
Fiscal Year 2003	$ 69,640

Estimated Outyear Funding (based on an annual 5% increase as agreed upon by the SJRIP Biology Committee at their 21 May 2002 meeting):

Fiscal Year 2005	$144,650
Fiscal Year 2006	$151,900
Fiscal Year 2007	$159,500
Fiscal Year 2008	$167,500

Colorado Pikeminnow Fingerling Production
San Juan River
FY-2004

Principal Investigators: Roger L. Hamman and Manuel E. Ulibarri
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Background

Once very common throughout the Colorado River Basin, Colorado pikeminnow have declined from historic levels and are now found primarily in the Upper basin of the Colorado River. Various factors have contributed to the decline of the specie including alteration of natural stream flows and temperature regimes, loss of habitat and habitat fragmentation as a result of water development and the introduction of nonnative fish species.

Colorado Pikeminnow are native to the San Juan River. Its historic distribution included the entire mainstem San Juan River up to Rosa, New Mexico, located approximately 25 miles upstream from present day Navajo Dam. Currently the species is considered extremely rare and the small population is estimated at less then 20 adults. This small group of fish has persisted in the San Juan River since the closure of Navajo Dam in 1962. Recent studies being conducted by the San Juan Recovery Implementation Program (SJRIP) indicate that the Colorado pikeminnow is reproducing and recruiting in the river to at least a limited degree, however the low numbers collected do not satisfy recovery goal requirements for the specie. The Recovery criteria calls for a target of 1,000 subadults fish established by the end of a five year down listing period, and 800 adults maintained during the 7 year delisting period. The Upper Colorado River Endangered Fish Recovery Program has recommended that the wild population be increased by augmenting with hatchery produced fish.

Dexter NFH & TC has been the leader in propagating and culturing Colorado pikeminnow (Ptychocheilus lucius) since 1981. The facility maintains several captive stocks as genetic reserves and has successfully produced fish for the Upper and Lower Colorado river basin programs and the SJ RIP. The major emphasis has been on the reproductive biology, broodstock development and culturing fry, fingerlings and adults. This work plan proposes to continue the production of 350,000 fingerlings (50 mm TL) annually for reintroduction in the San Juan River. Funding is also requested to provide proper care of broodstock necessary to successfully carry out this study for future years and aide in restoration of the species.

Stocking will require coordination with New Mexico FRO, CRFP-Grand Junction, New Mexico Department of Game and Fish, Colorado Division of Wildlife and Utah Department of Wildlife Resources.

Objectives

1) Produce 350,000 fingerlings (50 mm TL) for stocking in the San Juan River in 2004.

2) Continue data collection on induced spawning of Colorado pikeminnow under controlled conditions.

3) Evaluate distributions methods of transporting 350,000 Colorado pikeminnow fingerlings from Dexter to the San Juan River.

Methods

Broodstock will consist of 400+ (F1) adults. These fish are 1991 year-class progeny from wild adults collected from the Colorado River. A maximum of 40 paired matings (1 female X 1 male) will be spawned during 2004. Given the past history of hormonal induced ovulation, 30 females (75%) should produce viable eggs during a given year. All members of the broodstock are PIT tagged and records of spawning pairs will be maintained at Dexter.

Ovulation will be induced with intraperitoneal injections of common carp pituitary (CCP) at the rate of 4 mg/kg of body weight. When eggs can be expelled using slight pressure, a female will be stripped and milt added from one male. Each individual egg lot will be enumerated and kept separate in Heath trays until hatching occurs, about 96 hours after fertilization.

When eggs begin hatching, larvae will be transferred to hatchery tanks and held until swim-up occurs, five to seven days. Fry will be enumerated and stocked into three earthen ponds ranging from .33 to .35 ha. Fry will be cultured in earthen ponds for 120 days and fingerlings (50 mm TL) will then be available for stocking in the San Juan River during November, 2004.

Budget for 2004

Personnel requirement:

Drain broodstock pond and transferring adults to fish culture building
Inject males and females with hormones
Prepare egg hatching system
Spawn broodstock and return to holding pond
Place eggs in hatching system and care for eggs
Prepared holding tanks for fry

Transfer fry from incubators to holding tanks	
Prepare pond to receive fry	
Pond management	
Transfer swim-up fry from holding tanks to ponds	
Daily feeding (including weekends and holidays)	
Weekly dissolved oxygen, temperature and pH recordings	
Drain fingerling ponds and transfer to fish culture building	
Prepare holding tanks for fingerlings	
Inventory (weights and numbers) for each pond	
Treat fish for parasites if required and/or needed	
Personnel Subtotal	**17,230.00**

Equipment and Supplies:

Hormones for spawning	500.00
Liquid oxygen and compressed oxygen	250.00
Heating water for hatching eggs (natural gas)	500.00
Heating water for fry to swim-up (natural gas)	500.00
Water quality monitoring equipment	1,250.00
Culture equipment (nets, seines, screens, etc.)	1,000.00
Pond management supplies	1,000.00
Pumping costs (electrical)	5,000.00
Fish feed	1,000.00
Maintenance costs for equipment	1,500.00
Equipment Subtotal	**12,500.00**

Reintroduction Costs:

Salaries	1500.00
Overtime	250.00
Per Diem	500.00
Fuel costs	200.00
Truck maintenance	250.00
Reintroduction Subtotal	**2,700.00**

Broodstock Care and Maintenance

Personnel requirements:

Drain broodstock pond and transfer adults to over-winter pond
Pond management
Daily feeding (including weekends and holidays)
Weekly dissolved oxygen, temperature and pH recordings
Prepare broodstock holding pond prior to spawning

Personnel Subtotal	**15,000.00**

Equipment and Supplies:

Culture equipment (nets, seines, screens, etc.)	750.00
Pond management supplies	2,500.00
Fish feed	2,000.00
Pumping costs (electricity)	6,750.00
Equipment Subtotal	**12,000.00**
Total	**59, 430.00**
15% Administrative Overhead	**8,914.00**
GRAND TOTAL	**$68,344.00**

Stocking of Fingerling Colorado Pikeminnow and Reporting of FY-2003 Results
Fiscal Year 2004 Project Proposal

Updated 4 June 2003
Principal Investigator: Dale Ryden and Chuck McAda
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Background:

Colorado pikeminnow is a federally-listed endangered fish native to the San Juan River. The capture of low numbers of Colorado pikeminnow of all life stages over the past ten years has confirmed that a small, but reproducing population of Colorado pikeminnow still exists in the San Juan. In 1996, experimental stocking of Colorado pikeminnow into the San Juan River was undertaken by the Utah Division of Wildlife Resources (UDWR). The purpose of this effort was to evaluate dispersal and retention of stocked juvenile Colorado pikeminnow as well as determining the availability, use, and selection of habitats critical to early life stage Colorado pikeminnow. Between 1996 and 2000, approximately 832,000 larval and age-0 Colorado pikeminnow were stocked into the San Juan River by the UDWR. In addition, 197 adult Colorado pikeminnow have been stocked into the San Juan River, 49 in 1997 and 148 in 2001. To date, 39 adult and several hundred juvenile stocked Colorado pikeminnow have been recaptured during either seining or electrofishing efforts. Based on data collected from these experimentally stocked fish, it is apparent that stocked, hatchery-reared, juvenile Colorado pikeminnow can survive in the San Juan River and can provide a viable method of supplementing the numbers and expanding the range of the wild San Juan River Colorado pikeminnow population.

The need for artificial propagation and augmentation of this species in the San Juan River is apparent for several reasons. Augmentation of Colorado pikeminnow would increase population numbers, provide more individuals for research purposes, add genetic diversity to the existing gene pool, and provide a riverine refugia population that would, hopefully, remain stable until further research can identify factors limiting successful recruitment of this species in the San Juan River. The San Juan River Long Range Plan identifies the need to assess the feasibility of, and then implement the augmentation of Colorado pikeminnow. In January 2003, ***An Augmentation Plan For Colorado Pikeminnow In The San Juan River*** was finalized. This augmentation plan provides the necessary guidance for augmentation efforts as well as directly fulfilling objective 5.3.8.2 of the San Juan River Long Range Plan.

The first stocking of Colorado pikeminnow under the direction of this augmentation plan took place on 24 October 2002 (plan was still in draft form), when 210,418 age-0 Colorado pikeminnow were stocked into the San Juan River, half each at RM 180.2 and RM 158.6. The Colorado pikeminnow augmentation plan calls for a minimum of 300,000 age-0 Colorado

pikeminnow to be stocked at these same two stocking locations (half at each location) for the next seven years (i.e., through 2009). In December 2002, a study was begun (under a separate workplan) to intensively monitor newly-stocked age-0 Colorado pikeminnow at several stations, throughout the river on three occasions during the year.

Objectives:

1.) Coordinate with Dexter National Fish Hatchery to procure and stock fish according to guidelines set forth in ***An Augmentation Plan For Colorado Pikeminnow In The San Juan River***.

2.) Provide a report that gathers information from various sources on fingerling production, numbers of fish stocked, subsequent recaptures during various sampling efforts (other than the intensive monitoring effort), and makes recommendations (if necessary) for modifying methods being employed for Colorado pikeminnow augmentation efforts.

Methods:

Objective 1: Young Colorado pikeminnow will be reared in grow-out ponds (under a separate workplan) at Dexter National Fish Hatchery (NFH) until late October or early November, at which time they will be harvested and stocked into the San Juan River in river sections specified in the augmentation plan (i.e., between Fruitland diversion and PNM weir; between Hogback diversion and Shiprock bridge). Once young Colorado pikeminnow are transported to the San Juan River, CRFP crews (two crews of two people each and two people to run shuttles) will load them into live wells and transport them downstream via boat, stocking them in several different appropriate locations in the two target sections of river. Fish will be stocked in roughly equal numbers in each of the two river reaches. This will allow young Colorado pikeminnow to be introduced into many appropriate low velocity habitats and avoid their grouping up in large numbers and thus becoming more susceptible to predation (e.g., by channel catfish).

Objective 2: After stocking, CRFP personnel will collect information on stocked fish from Dexter NFH (numbers produced, size at stocking, locations stocked at) and on recaptures during subsequent monitoring and sampling efforts by various agencies (other than the intensive Colorado pikeminnow monitoring effort). This data will be examined to help determine if augmentation efforts are successful. Success will be determined by examining post-stocking dispersal patterns, analyzing age and growth data, and using mark-recapture population estimators (e.g., Program MARK) to determine survivorship, with the end goal of determining if progress is being made towards reaching target numbers set forth in the Colorado pikeminnow augmentation plan. Results obtained will be used to make recommendations for modifying (if necessary) methods being employed for augmentation efforts in future years.

Products:

An interim progress report detailing the field activities performed in 2004 will be produced by 30 March 2005. A “draft final” of this report, incorporating all comments received will be completed by 1 June 2005. DBASE IV files containing information on stocked and recaptured

Colorado pikeminnow will be submitted to the University of New Mexico's Museum of Southwestern Biology (Division of Fishes) for inclusion on the San Juan River Recovery Implementation Program integrated database CD-ROM and web page by 31 March 2005.

Fiscal Year 2004 Budget:

Personnel	
Objective 1 (6 man days): stocking	$ 1,940
Subtotal	$ 1,940
Travel and Per Diem (12 days)	$ 2,600
Objective 2 (25 days):Meeting attendance, coordination, data input, data analysis, report writing	$ 8,080
Subtotal	$ 10,680
Total	$ 12,620
Service Administrative Overhead (20.00%)	$ 2,524
GRAND TOTAL	**$ 15,144**

Previous Years' Funding:

Fiscal Year 2002 (included costs for radio-tracking of stocked adult pikeminnow, now under a separate workplan)	$48,600
Fiscal Year 2003	$15,144

Estimated Outyear Funding (based on an annual 5% increase as agreed upon by the SJRIP Biology Committee at their 21 May 2002 meeting):

Fiscal Year 2005	$15,900
Fiscal Year 2006	$16,695
Fiscal Year 2007	$17,530
Fiscal Year 2008	$18,400
Fiscal Year 2009	$19,320

Maintenance of an Interim Holding Facility for Larval Razorback Sucker [1]
Fiscal Year 2004 Project Proposal

Principal Investigator: Thomas F. Turner and Heather L. Parmeter
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Background:

The Five-Year Augmentation Plan for Razorback Sucker in the San Juan River, completed and approved in August 1997, provided guidance for re-establishment of this endangered native fish in the San Juan River. The augmentation plan recommended the stocking of 31,800 razorback sucker into the San Juan River during Year 1. However, between 3 September 1997 and 15 October 1998 a total of only 4,164 razorback sucker (progeny from adults from either Lake Mohave, Green River, and San Juan River arm of Lake Powell) have been stocked in the San Juan River (Table 1).

Table 1. Summary of San Juan River razorback sucker stocking efforts.

DATE	NUMBER	SIZE	RELEASE LOCATION	PARENTAL STOCK
3 SEP 1997	1,027	JUVENILE	Hogback Diversion	Lake Mohave
17 SEP 1997	227	JUVENILE	Hogback Diversion	Green River
19 SEP 1997	1,631	JUVENILE	Hogback Diversion	SJR Arm of Lake Powell
22 APR 1998	124	JUVENILE	Hogback Diversion	Green River
28 MAY 1998	(total combined w/ 22 APR 1998)	JUVENILE	Hogback Diversion	Green River
14-15 OCT 1998	1,155	JUVENILE	Hogback Diversion	Ojo Amarillo Pond
TOTAL	4,164			

The inability to achieve San Juan River razorback sucker augmentation goals has been due to a suite of circumstances all of which ultimately result in a lack of fish. Rearing facilities outside of the San Juan River Basin lack the capabilities to continue to hold and rear razorback sucker for the San Juan River Basin Recovery Implementation Program (SJRBRIP). Given this lack of resources, efforts were undertaken to develop and establish rearing facilities (holding ponds) within this basin thereby affording self-sufficiency to the San Juan River razorback sucker augmentation program.

Unfortunately, water temperatures at San Juan River grow-out ponds (during March-April) have been identified as being too low to sustain razorback sucker larvae. In addition, a structural failure in August 1999 at Ojo Amarillo Pond, in combination with lower than expected rates of survival, resulted in the loss of the majority of razorback sucker available for 1999-2000 augmentation. Even with rehabilitation of Ojo Amarillo Pond, the number of razorback sucker currently available to SJRBRIP will not be sufficient to achieve the goals prescribed in the five-year augmentation plan until the issues of low water temperature at holding ponds is resolved.

In 2001, we donated the use of a re-circulating larval fish holding and rearing facility (=closed-system) to the program for evaluation of this larval razorback sucker interim holding facility pilot project. This system was selected because it had proved successful and in past cyprinid (minnow) rearing projects. The system was able to hold large numbers of individuals and flexible enough to accommodate a range of environmental requirements. In addition, start-up costs for use of the re-circulating larval fish holding was minimal. In FY 2001, the San Juan River Research Program provided funds for maintenance of the closed-system, specimen rearing, personnel costs, and transportation.

We received about 32,000 larval razorback sucker from Dexter National Fish Hatchery and Technology Center on 28 March 2001 and about 20,000 larvae on 11 April 2001 from Willow Beach National Fish Hatchery. As of 30 April 2001, we estimated a survival rate exceeding 95% of the stock received. Most of the Dexter larval razorback sucker had achieved the juvenile developmental stage and were about 15 mm TL (as of 30 April 2001). Larval razorback sucker from Willow Beach, which were about two weeks younger than those from Dexter, had progressed to the metalarval stage and were about 12 mm TL (as of 30 April 2001).

On 16 May 2001, all larval razorback sucker were transported to Farmington for release in Ojo Amarillo and Avocet ponds (water temperature = 21^{o}C). The survival estimate for the fish from the Dexter spawn (originally 32,000) was between 60-65% (19,200 to 20,800). Conversely, the survival rate for fish from Willow Beach (n=21,000) was higher and estimated to be between 75-80% (15,750 to 16,800). The two lots of fish remained separate throughout the duration of rearing.

The reason for the higher survival rate for Willow Beach fish was that they were held for a shorter period, were not reared to the large size of Dexter fish, and were less concentrated during rearing (first two factors were most important). The greatest loss of Dexter fish occurred during the final two weeks in captivity as those fish exceeded 15 mm TL. They had achieved the juvenile stage of development (for some time) and appeared healthy but for some reason

(currently unknown) there was a chronic daily loss of 100-200 individuals. Water quality was not an issue (at least for the parameters being checked) and fish continued to feed up until death.

Between 1-10 April 2002 approximately 70,000 larval razorback sucker were transported from the Dexter National Fish Hatchery and Technology Center (DNFHTC) to the aquatic research facility of the Division of Fishes (MSB) and placed in the closed-system rearing facility. Fish were reared for 6-8 weeks before being released. On 27 May 2002 between 58,000-60,000 late-stage larval and early-juvenile razorback sucker were taken by MSB personnel to Avocet East, Avocet West, and Hidden grow out ponds. The sample was divided in three approximately equal lots of 20,000 fish. Released razorback sucker ranged from 7 - 38 mm SL, with an average of approximately 17 mm SL (n=20). Water temperature in the three ponds ranged from 22-24°C.

During FY 2003, the San Juan River Basin Biology Committee agreed to postponing (for one year) the stocking of the rearing ponds so that an accurate assessment of the density and size structure of razorback sucker in those ponds could be obtained. Funds (FY 2003) had already been committed for the rearing project at the time this decision was made. Those funds were used to maintain and make modifications to the system (improved filtration efficiency) which should be manifested in reduced maintenance costs in the future.

At the time of submission of this scope of work, there were no results from the pond assessment activity and no decision had been made regarding the stocking protocol of razorback sucker into rearing ponds during FY 2004. Until those projects are completed, the status and level of activity designated in this scope of work remains tenuous.

Description of Study Area:

Larval razorback sucker will be obtained from available sources (i.e., Dexter National Fish Hatchery and Technology Center) and transported to interim rearing facilities at the University of New Mexico. The rearing facility has been re-configured to hold and rear up to 150,000 larval razorback sucker for a period of between 6-10 weeks. Water temperature information acquired from Ojo Amarillo and Avocet ponds suggest that by mid-May or early June water temperatures will have achieved a sufficient level to sustain larval razorback sucker. These data indicate that the interim holding facilities should be prepared to accommodate larvae for at least 6 and up to 10 weeks. The goal will not be to hold larval fish in the interim facility for a pre-determined time period but instead to establish them in the more natural conditions of rearing ponds as soon as conditions allow.

Objectives:

1.) Short term rearing of up to 150,000 larval razorback sucker available from various sources
2.) Transfer reared larval razorback sucker to rearing ponds
3.) Continued assessment of success of interim rearing effort

Methods:

Members of the U.S. Fish and Wildlife Service's Colorado River Fishery Project Office in Grand Junction (CRFP-GJ), Colorado will coordinate the distribution of larval razorback sucker during March and April and spawning of brood stock adult razorback sucker at Dexter National Fish Hatchery and Technology Center (or other appropriate facilities). Larval razorback sucker (ca. swim-up stage) will be transferred to the MSB rearing facility with handling and transportation following existing U.S. Fish and Wildlife Service protocols. Growth and survival will be tracked during the rearing tenure at MSB. Personnel from CRFP-GJ will determine when it is appropriate to transfer larval razorback sucker from the interim MSB holding facilities to Ojo Amarillo and Avocet ponds (presumably May to June). This transfer and disposition of larvae will be determined and coordinated by CRFP-GJ with the assistance of MSB personnel.

Products:

A draft report assessing the success of the 2004 razorback sucker interim holding facilities will be prepared and distributed by 31 March 2005. That report will include information on the different stocks of larval razorback sucker holding facility success. Upon receipt of written comments, that report will be finalized and disseminated to members of the San Juan River Biology Committee by 1 June 2005. An electronic spreadsheet containing information from the project will also be submitted in accordance with the aforementioned schedule. Voucher series of fish collected from this study will be curated in the Division of Fishes, Museum of Southwestern Biology (MSB), Department of Biology, at the University of New Mexico.

Budget FY-2004:

Personnel

Laboratory Research Associate (25 staff-days) (system management, disease control, feeding, supervision)	$	7,500
Laboratory Technician (25 staff-days) (feeding, cleaning, specimen care)	$	5,000
Subtotal	$	12,500

Travel and per diem

Travel and per diem (acquiring and stocking fish; attending meetings)	$	1,000
Shipping supplies and costs (for specimens)	$	500
Subtotal	$	1,500

Equipment and Supplies

Larval fish food	$	500
Miscellaneous supplies (for rearing system)	$	1,500
Subtotal	$	2,000
Total	$	16,000
Administrative Overhead	$	2,400
GRAND TOTAL	**$**	**18,400**

Out-year funding (based on 5% increases):

Fiscal Year 2005	$	19,305
Fiscal Year 2006	$	20,424
Fiscal Year 2007	$	21,275

Razorback Sucker Augmentation Ponds Limnological Study

Principle Investigator: Vincent Lamarra
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and

Principle Investigator: Ernie Teller
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Study Area:

The study area for this project involves the razorback sucker augmentation ponds recently built on the Navajo Indian Irrigation Project.

Background:

This work plan represents a continuation of the limnological investigation of the razorback sucker augmentation ponds located on the Navajo Indian Irrigation Project. It is anticipated that the Navajo Nation will request that the long-term operations and maintenance be undertaken by the Navajo Fish and Game staff. This proposal is a bridge towards that goal. The major objective of the first year of the study was to develop a Management Plan for the ponds. This investigation will finalize the draft plan, and institute a training program for its implementation by the Navajo Nation.

Objectives:

1.) Finalize the Draft Management Plan and establish annual reporting requirements

2.) Implement a long term Hydrologic, Water Quality and Biological monitoring plan

3.) Undertake a training program for the long-term operations and maintenance of the razorback augmentation ponds

Methods:

1.) Finalize the Draft Management Plan and establish annual reporting requirements
During the first year of this investigation, a systematic set of biological and chemical samples were collected to better define the factors which are limiting the growth rates of razorback suckers in the grow-out ponds located on the NAPI facility. The results of these investigations were incorporated into the draft plan, which will be reviewed by the San Juan RIP Biology Committee. This Task will revise that draft Management Plan.

2.) Implement a long term water quality and biological monitoring plan
It is anticipated that a long-term water quality and biological monitoring program will be needed to track the results of the ongoing management of the ponds. This program will include both the growth rates of the target fish as well as limnological parameters.

Parameters will include quarterly water quality grab samples (ortho-P; total-P; NH3; NO2-NO3; heavy metals; phytoplankton biomass (Chl a); and invertebrates (zooplankton and benthic) biomass. Field parameters such as pH, Dissolved Oxygen and temperature will also be measured.

3.) Undertake a training program for the long-term operations and maintenance of the razorback augmentation ponds
This task will train Navajo Nation staff to fully implement the Final Grow-out Pond Management Plan. This training will include instructions on appropriate field methodologies, QA/QC procedure, reporting requirements as well as periodic facilities inspections.

Products:

A annual reports will be produced as part of this ongoing management program. This report will include the summation of the analytical water quality data as well as the biological parameters including the growth rates of the target species. Comparisons will be made to previous years results.

Budget FY-2004:

Category	Staff-Days		Cost
Personnel:			
ERI/KBE	20	$	19,600
Subtotal	20	$	19,600
Expenses			
Travel		$	3,000
Per Diem		$	360
Lodging		$	300
Supplies		$	2000
Computer		$	350
Laboratory		$	5000
Subtotal		$	11,010
Overhead (10% of subcontract)		$	2,400
NM gross receipts tax (5%)			1,650
Total		**$**	**34,660**

HYDROLOGY CHAPTER

2004 WORK PLAN

Completion of the 3rd Generation San Juan River Basin Hydrology Model
San Juan River Basin Recovery Implementation Program - Hydrology Committee
Fiscal Year 2004 Project Proposal

Principal Investigator: Pat Page
Bureau of Reclamation
835 E. 2nd Avenue, Suite #300
Durango, CO 81301
(970) 385-6560 ppage@uc.usbr.gov

Background:

The 3rd Generation San Juan River Basin Hydrology Model (3rd Generation Hydrology Model) is being developed to rectify some known deficiencies in previous generation models and to model daily flows on the San Juan River mainstream to eliminate the disaggregation of monthly model flows completed previously with a model post-processor. The development should be around 91% completed at the end of FY2003. Additional funds are required in FY2004 to complete the data and model development, including documentation. This request includes a contingency fund to cover additional unforeseen work. It should be noted that this request is for the specific areas that require additional funds but that a good deal of the work was accomplished with FY2003 and FY2002 (contractor) funds. The actual FY2004 work will primarily be the implementation of revised operating criteria and completion of documentation which could not be done until data development is completed.

Study Area:

San Juan River Basin

Objectives:

1. Data Analysis and Development – Due to unforeseen data analysis and development work, additional funds are needed to complete the model. The primary effort is to analyze the naturalized flows to identify areas of deficit knowledge and data. In particular, technical staff have recommended that incidental losses be included in the computation of naturalized flows in the entire basin.

2. Model Reconfiguration and Operation – Due to the adjustments to the naturalized flows computation, model configuration changes were required. The implementation of incidental losses also requires modification of data management procedures and depletion reporting computations. In addition, adjustments to forecast computations were required that were unanticipated.

3. Contingency Fund - Because it is imperative that the model be completed in FY2004, the Hydrology Committee requests that a contingency fund be established that would cover any additional unforeseen data and model development costs. The Contingency Fund would be used only on an "as-needed" basis, and only after Hydrology Committee approval.

Products:

Completion of 3rd Generation Hydrology Model with documentation. Technical development of the model will be completed in January, 2004; draft documentation will be completed in February, 2004; and final documentation, incorporating comments from Hydrology Committee members, will be completed in June, 2004.

Budget FY-2004:

Objective	Staff days	Labor[1]	Travel	Other
Objective 1				
Personnel	46.25	$41,075		
Travel				
Equipment and supplies				
Objective 2				
Personnel	41.00	$29,651		
Travel			$500	
Equipment and supplies				
Objective 3				
CONTINGENCY FUND				$20,000
Sub-total	87.25	$70,726	$500	$20,000
Total (rounded)				**$91,000**

[1] Labor costs calculated based on Denver USBR costs per day of $808 and Durango USBR costs per day of $600. Objective 1 includes 26.5 days of Keller-Bliesner Engineering staff, via existing contract.

Maintenance and Operation of the San Juan River Basin Hydrology Model
San Juan River Basin Recovery Implementation Program - Hydrology Committee
Fiscal Year 2004 Project Proposal

Principal Investigator: Pat Page
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Background:

The model will be made available to generate and analyze runs associated with Section 7 Consultations and/or special requests from the Biology or Coordination Committees related to the flow recommendations or other hydrological aspects of the Program. In order for the model to be available for such requests, the model and data must be maintained to adjust configurations, correct for errors, and evolve the data set forward through time. The FY2004 request includes funds to provide technical transfer from the model developer to the model users and maintainers. The scope of model operation in this FY2004 request has been reduced to reflect the slip in the model development schedule (i.e., operation of the model can not be performed until the model is completed).

Study Area:

San Juan River Basin

Objectives:

1. Maintain data to evolve the data set forward through time.

2. Maintain the model to adjust model configuration, methodologies, data, or assumptions.

3. Provide hardware and software support.

4. Obtain Riverware upgrades and technical support.

5. Generate and analyze model runs associated with Section 7 consultations or special requests from the Biology and/or Coordination Committees. Assumes that three consultations in FY04 will be requested, requiring five model runs/consultation. It also assumes that the Coordinating Committee will request two special runs in FY04. A consultation run will usually require a model reconfiguration and the implementation of operating criteria. Each consultation request will require approximately eleven staff days; each special run will require five staff days.

6. Provide technology transference to Reclamation's Western Colorado Area Office staff in the details of maintaining the data and models, and in operating the models.

Products:

Hydrological analysis of water development scenarios or other scenarios as requested by stakeholders or Program committees.

Budget FY-2004:

Objective	Staff Days	Labor	Travel	Equipment and Supplies
Objective 1				
Personnel	15	$10,040		
Travel				
Equipment and Supplies				
Objective 2				
Personnel	15	$10,040		
Travel				
Equipment and Supplies				
Objective 3				
Personnel				
Travel				
Equipment and Supplies				$5,500
Objective 4				
Personnel				
Travel				
Equipment and Supplies				$5,000
Objective 5				
Personnel	4	$9,574		
Travel				
Equipment and Supplies				
Objective 6				
Personnel	20	$12,120		
Travel			$1,500	
Equipment and Supplies				
Subtotal	54	$41,774	$1,500	$10,500
Total				**$53,774**

*Note: Staff costs include USBR Denver Technical Service Center staff ($808/day) and USBR Western Colorado Area Office staff ($600/day)

Estimated Out Year Funding (Based on 5% allowance for inflation and accounting for full years of operating the model)

(Note: Out year budget could be increased if additional hydrological Program duties are identified and assigned to the Reclamation modeler. The Hydrology Committee encourages Reclamation to staff this person in the Durango office.)

Fiscal Year 2005	$76,900
Fiscal Year 2006	$80,750
Fiscal Year 2007	$84,800
Fiscal Year 2008	$89,000

Backup Information for Scope of Work Objectives:

1. Data maintenance is to evolve the data set forward through time and make other adjustments to the data.

2. Model maintenance is to adjust the model configuration or operating criteria to correct for errors or other changes.

3. RiverWare maintenance cost is contribution of SJRIP to Upper Colorado Region's RiverWare support costs.

4. Program support is to make and analyze all model runs that are associated with Section 7 Consultations or to make special runs for the Coordinating Committee. The above computation assumes that 3 consultations per year will occur, requiring 5 model runs/consultation. It also assumes that the Coordinating Committee will request 2 special runs/year. A consultation run will usually require a model reconfiguration and operating criteria implementation and testing. Special runs may also require some setup time. The cost estimate assumes that a consultation run will require 3 days of setup time, 1 day to run and analyze each run, and 3 days to report the results. Therefore, each consultation run will take approximately 11 days. It is assumed that special runs will require 2 days of setup time, 1 day to run and analyze, and 1 day to report results.

5. Technical transfer is to provide transfer of technology necessary to operate and maintain the data and model

Improve Stream Gaging and Flow Measurements
San Juan River Basin Recovery Implementation Program - Hydrology Committee
Fiscal Year 2004 Project Proposal

Principal Investigator: Pat Page
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(970) 385-6560 ppage@uc.usbr.gov

Background:

There are five USGS streamflow gaging stations on the main stem of the San Juan River that are very important to the operation of the river and play an important role in the implementation of the flow recommendations. Stream gaging data on the San Juan River are needed to attempt to reliably develop and implement flow recommendations.

Study Area:

San Juan River Basin in New Mexico

Objectives:

1. Provide funding to the USGS to take additional flow measurements as needed at the four San Juan River gages in New Mexico. (Note: Base cost for operation of the stations is paid for by non-Program funds.)

Products:

1. Improved flow measurement and more accurate gage readings.

2. Technical presentation at the end of the year from USGS summarizing the activities completed and the value of obtaining additional readings.

Budget FY-2004:

Objective	Staff days	Labor	Travel	Equipment and supplies
Objective 1				
Personnel	7.5	4,500		
Travel			1,000	
Equipment and supplies				
Total				$5,500

Estimated Outyear Funding (Based on 5% allowance for inflation)

Fiscal Year 2005	$5,775
Fiscal Year 2006	$6,060
Fiscal Year 2007	$6,360
Fiscal Year 2008	$6,680

PROGRAM COORDINATION AND MANAGEMENT CHAPTER

2004 WORK PLAN

Program Coordination
Fiscal Year 2004 Project Proposal

U.S. Fish and Wildlife Service
2105 Osuna NE
Albuquerque, New Mexico 87113
(505) 761-4752
Shirley_Mondy@fws.gov

Background:

The San Juan River Recovery Implementation Program (Program) is designed to simultaneously address endangered fish species recovery and development of water resources within the Basin. The Program includes representatives from not only Federal agencies, but also the States of Colorado and New Mexico, the Jicarilla Apache Nation, the Southern Ute Indian Tribe, the Ute Mountain Ute Tribe, the Navajo Nation and the water development interests, most of which have legal mandated responsibilities to the endangered fish and/or the water resources.

The Service is responsible for directing and coordinating the overall Program. As stated in the Program Document, the Service will appoint a Program Coordinator who will be responsible for overall Program coordination and dissemination of information about Program activities.

Tasks:

1. Coordinate the activities of the Biology, Hydrology and Coordination Committees.

2. See that approved recovery activities are implemented.

3. Disseminate information to involved state, federal, and tribal agencies.

4. Coordinate activities with the Upper Basin Recovery Implementation Program.

5. Coordinate and disseminate information on Program activities to the public through brochures, newsletters and/or the website.

6. Forward plans and recommendation to the Coordination Committee for review and approval.

7. Annual Work Plan:

   A. Work with the Biology and Hydrology Committees to identify and expedite individual projects that are needed to accomplish the long range plan for each of the recovery elements.
   B. Draft an annual work plan consisting of high priority individual projects, formulated within the available funding.
   C. Forward the work plan to the Coordination Committee for review and approval.

8. Maintain records showing distribution and expenditures of all annual and capital funds expended under the work plan by each funding source.

9. Maintain a list of interested parties and provide those parties with the meeting dates, times, locations, and agendas for Program meetings.

10. Provide draft and final summaries of meetings to committee members.

11. Report to the Coordination Committee at each meeting the status of Program activities and research projects, and accomplishment of milestones; report any problems with maintaining schedules and provide recommendations for solving those problems; implement the recommendations of the Coordination Committee to resolve scheduling problems.

12. Provide support materials for annual funding efforts with the U.S. Congress and state legislatures.

Budget:

Personnel		
Coordinator (3/4 time salary and benefits)	$	75,600
Program Assistant (3/4 time salary and benefits)	$	33,300
Travel/Per Diem		
Coordinator		
(12 meetings, 1 trip to Denver)	$	2,500
Program Assistant		
(12 meetings, 1 trip to Denver)	$	2,500
Committee Meetings		
supplies	$	1,000
meeting space - $100/day Farmington - $300/day Durango	$	1,500
mailings	$	1,000
public notices - ($80/meeting)	$	1,000
Printing/publication	$	3,000
TOTAL	$	121,400
Administrative charge (20%)	$	24,280
Grand Total	**$**	**145,680**

Out year Costs (based on 5% inflation):

FY2005 - $152,964 FY2006 - $160,612

Program Management - Base Funding
Fiscal Year 2003 Project Proposal

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Background:

Program Management funds support Reclamation staff involved in program administration. Funds are used for the administration of funding agreements, including issuing requisitions for program supplies, and the preparation and oversight of work conducted under interagency agreements, cooperative agreements, contracts, and grants. The funds are also used for participation on the technical committees, implementation of committee assignments not specifically identified in a scope of work, reporting, and coordination of water operations.

Management support for Capital fund projects, including technical oversight, budgeting, preparation of bids and funding agreements is covered in a separate scope of work

Tasks - 2004

1. Coordinate and manage the hydrology-related tasks performed by the Hydrology Committee, including administering cooperative agreements and contracts with consultants, accounting for expenditures, developing and providing status reports, and coordinating work items to ensure work is completed as planned.

2. Coordinate, administer, and manage Biology Committee and Program Coordination funding agreements (cooperative agreements, grants, interagency acquisitions, and service orders) and equipment purchase requisitions as identified in the annual Work Plan (other than those covered in Task 1.)

***Budget FY-2004:**

Task 1:	
Personnel (17 staff days ($705/day))	$12,000
Travel (3 trips @ $500)	$ 1,500
Subtotal	$13,500
Task 2:	
Personnel (90 regional staff days (450/day))	$40,500
Travel (4 trips @ $600)	$ 2,400
Subtotal	$42,900
TOTAL	**$56,400**

* Note: This budget will likely increase in out years as the Program implements the Contracting Procedures and Reclamation develops a better sense of the associated increased workload, i.e. new start requests and unsolicited proposals. Staff day costs under Task 1 represent an average of personnel costs from Reclamation's Western Colorado Area Office ($602) and the Denver Technical Service Center ($808).

CAPITAL PROJECTS CHAPTER

2004 WORK PLAN

Capital Improvement Program Management
San Juan River Recovery Program
Fiscal Year 2004 Project Proposal

Principal Investigator: Brent Uilenberg
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Background:

The purpose of the San Juan Capital Improvements Program is to implement capital project which have been identified by the Program as necessary for the recovery of the endangered fish. As defined in Public Law 106-392 capital projects include "...planning, design, permitting or other compliance, pre-construction activities, construction, construction management, and replacement of facilities, and the acquisition of interests in land or water, as necessary to carry out the Recovery Implementation Programs".

Study Area:

San Juan River Basin

Objectives:

1. Coordinate the preparation of Federal budget requests.

2. Develop and manage cooperative agreement with the National Fish and Wildlife Foundation which provides the mechanism to utilize non-Federal cost share funds to implement capital projects.

3. Develop and manage contracts and agreements to accomplish construction and acquisition of capital projects.

4. Account for and provide capital project expenditure reports to the Coordination Committee.

5. Coordinate planning, design, permitting, pre-construction, construction and acquisition of capital projects.

Products:

Financial reports will be periodically provided to the Coordination Committee documenting the status of Federal appropriations and non-Federal cost sharing contributions.

Budget FY-2003:

Objective	Staff days	Labor	Travel	Equipment and supplies
Objective 1				
Personnel - 10 staff days @ $500 per day	10	5,000		
Travel			0	
Equipment and supplies				100
Objective 2				
Personnel	15	7,500		
Travel - 2 trips at $500 per trip			1,000	
Equipment and supplies				200
Objective 3				
Personnel - 20 staff days @ $500 per day	20	10,000		
Travel - 3 trips at $500 per trip			1,500	
Equipment and supplies - communication and computer				200
Objective 4				
Personnel - 10 staff days @ $500 per day	10	5,000		
Travel - 1 trips at $500 per trip			500	
Equipment and supplies				100
Objective 5				
Personnel - 50 staff days @ $500 per day	50	25,000		
Travel - 3 trips at $500 per trip			1,500	
Equipment and supplies				500
Sub-total	105	52,500	4,500	1,100
Total				**58,100**

Operation of Public Service Company of New Mexico
Fish Passage Structure and NAPI Ponds Management Training
Fiscal Year 2004 Project Proposal

Principal Investigator: Bob Norman
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And
Principal Investigator: Jeffrey Cole
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Study Area:
Public Service Company of New Mexico Diversion Dam is located at RM 166.6

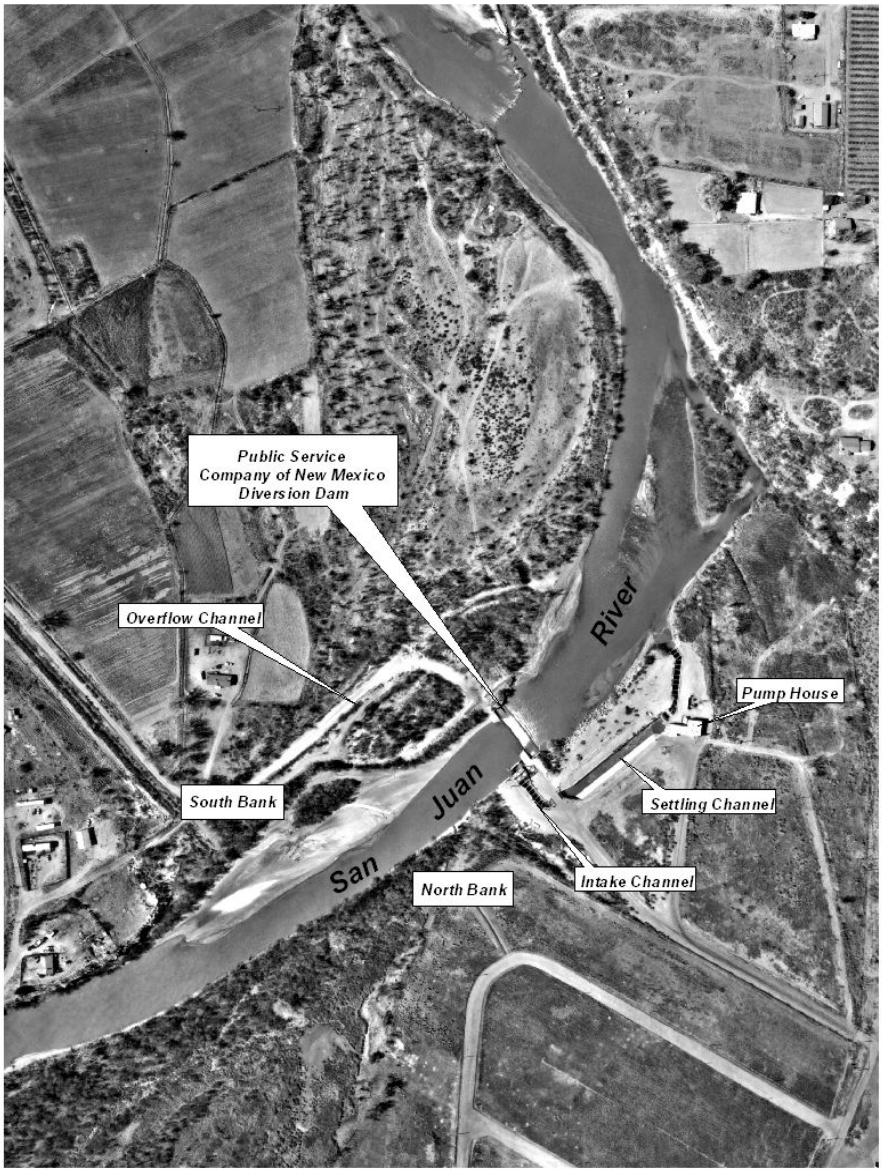
Collections:
The fish trap at the upstream end of the fish passage provides the ability to capture all fish that use the passageway. Specimens collected will be inspected to determine if any rare fishes (Colorado pikeminnow, roundtail chub, and razorback sucker) are present in the trap. All identifiable rare fish and all large-bodied native fish (i.e., flannelmouth and bluehead suckers) will be released. All other specimens will be removed from the river.

Background:
The PNM Diversion Dam (see Figure 1) was constructed in 1971. The 3.25-foot high diversion dam (weir) is located on the San Juan River about 12 miles downstream of Farmington, New Mexico near the town of Fruitland at River Mile 166.6. Facilities at the diversion include a concrete weir, a series of screened intake structures, an intake channel, a settling channel, and a pump house.

Water flows over the dam into a stilling basin created by a concrete apron. The stilling basin is the width of the river. The presence of the dam and the basin creates a barrier to fish moving upstream. As flows increase, the difference in the upstream and downstream water levels is reduced. Although water levels are reduced, water velocities increase and the weir provides an impediment to upstream fish movement. Recovery studies conducted as part of the SJRRIP have shown that some fish are able to move upstream past the weir but their specific method of movement is not known and the number of fish discouraged from upstream movement by the presence of the weir is also unknown. One possible method of upstream movement could occur during high river flows. When the flow in the San Juan River is above 7,000 cfs, some of the flow goes around the dam making it possible for fish to go around the dam at these higher flows.

A 4-foot by 6-foot sluiceway in the weir located on the north side of the river is used to sluice

the inlet structure of sediment. Normal sluice gate operations have the sluice gate open between 8 and 12 inches. Trash racks and isolation gates are located at the point of diversion. A concrete settling channel about 490 feet long conveys river water to the pump house or returns it to the river. Diverted water moves through traveling screens to three pumps, together they are capable of pumping a maximum of 17,000 gallons per minute (37 cfs) to a 110-acre storage reservoir (Figure 2). From the storage reservoir, the water is pumped to San Juan Generating Station (SJGS).



The facility provides an average of approximately 1 million gallons of water per hour (24,200 acre-feet per year) to PNM for cooling operations for the SJGS (Tetra-Tech 2000).

A need has been identified by the San Juan River Basin Recovery Implementation Program (SJRRIP) to restore endangered fish passage upstream past the PNM Diversion Dam. The purpose of establishing fish passage would be to protect and recover native Colorado

pikeminnow (*Ptychocheilus lucius)* and razorback sucker (*Xyrauchen texanus*) populations in the San Juan Basin while water development proceeds in compliance with all applicable Federal and State laws, including fulfillment of Federal trust responsibilities to the Southern Ute Indian Tribe, Ute Mountain Ute Tribe, Jicarilla Apache Nation and the Navajo Nation. In addition, other native fish species would benefit from restored passage.

The fish passageway will extend the range of these two native fishes upstream about 50 miles into historical habitat and may allow Colorado pikeminnow to naturally re-colonize these upstream reaches.

A fish trapping facility located at the upper end or forebay of the fishway allows researchers to sort, examine, and count fish and remove nonnative fish from the system.

Objectives

1. Determine the use of the fish passageway by juvenile and adult native and nonnative fishes.

2. Identify any Colorado pikeminnow congregations that may be related to the spawning period in the San Juan River.

3. Maintain the facility in a manner that assures long-term benefit.

End Products

1. Definitive data on passage--number of species; numbers per species; seasonal use and distribution by species.

2. Well maintained and operable fish passage facility.

Methods:

Working with the Program, Reclamation will contract with the Navajo Nation to perform the long-term operation and maintenance of the passageway. Work performed by the Nation is grouped in 2 general areas, operation and maintenance.

Fish and Wildlife Service personnel will provide necessary fish passageway training. Training will be provided in Grand Junction, Colorado at the Redlands Fish Passage on the Gunnison River. The training will assure the follow proficiencies:

1. Proper fish handling skills.
2. Species identification
3. PIT Tagging skills

Operation

1. Operate the fish trap and passage way from April 1 through October 31 each year.
2. Passage is visited once a day to check trap, sort fish, and remove trash as needed. Steps are as follows:
    1. Lower water in trap

2. Collect fish in nets and remove from trap
3. Sort fish by native and non-native species (dispose of non-native species)
4. Enumerate and record all fish 4" in length or longer.
5. Check Colorado pikeminnow and razorback sucker for presence of a PIT tag.
6. If tag is present record number, tag fish if no tag is found.
7. Weigh and measure each Colorado pikeminnow and razorback sucker (use total length in mm, weight in grams).
8. Return all native species to the river via the fish return pipe.
9. Raise water in trap.

3. Crews checking the fish trap are also responsible for periodic cleaning of riverborne sediment in the fish trap that usually builds up during runoff.
4. Daily cleaning of surface and submerged trash, debris, and riverborne algae from the trash racks and bar screens in the forebay of the fish passageway, and aluminum conduit screens in the fish trap. The amount of algae, debris, trash, and sediment that accumulates daily at this site is seasonally variable, depending upon flow magnitude and water volume during the water year.
5. Analyze and evaluate data and prepare annual progress report.
6. Prepare draft and final report.

Maintenance

1) Maintain the fish passage facility as necessary. Maintenance will include inspection of facilities for items that need to be repaired. Painting as necessary to control corrosion. Lubrication of moving equipment. Checking fluid levels in gear boxes and cooling radiators, if any.
2) During the first 2 years of operation representatives from the Navajo Nation, Reclamation, and FWS will inspect the facility to identify any design deficiencies and maintenance requirements.
3) After the first 2 years of operation, representatives from the Navajo Nation, Reclamation and the FWS will perform an inspection every 3 years.
4) In the event of a significant flood event, representatives from the Navajo Nation will notify Reclamation, BIA and the FWS and all parties will inspect the facility for damage.

Deliverables/Schedule:

1) Fish number will be recorded daily and a monthly fish passage report shall be submitted to the U.S. Fish and Wildlife Service by the 15th of each following month including time and date each time the trap was checked, number of species, and lengths, weights and PIT Tag numbers of each endangered fish.
2) Analyze and evaluate data and prepare annual progress report.
3) Prepare draft and final report.

NAPI Ponds Management Training

The individual that is operating the PNM Fish Ladder will also work with Vince Lamarra and BIA staff on managing the NAPI Razorback sucker grow out ponds. Water quality will be monitored daily. Water levels will be maintained as necessary, and aquatic vegetation will be removed.

Budget

Fish Passage Operation, Maintenance and Annual Report and NAPI Pond Management		
	Labor (1 ½ people)	46,065
	Vehicle Expenses	9,000
	Supplies Expenses	2,500
	Indirect Cost Rate @ 15.2%	8,750
Total		66,315

References:

Burdick, B. D. 2001. Upper Colorado River Recovery Implementation Program 2001 Scope of Work for Evaluation of Redlands Fish Passage Structure.