San Juan River Basin Recovery Implementation Program

Fiscal Year 2002 Annual Budget and Work Plan

Approved
November 2, 2001

San Juan River Basin Recovery Implementation Program

FY 2002 Work Plan

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A-45	Standardized Monitoring Integration Report	MEC	$ 235,279		$ 235,279	B
	subtotal		**$ 713,051**	**$ 0**	**subtotal $ 713,051**	

Page #	Title	Agency	Program	Other Direct	Total	Base or Capital
B. Peer Review						
B-1	Peer Review	BIO/WEST	$ 32,000		$ 32,000	B
	subtotal		**$ 32,000**		**subtotal $ 32,000**	
C. Research Activities						
C-1	Population Model Refinements	ERI/MEC	$ 38,062		$ 38,062	B
C-5	Characterization of Razorback Spawning Bar	KB/ERI	$ 27,325		$ 27,325	B
C-9	Water Temperature Analysis	KB/ERI	$ 19,240		$ 19,240	B
C-11	Navajo/San Juan Temperature Model	BR	$ 22,960		$ 22,960	B
C-17	Hybridization of Razorback Sucker	UNM	$ 14,375		$ 14,375	B
	subtotal		**$ 121,962**		**subtotal $ 121,962**	

Page #	Title	Agency	Program	Other Direct	Total	Base or Capital
D. Recovery Efforts						
D-1	Nonnative Species Control	FWS, Abq	$ 130,040		$ 130,040	B
D-7	Nonnative Species Control - Lower San Juan	UDWR	$ 69,820		$ 69,820	B
D-11	Razorback Sucker Augmentation (includes $20,000 for pit tags)	FWS, G.J.	$ 67,600		$ 67,600	20,000 C 47,000 B
D-17	Augmentation and Monitoring of Colorado Pikeminnow	FWS, G.J.	$ 48,600		$ 48,600	B
D-21	Pikeminnow Fingerling Production	FWS/DNFHTC	$ 28,500		$ 28,500	B
D-23	Interim holding facility for larval razorback sucker	UNM	$ 52,325		$ 52,325	B
	subtotal		**$ 396,885**	**$ 0**	**subtotal $ 396,885**	

Page #	Title	Agency	Program	Other Direct	Total	Base or Capital
E. Hydrology Committee						
E-1	San Juan RIP Naturalized Flows	BR, KB	$ 363,419		$ 363,419	B
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E-15	Additional Model Runs	BR	$ 10,000		$ 10,000	B
	Subtotal		**$ 396,419**		**subtotal $ 396,419**	
F. Program Coordination and Management						
F-1	Program Coordination	FWS, Abq		$ 140,902	$ 140,902	
F-5	Program Management	BR	$ 23,992	$ 41,008	$ 65,000	B
	subtotal		**$ 23,992**	**$ 181,910**	**subtotal $ 205,902**	

Page #	Title	Agency	Program	Other Direct	Total	Base or Capital
G. Capital Projects and Management						
G-1	Capital Projects Management	BR	$ 90,000		$ 90,000	C
G-3	Operation of PNM Fish Passage Structure	Navajo Nation	$ 0		$ 0	C
	PNM Fish Passage	BR	$ 1,450,000		$ 1,450,000	
	Hogback and Cudei Reimbursement	BR/BIA	$ 1,500,000		$ 1,500,000	
	Rearing Ponds					
	subtotal		**$ 3,040,000**	**$ 0**	**subtotal $3,040,000**	

Summary

Program Component	Base Funds	Capital Funds	Other Funds	Total
A. Monitoring	$ 713,051			$ 713,051
B. Peer Review	$ 32,000			$ 32,000
C. Research Activities	$ 121,962			$ 121,962
D. Recovery Efforts	$ 376,885	$ 20,000		$ 396,885
E. Hydrology	$ 396,419			$ 396,419
F. Program Coordination and Management	$ 23,992		$ 181,910	$ 205,902
G. Capital Projects and Capital Project Management	$ 0	$ 3,040,000		$ 3,040,000
Total Program Budget Proposals	**$ 1,664,309**	**$ 3,060,000**	**$ 181,910**	**$ 4,906,219**

Monitoring

Adult/Juvenile Fish Community Monitoring
Fiscal Year 2002 Project Proposal

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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 1998 refined this baseline data and provided data on specific habitat usage by rare fish species. Adult monitoring has proven to be the most effective tool for monitoring populations of stocked razorback sucker and recently stocked adult Colorado pikeminnow. In addition adult monitoring has recently captured numerous stocked, early life stage 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.

Thirty-two intensive electrofishing surveys conducted from 1991 to 2000 expanded our knowledge on the distribution and abundance of the San Juan River fish community. As of October 2000, nineteen wild juvenile and adult Colorado pikeminnow have been collected and PIT-tagged; 13 of the 19 Colorado pikeminnow were radio-tagged. In addition, 10 adult and over 200 juvenile, experimentally-stocked Colorado pikeminnow have been recaptured (95 of these fish were captured on the October 1998 adult monitoring trip). Twenty-four roundtail chub were collected, 19 of these were PIT-tagged. No wild razorback sucker were collected, however 77 stocked razorback sucker have been recaptured during adult monitoring trips. The 2001 adult monitoring trip is scheduled for late September through early October 2001.

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 2002, to measure fish community response to reoperation flows from Navajo Dam, monitor populations of experimentally-stocked Colorado pikeminnow and razorback sucker, and assess impacts of instream diversion structures to native fish species. In support of objective #4 below, nonnative fish removal will continue to be done on all 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.) Determine shifts in fish community structure, abundance and distribution, and length/weight frequencies under the reoperation flow regime.

2.) Monitor Colorado pikeminnow population trends (spawning and staging areas, habitat needs).

3.) Monitor experimentally stocked razorback sucker and Colorado pikeminnow (growth rates, dispersal patterns and habitat use).

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

5.) Produce a three-year synthesis report for results and findings of 1999-2001 adult monitoring field work. Produce an interim progress report for results and findings of 2002 adult monitoring field work.

Methods:

Objectives 1-5: One adult monitoring trip will take place in fall 2002. 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 far 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 be conducted in a continuous downstream fashion, sampling 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 (designated mile), all fish collected will be weighed, measured, and sexed (if possible). All native fish collected will be returned alive to the river. All nonnative fish collected will be removed from the river. All predatory lacustrine fishes (i.e. - walleye, striped bass, largemouth bass, small mouth bass, etc.) 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 and wild razorback sucker greater than 200 mm TL will be implanted with PIT (Passive Integrated Transponder) tags. Wild, adult Colorado pikeminnow will also be implanted with radio transmitters. Notes will be kept on any parasites and/or abnormalities observed on collected fishes.

Radio tag implantation and fish transport will follow the protocols attached to the San Juan River Seven Year Research Plan (1991). 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 not included in this budget.

Products:

A three-year synthesis report for adult monitoring data collected from 1999-2001is scheduled to be available by 31 March 2002. The "draft final" of this three-year synthesis report, which incorporates comments received, is scheduled to be completed by 1 June 2002. An interim progress report for adult monitoring data collected during 2002 is scheduled to be available by 31 March 2003. The "draft final" of this interim progress report which incorporates comments received, is scheduled to be completed by 1 June 2003. DBASE IV files containing information on total catch and length/weight data gathered on adult monitoring trips will be submitted to Keller-Bliesner Engineering for inclusion on the San Juan River Recovery Implementation Program integrated database CD-ROM by 31 March 2003.

Budget (FY-2002):

Personnel		
Objectives 1-4 (5 man days): logistics		$ 1,020
Objectives 1-4 (105 man days): electrofishing, radio telemetry, removal of nonnative fish		$21,480
	Subtotal	$22,500
Travel and Per Diem (32 days)		$ 6,500
Data Analysis and Reporting (40 days)		$ 8,000
	Subtotal	$14,500
Equipment and Supplies--i.e., maintenance, repair, replacement of:		
Field equipment: nets, PIT tag gear, rafts, generators, electrofishing equipment, camping equipment, radio receivers, etc.		$ 3,000
	Total	$40,000
Service Administrative Overhead (20.00%)		$ 8,000
U.S. Fish and Wildlife-CRFP Total		$48,000
Funding for participation of other agencies:		
New Mexico Dept. of Game and Fish-Santa Fe		$ 2,000
U.S. Fish and Wildlife Service-Albuquerque		$ 4,000
Utah Division of Wildlife Resources-Moab		$ 4,000
	Subtotal	$10,000
GRAND TOTAL		**$58,000**

Previous Years' Funding:

Fiscal Year 1997	$49,400
Fiscal Year 1998	$50,000
Fiscal Year 1999	$43,900
Fiscal Year 2000	$43,900
Fiscal Year 2001	$54,400

Estimated Outyear Funding:

Fiscal Year 2003	$59,700
Fiscal Year 2004	$61,500
Fiscal Year 2005	$63,300
Fiscal Year 2006	$65,200
Fiscal Year 2007	$67,200

YOY/Small Bodied Fish Monitoring
Fiscal Year 2002 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 bodied, 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 2002 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).

In addition to accomplishing work (field, laboratory, data analysis, and report writing) specific to the young-of-year/small-bodied fish monitoring effort, this proposal includes work that is devoted to other aspects (e.g. participation in telemetry studies, native-nonnative interaction study, and larval fish sampling) of the San Juan River Basin Recovery Implementation Program. Budgeting for these activities is included with that 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 each collection. All identifiable rare fish and all large- bodied native fish (i.e., flannelmouth and bluehead suckers) >150 mm TL will be released. 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 weight).

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-bodied 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 mm) and weight (±1 g) 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, weight, 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 in 10% formalin and returned to the New Mexico Department of Game and Fish Laboratory for identification, enumeration, and measurement (total length and weight). 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 (latitude and longitude) 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, 4 mm 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 habitat diversity/complexity will be sampled. Location (latitude and longitude) 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.

Water quality data (ambient temperature, 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 2002 monitoring effort will be summarized by geomorphic reaches. Minimally, the annual report will report density per species (number/m^2) per geomorphic reach, size-structure of commonly-collected species populations by geomorphic reach, and rare fishes and the mesohabitats each was found in. Data obtained from secondary and primary channel sampling will be reported separately. Backwater and embayment data will be reported in the primary channel portion of the annual report. 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 2002 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 Committee by 31 March 2003.

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 (32 man days)	$8,000
Travel and per diem	3,000
Specimen sorting and identification, specimen curation, and data compilation	
Personnel (64 man days)	16,000
Annual small-bodied/YOY data synthesis, analysis, and report preparation	
Personnel (40 man days)	10,000
Administrative Support (10 man days)	2,000
Subtotal	$39,000
Report reviews and integration (e.g., annual & Long Range Plan) and meeting attendance (per diem only)	
Personnel (20 man days)	5,000
Travel and Per Diem	2,000
Administrative Support (5 man days)	1,000
Subtotal	$8,000
TOTAL	$47,000
Indirect Costs (10%)	4,700
GRAND TOTAL	**$51,700**

[1]Budget does not include in-kind contributions of about $22,000 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	48,400
Fiscal Year 2004	50,820
Fiscal Year 2005	53361
Fiscal Year 2006	56,029
Fiscal Year 2007	58,830

Proposal requesting funds to provide assistance with the sorting, identification, and measuring of an extensive backlog of FY 2000 San Juan River larval fish samples
Fiscal Year 2002 Project Proposal

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and

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Background:

Sampling during summer and autumn of 2000 resulted in collection of previously unseen (massive) numbers of larval and YOY fishes in the San Juan River. These collections were generated under research and monitoring projects being funded by the San Juan River Recovery Program through the New Mexico Department of Game and Fish. The field portion of the red shiner research project was concluded in autumn 2000 while the YOY/small-bodied fish monitoring was initiated (under direction of NMGF) in autumn 1998. Favorable river conditions facilitated the reproduction of San Juan River fishes and likewise favorable collecting conditions resulted in the taking of immense numbers of individuals (primarily larval or YOY).

The enormous number of specimens taken during these investigations was atypical when compared with the same research conducted during prior years. Currently, approximately 50% of the YOY/small-bodied fish monitoring samples have been processed yielding over 29,000 fishes. Again, it needs to be noted that only 50% (approximately) of the samples have been processed to date. Based on this projection it is likely that the 2000 YOY/small-bodied fish monitoring samples will (once completed) produce more than twice as many fish (in two weeks) than autumn sampling did in seven years.

Similar statements can be made regarding the number of fishes collected under the final red shiner sampling regime. Samples taken through August 2000 under the red shiner project have been processed. Even though this represents processing of about 50% of the red shiner samples, it is estimated that over 75% of the total catch (by number) still remain in the unprocessed samples. The hypothesis is that the large number of individuals present in the unsorted samples

was due, in part, to the late and intensive spawning of non-native cyprinids (e.g. red shiner, fathead minnow) and low autumnal flows in the river which concentrated the fish in relatively small habitats. If true, the result would be a higher than normal catch per unit effort (higher number of fish per surface m^2 of water sampled) during this sampling period (autumn). The primary scope of fall monitoring and the extreme rarity of Colorado pikeminnow and razorback sucker in the San Juan River preclude the possibility of sub-sampling of these collections. This is not the first (or only) instance in which research projects generated significantly more material than anticipated by the principal investigator. In the early 1990s, collections by the U.S. Bureau of Reclamation (Durango) personnel in the San Juan River near the mouth of Lake Powell generated more specimens than the principal investigator was able to process under the funding restraints of the initial research proposal. The additional funds that were provided to expedite sorting and identification of those collections were extremely important as those samples yielded some of the largest collections of naturally reproducing larval Colorado pikeminnow. Delays or failure in the processing of those samples would have hindered the overall understanding of the dynamic relationship between the flow and the fish community.

Members of the San Juan River Biology Committee are now preparing to write an integration report (the second by the committee) that will summarize the results of 1997-2002 research efforts. The results of the aforementioned 2000 collections are deemed crucial to any synthesis document. As it would not be possible for the principal investigating agency to complete the timely processing of these samples, it was the recommendation of the San Juan River Biology Committee that addition funds be designated for the sole purpose of expediting this task (processing of 2000 samples). The specific goal of this proposal is to solicit funds to allow the rapid processing of this valuable dataset so that initiation of work on the integration report is not delayed.

Study Area:

This project does not involve the collection of specimens but only the processing of samples gathered under the red shiner and YOY/Small-bodied research components of the San Juan River Research program.

Objective:

Sort, identify, enumerate, measure and provide both electronic and hard-copy of collection information by field number to Principal Investigator in timely manner

Methods:

Larval fish collections generated by NMGF research projects (Secondary Channel sampling and YOY/Small bodied fish monitoring) will be acquired from NMGF (unsorted and unprocessed) and taken to MSB where they will receive priority from Division personnel. Samples will be subjected to standardized fluid transfer protocol (from formalin to water, to 35, 50, 70 % ethyl alcohol), accessioned, and a list of collections received forwarded to the Principal Investigator.

After processing through fluids, samples will be sorted, specimens identified to species, larval fish identification verified, and individuals enumerated and measured (TL and SL mm).

The resulting data will be supplied to the Principal Investigator in an electronic format of their preference. Given the need for rapid processing (if these data are to be available for the next integration report), we will endeavor to complete the entire process in a maximum of three months following receipt of specimens. Costs for cataloguing this material into the permanent MSB Fish Division collection are not included in this proposal as those expenses are covered under the San Juan River specimen curation and larval fish identification project. (It will not be possible to complete curation will not be completed within the aforementioned three-month time-frame).

Products:

A one page draft report chronicling the sorting, identification, and measuring process for this extensive backlog of FY 2000 San Juan River larval fish samples will be prepared and distributed by 31 March 2003 to the San Juan River Biology Committee for review. The research report, generated as a result of the processing of these specimens, is the responsibility of the NMGF principal investigator. A by-product of this work will be the timely completion of the 1997-2002 integration report. Upon receipt of written comments, the one page chronology will be finalized and disseminated to members of the San Juan River Biology Committee by 1 June 2003.

Budget FY-2002:

Personnel			
	Sample processing/Data compilation (55 man-days) (initial sorting of samples, final verification of all specimens, enumeration and measuring of specimens, data entry, data verification, data compilation)	$	16,500
	Administrative Overhead	$	2,475
	GRAND TOTAL	**$**	**18,975**

There is no outyear funding for this project.

San Juan River Drifting Larval Fish Collecting
Fiscal Year 2002 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 previously 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.

Since the initiation of this research program, five 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 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). That individual represents the only larval Colorado pikeminnow collected during drift net sampling at the Mixer. 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 drift netting samples did not yield any Colorado pikeminnow.

A comparison of 1995 and 1997 morning versus evening drift-net sampling indicated no significant differences in catch rate or ichthyofaunal composition. However, the supplemental data produced by evening sampling provided additional resolution to questions concerning drift patterns. In 1995, a drifting larval Colorado pikeminnow was collected during the evening of 2 August and an additional individual (larval) was collected the following morning (3 August). Given the relative rarity of target species in the San Juan River and the extremely limited number of larval Colorado pikeminnow and roundtail chub collected, we redesigned passive drift-netting protocol so that sampling can be conducted during both morning and evening. In addition, we instituted a sampling regime to be conducted during the last week of July or first week of August with nets to be set every other hour when hydrologic and weather conditions allow. All drifting larval Colorado pikeminnow were collected during this period.

Table 1. Summary of larval and YOY Colorado pikeminnow collected in the San Juan River during larval drift-netting (1993-1998) 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
TOTAL		5					

There has not been any additional non-stocked larval Colorado pikeminnow collected in the drift since August 1996. In 1998, 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 two years 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 more "normal" flow year resulting in the collection of over 2,100 specimens (1,370 at Four Corners an 768 at Mexican Hat). No Colorado pikeminnow were collected in drift studies during these years (1998-2000).

The limited number of adult San Juan River Colorado pikeminnow (versus stocked individuals) is reflective 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 Biology Research Team 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 drift. There are no means to differentiate between native versus stocked drifting 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 FY 2003 (increasing from two-to-three sites). Another suggestion for Colorado pikeminnow studies in FY 2003 was to perform targeted sampling for Colorado pikeminnow soon after the spawning period (declining limb of the hydrograph which typically occurs in July-early August). 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 will be considered and evaluated during FY 2002 research efforts in reference to the FY 2003 work plan.

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 two drift-netting stations for this study will be the San Juan River between RM 128 and Mexican Hat (RM 53). Under this scope of this project, we do not anticipate making any collections in the reach 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 San Juan River fishes
5.) Attempt to validate presumed spawning period of Colorado River pikeminnow

Methods:

Daily drift samples will be collected at two predetermined localities (Four Corners and Mexican Hat) starting in early July and continuing until the end of August. Collections will be made using MEC each day at dawn and dusk for about two-hours. GPS readings 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. The amount of water filtered by each net (m^3) will be measured by mechanical flow-meters suspended in the center of the nets. This information (m^3) will allow us to determine catch per unit effort based on volume of water sampled versus time sampling. At the end of each sampling period, the collections will be labeled with unique field numbers and preserved in 5% buffered formalin.

All fish specimens will be identified and counted. In addition, specimens will be assigned to more coarse categories such as "drift" and "incidental". The former category refers to individuals with minimal or no control over their longitudinal movement. The latter classification refers to individuals whose developmental stage should have allowed them to avoid capture in passive drift nets.

Collection data will be converted to catch rate and compared across and within sites by species. In addition, catch rate between and within sites will be compared across time. 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 2002 passive larval drift sampling activities and collection efforts downstream of the putative spawning bar will be prepared and distributed by 31 March 2003 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 2003. 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 georeferenced 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-2002:

Personnel		
Collecting efforts (60 man-days)		
(Sampling activities, supervision)		$ 18,000
Sample processing (17 man-days)		
(Collection processing)		$ 5,000
Report Preparation (10 man-days)		
(Data entry, analysis, report writing)		$ 3,000
	Subtotal	$ 26,000
Travel and per diem		
Travel (mileage - 4WD - Alb to sites)		$ 2,500
Field per diem (90 man-days)		$ 4,100
	Subtotal	$ 6,600
Equipment and Supplies		
Equipment repair and upkeep (trailer, drift nets, flow meters)		$ 500
Sampling/Field Gear (flow meters, t-posts, storage materials		$ 1,500
Laboratory Equipment/Supplies		
(fixatives, jars, vials, stereoscope, dissecting tools)		$ 1,000
	Subtotal	$ 35,600
	Administrative Overhead	$ 5,340
	Grand Total	**$ 40,940**

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

Fiscal Year 2001	$ 35,834
Fiscal Year 2002	$ 40,940
Fiscal Year 2003	$ 42,987
Fiscal Year 2004	$ 45,136
Fiscal Year 2005	$ 47,393
Fiscal Year 2006	$ 49,763
Fiscal Year 2007	$ 52,521

San Juan River Larval Razorback Sucker Survey
Fiscal Year 2002 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 the 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.

As 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 sucker 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 allow 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 sucker 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 backwater 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 collection 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. Tentative identifications of individuals revealed 138 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.

The results of this investigation suggest continued recruitment of adult reproductively mature razorback sucker to the population. Since 1998, 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 2001. We propose to continue this sampling regime until there is a several year (3-5) stabilization in the number of larval razorback collected.

While there has been essentially no change in budget from FY 1999 through FY 2001, the FY 2002 budget reflects an increase for this project. The request for increased funding is primarily a reflection of the expanded activities and effort that began in FY 2000. The range of the study area and number of sampling forays has increased annually since the 1999 pilot study but the budget has remained stagnant. The current budget request is representative of the actual costs incurred by this study and is primarily reflected in additional personnel costs.

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 Diversion Dam (near RM 142) and the Clay Hills boat landing (ca. RM 5) 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 FY 2002, sampling will include an additional 14 river miles of the San Juan River (the reach between Cudei Diversion Dam 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 correlations 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.) Attempt to validate presumed spawning period of San Juan River catostomids using data from the razorback sucker and Colorado pikeminnow larval fish studies.

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

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

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

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

8.) 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 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 inflatable rafts. The tentative sampling schedule will be on a bi-weekly (approximately) interval.

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. Habitat type, length, maximum depth and substrate of the habitat will be recorded. For seine samples, length and number of each seine haul will be determined. Specimens will be preserved in the field for future laboratory processing. Catch per unit effort will be determined as the number of fish per m^2 sample for seine samples and the number of fish per hour for individuals collected in light-traps.

Catch rate data will be compared across and within sites by species. In addition, catch rate between and within sites 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:

A draft report for the 2002 razorback sucker sampling activities will be prepared and distributed to the San Juan River Biology Committee for review by 31 March 2003. Upon receipt of written comments, that report will be finalized and disseminated to members of the San Juan River Biology Committee by 1 June 2003. 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 georeferenced 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-2002:

Personnel		
Collecting Efforts (53 man-days) (Sampling activities, collection management)		$ 16,000
Sample Processing (23 man-days) (Collection processing)		$ 7,000
Report Preparation (10 man-days) (Data entry and analysis, report writing)		$ 3,000
	Subtotal	$ 26,000
Travel and Per Diem		
Travel (mileage, shuttle costs, vehicle storage)		$ 2,500
Field per diem (33 man-days)		$ 1,500
Non-Field per diem (6 man-days)		$ 500
	Subtotal	$ 4,500
Equipment and Supplies		
Rafting Equipment maintenance/upkeep		$ 2,000
Sampling/Field Gear		$ 500
Laboratory Equipment/supplies (fixatives, jars, vials dissecting tools)		$ 500
	Subtotal	$ 3,000
	Total	$ 33,500
Administrative Overhead		$ 5,025
Grand Total		**$ 38,525**

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

Fiscal Year 2001	$	21,965	Fiscal Year 2006	$	46,828
Fiscal Year 2002	$	38,525	Fiscal Year 2007	$	49,169
Fiscal Year 2003	$	40,451			
Fiscal Year 2004	$	42,474			
Fiscal Year 2005	$	44,598			

San Juan River Specimen Curation and Larval Fish Identification
Fiscal Year 2002 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 (larval drift netting samples, razorback sucker larval fish sampling, spawning bar fish collections). The samples (almost 600) generated by the aforementioned three studies resulted in the collection of over 20,000 larval fish during 1998 (this is an estimate as all samples have not been processed - at present we have sorted and identified over 15,000 larval fish).

In 1999, we processed almost 65,000 larval and juvenile fishes collected by the New Mexico Department of Game and Fish, Utah Division of Wildlife Resources, and University of New Mexico. As in the past, deviations in the identifications of those samples have been noted and forwarded to the principal investigators. Most of the non-MSB samples from calendar year 2000 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 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. After discussion of this issue with the San Juan River Biology Committee, it was decided that it would not be feasible to prepare annual budgets for the San Juan River Specimen Curation and Larval Fish Identification Project based upon speculation as to the number of samples that would be processed. Instead, it was deemed necessary to prepare a budget that would 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.

In instances where research projects generated significantly more material than was originally anticipated by the principal investigator (i.e., 1992-1994 USBR Durango), we were requested (after coordinated with the P.I. of that work) to undertake all sorting and processing responsibilities. The additional work includes the extremely time consumptive initial processing, sorting, and identification of specimens that was the contractual responsibility of the primary researcher. The Biology Committee deemed those efforts outside of the scope of work of the annual San Juan River Specimen Curation and Larval Fish Identification Project but instead in need of discrete scopes of work and budgets.

The majority of samples being archived 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 Farmington and the Clay Hills boat landing (RM 2.9) just above Lake Powell in Utah.

Objectives:

1.) Sort, identify, enumerate, and report on larval fish drift collections

2.) Verify species identifications

3.) Provide a permanent repository for San Juan River fish collections, field notes, and associated data

4.) Assist principal investigators with secondary collection sorting and identifications

5.) Begin development of electronically available GIS reference database

Methods:

Larval fish drift collections generated by UNM-NMGF research projects (Colorado pikeminnow drift-netting study, razorback sucker larval fish survey, Colorado pikeminnow spawning bar larval fish sampling) are received unsorted and processed as stated above. In addition to recording the length ranges for each species in each collection, we also note the presence of larval, juvenile, and adult specimens in the samples. The annual report on larval fish will be prepared by UNM personnel (as it has been since 1995).

We have assisted principal investigators by taking on the responsibility of processing unsorted collections. Specimens are sorted, identified, counted, measured, catalogued, and data submitted to the principal investigator for inclusion in reports. In the past, this work has had to be done on relatively short notice.

Samples from projects are received after the principal investigator has completed their work and prepared the necessary annual report. This means that there will be a lag of one year in reference collection of specimens and processing of those samples. All 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.

Products:

A draft report of the 2002 San Juan River specimen curation and larval fish identification sampling activities will be prepared and distributed by 31 March 2003 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 2003. 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-2002:

Personnel		
Collection transfer (25 man-days) (fluid and jar transfer, specimen enumeration, labeling, storage)		$ 7,500
Collection processing (73 man-days) (Final verification of all specimens, data compilation, data entry and management, supervision)		$ 22,000
	Subtotal	$ 29,500
Travel and per diem		
Travel (airlines, mileage – 2 trips)		$ 700
Per diem (6 man-days)		$ 500
	Subtotal	$ 1,200
Equipment and Supplies		
Laboratory Equipment/Supplies (Vials, jars, alcohol, acid-free labels)		$ 2,000
Computer supplies/maintenance		$ 1,000
	Subtotal	$ 3,000
Total		$ 33,700
Administrative Overhead		$ 5,055
	Grand Total	**$ 38,755**

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

Fiscal Year 2001	$	35,938	Fiscal Year 2005	$	42,728
Fiscal Year 2002	$	38,755	Fiscal Year 2006	$	44,864
Fiscal Year 2003	$	38,755	Fiscal Year 2007	$	47,107
Fiscal Year 2004	$	40,693			

Long Term Monitoring - Channel Morphology
Fiscal Year 2002 Project Proposal

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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 report will be submitted by March 31, 2003, and the final report will completed by June 1, 2003. That data for the database will be submitted by March 31, 2003.

Budget FY-2002:

Category	Staff-Days	Cost
Personnel:		
Coordination & report	28	$ 19,320
Cross-section survey	40	$ 24,920
Spawning bar monitoring	33	$ 21,340
Backwater perturbation monitoring	48	$ 30,520
Subtotal	149	$ 96,100
Travel/per diem:		
Data analysis & report	0	$ 0
Cross-section survey	30	$ 6,310
Spawning bar monitoring	18	$ 3,860
Backwater perturbation monitoring	21	$ 4,275
Subtotal	69	$ 14,445
Equipment Rental (boats, survey inst.)		$ 1,930
Misc. supplies, copies,etc.		$ 2,500
Overhead (10% of subcontract)		$ 794
Grand Total		**$ 115,769**

Outyear funding:

FY 2003	$122,000
FY 2004	$128,000
FY 2005	$134,000
FY 2006	$141,000
FY 2007	$148,000

Habitat Mapping
Fiscal Year 2002 Project Proposal

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

and

Principal Investigator: Vince Lamarra
Ecosystems Research Institute
975 South State Highway, Logan, UT 84321
(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 2001 mapping. The draft report and data submission will be completed by March 31, 2003. The final report will be submitted by June 1, 2003. Reporting for the 2002 mapping will be in the 2003 budget.

Budget FY-2002:

Category	Staff-Days	Cost
Personnel:		
Field Mapping & interpretation	54	$ 26,620
Digitizing & data processing	31	$ 14,060
Data Analysis	9	$ 5,820
Subtotal	94	$ 46,500
Travel/per diem:		
Field Mapping & interpretation	26	$ 3,250
Digitizing & data processing	0	$ 0
Spawning bar monitoring	0	$ 0
Backwater perturbation monitoring	0	$ 0
Subtotal	26	$ 3,250
Equipment Rental (boats, equipment)		$ 700
Map prints, binders, misc. supplies		$ 1,187
Overhead (10% of subcontract)		$ 2,515
Grand Total		**$ 54,152**

Outyear funding:

FY 2003 - $ 57,000
FY 2004 - $ 60,000
FY 2005 - $ 63,000
FY 2006 - $ 66,000
FY 2007 - $ 69,000

Water Temperature Monitoring
Fiscal Year 2002 Project Proposal

Principal Investigator: Ron Bliesner
Keller-Bliesner Engineering
78 East Center, Logan, UT 84321
(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:

A draft annual report and data files for inclusion in the GIS database will be produced by March 31, 2003. The final report will be completed by June 1, 2003.

Budget FY-2002:

Category	Staff-Days	Cost
Personnel:		
Data Collection	4	$ 2,520
Data Analysis	6	$ 4,170
Subtotal	10	$ 6,690
Travel/per diem:	2	$ 270
Data logging Equipment Rental		$ 200
Misc. supplies		$ 200
Overhead (10% of subcontract)		$ 0
Grand Total		**$ 7,360**

Outyear funding:

FY 2003	$ 7,700
FY 2004	$ 8,100
FY 2005	$ 8,500
FY 2006	$ 8,900
FY 2007	$ 9,300

Water Quality Monitoring
Fiscal Year 2002 Project Proposal

Principal Investigator: Ron Bliesner
Keller-Bliesner Engineering
78 East Center, Logan, UT 84321
(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
GALLEGOSCANYON 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:

A draft annual report and data files for inclusion in the GIS database will be produced by March 31, 2003. The final report will be completed by June 1, 2003.

Budget FY-2002:

Category	Staff-Days	Cost
Personnel:		
Data collection and analysis	17	$ 4,750
Travel/per diem:	9	$ 1,000
Equipment cost (sampling equipment rental)		$ 900
Laboratory analysis		$ 17,000
Overhead (10% of subcontract)		$ 1,700
Grand Total		**$ 25,350**

Outyear funding:

FY 2003	$ 26,400
FY 2004	$ 27,500
FY 2005	$ 28,600
FY 2006	$ 29,700
FY 2007	$ 30,900

GIS Based Integrated Database Maintenance
Fiscal Year 2002 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 for this task is for the San Juan Basin below Navajo Dam.

Collections:

None.

Background:

In 1996 a GIS database was developed to provide a tool for compiling, maintaining and analyzing all data collected as a part of the San Juan River Basin Recovery Program. All updates will be coordinated through FWS-Region 2, the main repository for the data.

Objective:

Update and Maintain GIS Database.

Methods:

1.) Prepare Standardized Data Formats. Utilizing data provided in the past, each researcher will be provided a requested data format for data inclusion to match previous data sets. For new data sets, the format will be developed based upon researcher input.

2.) Update and Maintain GIS Database. Datasets provided by each researcher will be added as coverages to the existing GIS database. A CD-ROM will be produced and distributed to researchers by June of each year containing data collected in all previous years. For inclusion, data must be received by March 31. All updates will be coordinated through FWS-Region 2, the main repository for the data.

Products:

A CD-ROM containing all data supplied by researchers by the cutoff date will be produced and copies distributed to all researchers by June 1, 2003.

Budget FY-2002:

Category	Staff-Days		Cost
Personnel:			
Analyze and adjust data formats	6	$	1,348
Update databases	32	$	18,270
Coordination and disk production	11	$	6,438
Subtotal	49	$	26,056
Travel/per diem:	0	$	0
Equipment Rental (boats, equipment)		$	0
CD's, copies, misc. supplies		$	1,000
Overhead (10% of subcontract)		$	1,190
Grand Total		**$**	**28,246**

Outyear funding:

FY 2003	$ 29,700
FY 2004	$ 31,200
FY 2005	$ 32,800
FY 2006	$ 34,400
FY 2007	$ 36,100

Three Year Standardized Monitoring Integration Report
Fiscal Year 2002 Project Proposal

Principle Investigator: Bill Miller
Miller Ecological Consultants, Inc.
1113 Stoney Hill Dive, Suite A, Fort Collins, CO 80525-1275
(970) 224-4505 mec@millereco.com

Study Area:

The study area for this task is for the San Juan below Navajo Dam.

Background:

The long-term monitoring program calls for production of a data integration and synthesis report covering the monitoring data from 1998-2001 in conjunction with data used to prepare the research period final report and the flow recommendation report. This task covers all aspects of research and monitoring completed under the San Juan River Basin Recovery Implementation Program (SJRIP). All principle investigators responsible for data collection and reporting over this period of time will be included in this data integration process.

2002 will be the first integration of the standardized monitoring program for the San Juan River Implementation Program. This will require synthesis and integration across all aspects of monitoring to be performed by the individual investigators for each aspect of monitoring. These include adult, juvenile and small bodied fish community, larval drift, habitat, geomorphology and water quality. The individual investigators responsible for each component will be completing a report on the three years of monitoring and also comparisons with the earlier research conducted during the seven-year research program.

The objective of this proposal is to facilitate the synthesis integration and also be the technical editor for the report that summarizes and synthesizes the three-year monitoring across all monitoring programs.

Objective:

1.) Integrate 1998 - 2001 data with earlier data and determine response to hydrology and influence on recovery of the endangered species for each individual study (by each investigator).

2.) Integrate individual study results to identify interactions and assess progress toward recovery (all investigators interactively).

3.) Evaluate and update flow recommendations based on new findings.

4.) Evaluate and update Standardized Monitoring and Long Range Plan.

Methods:

1.) 1998-2001 data analysis. Each investigator will evaluate data collected for each study they were responsible for and integrate with previously collected data, where applicable. The extended data set will be used to assess relationships to flow and impact on recovery. Conclusions reached earlier will be evaluated in light of the additional data and changes explained.

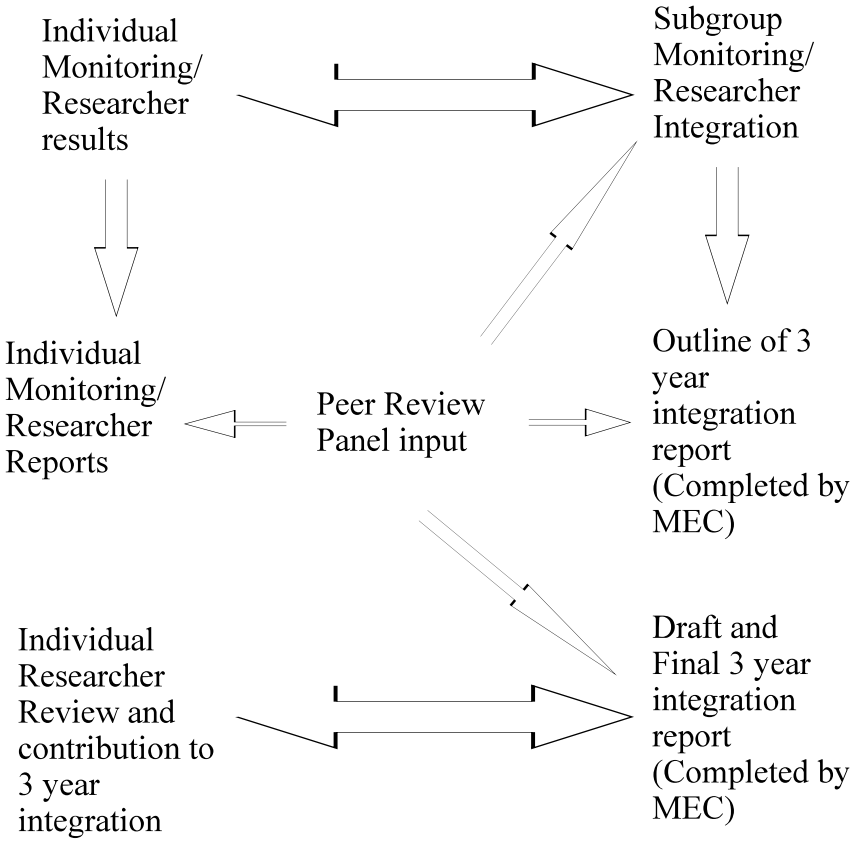
2.) Integration of findings of all studies. Group data exchange and analysis meetings will be held between individual researchers, including participation with appropriate peer reviewers, to explore relationships between study findings.

3.) Evaluate and update flow recommendations based on new findings. Based response of the geomorphology, habitat and fish community to flows since implementation of the flow recommendations, the foundation of the flow recommendations will be evaluated. If the new data suggest modification to the recommendations, they will be proposed.

4.) Evaluate and update Standardized Monitoring and Long Range Plan. Both the Standardized Monitoring Program and Long Range Plan will be reviewed and updated, as needed, based on the integrated findings.

5.) Preparation of draft and final integration/synthesis report for the Standardized monitoring program. MEC will function as the facilitator/editor for the standardized monitoring report, the focus of this effort will be to attend sub group meetings between individual investigators who are synthesizing and integrating data sets to arrive at an overall outline for the integration document (Item 2 above). This outline based on the individual reports from each investigator as well as the final chapter, which is being proposed to be synthesized by the Peer Review Committee or select individuals from the Peer Review Committee, will be developed into a cohesive document. Figure 1 displays the inter action between the individuals, subgroups, peer review panel and MEC in the overall integration and report preparation process. The report will be produced using WordPerfect or MS Word software. The draft report will be submitted for review and comment by the Biology Committee, Peer Review Panel and researchers. The draft final report will be submitted to the Biology Committee, Peer Review Panel and Coordination Committee for review and comment. Comments will be addressed and a final report completed.

Figure 1. Flow Chart of integration process for 3 year integration report.



Schedule:

The total time required to complete the integration is show below. This schedule assumes that Day 1 is the date that all FY2002 funding is in place and agencies and contractors have received approval begin FY2002 work tasks. The schedule for preparation of the report is as follows:

Item/Task	Start Date	End Date
Individual Researcher results	Day 1	Day 60
Individual Researcher Reports, Subgroup meetings, Outline of 3 year report and Peer Review involvement	Day 60	Day 150
Preparation of 3 year report	Day 150	Day 210
Distribution of Draft report	Day 211	Day 211
Draft report comment period for individual researchers and peer review panel	Day 211	Day 241
Draft Final Report Preparation	Day 241	Day 260
Comment period for draft Final Report	Day 261	Day 290
Final Report Preparation	Day 290	Day 310
Distribution of Final Report	Day 310	Day 310

Subgroups:

Two subgroups, biological and physical habitat, will be established for the integration report. The following subgroups members are proposed for completion of the integration report. Each subgroup is open for anyone to attend. The proposed members are based on responsibilities during monitoring activities.

Biological: Fish and Wildlife Service, New Mexico Game and Fish, University of New Mexico, Utah Dept. of Wildlife Resources, Drs. Ross and Ryel, Miller Ecological Consultants, Inc.

Physical: Keller-Bliesner Engineering, Ecosystems Research, Bureau of Reclamation, Fish and Wildlife Service, Miller Ecological Consultants, Inc., Drs. Pitlik, Ryel, and Wesche.

Products:

Each investigator will prepare a summary report of individual findings covering the 1998-2001 period and comparing those findings to those of the 1998 final reports. In addition, each

investigator will contribute to the drafting of sections of a summary integration report, evaluating the progress towards recovery, flow recommendations, monitoring plan and long range plan.

The integration report of the standardized monitoring plan will include the following three phases: 1) a draft report for the Biology Committee and Peer Review panel; 2) a draft final report to be submitted to the Biology Committee, Peer Review Panel and Coordination Committee; and, 3) a final report on the integration and synthesis of the first three years of the standardized monitoring program. All draft reports will be submitted via email or on CD as Adobe PDF format. The final report will be in both limited number of hard copies (100) as well as Adobe PDF format for direct posting to the web site.

Subgroup Members:

Biology Subgroup: FWS, NMGF, UNM, UDWR, MEC, Drs. Ross and Ryel; peer reviewers

Physical habitat & Hydrology subgroup: K-B, ERI, MEC, Drs. John Pitlik and Ryel; peer reviewers

Physical habitat, Hydrology & Biology Integration: FWS, NMGF, UNM, K-B, ERI, MEC, peer review

Budget FY-2002:

Entity	Labor	Travel and Per Diem	Supplies and Misc.	Overhead	TOTAL
USFWS, Albuquerque	$6,000.00	$3,500.00	$ 500.00	Included	$ 10,000
USFWS, Grand Junction	$19,000.00	$4,000.00	$ 0.00	Included	$ 23,000
NMDG&F	$20,000.00 (65 staff days)	$4,000.00	$ 0.00	Included	$ 24,000
UNM	$17,500.00 (38 staff days)	$3,000.00 (10 trips)	$ 750.00	$ 3,750	$ 25,000
K-B Engineering/ ERI	$98,490.00 (150 staff days)	$3,000.00 (10 days)	$ 500.00	$ 4,969	$ 106,959
UDWR	$8,000.00	$3,000.00	$ 1,000.00	Included	$ 12,000
MEC	$25,280.00 (42 staff days)	$3,340 (4 meetings)	$5,700.00	Included	$ 34,320
TOTAL	$ 194,270	$ 23,840	$ 8,450	$ 8,719	**$ 235,279**

Peer Review

Peer Review for 2002
Fiscal Year 2002 Project Proposal

Principal Investigator: Paul B. Holden
BIO/WEST, Inc., Logan, Utah
Jicarilla-Apache Tribe
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Background:

A Peer Review Panel was established in 1997 to assist the SJRIP with reports and plans for future studies. Scientists on that panel included:

> Dr. Clark Hubbs - Fishery ecologist and professor emeritus from the University of Texas. Clark served on the Peer Review Panel for the Grand Canyon Environmental Studies.
>
> Dr. David Galat - Fishery Ecologist with the National Biological Survey and Missouri Cooperative Fishery Unit who is working on native fishes and instream flow issues on the Missouri River.
>
> Dr. Ellen Wohl - Associate Professor in the Department of Earth Sciences at Colorado State University. Ellen has been involved with peer review of Upper Colorado River Basin projects and has expertise is geomorphology and sediment transport.
>
> Dr. Ron Ryel - Biostatistician and ecologist with experience in population modeling. Ron has been involved with endangered fish issues in the Grand Canyon and the Upper Colorado River Basin.

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 will be extensively involved in assisting the Biology Committee prepare a summary report of the first three years of monitoring. This will require both meeting with the Biology Committee several times and meeting with subgroups of the Biology Committee that are working on specific portions of the report.

This proposal provides for funding for the Peer Review Panel activities during 2002.

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 2002 two or three times as the monitoring report is discussed. Individual Peer Reviewers will work with Biology Committee subcommittees that will be responsible for putting sections of the monitoring report together. This may require some writing of portions of the report, but most of the writing will be completed by the Biology Committee. They will also review other Program reports when they are in draft and final form, including the Long Range Plan and some research reports, such as the final bioenergetics model.

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. Additional Peer Review Panel members may be added if a particular expertise is needed by the Biology Committee.

During 2002 it is proposed to change the Peer Review Panel membership to obtain expertise needed to review and assist with the three year monitoring report. This will take a larger time commitment than used in the past. Existing Peer Review Panel members that are being asked to assist in 2002 are Drs. Ron Ryel and Dr. David Galat. Dr. Ryel has the time to commit to an extended Peer Review presence. Dr. Galat will contribute by attending up to three Biology Committee meetings but will not have the time to work more closely with the subcommittees. It is proposed that a river hydrologist/geomorphologist familiar with cobble bedded streams and Colorado River fish habitat be added to the Panel. It is also proposed that an addition fishery ecologist also be added to the Panel. The Biology Committee will request names of potential peer review candidates and make a decision on new panel members at their September meeting in 2001.

Products:

Peer review participation at 3 Biology Committee meeting and additional subcommittee meetings, letter reports from each peer reviewer.

Primary Contact: Dr. Paul Holden
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1063 W. 1400 N.

Logan, UT 84321
Phone:435-752-4202
FAX:435-752-0507
e-mail: pholden@bio-west.com

Personnel:

Additional river geomorphologist

Dr. David Galat
Missouri Cooperative Fish and Wildlife
Research Unit
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University of Missouri
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FAX: 573-884-5070
email: david_galat@muccmail.missouri.edu

Additional Fishery Ecologist

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1649 N. 1000 E.
North Logan, UT 84341
Phone: 435-753-6077
FAX: 800-446-0357
email: range@cc.usu.edu

Budget FY-02:

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 Dr. Ryel will spend approximately 20-25 days, and the geomorphologist and fishery ecologist will spend approximately 15- 20 days each.

Salaries:	$	32,000
Travel:	$	8,000
Total	$	40,000

Funds remaining from 2001 are $8,000.

Total new Budget: $32,000

Future use of the Peer Review Panel is not known but they likely will be used again in 2004 when the 5 year monitoring report is completed.

Research Activities

San Juan River Population Model Refinements.
Fiscal Year 2002 Project Proposal

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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 pike minnows and razorback suckers in the river.

That models as proposed 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 2002 program is to better parameterize structural and functional components of these conceptual models. Three approaches are currently under investigation each of which is centered on a different hierarchical organization. They are:

A. BIOENERGETICS This approach is individual based (structural) and summed for population effects .In addition, functional energetic (ingestion/egestion, assimilation, etc.) Are considered.

B. POPULATIONS This conceptual approach utilizes densities/biomass, size/age structure, etc of individual populations. The populations sizes will be tiered to habitats and habitat requirements.

C. TROPHIC STRUCTURE An attempt is being made to understand the food web structure of the river based upon functional groups. This approach utilizes biomass estimates at all trophic levels and will look at the movement of energy and biomass between trophic groups (IE grazers, detritivores)

Population estimates collected in 1998, 1999, 2000 and those scheduled for 2001 will be used in model verification and validation. No field data collections are proposed for FY2002. The focus of FY2002 is to refine the model into a working framework that includes all three of the above

approaches into one model. In addition, new components may be added to the model to address new fish species not in the original model. These species include roundtail chub and striped bass.

Other tasks for FY2002 are preparation of the draft and final report, model documentation, and integration of 1998 through 2001 population estimate data.

This additional population effort is intended to provide additional information for use in refining the correlation between population estimates and relative abundance data.

Population dynamics of lotic fish communities are largely a function of the condition of and changes in their physical environment and the resulting responses in both primary (phytoplankton and periphyton) and secondary (zooplankton, micro-and macro invertebrates) production, and upon which these fishes rely to varying degrees for forage. Although the importance of these relationships are universally recognized by fisheries researchers, these lower trophic levels and the physical processes which influence them are often poorly understood in many aquatic systems. Yet these physical (substrate characteristics, temperature, water transparency, dissolved oxygen, etc.) and biological components of the ecosystem form the framework within which fish populations exist and function. In the San Juan and Animas Rivers, these factors are highly influenced by the flow regime associated with the annual spring runoff as well as summer storm events. This influence of the flow regime makes the study of these physical and biological components of the ecosystem especially relevant in rivers where the management of flow is considered vital to the health of t of fish population of concern.

Objectives:

1.) Further refine the correlation between population and abundance of fish using the first pass of population estimate and relative abundance during monitoring surveys.

2.) Incorporate data on forage base in the San Juan and Animas rivers for use on carrying capacity determinations in the population model.

3.) Determine the temporal changes in physical and biological conditions in selected riffle and run habitats in the San Juan and Animas Rivers in order to calibrate the bioenergetics-trophic model.

Methods:

The model will be produced using Stella software and the Wisconsin bioenergetics models. The modeling software will be configured to include multiple species and lifestages. Model documentation will be produced an Adobe PDF format for distribution.

Schedule:

Model refinement will be concurrent with preparation of model documentation. Model refinement will begin with the notice that funding has been secured. Completion of the model documentation is scheduled for 9 months after the start date.

Products:

A draft and final report on model documentation that includes a description of model application and use will be delivered to the Biology committee.

Budget FY-2002:

All funding for FY 2002 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	$ 19,150.00 (50 Staff days)	$ 12,530.00 (25 Staff days)	$ 31,680.00
Travel	$ 1,324.00 (10 staff days)	$ 2,100.00 (10 Staff days)	$ 3,424.00
Equipment	$ 1,110.00	$ 0.00	$ 1,110.00
Supplies	$ 0.00	$ 500.00	$ 500.00
Overhead	$ 0.00	$ 1,348.00	$ 1,348.00
Total	$ 21,584.00	$ 16,478.00	$ 38,062.00

Characterization of Razorback Spawning Bar
Fiscal Year 2002 Project Proposal
(2-year study)

Principal Investigator: Ron Bliesner
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Study Area:

The study area consists of the San Juan River in the Vicinity of Aneth, UT, or other identified Razorback Spawning locations.

Collections:

Interstitial and course substrate samples for grain size analysis.

Background:

Razorback sucker monitoring has identified aggregations of ripe males and females in a primary location in the river near Aneth, UT the last three years during typical spawning time. While actual spawning has not been observed, the conditions are right for spawning to occur and larval razorback suckers have been found in the larval drift studies downstream of this site. Since little is known about suitable spawning habitat for razorback sucker in the San Juan River, characterizing this site at or near the time of fish observation could aid in the understanding of the nature of the spawning site.

Objectives:

1.) Identify and characterize typical characteristics of a suspected razorback spawning site.

2.) Characterize habitat in the vicinity of the suspected spawning site.

3.) Identify other potential sites with similar characteristics

4.) Coordinate with the razorback sucker monitoring program to analyze findings.

Methods:

1.) Characterize spawning bar characteristics. As soon as the razorback sucker monitoring program identifies the presence of ripe fish at a location, a crew will be mobilized to the site to characterize the bar. (Up to three locations will be surveyed.) Topographic surveys will be completed for each of the sites identified utilizing total station or gps survey equipment and survey control bench marks established at each site.

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.

Bar morphology will be determined by producing three-dimensional plots of the surveyed surface. Characteristics of the bar will be compared to other bars characterized during the 7-year research period.

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.

Gross water quality parameters (temperature, DO, Ph, Conductivity) will be collected at the site and from local tributaries.

2.) Map habitat in the vicinity. Utilizing existing aerial photography taken near the flowrate at sampling as a base map, detailed habitat mapping will be completed to the long-term monitoring protocol for one mile up and downstream of the site. The information will be digitized and the data summarized.

3.) Identify other potential sites. Based on the characteristics identified at the suspected spawning sites, including vicinity habitat mapping, a review of mapped habitat will be completed and similar sites identified. A field investigation will be completed to characterize those identified as being similar utilizing the protocol in Task 1. This activity will be completed in the second year of the study based on preliminary data review in year one. The budget shown assumes complete surveys on 5 additional sites. If more sites are identified, the budget will be adjusted accordingly.

4.) Coordination with razorback sucker monitoring team. Data analysis will be coordinated with the razorback sucker monitoring team to compare habitat and substrate data with observed fish position. As disturbance of the fish at spawning time should be minimized, no field work will be completed without the approval of the Biology Committee and the razorback sucker monitoring team.

Products:

A summary report will be prepared covering the findings and comparing them to literature results, including unpublished observation data in the upper Colorado River Basin. A draft monitoring plan will also be prepared to track changes at this site and identify other potential sites.

Budget FY-2002:

Category	Staff-Days	Cost
Personnel:		
Field data collection and analysis	42	$ 20,956
Travel/per diem:	22	$ 3,350
Equipment Rental (boats, survey inst.)		$ 1,500
Misc. Supplies		$ 200
Overhead (10% of subcontract)		$ 1,319
Grand Total		**$ 27,325**

Budget FY-2003 (subject to change based on 2002 results):

Category	Staff-Days	Cost
Personnel: Field data collection and analysis	60	$ 31,066
Travel/per diem:	34	$ 4,350
Equipment Rental (boats, survey inst.)		$ 2,000
Misc. Supplies		$ 200
Overhead (10% of subcontract)		$ 1,300
Total		**$ 38,916**

Water Temperature Analysis - San Juan River
Fiscal Year 2002 Project Proposal

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Study Area:

The study area for this task is for the San Juan below Navajo Dam.

Collections:

None.

Background:

Water temperature monitoring in the San Juan River since 1992 has indicated a suppression of water temperature in the river due to hypolimnetic releases from Navajo Dam and mimicry of a natural hydrograph. The Program Evaluation Report identifies this temperature suppression as a potential limiting factor in the ability of Colorado pikeminnow to spawn at an appropriate time above RM 150.

Objective:

1.) Analyze collected and historical temperature data and define impact of hypolimnetic release on downstream water temperature.

2.) Assess the impact of the observed temperature change on range limitation and spawning date for Colorado Pikeminnow, razorback sucker and other species.

Methods:

1.) Analyze temperature data and define impact of hypolimnetic release on downstream water temperature. Temperature data collected since 1992 will be analyzed to develop a temperature/flow relationship for the San Juan River. This relationship will be used to assess expected temperatures form Navajo Dam to Bluff, Utah for the typical range of flow conditions experienced during the test period. The results will be compared to historically available data to assess the impact of reservoir operation on temperature.

2.) Assess the impact of the predicted water temperatures on range limitation and spawning date for Colorado pikeminnow, razorback sucker and other species. A literature search will be completed and the results summarized relative to the impact of water temperature on Colorado pikeminnow, razorback sucker and other species behavior. Utilizing the results of the temperature analysis, anticipated impacts to range limitation and spawning date by location will be assessed in the San Juan River.

Products:

A draft report documenting the temperature analysis and identifying relationships and temperature changes in the river relative to pre-dam conditions will be prepared by July 31, 2003, and a final report will be completed by September 30, 2003. A discussion paper will be produced summarizing the literature on the influence of water temperature on Colorado Pikeminnow behavior and assessing the impacts of water temperature in the San Juan.

Budget FY-2002:

Category	Staff-Days	Cost
Personnel:		
Data analysis & report	27	$ 18,040
Travel/per diem:	0	$ 0
Misc. supplies, copies,etc.		$ 500
Overhead		$ 700
Grand Total		**$ 19,240**

Navajo And San Juan River Temperature Model
Fiscal Year 2002 Project Proposal

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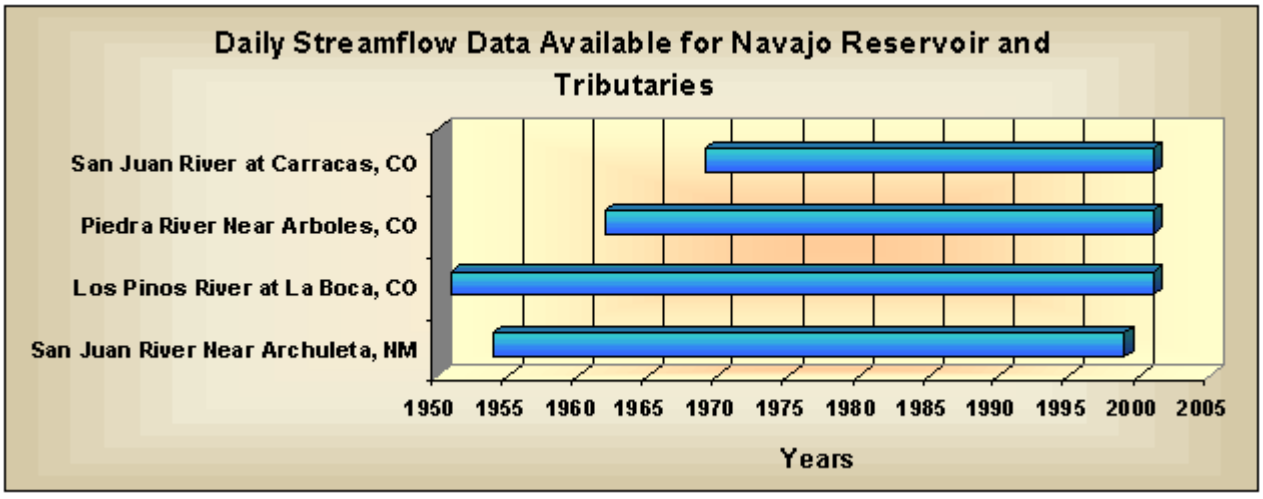
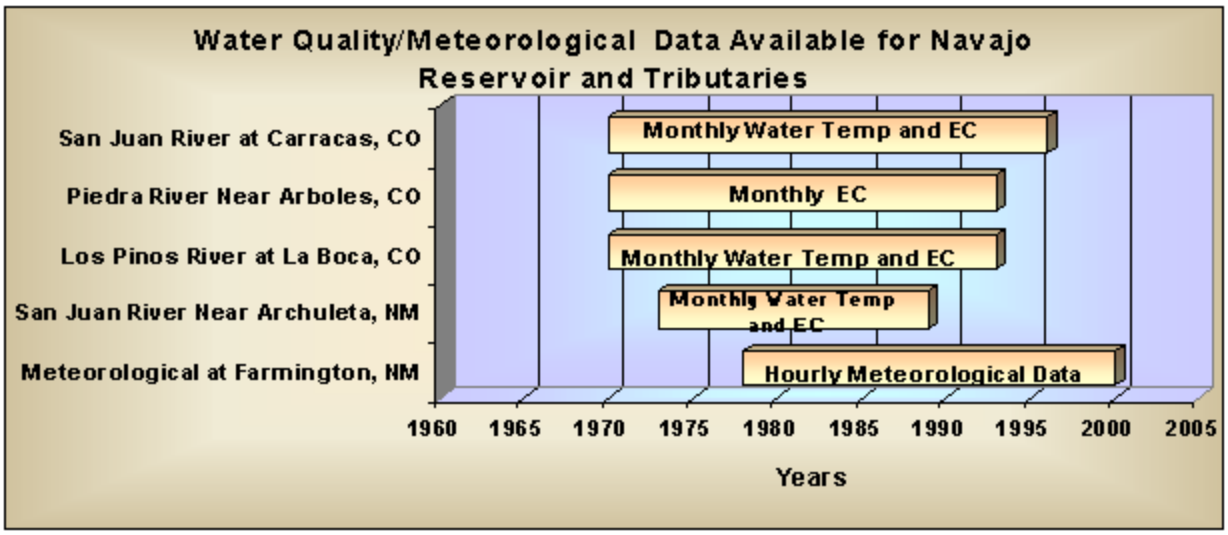
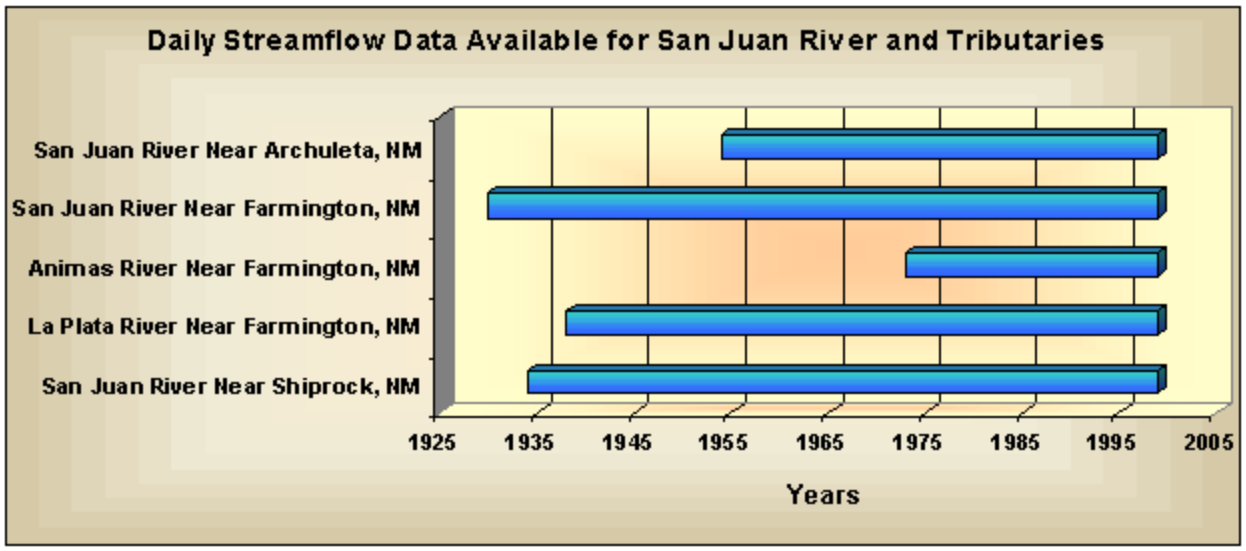
Background:

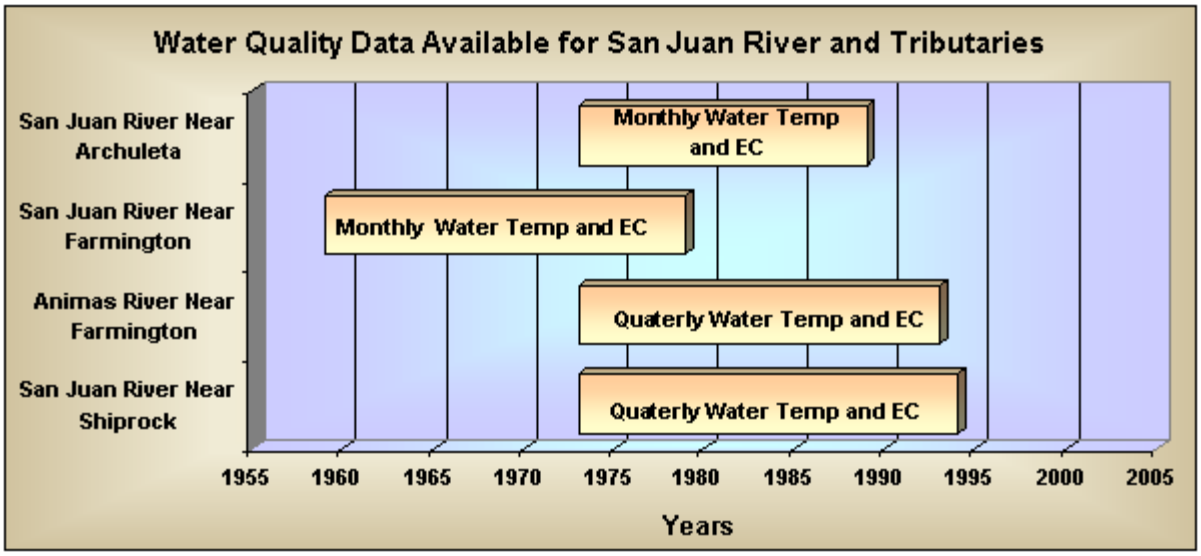
Studies have postulated that the changes in hydrology and water temperature releases from the Navajo Dam could benefit the Colorado pikeminnow and razorback sucker. It is believed that increasing temperatures in the San Juan River could benefit razorback sucker and Colorado pikeminnow growth and reproduction above River Mile 150 (near Shiprock NM). Specific temperature targets for the San Juan River are proposed to be developed in a separate scope of work for 2002. This scope of work proposes to use temperature models to determine the feasibility of achieving the desired river temperatures.

Presently there are streamflow, water quality and meteorological data available for the Navajo Reservoir and the San Juan River below the dam. The four graphs (below) indicate availability of data for certain periods from the USGS, Storet and National Weather Services Databases. Fundamentally the information available is sufficient to run temperature models. Based on the results of the models, more data could be gathered if fine-tuning is deemed necessary.




Water Quality/Meteorological Data Available for Navajo Reservoir and Tributaries
San Juan River at Carracas, CO
Piedra River Near Arboles, CO
Los Pinos River at La Boca, CO
San Juan River Near Archuleta, NM
Meteorological at Farmington, NM
Monthly Water Temp and EC
Monthly EC
Monthly Water Temp and EC
Monthly Water Temp and EC
Hourly Meteorological Data
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Years


Daily Streamflow Data Available for San Juan River and Tributaries
San Juan River Near Archuleta, NM
San Juan River Near Farmington, NM
Animas River Near Farmington, NM
La Plata River Near Farmington, NM
San Juan River Near Shiprock, NM
1925
1935
1945
1955
1965
1975
1985
1995
2005
Years



Objectives:

The objectives for this study are to find the best solutions to the followings:

1.) To determine potential temperature regimes in the San Juan River down to approximately River Mile 150 that would result from various TCD options.

2.) Compare and contrast release water temperature for a historic period with and without TCD modifications.

3.) Determine the times of year in which water temperature targets can be met.

4.) Determine the effect of TCD on the heat budgets in the reservoir.

The above goals will be addressed through the utilization of reservoir and river temperature models applied to the Navajo Reservoir and the San Juan River using CE-QUAL-W2 (W2) and QUAL2E. These models will predict release temperatures with different TCD scenarios, and river temperature variations with changes in flow.

Study Area:

The study area includes Navajo Reservoir and the San Juan River below Navajo Dam to Shiprock.

Methods:

A two phased approach will be used to determine potential temperature regimes in the San Juan River below Navajo Dam to Shiprock. The W2 model will be used to determine available temperatures for various reservoir release options and to model the initial tailwater reach as mixing occurs if various penstock/TCD release options are utilized. The Qual2E model will use the output generated by the W2 model and flow information to determine downstream warming in the river to Shiprock. Phase one will define the best time period to incorporate the model of the Navajo Reservoir using W2. The W2 model requires meteorological data including hourly air temperatures, dew-point temperatures, wind speeds, wind directions and cloud covers, as well as data indicating daily inflows and outflows of all major tributaries, inflow and outflow water temperatures, total dissolved solids (TDS) and total suspended solids (TSS). Finally, detail geometry of the reservoir and the downstream tailwater must be obtained. A combination of topographical map and the "Instream Flow Incremental Methodology" study will be used to generate reservoir and river geometries for the Navajo system. The models will be calibrated using in-reservoir temperature profiles and release time-series water temperature data. The calibrated water temperature model will be used to test combinations of flows and withdraw levels in the reservoir to meet the target temperature range for the downstream needs of the San Juan River. Similar work has been done on the Glen Canyon Dam where a temperature control device (TCD) is being considered to help endangered fishes. We applied W2 on Lake Powell. We were able to determine the earliest date when the temperature target can be met, whether the heat budget in the reservoir is affected, and the most effective TCD design. Phase two will incorporate reservoir release water temperatures modeled by W2 as inputs to the river model (QUAL2E).

Schedule:

1.) Analyze data to select best period for modeling (May 2002).

2.) Build detail geometry data for Navajo Reservoir and downstream tailwater (July 2002).

3.) Input model data (September 2002).

4.) Calibrate reservoir temperature models (January 2003).

5.) Analyze temperature scenarios (March 2003).

6.) San Juan River temperature model using QUAL2E (May 2003).

7.) Report (September 2003).

Deliverables/Due Dates:

1.) Data analysis: May 2002

2.) Detail Geometry of reservoir: July 2002

3.) Input model data: September 2002

Budget FY-2002:

Labor	$ 21,720.00
Travel	$ 1,240.00
TOTAL	**$ 22,960.00**

FY - 2003:

Deliverables/Due Dates:

1.) Reservoir model calibrations: January 2003

2.) Scenario analyses: March 2003

3.) River model: May 2003

4.) Final report: September 2003

Budget FY-2003:

Labor	$ 22,400.00
Travel	$ 1,240.00
TOTAL	**$ 23,640.00**

Budget Summary (FY 2002 - 2003):

FY-2002	$ 22,960.00
FY-2003	$ 23,640.00
TOTAL	**$ 46,600.00**

References:

Cole, T. M. 1995. "A Two-Dimensional, Laterally Averaged, Hydrodynamic and Water Quality Model, Version 2.0", Final Report E-86-5, U.S. Army Corps of Engineers.

Holden, B. P. (Ed.). 1999. "Flow Recommendations for San Juan River", San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM.

Temperature Modeling for Navajo Reservoir and San

	Temperature Modeling for FY-2002		
Budget Category	**Unit (day)**	**Unit Cost**	**Total Cost**
Personnel			
WQ scientist (UCRO)	5	$504.00	$2,520.00
Engineer (UCRO)	30	$360.00	$10,800.00
Technician (UCRO)	10	$280.00	$2,800.00
Grad Student (BYU)	20	$280.00	$5,600.00
Total Personnel Costs			$21,720.00
Travel	**Unit (person)**	**Unit Cost**	**Total Cost**
Airfare	4	$200.00	$800.00
Per diem	4	$110.00	$440.00
Total Travel Cost			$1,240.00
Total Cost for FY-2002			**$22,960.00**

	Temperature Modeling for FY-2003		
Budget Category	**Unit (day)**	**Unit Cost**	**Total Cost**
Personnel			
*Model Review	10	$800.00	$8,000.00
Engineer (UCRO)	40	$360.00	$14,400.00
Total Personnel Costs			$22,400.00
Travel	**Unit (person)**	**Unit Cost**	**Total Cost**
Airfare	4	$200.00	$800.00
Per diem	4	$110.00	$440.00
Total Travel Cost			$1,240.00
Total Cost for FY-2003			**$23,640.00**

Total Project Cost	**$46,600.00**

*Model Review: The models will be reviewed by J. E. Edinger Associates, Inc. Research and Applications in Watershed and Waterbody Science Consultants

Determination of Occurrence of Hybridization of San Juan River Razorback Sucker Through Genetic Screening of Larval Fishes
Fiscal Year 2002 Project Proposal

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Background:

The first record of naturally reproducing San Juan River razorback sucker was on 21-22 May 1998 with the collection of two larval fish near river miles 88.8 and 80.2. These specimens provide verification of spawning by the augmented-introduced population. In 1999, seven larval razorback sucker were collected between 4 May and 14 June. The seven larvae (razorback) were taken in backwater or low velocity habitats located between river miles 96.2 and 11.5 with almost half (n=3) of those individuals being taken downstream of Mexican Hat. The considerable increase in number of razorback sucker collected between 1999 and 2000 was deemed indicative of the gradually increasing number of adult razorback sucker being recruited into the spawning cohort. Tentative identifications of larval fish collected during the 2000 survey revealed 138 larval razorback sucker in 24 separate collections. The putative larval razorback sucker were collected in low velocity habitats between river miles 124.8 and 8.1 with the lowest-most sampling location (that yielded larval razorback sucker; RM 8.1) producing 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.

The results of this investigation suggest continually increasing recruitment of adult reproductively mature razorback sucker to the population. Since 1998, there has been a logarithmic increase in the number of individuals collected and we expect this trend to continue in 2001. The number of larval razorback sucker being spawned, while increasing annually, is still not deemed of sufficient magnitude to allow for recruitment of larvae to the juvenile population. The small-bodied fish collecting effort undertaken during the fall monitoring program (conducted by NMGF) is the sampling mechanism that will be used to determine if recruitment between these developmental stages has occurred.

Hybridization of razorback sucker with sympatric sucker taxa occurs throughout the Colorado River Basin. Lower Colorado River Basin razorback sucker x flannelmouth sucker hybrids have been reported in both Lake Mohave (Minckley 1983, Bozek et al. 1984) and the Grand Canyon reach of the Colorado River (Suttkus and Clemmer 1979). There are numerous reports of razorback sucker x flannelmouth sucker hybrids in the Upper Colorado River Basin (Banks 1964, Holden and Stalnaker 1975, McAda and Wydoski 1980, Tyus and Karp 1990). Holden (1973) collected nearly as many hydrid razorback sucker x flannelmouth sucker (n=40) as putative pure

razorback sucker (n=53). He also reported (Holden 1973) that the incidence of hybridization in the Upper Basin appear to be increasing.

In their study of spawning and movement of razorback sucker in the Green River, Tyus and Karp (1990) reported capturing both ripe flannelmouth sucker and bluehead sucker syntopically with ripe razorback sucker. They also documented suspected flannelmouth sucker x razorback sucker hybrids (n=17) within an aggregation of ripe flannelmouth sucker, bluehead sucker, and razorback sucker in Yampa Canyon and the upper Green River (Tyus and Karp 1990). These and the aforementioned hybrids were determined based on morphological characters that appeared intermediate when compared with putative pure taxa.

Given the limited number of reproductively active razorback sucker in the San Juan River and small number of razorback sucker larvae being collected it was not previously deemed necessary to perform genetic analysis to ascertain the parental stock of larval San Juan River razorback sucker (i.e., whether they were intergeneric hybrids). With the collection of 138 larval razorback sucker in 2000 and the anticipated collection of an equal or greater number of razorback sucker larvae in 2001, reproduction by this species has achieved a level (as determined by the number of individuals being collected) sufficient to warrant such an investigation.

Hybridization has been identified as an important factor that influences survivorship and successful recruitment to the breeding population (Pitts et al. 1997). Hybrid offspring often have higher probabilities of early mortality (Dowling and Moore 1985, Pitts et al. 1997). The persistence of hybrid offspring may facilitate genetic exchange among species disrupting the genetic cohesion of species. Hybridization is known to occur most frequently when environmental conditions have changed dramatically from historical conditions. Given the changes in the San Juan River system, the absence of resident population, and the recent introduction of razorback sucker, the opportunity for hybridization of this species may be greater than documented in other Colorado River Basin systems.

To achieve recovery of this species, it is essential to develop baseline genetic information that will document whether hybridization among re-established razorback sucker, flannelmouth sucker, and bluehead sucker is occurring. This objective was identified in the San Juan River Basin Recovery Implementation Program Plan Item (5.3.7 and 5.3.7.1). These objectives are designed to characterize the genetic makeup of endangered fish species with the goal of maintaining the genetic diversity of these taxa.

In contrast to many other Upper (and Lower) Colorado River Basin river drainages, the San Juan River did not have a resident population of razorback sucker at the time that augmentation of this species was initiated. The presumption has been that individuals repatriated to reaches containing resident populations of razorback sucker would intermingle and spawn with resident razorback sucker. The absence of adult razorback sucker from the San Juan River when augmentation was initiated was a concern because of the increased possibility that augmented razorback sucker would spawn with other catostomids. The number of flannelmouth sucker and bluehead sucker present in the San Juan River as compared to the number of released razorback sucker (a maximum of about 4,000) reduced the probability of razorback sucker pairing versus

hybridization. The former statement is a probability-based presumption and does not take into consideration premating mechanisms.

The 1998-2000 larval razorback sucker study resulted in the first records of naturally reproducing population of augmented razorback sucker. Since it is likely that the augmentation process will be duplicated in other portions of this species former range, it is important to determine if these individuals are the progeny of razorback sucker parentage or are hybrids. This information is most effectively obtained from focused genetic analysis.

A number of genetic screening techniques, used routinely on fish larvae in our laboratory, have been developed and are especially well suited to investigate hybridization. This goal will be accomplished through the use of a DNA based screening of larval fishes that will unambiguously identify parentage of larval individuals. Details regarding the genetic techniques to be employed are appended to this study proposal.

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 5) 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 FY 2002, sampling will include an additional 14 river miles of the San Juan River (the reach between Cudei Diversion Dam 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. All collections used in this genetic study will be made as part of the San Juan River larval razorback sucker survey.

Objectives:

1.) Develop baseline information based solely on FY 2002 collections that documents the presence or absence of hybridization among re-established razorback sucker, flannelmouth sucker, and bluehead sucker.

2.) Provide unambiguous identification of parentage of larval suckers collected in the San Juan River during FY 2002.

3.) Provide spatial and temporal delineation of parentage of larval suckers collected in the San Juan River during FY 2002.

Methods:

Larval razorback sucker that will be genetically examined in this study proposal will be obtained under the "San Juan River Larval Razorback Sucker Survey" submitted by Gottlieb, Brandenburg, and Platania. The protocol for acquisition of those collections is provided in the aforementioned study proposal and is also appended to this proposal. There are no costs included in this proposal associated with the collection of the larval razorback sucker as all

collection costs are being borne by the "San Juan River Larval Razorback Sucker Survey Fiscal Year 2002 Project Proposal."

The only change in sampling methodology and protocol for the San Juan River Larval Razorback Sucker Survey that would need to be initiated, if this genetic study proposal is approved, would be preservation of samples in ethanol instead of buffered formalin (as is currently standard procedure).

Products:

A draft report for the 2002 razorback sucker sampling activities will be prepared and distributed to the San Juan River Biology Committee for review by 31 March 2003. Upon receipt of written comments, that report will be finalized and disseminated to members of the San Juan River Biology Committee 1 June 2003. 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-2002:

Personnel			
	Laboratory Research (16 man-days) (perform genetic analysis)	$	8,000
Travel and per diem			
	Non-Field per diem (SJR meeting attendance)	$	500
Equipment and Supplies			
	8 reactions x 100 individuals @ $5.00/reaction	$	4,000
	Total	$	12,500
	Administrative Overhead	$	1,875
GRAND TOTAL		$	**14,375**

There is no outyear funding for this project.

Literature Cited:

Banks, J. L. 1964. Fish species distribution in Dinosaur National Monument during 1961-1962. Master's Thesis, Colorado State University, Fort Collins.

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APPENDIX I – Molecular Methods

Total genomic DNA will be isolated from individual putative larval razorback sucker. Larvae are suspended in 200 ml STE buffer (0.1 M NaCl, 0.05 M Tris-HCl pH 7.5, 0.001 M EDTA), 10 ml of a 20% solution of SDS, and 4 ml proteinase K (10 mg/ml stock). Samples are then incubated at 55^{o}C from four hours to overnight in a circulating water bath. Digested samples will be extracted with 200-ml phenol-chloroform-isoamyl alcohol (25:24:1) and then extracted once with 200-ml chloroform. Finally, DNA is precipitated by adding 2.5 volumes of ice cold 100% EtOH and 0.1 vol of 2 M NaCl, and cooling at -80^{o}C for 15 minutes. After precipitation and centrifugation, DNA pellets are dried in a vacuum centrifuge, and resuspended in 30 ml of sterile water.
Individual larvae will be screened using DNA based techniques that rely on amplifying DNA

fragments via polymerase chain reaction (PCR). This technique is well suited for screening larval fishes because very little sample DNA is needed for screening. Two kinds of genetic markers have been developed in our laboratory for use in studying hybridization. The first class of markers, DNA microsatellites, are short nuclear elements that are highly variable within and among species. Because microsatellite markers are found in the nuclear genome, genetic profiles of offspring are inherited both from their mother and father. It is impossible to determine based solely on microsatellite DNA, which species was which parent. In many cases, fish hybridization is unidirectional, *i.e.*; one species is always the female parent of hybrid offspring. Understanding the directionality of hybridization is critical for many management applications, and thus we propose to use a strictly maternally inherited genetic marker to identify the female parent of putative hybrids. The markers we have developed for this purpose are in the mitochondrial (mt) genome and are inherited strictly maternally. Thus, the mtDNA profile unambiguously identifies the female parent in a hybridization event.

Eight microsatellite loci have been developed for the razorback sucker and are used routinely in our laboratory on a number of catostomid species. Microsatellites are found in the genomes of many vertebrates, including fish. They are a DNA-based marker that is analyzed via polymerase chain reaction (PCR), so they can be applied to very small ethanol preserved specimens, such as fish larvae (Turner, 2001). Numerous microsatellite loci originally identified for razorback sucker work well for other catostomids. More importantly, these loci exhibit fixed genetic differences (e.g., they are species-diagnostic) between the sucker species tested in our laboratory (white sucker and Rio Grande sucker). Other laboratories have demonstrated fixed genetic differences in these loci between razorback sucker, bluehead sucker, and desert sucker (T. Dowling, Arizona State University, personal communication). The demonstration of fixed genetic differences indicates that these markers are especially well suited for hybridization studies of San Juan River catostomids

Comparative mtDNA sequence data from several sucker species has been used, in our laboratory, to identify polymorphic 300 bp (approximate) fragments for screening. PCR primers were designed to permit screening using single-stranded conformational polymorphisms (SSCPs) following methods outlined below. Total genomic DNA will be isolated from fin clips of adult individuals and entire larval fishes. PCR amplification will be conducted in 10-ml volumes in an Omn-E thermal cycler (Hybaid). Microsatellite loci are analyzed on 6% polyacrylamide gels (Sequagel, National Diagnostics) and are currently visualized by autoradiography. They will ultimately be optimized for the ABI 377. Alleles will be scored by length in base pairs relative to the known size standards. For mtDNA, sample DNA will be subjected to PCR using primer pairs described above. Following PCR, samples will be denatured in boiling water for 5 minutes, and immediately quenched in ice slurry to prevent renaturation of double-stranded DNA. Cold samples will be loaded into a 5% non-denaturing polyacrylamide (37.5:1 acrylamide:bis-acrylimade) gel with 5% glycerol. The samples will be subjected to electrophoresis at 10 W for 16 h at room temperature. Fragments will be visualized by autoradiography and scored by comparing their relative mobilities. At least two representives of variable haplotypes on each gel will be sequenced using an ABI 377 automated sequencing apparatus. All of the equipment necessary for successful completion of the project is present in our laboratory.

Turner, T. F. 2001. Comparative study of larval transport and gene flow in darters. Copeia 2001(3): 766-774.

APPENDIX II:

Collection Methods: (modified from San Juan River Larval Razorback Sucker Survey Fiscal Year 2002 Project Proposal)

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 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 inflatable rafts. The tentative sampling schedule will be on a bi-weekly (approximately) interval.

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. Habitat type, length, maximum depth and substrate of the habitat will be recorded. For seine samples, length and number of each seine haul will be determined. Specimens will be preserved in the field (in 95% ethanol) for future laboratory processing. Larval fish tentatively identified as razorback sucker will be sent to Darrel E. Snyder (Larval Fish Laboratory, Colorado State University) for verification of identification. Upon confirmation and return of those specimens, a subsample of larval razorback sucker will be selected for genetic analysis. Those sub-samples will contain (minimally) larval razorback sucker that represent the temporal (earliest and latest collections of this taxon) and spatial (most upstream and downstream collections of this taxon) extremes recorded during the 2002 San Juan River Larval Razorback Sucker Survey.

Recovery Efforts

Non-Native Species Monitoring and Control
Fiscal Year 2002 Workplan Proposal

Principal Investigators - Jason Davis and Jim Brooks
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Background:

During 1991-1997, nonnative species studies on the San Juan River focused on the identification of impacts to native fishes. Research characterized the distribution and abundance of non-native species in main channel habitats, seasonal movements of channel catfish and common carp, the food habits of non-native predators, primarily channel catfish, the 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 predator in main channel collections. Data indicated that channel catfish occupied a variety of habitats within the main channel, generally exhibited localized movement, and at lengths > 450 mm TL preyed upon native species.

The emphasis of removal of channel catfish and common carp was placed on a portion of Reach 6 (PNM weir to Hogback Diversion) and was designed to address removal or minimization of the reproductive effort in the upper portion of the species' occupied range. Mechanical removal efforts employed during 1998-2000 removed more than 8,000 channel catfish and 5,000 common carp. Analyses of 1998-2000 data illustrated the decline in the abundance of channel catfish > 300 mm TL, presumably due to removal efforts, throughout the study area. Common carp, on the other hand, did not change in distribution and abundance or size class structure.

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 was initiated in 1998 and continued through 2000. Channel catfish were removed by raft-mounted electrofishing gear and transplanted by State of New Mexico hatchery truck to closed impoundments managed for recreational fisheries. This effort was strongly supported by the State of New Mexico and the local public.

Other nonnative species are also a major concern during removal efforts, particularly with recent survey results. Electrofishing surveys in the San Juan River during 2000 identified the widespread distribution and high abundance of striped bass during post runoff upstream as far as the PNM weir. Autumn surveys indicated that striped bass did not persist in the San Juan River upstream of Lake Powell, likely an artifact on increasing water temperature and turbidity. This species poses a substantial threat to native San Juan River fishes through predative impacts and necessitates increased removal efforts.

This workplan proposes to continue mechanical removal of channel catfish and other non-native species by raft-mounted electrofishing. Monitoring data on the distribution, abundance, and food habits of non-native species will be collected and analyzed. The size at sexual maturity for channel catfish in the San Juan River will be evaluated by examination of reproductive organs from all size classes encountered. Data analyses of channel catfish abundance in collections and capture rate by size class will be employed to identify target catch per unit effort by size class. Sustained attainment of a target catch per unit effort in upstream reaches will be used to trigger a shift in removal emphasis to the next downstream reach. Transplantation of San Juan River channel catfish to isolated impoundments currently used for recreational fisheries will be continued.

Objectives:

1.) Continue data collection and mechanical removal of non-native species during main channel adult 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.) Continue transplantation of channel catfish to fishing impoundments isolated from the San Juan River.

4.) Characterize the distribution and abundance of striped bass into the San Juan River upstream of Lake Powell during removal efforts and determine predative impacts via stomach content analysis.

5.) Relate size of channel catfish to sexual maturity for use in development of a specific target objective for removal efforts.

6.) Develop catch per unit effort targets for use in evaluation of mechanical removal in discrete river reaches.

Methods:

Mechanical removal will continue during the fall main channel monitoring efforts. During these sampling efforts, all nonnative 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 1993-1996 will be recorded in the field and integrated into existing databases for movement and abundance. Catch per unit effort (CPUE) will be calculated as number of fish collected per minute electrofishing time and be calculated for the total collection and for each species. Analyses will include comparison to 1991-2000 data summaries.

A minimum of six sampling trips for mechanical removal in the San Juan River reach between PNM Weir and Hogback will occur weekly, February-March 2002. Each sampling trip effort will be three consecutive days of repetitive removal from the removal reach. Monthly removal efforts will be employed during June, July, August, September and December. 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 sacrificed and appropriate data recorded for location, length/weight, and, for lacustrine predators, stomach contents. Total and individual daily CPUE will be calculated to evaluate efforts of short-term suppression efforts to locally deplete nonnative species numbers.

A minimum sample of 500 channel catfish will be analyzed for development status of reproductive organs. Specimen standard and total lengths (nearest 1 mm), weight (nearest g), sex, method of capture, location (RM), and date will be recorded. The suggestions of Lagler (1956) will be followed for determination of the maturity and state of sexual organs. Sexual organs will be classified as immature (no eggs or milt evident), ripe (eggs and milt grossly evident), or spent (ovaries or testes involute) for the suspected spawning season (April - August) and as immature (no eggs or milt evident) and mature (eggs or milt apparent) the remainder of the year. The length frequency for specimens with mature reproductive organs will be determined to characterize the relationship between size and sexual maturity.

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 2001 and 2002. If it is determined that abundance and distribution are high, based upon spring sampling for both mechanical removal efforts and razorback sucker monitoring, specific removal efforts will be employed between Farmington, New Mexico and Bluff, Utah. Two sampling efforts during July and August after cessation of high flows will be employed, using three electrofishing rafts. All nonnative fishes will be removed. Lacustrine non-native species (primarily striped bass, walleye, largemouth bass) collected in the San Juan River will be sacrificed for stomach content analysis and determination of gender and reproductive status. Stomachs will be removed from each specimen captured and preserved in 10% formalin for lab analyses. Data recorded for each specimen are date, location (RM segment), species, standard and total lengths (nearest 1 mm), weight (nearest 1 g), and sex. Stomach content analyses will identify frequency of occurrence and weight by individual prey species, stomach fullness and relate standard length of identifiable prey species to predator standard length.

Catch per unit effort (CPUE) data will be analyzed for two size classes (adult >300 mm TL, immature< 300 mm TL) of channel catfish to monitor and evaluate changes relative to removal efforts. The objective is to develop a target CPUE for each size class and allow for a shift in removal efforts to the next downstream river reach, once the target is obtained. The target CPUE for channel catfish is currently unknown and will be based upon historic CPUE values for channel catfish and current sampling efforts during 2001. Identification of statistically defensible target CPUE using data through 2001 and attainment of the target CPUE may result a decision to relocate intensive removal efforts to the next stream segment downstream (Hogback Diversion to Shiprock Bridge). A minimum of two removal efforts in the PNM Weir to Hogback

Diversion would occur during 2002 to continue suppression of extant channel catfish and maintenance at or below the target CPUE.

Deliverables:

Participation will continue in data integration efforts to incorporate 1998-2001 data, produce a summary report, refine flow recommendations as appropriate, and complete revision of SJRRIP planning documents . An electronic data file will be provided for inclusion in the centralized database by 31 March 2003. A summary report detailing findings will be completed in draft by 31 March 2003 for SJRIP Biology Committee review and finalized by 1 June 2003.

Budget (FY-2002):

Personnel:		
Nonnative species removal/channel catfish translocation (168 mandays)	$	58,700
Laboratory processing of samples (11 mandays)	$	3,900
Reporting/data management (40 mandays)	$	13,900
Subtotal	$	76,500
Travel/per diem:		
Removal/translocation (113 days)	$	8,500
Reporting/data management (12 days)	$	900
Subtotal	$	9,400
Equipment and supplies		
Removal/translocation (generator replacement, equipment maintenance)	$	5,000
Laboratory (preservatives, containers, dissecting instruements)	$	300
Reporting/data management (administrative supplies)	$	1.500
Subtotal	$	5,800
T0TAL	$	91,700
Administrative Overhead (20%)	$	18,340
Funding for participation of other agencies:		
New Mexico Department of Game and Fish - Santa Fe	$	10,000
U.S. Fish and Wildlife Service - Grand Junction	$	5,000
Utah Division of Wildlife Resources - Moab	$	5,000
GRAND TOTAL	**$**	**130,040**

Outyear Funding:

Fiscal Year 2001	$	117,240
Fiscal Year 2003	$	133,940
Fiscal Year 2004	$	137,660
Fiscal Year 2005	$	141,790
Fiscal Year 2006	$	146,040
Fiscal Year 2007	$	150,420

Non-Natives Species Removal in the Lower San Juan River
Fiscal Year 2002 Project Proposal

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Background:

Introductions of non-native fish species into the Upper Colorado River Basin have created a difficult problem. Non-native species prey upon and compete with native species, resulting in the decline of the native population. Large predacious species introduced as sport fish into reservoirs have increasingly made their way into the riverine habitat that has historically been the domain of the native fish. Northern pike, walleye, largemouth bass, and sunfish are 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 to target non-native species in the 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 at larger sizes prey on the native fish community. Data from 1998-2000, 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 Reach 6 between the Hogback Diversion Dam and the PNM Weir.

Other non-native 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 (stripers). Recently, striped bass from Lake Powell have become an issue in the San Juan River. 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. Widespread abundance and distribution of striped bass was observed in July 2000 during electrofishing surveys on the San Juan River. Surveys in the fall of 2000 indicated lower numbers of stripers than had been found previously, but some individuals persisted into October. Electrofishing surveys in 2001 have once again documented the presence of striped bass in the river (Dale Ryden, pers. comm.). The likelihood of stripers preying upon native and endangered fish poses a particular 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 associated removal efforts to protect the native and endangered fish community in the river.

This workplan proposes to identify when the majority of striped bass tend to move up into the San Juan River, in addition to actively removing them and other non-natives in the lower section of river. This project is an exploratory effort that will serve to determine what time frame will be

most effective so that more intensive and specific efforts may be implemented through a long-term removal/control program 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.

Objectives:

1.) Determine when striped bass move out of Lake Powell and into the San Juan River.

2.) Initiate mechanical removal efforts of large bodied non-native species in the lower portion of the San Juan River.

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

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 17 is part of Geomorphic Reach 2 and is primarily bedrock confined and dominated by riffle-type habitat. RM 17 down to Clay Hills includes Geomorphic Reach 1 where the river is canyon bound with an active sand bottom. Habitats within this section are heavily influenced by the shifting thalweg, changing river flow, and reservoir elevations.

Methods:

Mechanical removal of non-native species will be conducted from Mexican Hat to Clay Hills, Utah. Sampling efforts 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 total of 10 trips is anticipated, beginning in March and continuing through October. Bi-weekly trips will be conducted around peak flows during spring run-off, which will likely translate to every other week sampling in May, June, and July. In addition, an eleventh trip will be conducted as a part of the annual fall monitoring effort in late-September/early-October. This schedule should allow for sampling of a variety of habitat conditions, including variable flows and turbidity.

All non-natives 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. Stomachs of lacustrine species will be taken for later analysis by USFWS-Albuquerque to determine predation on rare and other native fish species. Any rare 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 rare fish collected will be returned to the river. Other native fish will not be netted. Catch rates will be calculated as number of fish caught per hour and river miles will be recorded for approximate collection locality.

General water quality parameters will be recorded including temperature, conductivity, salinity, and dissolved oxygen. Daily water discharge 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.

Deliverables:

A draft report for the Non-Native Species Removal in the Lower San Juan River activities will be prepared and distributed to the San Juan River Biology Committee for review by March 2003. 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, the report will be finalized and forwarded to members of the San Juan River Biology Committee 1 June 2003. 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-2002:

Personnel:	UDWR	USFWS/NMGF
Biologists (60 days)	$ 12,000	$ 12,000
Technicians	$ 11,000	
Project Leader	$ 2,400	
Travel/per diem:	$ 4,000	$ 1,000
Data Analysis and Reporting:	$ 5,000	
Equipment and Supplies:		
Raft Mounted Electrofisher	$ 10,000	
Misc.	$ 1,000	
Subtotal	$ 45,400	$ 13,000
Administrative Overhead		
UDWR (20%)	$ 9,080	
USFWS/NMGF		$ 2,340
Total	$ 54,480	$ 15,340
Grand Total	**$ 69,820**	

Budget FY-2003:

Personnel		UDWR		FWS/NMGF
Biologists (60 days)	$	12,600	$	12,600
Technicians	$	11,550		
Project Leader	$	2,520		
Travel/per diem	$	4,200	$	1,050
Data Analysis and Reporting	$	5,250		
Equipment and Supplies				
Misc.	$	2,000		
Subtotal	$	38,120	$	13,650
Administrative Overhead				
UDWR (20%)	$	7,624		
FWS/NMGF			$	2,730
Total	$	45,744	$	16,380
Grand Total	**$**	**62,124**		

References:

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.

Razorback Sucker Augmentation
Fiscal Year 2002 Project Proposal

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Background:

Razorback sucker are native to the San Juan River. At present this species is extremely 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 was outlined in An Experimental Stocking Plan For Razorback Sucker In The San Juan River. Between 1994 and 1996, a total of 939 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 939 were progeny of paired matings between San Juan River arm of Lake Powell adults. All fish were PIT-tagged before release into the wild. In March 1994, 15 razorback sucker were divided and stocked in equal numbers at river mile (RM) 136.6, 117.5, and 79.6. Between 27 October and 18 November 1994 and additional 671 razorback sucker were stocked in roughly equal numbers at these same three stocking sites and at Hogback Diversion (RM 158.6). On 27 September 1995, 16 razorback sucker were stocked at Hogback Diversion. The last stocking associated with this study occurred on 3 October 1996, when 237 razorback sucker were stocked at Hogback Diversion. 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 64,618 razorback sucker into the San Juan River between 1997 and 2000. Stocking of razorback sucker from various sources into the San Juan River began in early September 1997. However, between 3 September 1997 and 20 October 2000 a total of only 5,208 razorback sucker were stocked into the San Juan River (Table 1). If razorback sucker stocked as part of the experimental stocking plan (1994-1997) are included, 6,147 razorback sucker have been stocked into the San Juan River since 1994. The 5,208 razorback sucker stocked as part of the five-year augmentation effort represents a shortfall of 59,410 fish when compared to numbers recommended in the five-year augmentation plan to date.

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 Recovery Implementation Program (SJRIP). Given this lack of resources, efforts were undertaken to develop and establish rearing facilities (grow-out ponds) within this basin thereby affording self-sufficiency to the San Juan River razorback sucker augmentation program.

Table 1. A summary of razorback sucker stocked into the San Juan River as part of the five-year augmentation plan. All stocked fish were PIT-tagged before being released into the wild.

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 X Yampa River
19 SEP 1997	1,631	JUVENILE	Hogback Diversion	Colorado River or Colorado River Arm of Lake Powell X Etter Pond
22 APR 1998 & 28 May 1998	124	JUVENILE	Hogback Diversion	Green River
14-15 OCT 1998	1,155	JUVENILE	Hogback Diversion	Lake Mohave
17-20 OCT 2000	1,044	JUVENILE & ADULTS	Hogback Diversion	Lake Mohave Green & Colorado Rivers
TOTAL	5,208			

As stated above, the number of excess razorback sucker currently available to the SJRIP from Upper Colorado River Basin (UCRB) recovery efforts will not be sufficient to make up current shortfalls and achieve the goals prescribed in the five-year augmentation plan. The approach currently being employed to address shortfalls is to obtain razorback sucker larvae from Willow Beach and Dexter National Fish Hatcheries (NFH). Razorback sucker held at these hatcheries are progeny of wild Lake Mohave adults. Since the majority of these larvae are produced in March, they will need to be temporarily retained until food availability and water temperatures are adequate in the holding ponds 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 holding facility will serve to maintain larvae in the interim (8-10 weeks) between their being obtained from hatchery facilities and a time when water temperatures at holding ponds increases to a level sufficient for rearing of

larvae. UNM personnel are currently using this system to raise approximately 52,000 razorback sucker that were obtained from Willow Beach and Dexter NFH in spring 2001.

Description of Study Area:

Larval razorback sucker obtained from Willow Beach and Dexter NFH in spring 2002 will be transported to interim rearing facilities at the University of New Mexico. The UNM rearing facility is sufficient to hold and rear approximately 50,000 larval razorback sucker for a period of between 6-10 weeks. Water temperature information acquired from holding ponds (Ojo and Avocet) during previous years, suggest that by May, 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 grow-out ponds as soon as conditions allow.

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

The study area for the monitoring of razorback sucker stocked into the San Juan River extends from RM 158.6 downstream to RM 76.4 (Sand Island boat landing) near Bluff, Utah.

Objectives:

1.) Transfer reared larval razorback sucker from MSB to grow-out ponds (CRFP)

2.) Maintenance of holding ponds (BIA-NIIP)

3.) Harvest razorback sucker from ponds, PIT tag, and stock fish downstream of Hogback Diversion (CRFP, BIA-NIIP)

4.) Monitor spawning season habitat use and movement patterns of hatchery-reared razorback sucker in the wild (CRFP)

5.) Monitor survival rates and growth rates of hatchery-reared, known-age razorback sucker in the wild (CRFP)

6.) Determine whether hatchery-reared razorback sucker will recruit into the adult population and successfully spawn in the wild (CRFP, MSB)

7.) Produce a three-year integration report for field work performed from 1999-2001. Produce an interim progress report for results and findings of razorback sucker monitoring field work performed in 2002 (CRFP)

Methods:

CRFP personnel will coordinate the obtaining of larval razorback sucker from Willow Beach and Dexter NFH during March and April 2002. 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 May to June). This transfer and disposition of larvae will be determined and coordinated by CRFP personnel with the assistance of MSB personnel.

Larval razorback sucker will be reared at grow-out ponds for two full growing seasons. Maintenance of water level and monitoring of pond water quality will be performed by BIA-NIIP personnel. Additional razorback sucker larvae may also become available as excess fish are culled from lots being produced for augmentation efforts in the UCRB. If this is the case CRFP personnel will transport these fish to the appropriate holding pond. In the fall, razorback sucker > 300 mm TL will be harvested using fyke nets, trammel nets, or other appropriate gear, PIT-tagged, and stocked into the San Juan River downstream of Hogback Diversion (RM 158.6).

Stocked fish will be monitored on two electrofishing/netting trips in 2002. Both trips will sample from RM 158.6-76.4. The spring sampling trip will occur before runoff begins, in late March or early April. The summer trip will occur after the hydrograph has returned to summer base flows. Electrofishing, seining, and trammel netting will be used to determine dispersal, and survival of stocked fish. The fall 2002 main channel fish community monitoring (i.e., long-term monitoring) trip will act as a third trip to monitor stocked razorback sucker throughout the year. Survival rates will be determined using either mark-recapture models (e.g., Program CAPTURE, MARK, Schnabel, Petersen) 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 electrofishing will be done every mile, instead of 2 out of every 3 miles and 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 Objectives 4 and 6, up to eight razorback sucker will be implanted with radio transmitters (one-year lifespan) on the fall 2001 main channel fish community monitoring trip. These fish will be tracked throughout the suspected spawning season for razorback sucker in the San Juan River (i.e., late February though early June). Tracking trips will be conducted on a monthly basis (minimum of four trips) from the last week of February to the first week of June. If spawning aggregations of razorback sucker are identified, trips will be done on a more frequent basis, concentrating on the spawning fish. Fish contacted during radio tracking trips will be tracked for a minimum of one hour each. At the end of the contact, 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 the fish 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 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 and/or seining. 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.

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 New Mexico Department of Game and Fish providing field personnel and equipment for monitoring trips. Other cooperating agencies will provide personnel and equipment for these trips as needed.

Products:

A draft three-year synthesis report analyzing data collected from 1999-2001 will be completed by 30 March 2002. A "draft final" of this report incorporating comments received will be completed by 1 June 2002. An interim progress report for razorback sucker monitoring trips conducted in 2002 will be completed by 31 March 2003. A "draft final" incorporating all comments received will be completed by 1 June 2003. DBASE IV files containing information on total catch and length/weight data gathered for rare fish species will be submitted to Keller-Bliesner Engineering for inclusion on the SJRIP integrated database CD-ROM by 31March 2003.

Budget – FY 2002:

Personnel		
Objectives 1 and 3 (42 man days): grow-out pond work		$ 8,616
Objective 4 (40 man days): radio telemetry		$ 8,208
Objectives 4, 5 and 6 (35 man days): electrofishing	$ 7,176	
	Subtotal	$ 24,000
Travel and Per Diem (24 days)		$ 5,000
Data Analysis and Reporting (30 days)		$ 6,000
	Subtotal	$ 11,000
Equipment and Supplies--i.e., maintenance, repair, replacement of:		
Field equipment: stocking truck, water pump, nets, PIT tag gear, rafts and jon boats, outboard motors, radio receivers, etc.		$ 3,000
	Total	$ 38,000
Service Administrative Overhead (20.00%)		$ 7,600
U.S. Fish and Wildlife Service-CRFP Total		$ 45,600
Funding for field assistance from NMDG&F		$ 2,000
PIT Tags (5,000 tags)		$ 20,000
	GRAND TOTAL	**$ 67,600**

Previous Years' Funding:

Fiscal Year 1997	$41,200
Fiscal Year 1998	$44,000
Fiscal Year 1999	$50,700
Fiscal Year 2000	$86,240 (includes cost of purchasing large number of PIT tags)
Fiscal Year 2001	$62,600

Estimated Outyear Funding:

Fiscal Year 2003	$69,630
Fiscal Year 2004	$69,840
Fiscal Year 2005	$71,940
Fiscal Year 2006	$74,100
Fiscal Year 2007	$76,330

Augmentation and Monitoring of Colorado Pikeminnow in the San Juan River
Fiscal Year 2002 Project Proposal

Principal Investigator: Dale Ryden and Frank Pfeifer
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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. 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 827,000 larval and age-0 Colorado pikeminnow were stocked into the San Juan River. To date, several hundred experimentally stocked fish 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 these 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. Development of an augmentation plan for this species in the San Juan River will provide the necessary guidance for augmentation efforts as well as directly fulfilling objective 5.3.8.2 of the San Juan River Long Range Plan.

Objectives:

1.) Procure and stock fish according to guidelines set out in the augmentation plan for Colorado pikeminnow in the San Juan River

2.) Track adult Colorado pikeminnow implanted with radio transmitters to determine survival, dispersal, habitat use, and possible spawning behavior.

Methods:

Objective 1: Young Colorado pikeminnow will be reared in grow-out ponds until late October or early November, at which time they will be harvested and stocked into the San Juan River at locations specified in the augmentation plan. Monitoring of stocked early life stage Colorado pikeminnow will be performed on trips for monitoring of stocked razorback sucker and during standardized fall monitoring trips.

Objective 2: On 11 April 2001, 148 adult Colorado pikeminnow were stocked into the San Juan River at RM 178.8. These fish averaged 539 mm TL. Eight of these adult fish were equipped with four-year life-span radio transmitters. These fish will be tracked about once a month to determine survival, dispersal, habitat use, and possible spawning behavior. If spawning activities are observed, more frequent tracking will be performed. Detailed information on habitat use and water quality will be taken at contact locations. Attempt may be made to recapture the fish (at researcher's discretion) to determine health, get age/growth information, and determine reproductive status.

Products:

An interim progress report detailing the field activities performed in 2002 will be produced by 30 March 2003. A "draft final" of this report, incorporating all comments received will be completed by 1 June 2003.

Budget FY - 2002:

Personnel

Objective 1 (5 man days): pond work and stocking	$ 1,032
Objective 2 (120 man days): radio-tracking	$ 24,628
Subtotal	$ 25,660
Travel and Per Diem (58 days)	$ 11,840
Equipment and Supplies--i.e., maintenance, repair, replacement of: Field equipment: stocking truck, water pump, nets, PIT tag gear, rafts and jon boats, outboard motors, radio receivers, etc.	$ 3,000
Total	$ 40,500
Service Administrative Overhead (20.00%)	$ 8,100
GRAND TOTAL	**$ 48,600**

Previous Years' Funding:
None (effort not previously undertaken)

Estimated Outyear Funding:

Fiscal Year 2003	$50,100
Fiscal Year 2004	$51,600
Fiscal Year 2005	$53,200
Fiscal Year 2006	$54,800
Fiscal Year 2007	$56,500
Fiscal Year 2008	$58,200
Fiscal Year 2009	$60,000

Colorado Pikeminnow Fingerling Production
Fiscal Year 2002 Project Proposal

Principal Investigator - Roger L. Hamman
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Background:

Dexter NFH & TC has been involved with the culture of Colorado pikeminnow (Ptychocheilus lucius) since 1981. The major emphasis has been on the reproductive biology, broodstock development and culturing fry, fingerlings and adults. This workplan proposes to produce 200,000 fingerlings (50mm TL) for stocking in the San Juan River during fiscal year 2002.

Stocking will require coordination with New Mexico FRO, Region 6 - Grand Junction, CO and New Mexico Game and Fish Department.

Objectives:

Produce 200,000 fingerlings (50mm TL) for stocking in the San Juan River during October 2002.

Methods:

Broodstock will consist of 400+ (F1) adults. These fish are 1991 year-class progency from wild adults collected from the Colorado River. A maximum of 30 paired matings (1 female X 1 male) will be spawned during 2001. Given the past history of hormonal induced ovulation, 22-23 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.

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, fry will be transferred to hatchery tanks and held until swim-up occurs, approximately five to seven days. Fry will be enumerated and stocked into two earthen ponds ranging from .33 to .35 ha. Fry will be cultured in earthen ponds for about 120 days. Fingerlings (50mm TL) will then be available for stocking in the San Juan River during October, 2002.

Budget FY - 2002:

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
Prepare holding tanks for fry
Transfer fry from incubators to holding tanks
Prepare ponds for fry
Pond management
Transfer swim-up fry from holding tanks to ponds
Daily feeding (including weekends & 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

Subtotal	$ 10,250

Equipment and Supplies:

Hormones for spawning	250
Liquid oxygen & compressed oxygen costs	250
Heating water for hatching eggs (natural gas)	500
Heating water for fry to swim-up (natural gas)	500
Water quality monitoring equipment	1,000
Culture equipment (nets, seines, screens, etc.)	1,000
Pond management supplies	1,000
Pumping costs (electrical)	5,000
Fish feed	1,000
Maintenance costs for equipment	1,500
Subtotal	$ 12,000

Reintroduction Costs:

Salaries	700
Overtime	250
Per Diem	250
Fuel Cost	150
Truck Maintenance	150
Subtotal	$ 1,500
Total	$ 23,750
Service Administrative Overhead (20%)	4,750
Grand Total	**$ 28,500**

Maintenance of an Interim Holding Facility for Larval Razorback Sucker
Fiscal Year 2002 Project Proposal

Principal Investigator: Steven P. Platania
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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 the 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 Recovery Implementation Program (SJR-RIP). 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.

Lake Mohave was initially identified as the best and most cost-effective source for razorback sucker for San Juan River augmentation. Large numbers of larval razorback sucker have been collected in Lake Mohave, over a relatively short period, during March-April (post razorback sucker spawning). Those fish were then transported to Ojo Amarillo and Avocet ponds, rearing ponds located south of Farmington and specifically maintained for razorback sucker.

Unfortunately, water temperatures at Ojo Amarillo and Avocet 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 the San Juan River Recovery Implementation Program (SJR-RIP) 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 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 estimate a survival rate exceeding 95% of the stock received. Most of the Dexter larval razorback sucker had achieved the juvenile developmental stage and are about 15 mm TL (as of 30 April 2001). Larval razorback sucker from Willow Beach, which are about two weeks younger than those from Dexter, had progressed to the metalarval stage and are 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°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.

The 2001 study demonstrated that the closed-system rearing facility was an efficient means for the temporary rearing of large numbers of larval razorback sucker. The facility was designed to maintain larvae in the interim (8-10 weeks) between hatching and a time when water temperatures at Ojo Amarillo and Avocet ponds increases to a level sufficient for rearing of larvae. The success of this project provided a viable source of larval razorback sucker that can be used for the augmentation effort of this species and the goals delineated in the program document.

For FY 2002 and subsequent years (up to FY 2007), the San Juan River Biology Committee is committed to increasing its razorback sucker augmentation abilities. Numerous grow-out ponds are being investigated for development and construction on the Navajo Reservation (San Juan River Biology Committee meeting 16 May 2001 – draft meeting summary). In addition, options regarding establishment of ponds on property of private citizens are also being explored. Regardless of the ultimate distribution of razorback rearing ponds, the need for interim holding facilities has been identified as a critical need to augmentation. The goal (starting in FY 2002) is to rear at least 150,000 larval razorback sucker annually for release to rearing ponds and ultimately introduction to the San Juan River.

The successful and efficient rearing of 150,000 larval razorback sucker will require a one-time designation of funds for construction of (a?) necessary and appropriate interim rearing system. The aquarium system employed in 2000 cannot be modified to accommodate the two-fold increase in number of specimens. In addition, that system did not make the most efficient use of the limited floor-space available for razorback sucker rearing. A completely new aquarium based ?? (again a closed-system) will be developed and constructed in sufficient time to accept the 150,000 larval razorback sucker expected in FY 2002. Costs for purchase of equipment and construction of that system are identified in this proposed budget. In subsequent years (i.e., FY 2003) costs for this project will be reduced as the system will have been completed and will only require funds for maintenance and upkeep (in addition to annual costs associated with rearing, salary, and supplies).

Description of Study Area:

Larval razorback sucker will be obtained from available sources (i.e., Lake Mohave, Willow Beach National Fish Hatchery, Dexter National Fish Hatchery and Technology Center) and transported to interim rearing facilities at the University of New Mexico. The rearing facility will need to be 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 Willow Beach National Fish Hatchery and 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 2002 razorback sucker interim holding facilities will be prepared and distributed by 31 March 2003. 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 2003. 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-2002:

Construction of Rearing System (FY- 2002)**:**

System Materials			
	Acrylic Aquarium Tanks (180 gallon) x 24	$	16,200
	Acrylic sump tanks (300 gallon) x 3	$	3,000
	Ultraviolet Sterilization (x 3)	$	2,900
	Pumps (x 3)	$	1,200
	PVC plumbing supplies/fittings	$	700
	Filtering systems (x 3)	$	1,500
	Lumber	$	750
	Subtotal	$	26,500
System Construction Personnel			
	Research Assistant (12 man-days) (facility design and construction)	$	3,000
	Technician (10 man-days) (construction assistance)	$	1,500
	Subtotal	$	4,500
	Total	$	31,000
	Administrative Overhead	$	4,650
	Grand Total	**$**	**35,650**

(Budget continued on next page.)

Rearing and Maintenance of System (FY 2002)**:**

Personnel			
	Laboratory Rearing (35 man-days) (system management, disease control, feeding, supervision)	$	10,500
Travel and per diem			
	Travel and per diem (acquiring and stocking fish; attending meetings)	$	1,000
	Shipping supplies and costs (for specimens)	$	500
Equipment and Supplies			
	Larval fish food	$	1,000
	Miscellaneous supplies (for rearing system)	$	1,500
	Total	$	14,500
	Administrative Overhead	$	2,175
	Grand Total	**$**	**16,675**

Cumulative Costs for Construction and Rearing (FY 2002):

Construction of Rearing System	$	31,000
Rearing and Maintenance of System	$	14,500
Subtotal	**$**	**45,500**
Administrative Overhead	$	6,825
Grand Total	**$**	**52,325**

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

Fiscal Year 2001	$ 13,800
Fiscal Year 2002	$ 52,325*
Fiscal Year 2003	$ 15,225
Fiscal Year 2004	$ 15,986
Fiscal Year 2005	$ 16,785
Fiscal Year 2006	$ 17,624
Fiscal Year 2007	$ 18,505

* includes both rearing/maintenance costs and system construction costs. Subsequent outyear budgets (2003-2007) are based on FY 2002 rearing and maintenance costs of $14,500.

Hydrology

Hydrology Committee Proposal No. 1
San Juan RIP Naturalized Flows
Recommendations For Addressing Problems
Fiscal Year 2002 Project Proposal

Background:

During September 2000, Hydrology Committee FY 2001 Proposal No. 1 was submitted to the Coordination Committee. This proposal outlined a process to reconfigure the hydrology model that was used to evaluate operating scenarios to determine if they meet the flow recommendations and to check, improve and/or replace data that were being used in the model. Small improvements were being made as the model was being used. However, because of several problems that existed with the model and the data used in the model, it was felt by the Hydrology Committee that a major overhaul was needed.

The Coordination Committee approved the proposal and agreed that San Juan River Basin Recovery Implementation Program funds could be used to work on the model. Work on the model was scheduled to start as soon as funding was approved. However, because of not knowing if funds were going to be available (problems at Western Area Power Administration), work on the model using program funds did not commence until January 2001. Some work was initiated using other funding sources.

Work is now proceeding on the overhaul of the model and on updating and correcting the data. However, because of the funding problems and not getting started on time, not all of the approved funds will be spent in FY 2001. $363,419 will be needed in FY 2002 to complete the work on the model. Work will continue as outlined in the FY 2001 Proposal, however, on a different time schedule. Table 1 shows an estimate of what will be completed in FY 2001 and what work will be completed in FY 2002.

Area of study:

The Area of study/hydrology modeling area includes the whole San Juan River Basin to Lake Powell.

Objectives:

The objectives of the modeling work remains the same as proposed in the FY 2001 Proposal and includes improving confidence in the model through improved data consistency, better modeling methods, better coordination and input with stakeholders, and improved model documentation.

Method of Approach:

In the process of completing the work in FY 2001, several of the tasks as outlined in the FY 2001 proposal, have either been combined with other tasks or the tasks have been divided into

several smaller tasks. This was done in order to help members of the Hydrology Committee better understand what was being done.

The following task descriptions as outlined in the FY 2001 is provided for reference. A summary of the status of each task is provided at the end of each task description.

A. Analyze gage errors and correct gage record as required for reasonable water balance.

Relationship to naturalized flow study: Could be implemented in existing model as a naturalized flow correction. Required as a part of the naturalized flow study.

Need: Existing gage records show periods of channel losses between gages, particularly between Bluff and upstream gages, that exceed reasonable losses. The losses usually occur during snowmelt runoff when flows are high and are as much as 100,000 AF in a given month when adjusted for other gaged inflow and diversions between gages. These large losses result in an under-estimation of streamflow and a model-projected failure to meet flow recommendations during times that they would otherwise be met.

Impact on available water: These errors have a direct impact on available water. While the magnitude of the errors have not been precisely determined nor the impact of their correction modeled, it is anticipated that additional water to meet the various system demands or more flexibility in dam operation may be provided.

Approach: A down-river water balance will be computed utilizing Archuleta, Animas at Farmington, San Juan at Farmington, Shiprock, Four Corners and Bluff gages. To identify the errors, unexplained gains and losses would be computed for each reach by adding gaged inflow and subtracting phreatophyte losses and estimated depletions between gages. An assessment of change in groundwater storage will also be computed and included in the analysis. Corrections to the computed gain or loss will be applied to adjust flow at anomalous gages by comparing gain/loss in adjacent reaches and adjusting the gage in error to arrive at balanced gain/losses relative to reach conditions. Previously estimated phreatophyte losses and man-induced depletions will be utilized in completing the adjustments. A technical memorandum will be prepared (funded under the documentation task, but completed within the schedule for this task) and circulated for review and approval of the approach by the Hydrology Committee and USGS prior to implementation.

Responsible Party: Consultant

Status: Contract to complete this task has been awarded and task is scheduled to be completed by September 1, 2001.

B. Evaluate CDSS model and databases, methods and documentation, resolve differences with San Juan River Basin Models (SJRBM) and data, and develop interface approach.

Relationship to naturalized flow study: Required as a part of the naturalized flow study. Not needed otherwise.

Need: CDSS and RiverWare presently do not have the same file structure, data needs or functionality. A careful review of the CDSS models, databases, and subsequent naturalized flow generation process is needed to develop the approach to interface the two modeling systems.

Approach: Reclamation will work with the state of Colorado or a designated consultant familiar with CDSS to resolve differences including depletion categories, modeling of off stream depletions, generation of synthesized data, nomenclature and configuration, and flow computation procedures and assumptions. Any functionality that would need adjustment in CDSS as recommended by the Hydrology Committee would also be identified. Once all issues are identified, a process for interfacing the two models would be developed, including methods of implementing CDSS functionality in RiverWare.

Responsible Parties: Reclamation and either the state of Colorado, a consultant familiar with CDSS or a combination.

Status: This task is approximately 77% complete. Interfacing of time-series data is complete. Node and support data interfacing are partially completed.

C. Develop data storage, analysis and retrieval system, including Data Management Interfaces (DMI's) between respective applications and databases.

Relationship to naturalized flow study: Required as a part of the naturalized flow study. Not needed otherwise.

Need: To provide seamless data sharing and analysis and to enhance model documentation, maintenance and upgrade functionality. interface tools (DMI's) will be developed.

Approach: This task addresses data handling only, whereas Task B is specific to modeling processes and interface approach. To the extent possible, data will be shared between databases using standard database exchange protocol, not directly between models. Text file formats will be consistent with existing data formats or as designed by the team. All CDSS computed data including depletions, synthesized flows, and naturalized flows will be populated in an appropriate Reclamation database. The population process will be automated to the extent possible, to improve the process of updating data. Data Management interfaces (DMI's) will be developed for each model to allow extraction and importation of the appropriate data from the respective databases.

Reclamation has existing GIS and time-series databases that run on various platforms. DMI's that communicate between databases and applications use Open Database Connectivity (ODBC) and Java Database Connectivity (JDBC) which are standard protocol for database communications. Existing databases or schemes would be enhanced and extended to support SJRBM. Data entry, data retrieval, and data integrity will be facilitated by use of databases and standard communication protocols.

Responsible Parties: Primarily Reclamation with some consultant time. Consultant must be familiar with CDSS and/or RiverWare.

Status: This task is approximately 77% complete. Database interfacing is mostly done but additional database development remains.

D. Correct 1970-1993 database to address concerns.

Relationship to naturalized flow study: Required as a part of the naturalized flow study. If naturalized flows are not recomputed according to the process outlined, then this task should go forward to correct known problems. The scope would change, however.

Need: The non-Colorado data in the CDSS database consists of the same values used in the present RiverWare model. There are some uncertainties concerning representation of values in the model, including reservoir evaporation, inconsistencies in non-agricultural depletions, concerns over crop mix and acreage and differences in estimates of consumptive use. These data elements need to be reviewed, updated and corrected to improve accuracy of naturalized flow estimates during this period.

Approach: Reclamation will work with the state of New Mexico to resolve differences in assumptions concerning New Mexico depletion issues, with review and approval by the Hydrology Committee before inclusion in the model. Reservoir net evaporation rates (evaporation less rainfall) for all reservoirs in the basin will be computed on a monthly basis for the period of record, rather than using average values as presently done. Arizona and Utah depletions will be reviewed, corrected and updated prior to inclusion in the database. All new data will be provided to Colorado for inclusion in the naturalized flow computation. The data will be provided as text files for inclusion through CDSS DMI's. All new information will be reviewed by the Hydrology Committee before final inclusion into the model.

Responsible Parties: Primarily Reclamation, with support from consultant familiar with the San Juan Basin, working with the states of New Mexico, Utah and Arizona.

Status: The task is approximated 20% completed. Reconfiguration is nearly completed but time series data development remains to be completed.

E. Extend data sets that do not exist to 1929.

Relationship to naturalized flow study: Required as a part of the naturalized flow study. Even if naturalized flows are not re-computed, analysis and verification of the nature of depletions prior to 1970 should be completed, although the analysis would be different.

Need: The approach to naturalized flow development in CDSS for Colorado is well documented for the entire modeling period from 1929 through 1998. Only review of the data with a possibility of minor corrections will be required. The sources and nature of the 1929 - 1970 data in the other states are not well documented. Presently, RiverWare assumes that off-stream depletions were computed in the same manor as the 1970-1993 period. Recent reports published by Reclamation (Colorado River Surplus Criteria, DEIS, July 2000) indicate that these off-stream depletions were not separately computed, but were lumped into the naturalized gain/loss for the reach in which they occurred. If this is truly the case, then available water is underestimated with the model.

Approach: The Colorado information will be reviewed and assessed for any needed changes, particularly in filling missing data. Any needed improvements will be implemented after Hydrology Committee approval. It is anticipated that the changes will be small, if any. Existing documentation for New Mexico, Arizona and Utah depletion estimates will be reviewed and the data validated and corrected, if necessary, utilizing consistent techniques for the full 1929-1993 period.

Responsible Parties: Primarily Reclamation with some assistance from a consultant.

Status: This task is approximately 16% complete. Colorado data are completed but rest of basin is incomplete.

F. Extend data sets forward through WY1999

Relationship to naturalized flow study: Optional analysis not necessary to match existing data set, but helpful for overall model maintenance, meeting the goals to periodically update the analysis period.

Need: Extension of the full data set maintains consistency with CDSS approach to maintain naturalized flows and modeling capability to within two years of current data and meets the goal of keeping the San Juan model current.

Approach: Depletion and water supply data will be updated based on existing data for the 1994-1999 period. Data will be entered into the CDSS database or interfaced through DMI's and utilized in the San Juan model, maintaining consistency of approach with the earlier period of record.

Responsible Parties: Primarily Reclamation with some assistance from a consultant.

Status: This task is approximately 15% complete. Recorded hydrology and diversions are available in usable formats but no work has been done on other data.

G. Configure CDSS for full data set and compute naturalized flows for the period of available data.

Relationship to naturalized flow study: Required as a part of the naturalized flow study. Not needed otherwise.

Need: The most cost-effective method of naturalized flow computation is to use the existing CDSS model.

Approach: Colorado or a consultant familiar with CDSS will update the CDSS database with data produced under the foregoing tasks, configure CDSS for naturalized flow calculation and operate the model to produce the monthly naturalized flows at the nodes identified in the model structure. Naturalized flows will be verified by operating the model in simulation mode with the configured depletions, comparing predicted flows against gage.

Responsible Parties: Primarily a consultant familiar with CDSS or the state of Colorado, with input from Reclamation.

Status: This task is approximately 18% complete. Configuration is complete except for main stem reconfiguration. Calibration awaits completion of task H.

H. Develop CDSS functionality in RiverWare.

Relationship to naturalized flow study: Required as a part of the naturalized flow study and model redevelopment. Not needed otherwise.

Need: To utilize CDSS generated naturalized flows, the San Juan model must replicate the methods used in CDSS.

Approach: CDSS functionality and nodal configuration will be analyzed and replicated in RiverWare. Some additional coding may be required to allow efficient replication. Return flow lagging and delivery priority are two known areas of additional functionality that must be implemented in RiverWare. Methods for handling variable irrigated area and variable efficiency depending on water supply presently included in RiverWare, may need implementation in CDSS. Upon review and approval of the Hydrology Committee, the identified functionality will be included in the appropriate model.

Responsible Parties: Primarily Reclamation with some consultant input.
Status: This task is approximately 69% complete. Engineering functionality has been implemented. Decision support (water rights) options are being tested.

I. Disaggregate monthly naturalized flows, diversions and depletions into pseudo daily values.

Relationship to naturalized flow study: Required as a part of the naturalized flow study and model redevelopment. Not needed otherwise.

Need: The flow recommendations require an estimate of timing of flows on a daily basis. The present San Juan model operates on a monthly time-step with results disaggregated into pseudo-daily values below Navajo Dam in a post processor, requiring recomputation of water balance for each run. As water development increases and the depletions depart from the historic pattern, this method becomes less accurate. Disaggregation of the naturalized flows and system demands below Navajo Dam into a pseudo-daily time step provides the most consistent method of approximating naturally shaped hydrographs necessary for the flow recommendations.

Approach: Once monthly naturalized flows are computed and calibrated, they would be disaggregated into pseudo-daily values by utilizing the gage pattern of a key-station representing reasonably naturalized flow for the same or similar drainage, adjusting values to maintain water balance and eliminate negative flows. A process would be developed and implemented for disaggregating monthly diversions and ET into pseudo-daily values. Non-irrigation demands would be computed on a psuedo- daily basis as well.

Two model implementations are possible. The first would be to continue the monthly operation, but prepare model rules that would maintain pseudo-daily accounting with the disaggregated values for each model object downstream of Navajo Dam. Upstream of Navajo Dam, the monthly time step would remain. San Juan-Chama diversions would be computed on the same pseudo-daily basis presently used in the model. The second approach would be to develop a psuedo-daily time-step model. To improve execution speed, a two-step process could be used whereby a full detail run would be completed and the tributaries not affected by operation of Navajo dam output. Then all the simulation runs could be completed utilizing the output from the detailed model for these "fixed" elements. In either case, additional calibration would be required to demonstrate agreement with gage flow. The final approach decision would be based upon an investigation of the practicality of each approach and the approval of the hydrology committee.

Having available the daily values in the model allows the Navajo Dam operating rules to have access to the data upon which the flow recommendations are based. It is likely that the operating rules will change based upon this new available data, requiring development of new rules within the San Juan model.

Responsible Parties: Reclamation and consultants.

Status: This task is 0% complete. Most work will not commence until monthly model output are available.

J. Update and calibrate the San Juan Basin RiverWare simulation model to match CDSS configuration.

Relationship to naturalized flow study: Required as a part of the naturalized flow study and model redevelopment. Not needed otherwise.

Need: Configuration to match CDSS functionality, nodal structure and results are necessary for correct utilization of CDSS naturalized flows. The present model has a number of processes that have been implemented to match USBR naturalized flows that have been the source of concern for model reviewers. Re-configuration to match naturalized flow assumptions is necessary to alleviate these concerns.

Approach: Once the functionality described in task H is completed, the RiverWare model will be configured to match CDSS on a monthly time step and calibrated to monthly gage flows. When satisfied with the results of the monthly calibration, the psuedo daily values will be introduced and again calibrated against gage flows. This second calibration step will attempt to match hydrograph shape by month, rather than target specific daily flows. In completing this calibration step, monthly mass balance will be preserved. The hydrograph shape calibration will utilize only the daily disaggregation features to avoid disrupting the monthly calibration. The final steps are to implement the reservoir operating rules designed to meet the flow recommendations, configure the model with the present baseline depletions and complete model simulations to optimize meeting system demands, including those for irrigation, municipal, industrial and fish and wildlife.

Responsible Parties: Reclamation and the consultants who assisted with the daily disaggregation.

Status: This task is approximately 3% completed. Some sensitivity testing has been identified but not yet performed. Scoping of alternatives should occur in early fall 2001. Implementation should commence in late fall 2001.

K. Coordinate development with Hydrology Committee and Interested Parties.

Relationship to naturalized flow study: Required as a part of the naturalized flow study and model redevelopment. Not needed otherwise.

Need: The quality of the model is improved as it is reviewed by an oversight group. The Hydrology Committee has been developed for that purpose. Other interested parties not presently participating on the Committee may also want review opportunity.

Approach: Reclamation and the involved consultants will prepare interim review documents and presentations to brief the interested parties on progress at key points in the development process as indicated in the tasks above and to incorporate input from the Committee. This information will be presented at regularly scheduled committee meetings.

Responsible Parties: Reclamation and consultants in relation to work completed by each.

Status: This task is approximately 30% complete. Coordination continues with Hydrology Committee and other interested parties.

L. Develop documentation.

Relationship to naturalized flow study: Required as a part of the naturalized flow study and model redevelopment. Documentation is required for any task completed.

Need: One of the key limitations in the development of the San Juan model to date has been the lack of, or difficulty in following, documentation of work performed in the past. Presently, documentation is being revised to better describe the process to date. Appropriate review and efficient long-term maintenance requires good documentation

Approach: During the completion of each task, detailed notes will be maintained and documentation of the completed task prepared. This documentation will be combined into formal model documentation, covering the basis of the naturalized flows, the construction of the model and a guide to model operation. Also, included will be a process for maintaining version control and archiving previous versions of the model and associated data relating to any key utilization of the model.

Responsible Parties: Reclamation and consultants in relation to the work accomplished.

Status: This task is approximately 21% complete. Web page has been prototyped that includes links to documentation. Development of the documentation continues for the hydrology model.

Table 1. Revised FY 2001 proposal estimated schedule, labor requirement and cost, and estimated funds to be expended in FY2001 and schedule and proposed funding for FY 2002 for completion of naturalized flow analysis and model development. (10/31/2001)

Task	FY 2001 Proposal	Professional time - staff days			FY 2001 Funds	FY 2002 Funds	Revised Estimated Total Cost	Revised Target Schedule
	Schedule	USBR	Consultant	Total				
A. Analyze and correct gage errors.	Nov-00	0	20	20	$16,000	$0	$16,000	Sep-02
B. CDSS interface	Nov-00	60.5	5	65.5	$25,092	$14,862	$39,954	Mar-02
C. Data systems development	Jan-01	60.5	5	65.5	$25,092	$14,862	$39,954	Mar-02
D. Correct 1970 -1993 database	Mar-01	15	0	15	$4,088	$5,084	$9,172	Mar-02
E. Extend data sets to 1929	Apr-01	10	0	10	$0	$6,540	$6,540	Feb-02
F. Extend data sets from 1993 to 1999	May-01	10	0	10	$0	$6,540	$6,540	Mar-02
G. Configure and Calibrate CDSS	Jun-01	89	8	97	$27,330	$37,736	$65,066	Mar-02
H. Implement functionality in Riverware	Jun-01	26	0	26	$16,788	$0	$16,788	Feb-02
I. Daily disaggregation	Aug-01	24	65	89	$0	$65,630	$65,630	Jul-02
J. San Juan Model upgrade / calibration	Sep-01	76	58	134	$0	$97,348	$97,348	Sep-02
K. Coordination with stakeholders	Through-out	26	10	36	$18,939	$26,268	$45,207	Sep-02
L Develop complete documentation	Nov-01	55	30	85	$13,601	$44,484	$58,085	Sep-02
				Expenses	$23,173	$44,065	$67,238	
				Total	$170,103	$363,419	$533,522	

Expenses include travel, software, work station procurement, work station training, work station support, and Riverware modifications.

Hydrology Committee Proposal No. 2
Improve Stream Gaging and Improve Flow Measurements in the San Juan River System
Fiscal Year 2002 Project Proposal

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 recommendation for the recovery of the endangered fish.

During FY2001 arrangements were made with the USGS to conduct one additional trip each month to each of the four San Juan River gages in New Mexico (Archuleta, Farmington, Shiprock, and Four Corners) at a total cost of $1,809 per month, or $21,672 per year. The USGS started taking the additional readings around July 1, 2001. Sufficient data has not been collected yet to evaluate this program.

Also arrangements were made to move the Four Corners gage to the right bank of the river. The original cost estimate to move the gage was $3,000. The final costs estimate by the USGS to move the gage was $7,063. A recommendation was made by the Hydrology Committee that the gage be moved. Arrangements were made with the USGS to move the gage.

Need:

The need still exists and there is still a very important need for accurate stream gaging data on the San Juan River to insure proper implementation of the flow recommendations. .

Approach:

The Hydrology Committee is recommending that we continue having the USGS take additional flow measurements and service the gaging station at least twice as often on the four stations on the San Juan River in New Mexico. (Note: initial cost for operation of the stations is paid by another program.) As states above the cost estimate for visiting the stations one additional time per month would cost $1,809 per month ($21,672 per year, FY2001 cost level) The Hydrology Committee is recommending that approximately $23,000 (increased due to probably increase by the USGS due to inflation) be budgeted to continue this program for another year.

Hydrology Committee Proposal No. 3

Additional Model Runs
Fiscal Year 2002 Project Proposal

Background:

In FY 2001, $10,000 was budgeted for the Hydrology Committee to conduct model "runs" to evaluate hydrology issues and sensitivity. No request have been made by the Coordination, Biology, or Hydrology committee and it appears that none of this funding will be needed during FY2001.

Need:

With the reconfiguration of the model being completed in FY 2002, there is a strong possibility that there will be requests by the Coordination, Biology, or Hydrology Committees for additional model runs..

Approach:

The runs would be conducted using the most current version of the model. In order to fund these model "runs" the Hydrology Committee is requesting $10,000 for Bureau of Reclamation to perform the work. The “runs” would be only at the request of the Coordination, Biology, or Hydrology Committees.

Program Coordination and Management

Program Coordination
Fiscal Year 2002 Project Proposal

U.S. Fish and Wildlife Service
2105 Osuna NE
Albuquerque, New Mexico 87113
(505) 346-2525, ext. 152
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 Tribe, the Southern Ute 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.

Objectives:

The following duties were outlined by the Program and amended by the Coordination Committee in February 1997.

1. Principal Investigators for each research effort are required to submit a brief report summarizing the accomplishments and problems of research activities for the previous year. The Program Coordinator will compile such reports for transmittal to the involved agencies and Coordination Committee.

2. Coordinating the activities of the Biology, Hydrology and Coordination Committees.

3. Ensuring that a long range plan, annual work plans, and annual progress reports for the San Juan River are prepared by the Biology and Hydrology Committees.

4. Seeing that approved recovery activities are implemented.

5. Disseminating information to involved state, federal, and tribal agencies.

6. Ensuring that appropriate federal scientific collecting permits are provided to each Principal Investigator and coordinating acquisition of scientific collecting permits from other responsible entities.

7. Advising participants of requests for initiation of consultation.

8. Coordinating activities with the Upper Basin Recovery Implementation Program and the Colorado River Fishes Recovery Team.

9. Coordinating and disseminating information on Program activities.

10. Assisting the Biology Committee in development of a long range plan with research and recovery elements and goals.

11. Forwarding plans and recommendation to the Coordination Committee for review and approval.

12. Annual Work Plan:
    A. Work with the Biology and Hydrology Committee 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.

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

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

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

16. Provide Coordination Committee with information packets containing materials and information related to the meeting agenda, one week in advance of meetings.

17. 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.

18. Advise the Coordination Committee of annual funding needs from each source.

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

20. Monitor payment and expenditures of "Section 7 funds" in the National Fish and Wildlife Foundation account.

Budget FY-2002:

Personnel		
Coordinator (¾ time salary and benefits)	$	71,016
Program Assistant (¾ time salary and benefits)	$	29,402
Travel/Per Diem		
Coordinator		
(12 meetings, 3 trips to Denver, 1 training)	$	4,100
Program Assistant		
(12 meetings, 1 trip to Denver, 1 training)	$	2,900
Committee Meetings		
supplies	$	2,500
meeting space - $100/day Farmington, - $300/day Durango	$	2,500
mailings	$	1,000
public notices - ($80/meeting)	$	1,000
Printing/publication	$	3,000
Subtotal	$	117,418
Service Administrative Overhead Charge (20%)	$	23,484
Grand Total	**$**	**140,902**

Out-year funding (based on 5% inflation)
FY 2003 - $148,000 FY 2004 - $155,000 FY 2005 - $163,000

Program Management
Base Funding
Fiscal Year 2002 Project Proposal

U.S. Bureau of Reclamation
125 S. State St.
Salt Lake City, UT 84138-1147

Background:

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

Management support for Capital fund projects, including technical oversight, budgeting, preparation of bids and funding agreements is covered within specific budgets for capital fund projects and are not included as part of this program management scope of work

Tasks - 2002

1. Administering and modifying, as needed, existing Intra-agency agreements for research and monitoring activities.

2. Administering and modifying, as needed, existing Cooperative Agreements with: the states of New Mexico, Utah, Colorado, and the University of New Mexico at Albuquerque for research and monitoring activities.

3. Distribution of Bureau of Indian Affairs contributions to research program through existing agreements.

4. Implementation of additional Cooperative Agreements or interagency acquisitions and requisitions as needed for base funded activities.

5. Support base funded research and monitoring activities and implement various assignments not identified within specific scopes of work as determined by Program Committees.

Budget FY-2002:

Personnel	$50,000
Travel/Per Diem	15,000
TOTAL	**$65,000**

Capital Projects

Capital Improvement Program Management
Fiscal Year 2002 Project Proposal

Principal Investigator: Brent Uilenberg
Bureau of Reclamation
2764 Compass Dr., Suite 106
Grand Junction, CO 81506
(970) 248-0641 builenberg@uc.usbr.gov

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. The current list of approved capital projects include: Razor Back Sucker Augmentation, Augmentation of Colorado Pikeminnow, Pikeminnow Fingerling Production, NIIP Grow Out Ponds, Hogback and Cudei Fish Passage (up to $2,000,000) and PNM Fish Passage. Reports will be periodically provided to the Coordination Committee on the status of these facilities and activities.

Budget FY-2002:

Objective 1

Personnel - 10 staff days @ $500 per day		$ 5,000
Travel		$ 0
Equipment and Supplies		$ 0
	Subtotal	$ 5,000

Objective 2

Personnel - 15 staff days @ $500 per day		$ 7,500
Travel - 2 trips to Denver at $500 per trip		$ 1,000
Equipment and Supplies		$ 0
	Subtotal	$ 8,500

Objective 3

Personnel - 30 staff days @ $500 per day		$15,000
Travel - 5 trips @ $500 per trip		$ 2,500
Equipment and Supplies - communication and computer assessment		$ 2,000
	Subtotal	$19,500

Objective 4

Personnel - 10 staff days @ $500 per day		$ 5,000
Travel		$ 0
Equipment and Supplies		$ 0
	Subtotal	$ 5,000

Objective 5

Personnel - 90 staff days @ $500 per day		$45,000
Travel - 10 trips @ $500 per trip		$ 5,000
Equipment and Supplies - communication and computer assessment		$ 2,000
	Subtotal	$52,000

Summary

Personnel - 155 staff days @ $500 per day		$77,500
Travel - 17 trips @ $500 per trip		$ 8,500
Equipment and Supplies - communication and computer assessment		$ 4,000
	Grand Total	**$90,000**

Operation of Public Service Company of New Mexico
Fish Passage Structure
Fiscal Year 2002 Project Proposal

Principal Investigator: Bob Norman
Bureau of Reclamation
2764 Compass Drive, Suite 106
Grand Junction, CO 81506
(970) 248-0634 rnorman@uc.usbr.gov

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.

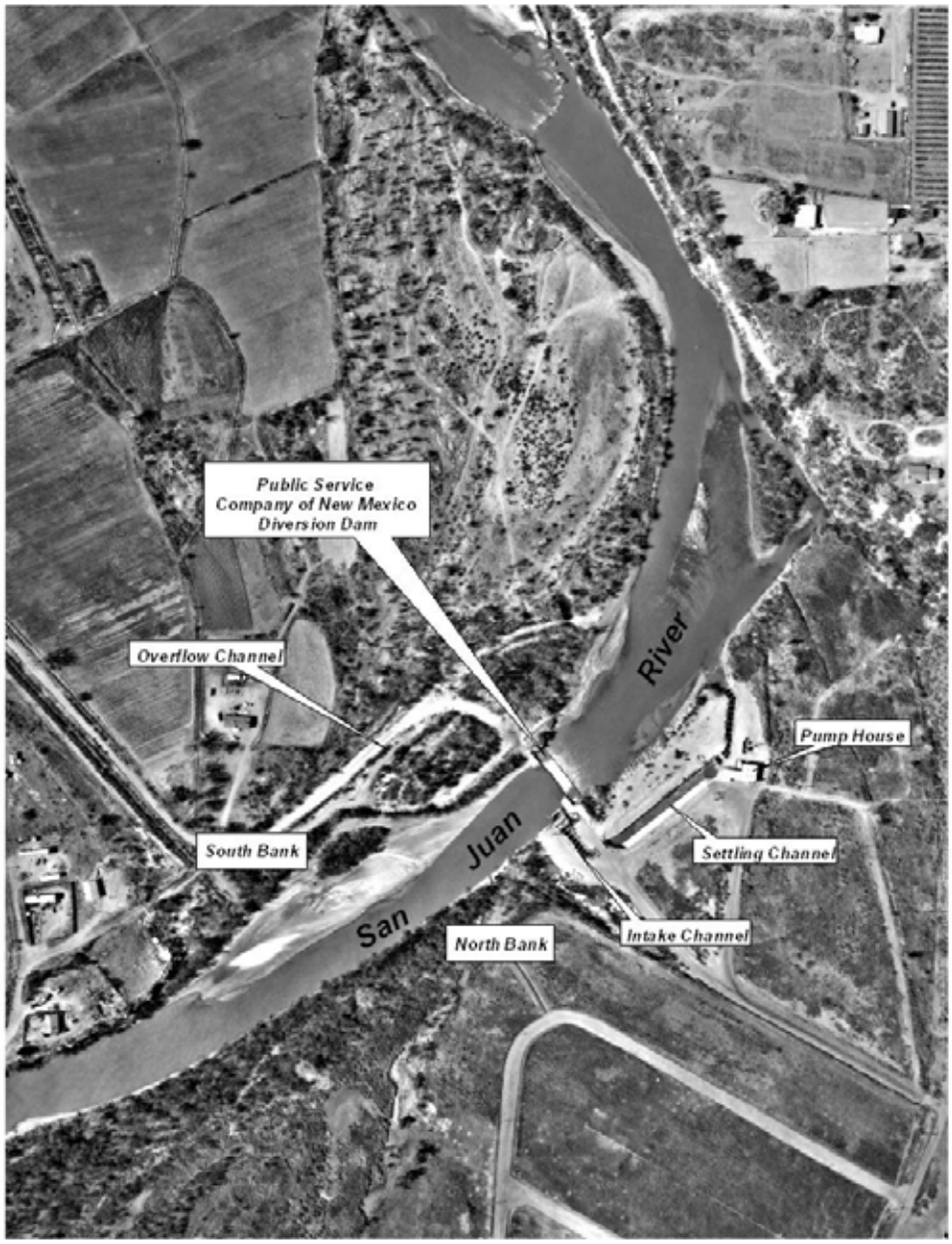
Background:

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.

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:

- Proper fish handling skills.
- Species identification
- 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:
   - Lower water in trap
   - Collect fish in nets and remove from trap
   - Sort fish by native and non-native species (dispose of non-native with exception of trout species) (Potentially provide channel catfish to non-profit organization like school, senior center, etc.).
   - Enumerate and record all fish 4" in length or longer.
   - Check Colorado pikeminnow and razorback sucker for presence of a PIT tag.

- If tag is present record number, tag fish if no tag is found.
- Weigh and measure each Colorado pikeminnow and razorback sucker (use total length in mm, weight in grams).
- Return all native and trout species to the river via the fish return pipe.
- 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.

Budget FY-2002:

Training		
Travel		$ 1,000
Labor		2,000
First Year Start-Up Supplies		
Dip nets	$	50
Rubber boots	$	75
PIT Tags	$	500
PIT Tag wand reader	$	2,000
Fish measuring board	$	75
Weighing scale	$	125
High pressure pump for cleaning trap	$	750
Crowding Screen	$	500
Misc hand tools	$	325
Fish Passage Operation		
Labor	$	20,000
Supplies	$	4,000
Fish Passage Maintenance		
Labor	$	2,000
Equipment	$	1,600
Supplies	$	500
Facility Inspection		
FWS - personnel costs	$	800
FWS - travel costs	$	150
Reclamation - personnel costs (inspection and	$	2,400
Reclamation - travel	$	150
Report Preparation		
Labor	$	3,000
Grand Total	$	42,000

References:

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