SAN JUAN RIVER RECOVERY IMPLEMENTATION PROGRAM

SEVEN YEAR RESEARCH PROGRAM

BUDGET AND WORK PLAN

FISCAL YEAR 1995

PREPARED FOR
SJRRIP COORDINATION COMMITTEE

PREPARED BY
SJRRIP BIOLOGY COMMITTEE

19 APRIL 1995

PAH SURVEY

FISCAL YEAR 1995 WORKPLAN

Background:
BLM will be continuing the PAH sample collection program as described in phase II of the Section 7 agreement. This includes resampling the locations that had measurable PAH samples in the 1994 sampling year as well as re-sampling all of the rivers. This will begin the collection of monitoring data portion of the PAH study. The data collected in 1995 will provide comparative data that will be added to the baseline data to provide information regarding environmental changes in PAH concentrations and locations throughout the San Juan Basin, ass applicable to the federal oil and gas leasing program. BLM will be monitoring the thirty river locations twice in 1995 to try to determine any seasonal affects on possible sediment loading before and after irrigation season and possibly the seasonal high run-off affects.

Another change that is being made in 1995 is to monotor the reduction in PAH concentrations that is achieved by the BLM pit remediation program. This investigation will be done by collecting samples from unremediated pit soils, then resampling the soils once the remedial activities have been concluded.

The NBS is planning to perform additional toxicity studies on razorback suckers and squawfish in 1995, as well as to determine field affects on the San Juan River and continuing the study of chemical nature of PAH's and theri relationships in nature.

Budget (funded by BLM):

Sample Analyses		$60,000
Equipment and supplies		10,000
	TOTAL	$70,000

NON-PROGRAM FUNDED RESEARCH

I.	BIA/NIIP		
	Geomorphic Characterization		$ 33,800
	River Channel Dynamics		173,000
	Habitat Mapping and Resource Utilization		225,550
	Flow/Habitat Modeling		100,650
	River Operations Modeling		9,850
	Water Temperature Monitoring		4,700
	Contaminant Survey Assistance and Lab Analysis		104,000
		Subtotal	651,550
II.	Southern Ute Tribe		
	Tributary and Colorado Squawfish Habitat		$ 12,900
		Subtotal	$ 12,900
III.	USBLM		
	PAH Survey		$ 70,000
		Subtotal	$ 70,000
		TOTAL	**$734,450**
		GRAND TOTAL	**$1,521,050**

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Adult Rare Fish Monitoring and Radio Telemetry Studies
Fiscal Year 1995 Project Proposal

Background:
Studies performed before 1991 documented a native San Juan River fish fauna of eight species, including 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. Adult monitoring studies are designed to refine this baseline data, as well as determine specific habitat usage by rare fish species. Information gathered during adult monitoring will aid in the selection of specific sites for detailed hydrologic measurements and larval drift sampling.

Fourteen intensive electrofishing surveys conducted from 1991 to 1994 have expanded our baseline knowledge on the distribution and abundance of the San Juan River fish community. Future monitoring will help determine fish community response to test flows from Navajo Dam. Seventeen Colorado squawfish and 11 roundtail chub were collected and PIT-tagged during these studies; 13 of the 16 Colorado squawfish were radio-tagged. No razorback sucker were collected. Subsequent radio telemetry efforts located the primary range and probable staging and spawning areas of Colorado squawfish. Location of probable spawning aggregations of Colorado squawfish led to the placement of larval drift stations below these sites. To date only one radio-telemetered Colorado squawfish has moved above any instream water diversion structure while under our observation. This fish was observed approximately 100 yards above the Cudei Diversion (RM 142.0) in the summer of 1994. After approximately a day and a half contact was lost with this fish at this location. It was later contacted below the diversion structure. Neither it, nor any other Colorado squawfish has been contacted above this structure since that time.

Adult monitoring will continue at least twice a year through 1997 to measure fish community response to research flows from Navajo Dam. Radio telemetry studies of Colorado squawfish will continue until all tags implanted in 1994 have expired. All new adult Colorado squawfish captured during 1995 adult monitoring trips will be implanted with radio tags. Additional radio tags will be implanted in adult Colorado squawfish during the October 1995 adult monitoring trip if a timely final decision is made to reduce releases from Navajo Dam to 250 CFS in winter 1995-1996 (November-February). The purpose of this work will be to document movement and habitat utilization by adult Colorado squawfish under low flow conditions. Adult monitoring will also sample for experimentally stocked razorback suckers and allow radio tracking of the same. Roundtail chub of sufficient size will be equipped with six-month radio tags to determine specific habitat use, potential spawning areas, and movement patterns. Aerial searches for radio-tagged fish will continue on a regular basis. Ground searches will be conducted during adult monitoring trips, razorback sucker monitoring trips, and other sampling efforts. Collection of tissue samples from rare fish for contaminants studies will continue.

Objectives:
1.) Determine shifts in fish community structure, abundance and distribution, and length/weight frequencies under the research flow regime.

2.) Monitor Colorado squawfish population trends and begin roundtail chub habitat-use studies (spawning and staging areas, habitat needs).

3.) Monitor experimentally stocked razorback sucker (growth rates and habitat use).

4.) Continue evaluation of movement data and rare fish distribution to

determine the extent to which current structures (dams, weirs, etc.) are impeding endangered fish movement.

Methods:
Objectives 1-4: Three adult sampling trips will take place in 1995. The May and October trips will be from Hogback Diversion, New Mexico to Mexican Hat, Utah. In July, the river will be sampled from Mexican Hat to Clay Hills, Utah. Electrofishing will be the primary sampling technique, although seining and trammel netting may also be employed. Radio tracking will be conducted on all adult monitoring trips and during regular aerial flights, as well as being coordinated with other research efforts throughout the year.

All fish collected will be enumerated by species, weighed, measured and returned to the river. Adult Colorado squawfish, roundtail chub, and wild razorback sucker will be PIT-tagged. Roundtail chub and wild razorback sucker will be implanted with radio transmitters. Tissue samples for contaminants analysis will be taken from these three species.

Radio tag implantation and tissue sampling will follow the protocols attached to the San Juan River Seven Year Research Plan. Electrofishing will follow the methods set forth in the 1991-1992 adult monitoring annual report. Seining and trammel netting will be done where suitable habitat is available at the sampling crews' discretion. The Service will have the lead for these adult monitoring trips and other cooperating agencies will provide personnel and equipment as needed.

Budget: FY-95

Personnel	
1 GM-13 Supervisor	$ 5,000
1 GS-11/12 Fishery Biologist	$ 2,000
1 GS-7/9 Fishery Biologist	$ 13,000
1 GS-6 Secretarial/Administrative Support	$ 3,000
Travel-Per Diem	$ 7,000
Equipment and Supplies	$ 7,000
Subtotal	$ 37,000
Service Administrative Overhead (17.65%)	$ 6,500
TOTAL	$ 43,500

Experimental Stocking of Razorback Sucker
Fiscal Year 1995 Project Proposal

Background:
Razorback sucker are native to the San Juan River. At present this species is extremely rare in the San Juan. 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. The information obtained from this effort should help provide recommendations to guide future augmentation efforts.

Eight adult razorback sucker from the San Juan River arm of Lake Powell were spawned at Ouray National Fish Hatchery in the spring of 1992. Most of the offspring from those paired matings were kept as refugia stock. The excess offspring, above and beyond refugia needs were reared at Wahweap ponds (Utah Division of Wildlife Resources) near Lake Powell. Fifteen of these razorback sucker were surgically implanted with six-month AVM radio tags and stocked in March 1994, five at each of three stocking sites. The remaining fifteen fish were reared to an average size of 673 grams, implanted with 23-month AVM radio tags in September 1994, and will be stocked in October 1994, five each at the same three stocking sites. All experimental stock were PIT-tagged. The three experimental stocking sites along the San Juan River are all between Shiprock, New Mexico and Bluff, Utah (RM 136.6, 117.5, and 79.6). In addition, up to 1,000 razorback sucker, taken in equal numbers from the family lots held at Ouray National Fish Hatchery (NFH) and Wahweap, will be PIT-tagged and stocked in equal numbers at each of the three aforementioned stocking sites as well as a fourth stocking site near Hogback Diversion, New Mexico (RM 158.6). A representative sample of these fish will have muscle plugs taken from them to allow baseline contaminants analyses to be performed. These fish will be PIT-tagged, muscle-plugged, and stocked in November 1994. Follow-up monitoring has begun and will continue on adult sampling trips, biweekly aerial flights, three summer monitoring trips in June, July, and August, and one winter monitoring trip. Radio-tracking will also be done during other research trips throughout the year. Additional ground radio tracking trips may be required if aerial tracking proves to be impossible.

The possibility of spawning the San Juan River arm of Lake Powell adults and producing another year class of F_1 progeny should be discussed, as well as the possibility of stocking the remaining F_1 razorback sucker at Wahweap in the San Juan River arm of Lake Powell. We also recommend that an attempt to capture further razorback sucker from the San Juan River arm of Lake Powell for broodstock purposes be made.

Objectives:
1.) Determine habitat use, possible spawning areas, survival, and growth rates for hatchery-reared razorback sucker in the wild.

2.) Determine if hatchery-reared razorback sucker can lead researchers to wild fish.

3.) Determine feasibility of using hatchery-reared razorback sucker to augment wild populations or repopulate historic habitat.

Methods:
Objective 1.) Electrofishing, seining, trammel netting and radio telemetry will be used to determine what types of habitats stocked razorback sucker are using. Detailed habitat information on substrate, depth, cover, velocity, and relation of this habitat to other habitats (riffle, pools, main and secondary channels, backwaters, shore, etc.) will be recorded. Water quality parameters including dissolved oxygen, water temperature, conductivity, and pH will be measured at

each location. Growth, reproductive status, and health information will be collected as well. General movement patterns will be determined through radio telemetry.

Objective 2.) If wild fish are collected during sampling, they will be PIT-tagged, weighed, measured, and radio-tagged if appropriate. Tissue samples for contaminants analysis will be taken.

Objective 3.) Displacement, general health, and survival of stocked fish will be examined to determine if using hatchery-reared razorback sucker for augmentation of wild populations is a feasible option.

The Service will have the lead for the razorback sucker experimental stocking and monitoring and other cooperating agencies will provide personnel and equipment as needed.

Budget: FY-95

Personnel	
1 GM-13 Supervisor	$ 4,000
1 GS-7/9 Fishery Biologist	$ 13,000
1 GS-6 Secretarial/Administrative Support	$ 2,000
Travel-Per Diem	$ 5,000
Equipment and Supplies	$ 6,000
Subtotal	$ 30,000
Service Administrative Overhead (17.65%)	$ 5,300
TOTAL	$ 35,300

EARLY LIFE STAGE:
NURSERY HABITAT REQUIREMENTS

FISCAL YEAR 1995 WORKPLAN

BACKGROUND

This component of research has been designed to characterize the early life stage of the ichthyofaunal community in the San Jaun system. It is directed at specifically determining the seasonal use of low-velocity habitats (nursery) by young-of-the-year (YOY) and Age 1 native and nonnative species. Platania (1990) estimated that Colorado squawfish spawned in the San Jaun River during the months of July and August. Intensive sampling of low-velocity habitats is initiated in mid-August. Fall (September) sampling characterizes the fish community in low-velocity habitats and represents the faunal conditions as the community prepares to over-winter. Those fish that over-winter are sampled during the March period. Although these protocol have been written to answer specific questions on the San Jaun River, much of the standardized samplin procedures draw heavily from existing protocols used currently on other Upper Basin rivers. The design is not intended to mimic those efforts, but rather to provide a method for comparison of data collected in the different systems.

OBJECTIVES

1) To empirically monitor the annual recruitment of YOY Colorado squawfish in relation to flow patterns in the San Jaun River.

2) To characterize the early-life stage icthyofaunal community in low-velocity (nursery) habitats.

3) To characterize nursery habitats and their use in the San Jaun River system.

METHODS

Young-of-the-Year Monitoring

One Fall (September) sampling trip will be conducted to characterize the fish community in low-velocity habitats river wide. This trip will start at the Hogback diversion in New Mexico (RM 158.6) and terminate at Clay Hills Crossing (RM 2.9) upstream of Lake Powell. Two backwaters in each 5 mi reach will be sampled. Protocols will be consistent with 1992, 1993, and 1994 methods.

The contents of all seine hauls will be searched for target species. Target species will be measured to the nearest millimeter Total Length (TL) and released. All other specimens will either be: 1) identified and enumerated as adults or sub-adults, or 2) preserved in a 10% buffered formalin solution in Whirlpak conatiners. A sample label will accompany the specimens, and the sample number, date, and San Jaun River Mile will be inscribed with permanent marker on the outer bag.

General habitat information will include: 1) Date, 2) location, 3) primary habitat type, 4) specific habitat type, 5) river orientation, 6) main channel temperature, 7) habitat temperature, 8) total length, 9) width (at three locations), 10) depth (at nine locations), 11) landmarks, 12) and a sketch of the site. Fish collection information will include: 1) sample number, 2) seine used, 3) time, 4) orientation of haul, 5) length, 6) width, 7) maximum depth, 8) substrate type, 9) fish preserved, and 10) number of whirlpaks.

In addition to these sampling efforts, we will compile and synthesize all of the empirical information collected since 1991 on the relationship between flows in the San Jaun River and recruitment and reproduction of Colorado squawfish. This synthesis will include larval drift information, and use of low velocity habitats.

Nursery Habitat

Four reaches will be sampled in the San Jaun River to evaluate Colorado squawfish nursery habitat: Mouth of Manchos (RM), Monezuma Creek (RM 89-84), Johns Canyon (RM 25-20), and Grand Gulch (RM 13-8). This area will be sampled in late-March/ early-April, late August, and September. All backwaters and similar habitat types (i.e. trickle-fed side channels, embayments, pools, etc.) will be sampled. The physical and biological habitat characteristics of low-velocity habitats will be measured. Relationships between the early life stage ichthyofaunal community and maintenance of nursery habitats will be investigated. The fluvial-geomorphic basis of habitat feature maintenance will be compared to similar habitat types in the Upper Basin. Habitat and fish community information collection will be consistent with that outlined above in YOY monitoring.

To enhance the ability to evaluate nursery habitat we propose the experimental introduction of YOY Colorado squawfish in 1996. This will require the development of a experimantal stocking plan in 1995. This plan will identify the appropriate number, locations, and genetic stock to be used in the study.

BUDGET

Personnel	$ 61,500
Travel	$ 5,000
Equipment	$ 11,500
TOTAL	$ 78,000

SAN JUAN RIVER LARVAL FISH
PASSIVE DRIFT-NETTING STUDY

WORK PLAN AND BUDGET
1995

BACKGROUND

Beginning in spring 1996, personnel from the Division of Fishes, Museum of Southwestern Biology (MSB), at the University of New Mexico will assume responsibility for the San Juan River larval fish passive drift-netting study. This project, formerly conducted by the Utah Division of Wildlife Resources, will continue with only minor changes in sampling protocol. Data collected from this research activity provides 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 affects of annual hydrology (and temperature) on their reproductive activities. Similar data are also obtained for other members of the ichthyofaunal community and contrasted with previously drift-net sampling to assess the affects 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. In the past, we sent the raw data from drift-net collections to the Utah Division of Wildlife. It was the responsibility of that organization to prepare draft and final report for the research team. We will assume responsibility for writing and distributing the San Juan River larval fish drift net report in 1995. We anticipate completing the first sort on those samples by the end of October 1995 followed soon after by a draft report.

OBJECTIVES

1. Determine the temporal distribution of San Juan River ichthyoplankton in relation to the hydrograph

2. Provide comparative analysis of the reproductive success of San Juan River fishes

3. Attempt to characterize downstream movement of ichthyoplankton

4. Attempt to validate presumed spawning period of Colorado River squawfish

5. Attempt to identify localities in the immediate proximity of the presumed Colorado squawfish spawning bed for placement of drift nets in 1996.

METHODS

1. Collect daily drift samples at two predetermine localities (Four Corners and Mexican Hat) starting soon after the end of spring runoff (mid-to-late June). At least two drift nets will be deployed at each station. Nets will be set each day at dawn and left in the water for about two-hours. The amount of water filtered by each net (m^3) will be measured by General Oceanic Flow-meters (Model 2030R) 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.

2. At the end of each two-hour net-set period, the contents of each net will

be rinsed into separate one-gallon plastic bags, labeled with unique field numbers, and preserved in 10% formalin. Drift material will be allowed to cure for at least two days before samples are processed and fishes separated from the debris. Cleaned samples were returned to the laboratory for analysis. All fish specimens will be identified and counted and assigned to a developmental stage according to Snyder (1976). 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.

3. 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 (1995 samples). Specimens will be distinguished and compared by residence status (native versus non-native) and catch rate over-laid with the annual hydrograph.

4. An attempt will be made to prepare a comprehensive synthesis and comparison of 1995 data with the results of the 1992-1994 drift net sampling. Minimally, a cursory comparison will be made with samples from previous years collections.

5. Coordinate with San Juan River researchers who are tracking the movements of Colorado squawfish and identify the putative spawning area for that species. Examine reaches in close proximity of the spawning area for their potential to become drift-net sampling stations in 1996.

BUDGET

Personnel	$24,000
Travel and Per Diem	6,000
Equipment and Supplies	4,783
Subtotal	34,783
Overhead (15%)	5,217
TOTAL	$40,000

SAN JUAN RIVER SECONDARY CHANNEL COMMUNITY DYNAMICS STUDY

FISCAL YEAR 1995 WORKPLAN

Background:

Preliminary inventories of San Juan River found differences in the ichthyofaunal composition of primary and secondary channels. Differences were found in fish species composition, relative abundances at various life stage, habitat availability, and water quality. In addition, adult Colorado squawfish were shown to use these secondary channel. Subsequently, four permanent study sites were selected between Hogback, NM and luff, UT to assess seasonal dynamics of fish population in secondary channels. Sites were selected to include representative secondary channel types of the San Juan River. Each sites was to be sampled about every three weeks from peak spring runoff through November, then every sixth week thereafter. These surveys also include sampling of fish by macrohabitats and habitat availability surveys. Combined with the concurrent secondary channel inventory investigations, intensive surveys at these four sites should provide a greater resolution to fish community and habitat dynamics. This information can then be used to asses the use of these areas as larval rearing or foraging habitats for Colorado squawfish, roundtail chub, and razorback sucker.

In July 1993, investigations of the four permanent sites was initiated. A total of 23,854 fish of 13 species was collected. Red shiner and fathead minnow were the first and second most abundant species, comprising 77% of the total catch. Three native species, speckled dace, bluehead sucker, and flannelmouth sucker were the next most abundant taxa collected cumulatively account for 20% of the catch. Eight specimens of roundtail chub were collected in 1993. Relative abundances of native and non-native fishes were most evenly distributed during early summer, whereas, non-native fish accounted for increasingly larger proportions of the catch as the year progressed. Sampling of permanent study site was continued through 1994, as was an analysis of habitat utilization and availability data.

Objectives:

1) Characterize the fish communities at four permanent sites in four secondary channels between Shiprock, New Mexico and Bluff, Utah.

2) Characterize seasonal changes in the fish communities within and between these four sites.

3) Characterize changes in the size-structure of the common species which occur at these sites.

4) Characterize seasonal changes in discharge and water quality at these sites.

5) Characterize changes in habitat availability at these sites.

6) Discriminate habitat use by common species within these sites.

7) Prepare a report which compiles, analyses and synthesizes all data collected from July 1993 through 1995. Based on this information and a complete review of literature pertinent to the study, recommendations will be made on future research needs and management options.

Methods:

1) Four permanent study sites (RM 87.4, RM 128.6, RM 134.9, and RM 140.8) will be sampled every sixth week from January to peak spring runoff (early July), then every three weeks thereafter through November. Fish will be sampled using seines and backpack electrofishing gear. Specimens ≥250 mm TL will be weighed, measured, floy-tagged, and released. Individuals <250 mm TL will be weighed, measured, and released. Specimens too small to be accurately identified in the field will be preserved in 10% formalin and returned to the laboratory for identification and measurement (SL). Specimens of Colorado Squawfish, roundtail chub, and razorback sucker large enough to be accurately identified in the field will be released. All specimens retained will be accessioned into the New Mexico Game and Fish Collection. These data will be used to meet objectives 1 through 3.

2) Fish will be collected, as described above, by macrohabitat. Habitat measurements within each macrohabitat will include depth, velocity, substrate, proximity to shore, and cover. Habitat availability will then be determined across 10 and 20 equally spaced transects per site, depending on site length and width. Depth, velocity, and substrate measurements will be taken along five or 10 equidistant points along each transect to give a total of 100 data points per site. Discharge of each secondary channel will be determined at the transect that yields the most accurate measurement (smooth bottom and laminar flow). Water quality (temperature, dissolved oxygen, conductivity, and salinity) will be taken at each site and in the adjacent primary channel. Thermographs placed in secondary channel at RM 12 8.6 and RM 1 34.9 will record hourly temperature throughout 1995. These data will be used to meet objectives 4 through 6.

3) Recapture data on floy tagged adult and sub-adult fish will be used to evaluate seasonal use of secondary channel. This data will also be used to determine growth of these species.

4) Data gathered will be analyzed and tested with the appropriate multi- and univariate statistical procedures to evaluate any conclusion to objectives 1 through 6. These results can then be used to determine any management recommendation which concern the dynamics of fish communities in secondary channels.

Budget: (Includes UNM Contracted Secondary Channel Community Dynamic Studies and NMHU contracted Tailwater Macroinvertebrate Community Studies)

Personnel	$57,500
Contracts	15,000
Travel/Per Diem	8,500
Aircraft (telemetry)	6,000
Equipment and Supplies	3,000
Subtotal	$90,000
Indirect Costs	4,000
Total	$94,000

NONNATIVE SPECIES INTERACTIONS

FISCAL YEAR 1995 WORKPLAN

Background:

Introduced species have been implicated in the decline of several native fishes. In the Colorado River system, introductions occurred simultaneously with flow-related habitat alterations. These events coincided with a basinwide decline in distribution and abundance of many native species, in particular the Colorado squawfish and razorback sucker.

Various laboratory and field studies have described the interactions among native and non-native species. Impacts on native fishes include resource overlap in both diet and habitat use (i.e., potential competition), predation, and hybridization.

There are non-native species that are potential predators of adult and juvenile natives in the San Juan River; the most important numerically is the channel catfish. The red shiner is a common, exotic, potential predator of larval native fish. Non-native species that are potential competitors of natives are dominated by carp, red shiner, and fathead minnow. The introduced white sucker hybridizes and may also compete with the native flannelmouth sucker.

Movement patterns of native and non-native fishes between main channel and secondary channel (i.e., low-velocity) habitats are not well known (Tyus 1990). If differences in movement patterns exist between native and non-native fishes particularly at different flows, a knowledge of those differences could be important in developing recovery programs for endangered fishes.

This component of the San Juan River research addresses the impacts of non-native species on native fishes. Research includes the effects of predation by non-native species on various life stages of native fishes, the commonality of resource use between native and non-native fish species, and the relation of these findings to differing flow regimes.

Objectives:

1. Determine food habits of potential Colorado squawfish predators (e.g., young channel catfish) in suspected native fish rearing areas.
2. Determine food habits and food availability of native and non-native fishes in backwaters and secondary channels and evaluate for dietary overlap.
3. Determine diel movement patterns of native and non-native fishes in backwaters and secondary channels in relation to flow patterns in the San Juan River.
4. Determine the distribution, abundance, and movement of channel catfish and carp.

Methods:

Channel Catfish and Carp Movement

Sampling protocol

Conducted concurrently with the adult monitoring sampling (mid-May, mid-August, and September/October) non-native fish will be collected by electrofishing and trammel netting. All non-native specimens collected will be identified, enumerated, and released. At designated miles (every fifth

mile) non-native specimens will also be measured (TL and SL), weighed, and sexed (when possible): channel catfish and carp (>=200 mm) will be floy tagged. All recaptured fish with floy tags will be measured and weighed and the tag number and capture location (i.e., river mile) recorded.

General Sampling requirements:

No. of trips: 2 (May and Oct)
Duration of each trip: 3-10 days
Personnel/trip: 2-3

SC/MC Fish Movement

Sampling protocol

Movement patterns of native and non-native fish into and out of selected secondary channel and backwater habitats (i.e., RM 134.2-133.8, RM 128.2, RM 127.2-126.6, RM 82.8-82.5) will be monitored (mid-July, late-August, late-October). Fish will be collected using hoopnets and minnow traps. Hoopnets (or minnow traps) will be located at both the upstream and downstream ends (where possible) of the selected sample sites near the main channel interface. Hoopnets and/or minnow traps will be monitored every 4 to 6 hours during a 24-hr period at each sample site. All captured specimens will be identified, enumerated by direction of capture (i.e., moving into or out of the secondary channel), and released. Collections with large numbers of specimens will be preserved and/or sub-sampled and preserved in 10% formalin for later identification. Sub-sampled collections in which specimens are released will be searched for rare species.

General Sampling Requirements:

No. of trips: 4 (Mar/Apr, Jun/Jul, Aug/Sep, Oct/Nov)
Duration of each trip: 4-6 days
Personnel/trip: 2-4

Food Habits

Sampling protocol

Food availability data will be collected in both main channel and secondary channel/backwater habitats. Seine and invertebrate samples (via surber, Hess, and dredge samples) will be collected at each secondary channel/backwater habitat sample site and adjacent main channel. Main channel and secondary channel invertebrate samples will be collected concurrently with the 24 hr fish movement sampling (described above) to determine food availability.

Food habits data will be collected concurrently with the fish movement and adult sampling efforts. Stomach contents of randomly selected native and non-native specimens will be examined for food habits and dietary overlap. Invertebrate samples will be preserved in 95% ethanol and stomach samples will be preserved in 10% formalin for later identification.

General Sampling Requirements:

Food habits: subsample of specimens collected from the SC/MC fish movement and adult sampling trips.

Budget:

Personnel		$40,000
Travel/per diem		5,000
Equipment and Supplies		10,000
	TOTAL	$55,000

ICHTHYOLOGICAL MONITORING OF THE LOWER SAN JUAN RIVER AND LAKE POWELL INFLOW AREA

FISCAL YEAR 1995 WORKPLAN

BACKGROUND:

The lowermost portion of the San Juan River and the associated inflow area of Lake Powell are unique habitats in the San Juan River system. The low gradient and resultant low velocity habitats in the lower river and upper San Juan Arm of Lake Powell appear to be important nursery habitats for young Colorado squawfish. In addition, lentic areas in the upper San Juan Arm of the lake supports the only known naturally occurring congregations of razorback sucker in the San Juan River Basin.

Colorado squawfish

In the San Juan River, studies since 1991 have collected young-of-year Colorado squawfish from backwaters and larval fish in the mainstream drift (Table 1). Collections of YOY Colorado squawfish during this time have occurred only below RM 12 in the lowermost reaches of the river and within the full pool elevation of Lake Powell. Platania (1990) also collected Young-of-year from backwaters in the lower San Juan but captured 8 fish higher in the system between approximately RM 85 and RM 126.

Table 1. Recent Capture Records for Young Colorado Squawfish in the San Juan River, 1991 - August 1994. (Lashmett 1994, Steve Platania, Tom Chart pers. comm.)

Date		Lifestage	Location (RM)
1991[1]			
1992	9/22	YOY	-6.3
1993	7/25	Mesolarvae	52
	7/26	Mesolarvae	52
	8/30	YOY	2.9
	8/31	YOY	-0.4
	9/1	YOY	1.8
	9/1	YOY	1.2
	9/2	YOY	-0.2
	9/2	YOY	-0.1
	9/2	YOY	-0.1
	10/10	YOY	0
	10/12	YOY	3.0
	10/12	YOY	1.0
	10/12	YOY	1.0
1994[2]	4/7	YOY[3]	11.7
	4/7	YOY[3]	11.7
	8/13	YOY	9.8

[1] No young fish found in collections during 1991
[2] Field identifications, preliminary analyses of preserved samples have not found additional Colorado squawfish in 1995
[3] 1993 year class

Colorado squawfish larvae hatch in 3.5 to 6.0 days at 20° to 22°C (Hamman 1981). Larvae emerge from the substrate soon after hatching and move or are transported downstream to low velocity river reaches where they occupy biologically productive habitats. Habitats utilized consist of warm, shallow, shoreline embayments and backwaters formed in the late summer by receding flows (Tyus and Haines 1991). Young-of-year, juvenile and subadult fish have also been collected from backwater areas over silt and sand bottoms.

The San Juan River exhibits a relatively high gradient for much of its length except near its inflow with Lake Powell. Nursery habitat for Colorado squawfish similar to what has been documented on the Green and Colorado rivers is sporadic except in the lowermost river reaches. The combination of relatively high gradient which has the potential to transport drifting larvae relatively far downstream in a short period of time and the limited availability of typical nursery habitats higher in the system make the lower San Juan with its low gradient/low velocity habitats potentially important to recruitment of Colorado squawfish in the system.

Razorback sucker

Current distribution of razorback suckers in the San Juan River, including recently introduced fish, is from approximately Four Corners (RM 119) to the San Juan Arm of Lake Powell. Naturally occurring or wild razorback suckers, however, have not been collected from the San Juan River in Colorado or New Mexico and have rarely been collected from the riverine portions of the San Juan River in Utah. Most collections of wild fish have occurred in the San Juan Arm of Lake Powell over suspected spawning locations. Recent reported collections[1] of the species in the San Juan River Basin total 41 different fish and include:

o Two adults were collected from an irrigation pond near Bluff, Utah, in 1976 (Platania 1990).

o One adult (550 mm TL) was captured November 14, 1983, at Neskahi Wash by the Utah Division of Wildlife Resources (UDWR) during their annual gill netting to monitor fish populations (UDWR in litt.).

o One adult (545 mm TL) was captured November 14, 1984, at Neskahi Wash by the UDWR during their annual gill netting to monitor fish populations (UDWR in litt.)

o One adult was captured April 1988, from the mainstem at approximately RM 82, near Bluff, Utah (Platania 1990).

o Twelve different adults were collected from a suspected spawning location in the San Juan Arm of Lake Powell near Piute Farms (RM -0.5) between March 20, and April 5, in 1987. Eight were ripe males and 4 appeared to be gravid females (Platania 1990).

o Ten adults (6 fish were recaptures from 1988) were collected at the same suspected spawning location in the San Juan Arm of Lake Powell near Piute Farms (RM -0.5) in spring 1988 (Platania 1990).

o One adult (601 mm TL) was captured November 14, 1989, at Neskahi Wash by the UDWR during their annual gill netting to monitor fish populations (UDWR in litt.).

o Fourteen adult razorbacks were collected (4 were recaptures) during April, 1990 in a joint effort by the UDWR , U.S. Bureau of Reclamation (USBR), and U.S. Fish and Wildlife Service (USFWS). Four of the fish collected had been previously tagged. Three had been tagged at Piute Farms during 1987 and 1988 and one had lost the Carlin tag but stilled retained the attachment thread. It is likely that the fish with the lost tag had also been previously collected at Piute Farms. Fish were collected over suspected spawning locations and ranged in size from 557 mm to 682 mm. Collections were from the

[1]All RM locations for collections were standardized to current system shown in Figure 1.

San Juan Arm of Lake Powell at approximately RM -0.5 (1 adult) and RM -5.5 (13 adults). Eleven of the fish were subsequently transported to Ouray National Fish Hatchery for broodstock development and genetic studies (McKay 1990).

o 3 adult razorback suckers were collected in early April 1991 near Nokai Canyon on the San Juan Arm of Lake Powell in a joint effort by the UDWR and USBR (USBR in litt.). All three adults were transported to Ouray National Fish Hatchery (T. Chart pers. comm.).

o Three adult razorback suckers were collected by UDWR during April 1992 near RM -10 in a cove on the south side of the San Juan Arm of Lake Powell (Stangl 1993).

Intensive ongoing collections between 1990 and 1994 as part of a continuing research program and the San Juan Recovery Implementation Program (SJRIP) have not resulted in the capture of any additional wild razorback suckers from riverine habitats in the San Juan River. Occurrence of larval or YOY razorback sucker in the San Juan River or the associated arm of Lake Powell is unknown. At present it is assummed that no significant recruitment of young fish is occurring. However, data is extremely limited.

GOALS AND OBJECTIVES

The available information on Colorado squawfish and razorback sucker in the San Juan River demonstrates a need to monitor low velocity habitats in the lower San Juan River and upper inflow of Lake Powell for the occurrence of young Colorado squawfish and adult and immaturare razorback sucker. Monitoring of these habitats will provide needed information on production of young squawfish in a given year and the potential importance of these habitats for recovery of the species. Monitoring of these habitats would also provide information on the status of razorback sucker in the San Juan Arm of Lake Powell.

Goal

To provide an integrated approach to monitoring of Colorado squawfish and razorback sucker in the lower San Juan River system, including the upper San Juan Arm of Lake Powell.

Objectives

1. Determine annual abundance of larval and YOY Colorado squawfish in low velocity riverine habitats below Clay Hills (RM 3.0) and in the inflow area of Lake Powell.

2. Monitor status of adult razorback suckers in the San Juan Arm of Lake Powell.

METHODS

Colorado squawfish

The inflow area of the upper San Juan Arm of Lake Powell will sampled using the same general methodologies as other early life stage studies of Colorado squawfish in the San Jaun System. This area will be sampled in late-March/ early-April, late August, and September. All backwaters and similar habitat types (i.e. trickle-fed side channels, embayments, pools, etc.) will be sampled. The physical and biological habitat characteristics of low-velocity habitats will be measured. Relationships between the early life stage ichthyofaunal community and maintenance of nursery habitats will be

investigated. The fluvial-geomorphic basis of habitat feature maintenance will be compared to similar habitat types in the Upper Basin.

Razorback sucker

Adult razorback sucker will be surveyed utilizing a variety of methods including: seining, electrofishing, netting, and aerial flights. Sampling will be conducted from spring through summer to establish habitat utilization ans timing of use by razorback sucker from RM 0 through RM -11. Emphasis will be placed during the March period. All adult fish captured will be examined for condition, weighed, measured, pit tagged (consistent will UBRIP & SJRIP protocols), and released. Tissue plugs will be obtained from fish captured for future analysis. Habitat features will be described and specific locations document with a Global Positioning System (GPS) unit for each fish captured.

ADMINISTRATION

Responsibility

Utah Division of Wildlife:
- Lead agency for ensuring that studies are coordinated
- Lead agency for ensuring that YOY Colrado squawfish sampling is consistent with nursery habitat studies in San Juan River
- Assist with razorback sucker sampling

National Biological Service/National Park Service:
- Assist with coordination efforts
- Lead agency for razorback sucker sampling

Bureau of Reclamation:
- Assist with coordination efforts
- Co-lead agency for YOY Colorado squawfish studies

BUDGET

ITEM	IN-KIND NPS ($)	IN-KIND NBS ($)	IN-KIND TOTAL ($)	SJRIP BOR ($)	SJRIP UDWR ($)	SJRIP TOTAL ($)	PROJECT TOTAL ($)
CSF:YOY							
PERSONNEL	3,500		3,500	10,000	6,000	16,000	19,500.00
EQUIPMENT	2,000		2,000	3,700	2,000	5,700	7,700.00
TRAVEL	2,000		2,000	3,000	2,000	5,000	7,000.00
SUB-TOTAL	7,500		7,500	16,700	10,000	26,700	34,200.00
RZ:ADULT/ YOY							
PERSONNEL		30,000	30,000				30,000.00
EQUIPMENT		6,000	6,000				6,000.00
TRAVEL		4,000	4,000				4,000.00
SUB-TOTAL		40,000	40,000				40,000.00
TOTAL	7,500	40,000	47,500	16,700	10,000	26,700	74,200.00

INSTREAM HABITAT QUANTIFICATION USING AIRBORNE VIDEOGRAPHY

FISCAL YEAR 1995 WORKPLAN

BACKGROUND:

This study utilizes airborne videography to quantify resultant endangered fish habitat versus flow on the San Juan River. This study examines the Navajo Dam test flow re-operation relationship between flow and the number and area of backwaters/side channels and other fluvial habitat categories on the San Juan River in New Mexico and Utah. Video interpretation provides synoptic information about number, size, and location of surface fluvial habitat features as observed from an airborne camera. The objective is to collect and interpret several years of videographic data from different flow scenarios and establish a relationship to assist in determining the optimal San Juan River flows needed to maximize critical fluvial habitat categories. Once sufficient data is collected to determine the quantity of habitat associated with flow, change or deterioration of habitat can be monitored. The 1992 data points encouragingly show the same general trend that was found from the 1991 data. At spring peak flow secondary channel habitat was maximized and trended lower as flow descended. The less abundant backwater habitat was maximized at the base flow levels. Spring flows produced a peak in backwater habitat due to overbanking and secondary channel activation. FY95 activities are intended to help refine the relationship developing from previous data collections and record test hydrograph response.

OBJECTIVES:

1. Acquire videography of spring peak flow to determine overbank flooding extent and channel change in order to monitor and assess trends in fluvial habitat along the length of the study area. This activity will create a historic recoed each year to record trends and capture unique flow events. This will help in gaining an understanding of the San Juan's habitat response to different hydrographs over the study area. Another benefit would be that this database would serve as a synoptic verification of habitat modelling.

2. Acquire and interpret videography of San Juan at 3000 cfs. This is necessary to help complete an even distribution of the flow variable for development of a general relationship between fluvial habitat associated with flow.

3. Complete interpretation and analysis of the 1993-high flow video data. Compile all data to date to determine the association between flow and habitat as found using aerial videography interpretation.

4. Acquire videography only, at time determined by BIA representative for intensive field mapping (BIA to provide funding for acquisition costs).

Methods:

Objective 1,2,4. The river will be videotaped using the Bureau of Reclamation helicopter based in Salt Lake City,Utah. Filming will be done at 2,000 feet above the river for a resultant pixel size of @ 1 square meter. If extensive over-bank flooding is evident, then a higher flying height will be used to capture the extent with as few double passes as possible.

Objective 2,3. The videographic tape will be digitized with a video frame capture board and software. Interpretation will be accomplished by using image processing software that allows manual interpretation of the digitized video frames. The raw data can then be quantified and statistically analyzed.

Objective 4. As in 1994, collect and deliver videography of the San Juan

River as determined by BIA representative. The videography mission will be flown on the instructed date and at the instructed height. The video tapes will be immediately delivered for printing and field mapping.

Budget:

Acquire spring peak videography	$ 5,000
Acquire 3000cfs videography	5,000
Interpret 3000cfs videography	15,000
Compile	5,000
Agency overhead	3,000
Travel	2,000
TOTAL	$35,000

FINAL REPORTS
TRIBUTARY STUDY AND ADULT COLORADO SQUAWFISH HABITAT USAGE IN THE SAN JUAN RIVER

FISCAL YEAR 1995 WORKPLAN

BACKGROUND

This work element is a completion of the San Juan River Tributary Study and the 1993/1994 habitat use study. The reports for both studies will include detailed analysis and comparison to other studies in the upper Colorado River basin. A final report will be prepared that includes all data collected for tributary studies from Colorado, New Mexico, and Utah. The habitat use study will include both the 1993 and 1994 data, including the winter observations, in a combined data analysis and presentation format.

PERSONNEL

The study would be conducted by Miller Ecological Consultants, Inc. (Miller). Miller will be responsible for all personnel and equipment to complete the reports. The principal investigator for the study will be Dr. William J. Miller. Dr. Miller will be responsible for final data analysis and the final reports.

SCHEDULE

The data analysis and draft reports will be completed for the annual research meeting in winter 1995. The final reports will be completed by August 1995.

COSTS

The costs are listed in Table 1. The costs include the estimates for time and expenses for each study task. All costs for equipment and direct expenses are included in the cost estimate. The funding for this study has been requested as part of the Southern Ute Indian Tribe contribution to the Seven Year Research Project.

Table 1. Estimated costs for FY1995 Final Reports on Tributary Study and Colorado squawfish habitat use study.

Total Labor	$12,000.00
Total direct	$ 900.00
Total cost	$12,900.00

SAN JUAN RIVER SPECIMEN CURATION
AND LARVAL FISH IDENTIFICATION

WORK PLAN AND BUDGET
1995

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. Changes in species identifications are noted and returned to the principal investigator along with the entire dataset (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, some secondary canal and miscellaneous collections made by various San Juan River researchers [lower San Juan River collections; U.S.B.R.-Lashmett; National Park Service]).

In 1994 we worked through the 40 Bureau of Reclamation collections (9,668 specimens) of juvenile and larval fish from the San Juan River arm of Lake Powell. In contrast to USBR collections from previous years, no Colorado squawfish were taken in 1994. In addition, we processed over 28 National Park Service light trap samples (27,000 specimens) from the San Juan River arm of Lake Powell. There were 508 larval fish drift samples taken in 1994, 202 at Four Corners and 306 at Mexican Hat. The sample data from this study (which produced 2,478 specimens) was submitted to the lead agency for that project (Utah Division of Wildlife Resources) in late-1994. The 1994 samples low-velocity habitat samples were received in January 1995 and will be processed by the end of summer 1995. Any significant deviations in the species identifications of those samples will be noted and forwarded to the principal investigators.

We will continue our work sorting, identifying, and curating samples collected during 1994 research activities. While the number of samples and specimens appears be increasing (especially in reference to juvenile sampling), the current level of funding has been adequate to allow us to complete our work, purchase needed supplies, and offset costs of attending San Juan River researchers meetings.

OBJECTIVES

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

2. Assist principal investigators with collection sorting and identifications

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

METHODS

1. 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 fish division collection.

2. We have assisted principal investigators by taking on the responsibility for 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.

3. Larval drift collections 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. Starting in 1995, the annual report for the larval fish portion of the study will be prepared by UNM personnel.

BUDGET

Personnel	$28,500
Travel and Per Diem	2,000
Equipment and Supplies	8,402
Subtotal	$38,902
Overhead (15%)	5,835
TOTAL	$44,737

Program Management - Reclamation
Fiscal Year 1995 Project Proposal

Background - Program Management funds are not used to support a specific study or project. Funds reserved for Program Management are used to provide staff time to support individual studies as requested, administer funding agreements and participate in and support Program committees. The bulk of these funds are allocated to Reclamation's Grants and Cooperative Agreements staff and the Biological Support Branch. During 1994 activities conducted by Reclamation included participation in the Recovery Program Committees, coordination of water operations and research activities, and administration of agreements with cooperating agencies. Management funds are important to insure that Reclamation's contributions to the program are properly administered and that funds are transferred in a timely and efficient manner.

Objectives -

1. Administer and modify as needed existing Intraagency agreements with; U.S. Fish and Wildlife Service Region 6, U.S. Fish and Wildlife Service Region 2, and National Biological Survey.

2. Administer and modify as needed existing Cooperative Agreements with; the states of New Mexico, Utah, Colorado, and the University of New Mexico at Albuquerque.

3. Administer and modify as needed Service Agreement with U.S. Bureau of Reclamation, Remote Sensing Branch for required services.

4. Distribute Bureau of Indian Affairs contributions to research program through existing agreements.

5. Implement additional Cooperative Agreements or Interagency Acquisitions as needed.

6. Provide staff support as needed to field studies.

Methods - Not applicable

Budget

Personnel	$26,000
Travel/Per Diem	4,000
TOTAL	$30,000

PROGRAM COORDINATION BY U.S. FISH AND WILDLIFE SERVICE

FISCAL YEAR 1995 WORKPLAN

BACKGROUND:

The San Juan River Recovery Implementation Program (SJRRIP) is designed to simultaneously address endangered fish species recovery and development of water resources within the Basin. The SJRRIP originated in the Biological Opinion for the Bureau of Reclamation (Animal-La Plata Project) and participation within the SJRRIP was a condition of biological opinions issued to the Bureau of Indian Affairs (Navajo Indian Irrigation Project) and the Bureau of Land Management (oil and gas development). The SJRRIP includes representatives from not only the above mentioned federal agencies, but also the states of Colorado and New Mexico, the Jicarilla Apache Tribe, the Southern Ute Tribe, and the Ute Mountain Ute tribe which all have legal mandated responsibilities to the endangered fish and/or the water resources.

In an advisory role to the Fish and Wildlife Service, the SJRRIP includes three committees. The Coordination Committee, chaired by the Regional Director for Region 2, Albuquerque, functions as the oversight committee, determining policy and reviewing products of the Biology and Navajo Dam Operating committees. The Biology Committee is responsible for developing work plans for answering technical questions regarding recovery and development of San Juan River resources, conduct of studies, reporting of study results, and development of a Longrange Implementation Plan to quide research and management efforts. The Navajo Dam Operating Committee serves in an advisory role, primarily to the Biology Committee, to coordinate flow requests designed to address research needs.

OBJECTIVES:

The responsibilities for coordination of this program this program lie with the Fish and Wildlife Service. The Service has appointed a Program Coordinator to act as a facilitator for meshing all committee actions and decisions. The Program Coordinator assists the Biology Committee with development of the Longrange Plan, presentation of that plan to the Coordination Committee, and in conjunction with the Biology Committee Chairman presentation of annual research findings to the Coordination Committee and the draft workplan for the succeeding program year. The coordination role also includes printing of research reports and all plans produced by the SJRRIP. Funding provided by the Service is directed through the Program Coordinator for various studies funded, meeting conduct, materials preparation, and administrative support.

BUDGET:

Personnel	$45,000
Travel/Per Diem	5,000
Meetings, supplies	10,000
Printing/publication	7,500
Administrative Support	12,500
TOTAL	$80,000

SAN JUAN RIVER CONTAMINANTS RESEARCH - DETAILED SURVEY

FISCAL YEAR 1995 WORKPLAN

Background

The present information regarding contaminant-related threats to endangered fish and aquatic habitat of the San Juan River is too limited to pinpoint exact locations, specific causes, and possible corrective action(s). Data from the 1994 synoptic survey will provide guidance in selection of sites for detailed study aimed at finding contaminant sources. The following tasks would provide data necessary for evaluating the issues and formulating solutions to contaminant related problems concerning aquatic habitat quality.

Objectives

Identify (1) the specific contaminants posing risks to endangered fish, (2) contaminant positioning within the various trophic levels of the aquatic ecological food chain, (3) locations/reaches of San Juan River or tributaries that present significant contaminant-related risks, and (4) probable sources/causes of any specifically identified contaminant problems.

Methods

Intensively sample the various physical and biological components from all trophic levels of the aquatic ecosystem at five locations/reaches along the San Juan River. Multiple samples of sediment, water algae, aquatic invertebrates, small fish (piscivorine prey-base) will be collected at each site. Techniques will depend upon site but may include kick-nets, light taps,l seines, electrofishing, grab samples, filtered water samples, sediment dredges, etc. Two composite samples of 3-5 individual fish of two species (4 total samples) of non-endangered suckers less than 250 mm in length will be collected at each site. Collections at specific sites will depend upon availability.

Data collected will include number and species identification for biological samples, sample weights, air and water temperatures, sample location, and collection date, meterological conditions (including water temperature and flow rates).

Surface, ground water and sediment sampling will be added to the list of samples collected. Water and sediment sampling and analyses will be contracted to the U.S. Geological Survey. Protocols used will be stand integrated composite sampling used during DOI studies and as prescribed by U.S. Geological Survey protocols.

Semi-permeable membrane devices (SPMDS) will be installed at sites identified in the 1994 studies to aid in identifying sources of PAH contamination. Protocols for procedures not covered and not determined as yet will be prepared as needed during annual program reviews and revisions of work statements in consultation with the San Juan Research Team.

Sample collections will be coordinated with ongoing field operations of the overall 7-year program where possible.

Muscle plugs will be completed by other members of the San Juan Research Team for analysis of selenium by neutron activation.

A product of these tasks will be identification of areas needing long term monitoring. This will become the baseline for long-term monitoring of contaminant-related risk/threats of the San Juan River aquatic ecosystem.

Budget

	FWS	BIA	Total
Personnel	$35,000.00	$30,000.00	$65,000.00
Travel/per diem	2,000.00	2,000.00	4,000.00
Vehicle/equipment use	1,000.00	1,000.00	2,000.00
Supplies	1,000.00	1,000.00	2,000.00
Analytical		70,000.00	70,000.00
TOTAL	$39,000.00	$104,000.00	$143,000.00

SAN JUAN RIVER BIOLOGICAL EFFECTS STUDIES

FISCAL YEAR 1995 WORKPLAN

Background:

Limited analyses of water, sediment, and tissue collected from the San Juan River have shown the presence of selenium and other inorganics at concentrations that could potentially be harmful to fish and wildlife. However, the biological significance of short-term (acute) or long-term (chronic) exposure to these elevated inorganics to threatened or endangered fish in the San Juan River in unknown. Information in needed to identify waterborne and dietary inorganics that may adversely affect the recovery of threatened or endangered fish. Acute tents should be conducted with individual elements and with mixtures of elwmnts in their onvirormental ration found at potentially harmful sites along the San Juan River. Those inorganics that show high toxicity in acute toxicity tests relative to their envirormental concentrations should be further evaluated in long-term tests to determine sublethal effects and to delineate tho relation between whole-body burdens and other biological effects.

Objectives:

I. Determine the chronic toxicity to larval Colorado squawfish (Ptychochoilus luciun) of combined waterborne exposure to a mixture of inorganics and a dietary exposure to organic selenium.

II. Determine the acute toxicity to larval roundtail chub (Gila robusts) of individual and mixtures of inorganics simulating conditions in the San Juan River.

III. Prepare the facilities for conducting a reproductive study with adult Colorado squawfish to be initiated in late FY95 and completed in PY96.

Methods:

I. A long-term chronic toxicity tout will be conducted according to standard methods, except that the wator quality will simulate that in the San Juan River. The test species will be Colorado squawfish acquired from Dexter Mational Fish Hatchery, NM. The test will be conducted for 120 days with a mixture of inorganics from a sits with elevated concentrations that potentially could be adversely affecting larval endangered fish. The study will include two replications each of a control and five treatments, and the water temperature and photoperiod will simulate conditions in the San Juan River.

The water quality in chronic toxicity tests will simulate that in the San Juan River in terms of the major cations and anions. For example, if the water quality at Shiprock, Now Nexico, were tested, it would be hardness 253 mg/L, alkalinity 136 mg/L, Ca 77 mg/L, Mg 15 mg/L, Na 51 mg/L, Cl 16 mg/L, S04 157 mg/L (mean of three observations; USGS, computer printout received 11/25/91).

The biological measures in the test will include water residues of selenium and other select inorganics (samples collectod at 15-day intervals), dietary residues of selenium and other select inorganics (samples collected at the beginning, middle, and end of the study), tissue residues of solonium (samples coll&cted at 30-day intervals), fish survival (recorded daily), growth (length and weight measured at 30-day intervals), behavior (recorded weekly), feeding behavior (videotaped after 30 days of exposure), and swimming performance (tested after 60, 90, and 120 days of exposure). These

biological endpoints will be compared to each other to derive inter-relations (i.e., tissue residue vs. effects on growth) and compared to environental data from the synoptic survey conducted by others to derive a hazard assesment of the potential of the waterborn mixture and dietary selenium to adversely affect threatened or endangered fish in the San Juan River.

Short-term acute toxicity tests will conducted according to standard methods of the American Society for Tooting and Materials, except that the water quality will stimulate that in the San Juan River. Test species will be conducted with larval roundtail chub acquired from fish spawned by personnel of the Colorado River Fishery Program, Grand Junction, CO, as fertilized eggs. If available, additional tests will be conducted with three life stages (swim-up, 30-60 day old, and 90 day old fry).

Tents will be conducted with mixtures of inorganics from sites with elevated concentrations of inorganics that potentially could be adversely affecting endangered fish. The mixtures will be reconstituted to simulate the onviroramental ration of the elements. Tests will also be conducted with individual elements comprising the mixtures so that the toxic contribution of individual elements in the mixtures can be derived. Elements that could be tented include arsenic, boron,chromium, copper, selenate, selenite, molybdenum, uranium, and vanadium.

The water quality in acute toxicity tests will simulate that in the San Juan River in terms of the major cations and anions, as described for the chronic toxicity tent above.

The endpoint of tents will be calculation of a 96-hour LC50 value (i.e., concentration of a tent chemical that kills 50% of the test animals in a 96-hour period). The toxicity of the individual elements will be used to determine the toxic contribution of each of the elements comprising the mixtures. The 96-hour LC50 values of the individual elements and their mixtures will be compared with the expected environmental concentrations to derive a hazard assessment of an inorganic's potential for adversely affecting threatened or endangered fish in the San Juan River.

III. The Yankton FRS facility will be modified to conduct a study with adult Colorado squawfish. The study will be initiated in late FY95 and completed in mid FY96. The facility will be modified to hold adult fish and exposure them for about 6 months to waterborne mixture of inorganics simulating conditions in the San Juan River and dietary selenium. Adults will k>e induced to spawn and the resulting hatch larvae exposed to the inorganic mixture and dietary selenium for about 30 days posthatching. The water quality will stimulate that in the San Juan River. The adult fish will be acquired from Dexter National Fish Hatchery, New Mexico.

The biological measures in the tent with adults will include water residues of selenium and other select inorganics (samples collected at 15-day intervals), dietary residues of selenium and other select inorganics (samples collected at the beginning, middle, and end of the study), tissue residues of selenium (samples collected at 30-day intervals), fish survival (recorded daily), growth (length and weight measured at 30-day intervals), behavior (recorded weekly), foeding behavior (videotaped after 30 days of exposure), number of eggs spawned, and number of eggs hatched.

The biological measures for the 30-day larvae study will include water residues of selenium and other select inorganics (samples collected at 15-day intervals), dietary residues of selenium and other select inorganics (samples collected at the beginning and end of the study), tissue residues of selenium (samples collected at the end of the 30-day study), fish survival (recorded daily), growth (length and weight measured at the end of the study), behavior

(recorded weekly), feeding behavior (videotaped after 30 days of exposure), and swimming performance (tested after 30 days of exposure). These biologicalendpoints will be compared to each other to derive inter-relations (i.e., tissue residue vs. effects on growth) and compared to environmental data from the synoptic survey conducted by others to derive a hazard asessoment of the potential of the waterborne mixture and dietary selenium to adversely affect threatened or endangered fish in the San Juan River.

Budget:

I. Long-term test with larval Colorado squawfish.

Personnel	$26,330
Travel/Per Diem	1,000
Equipment and Supplies	5,400
Selenium diet	3,500
Chemical analysis	2,500
Subtotal	38,730
NBS Administrative - 19%	7,360
TOTAL Section I Budget FY95	$46,090

II. Tests with roundtail chub.

Personnel	$16,000
Travel/Per Diem	
Equipment and Supplies	2,400
Subtotal	18,400
NBS Administrative - 19%	3,500
TOTAL Section II Budget FY95	$21,900

III. Prepare facility for conducting reproductive study with adult Colorado squawfish.

Personnel	$11,400
Travel/Per Diem	
Equipment and Supplies	9,500
Subtotal	20,900
NBS Administrative - 19%	3,970
TOTAL Section III Budget FY95	$24,870

Total Section I and II Proposed Budget TY$92,860

SAN JUAN RIVER SEVEN YEAR RESEARCH PROGRAM
BUDGET
FISCAL YEAR 1995

PROGRAM FUNDED RESEARCH

I.	Core Research	
	Adult Monitoring and Radio Telemetry (USFWS, R6)	$ 43,500
	Experimental Stocking of Razorback Sucker (USFWS, R6)	35,300
	Early Life Stage: Nursery Habitat Requirements (UDWR)	78,000
	Razorback Sucker Stock Maintenance (UDWR)	5,000
	Larval Drift (UNM)	40,000
	Secondary Channel Characterization (NMDGF)	94,000
	Nonnative Species Interactions (USFWS, R2)	55,000
	Lower San Juan River/Lake Powell Inflow (USBR, UDWR)	26,700
	Videography (USBR)	35,000
	Specimen Identification and Curation (UNM)	45,000
	Program Management (USBR)	30,000
	Program Coordination (USFWS, R2)	62,200
	Subtotal	$549,700
II.	Contaminant Research	
	Contaminant Survey (USFWS, R2 and R6)	39,000
	Biological Effects (NBS)	92,900
	Subtotal	$131,900
III.	Other Research	
	Fish Health Studies (USFWS, R2)	20,000
	Subtotal	$ 20,000
IV.	New Research	
	Mechanical Removal of Channel Catfish (NMGF, USFWS)	40,000
	Study Integration (Jicarilla)	45,000
	Subtotal	$ 85,000
	TOTAL	**$786,600**

Fund Sources:

State of Colorado	$ 3,000
USBR	411,600
BIA/NIIP	130,000
BIA/ALBUQUERQUE	50,000
USFWS/R2	192,000
TOTAL AVAILABLE	**$786,600**

SAN JUAN HABITAT RESEARCH

FISCAL YEAR 1995 WORKPLAN

GEOMORPHIC CHARACTERIZATION

Background

The geomorphology of the San Juan and Animas Rivers is being characterized and geomorphically distinct reaches identified as a part of the 1994 work plan. The definition of these reaches will form the basis for development of management plans to address the conditions of the various reaches and integrate these individual plans into an overall management strategy for the river system. Understanding the relationship between the geomorphic characterization and changes in the hydrograph will be required to complete the flow/habitat modeling and is an integral part of analysis of channel dynamics.

Comparison of the characteristics of the reaches defined in the 1994 study with reaches of the upper Colorado River system will aid in the understanding of conditions beneficial to the endangered species. The comparison of geomorphic characterization will complement comparison of habitat availability and will aid development of management strategies.

Objectives

1. Develop Hydrology/Geomorphology Relationships by Reach. Development of hydrology/geomorphology relationships will allow refinement of flow/habitat models for each reach, providing a geomorphic foundation for habitat/flow relationships and individual reach analysis.

2. Review Literature and Interface with Upper Basin Researchers to Examine the Geomorphic Characterization of Important Reaches of the Upper Colorado System. A comparative database for the Upper Colorado River System will be compiled from existing data for comparative data sets collected in the San Juan.

3. Compare Upper Colorado River and San Juan River Basin Geomorphology. Comparison of the two data sets at the geomorphic level will allow an assessment of the difference in the capability of the systems to produce habitat. This comparison will require an analysis of the hydrology/geomorphology interactions of the two systems for meaningful comparison.

Methods

1. Develop Hydrology/Geomorphology Relationships by Reach. Utilizing geomorphic data from 1992-1994, relationships between geomorphic condition and hydrology will be examined for each reach. Conditions required for cobble bar and sand bar formation, cobble bar cleaning, and backwater formation and maintenance will be examined for each reach based on the slope, sinuosity, alluvial material makeup, substrate size, tributary influence, braiding, etc. of each reach. Both stochastic and statistical relationships will be examined.

2. Review Literature and Interface with Upper Basin Researchers to Examine the Geomorphic Characterization of Important Reaches of the Upper Colorado System. Reports detailing geomorphic conditions in the upper basin, particularly in areas of importance to the endangered species for spawning, adult habitat or Y-O-Y nursery, will be reviewed. Preliminary review indicates that most data available deals with Y-O-Y nursery areas in the Green River and spawning areas in the Yampa and Colorado Rivers, but the full

available database will be explored. Discussions with geomorphologists in the upper basin will be conducted to assess availability of data of common interest and sharing of concepts in data collection and analysis.

3. Compare Upper Colorado River and San Juan River Basin Geomorphology. Utilizing data from items 1. and 2. above and available hydrology from both systems, a comparison of geomorphic conditions of the two systems will be completed. The comparison will include differences in sediment load, sediment transport capability, cobble size distribution, cobble availability, sand bar formation, backwater formation, distance between spawning and nursery areas, conditions in adult use areas, etc. Quantification of differences will complement the data set for comparative habitat and species abundance from the two systems and will aid in determination of limiting factors to recovery and methods of reducing limiting factors at the geomorphic level.

Budget (Funded by BIA)

Labor	$ 26,200.00
Travel: per diem	1,430.00
Vehicle/Equipment use	2,000.00
Supplies	1,100.00
Overhead (10%)	3,070.00
TOTAL:	$ 33,800.00

RIVER CHANNEL DYNAMICS

Background

An understanding of river channel dynamics is the second step in development of a river management plan. Understanding the history of channel change in relation to hydrologic events, precipitation patterns, construction of dams, etc. is important to the understanding of the system in which the endangered fishes have existed over the past 100 years as well an understanding of the effects of man's modification and conceptualization of the expected response of the channel to management changes in the future. Predictive modeling of river response to selected management actions allows formulation of a management plan to achieve desired objectives. Measurement of channel response to management actions during the research period allows determination of the empirical relationship of channel response to flow and calibration of any modeling efforts to predict effects of river management in the future.

In addition to measurement of cross section change, an understanding of the hydraulic conditions necessary to entrain (and thereby clean) cobble and gravel to prepare spawning sites and the transport mechanisms that are at work forming low velocity habitat suitable for y-o-y nursery are critical to the development of a river management plan to maximize these two important habitat types.

Data collection and preliminary analysis was initiated in 1992 and has continued through 1994. Many of the data collection tasks will continue for the duration of the research period.

Objectives

1. Complete Historical Analysis. This includes completion of a detailed literature review, analysis of historic hydrographs and completion of

aerial photography interpretation. (Initial review completed in 1994. Updated with additional information in 1995.)

2. River Geometry Analysis. Determine short term and long term change in river cross sections at key locations.

3. Suspended Sediment Analysis. Determine short term sediment transport and compare to long term record. Examine effect of various hydrographs on sediment transport.

4. Cobble/Gravel Entrainment Analysis. Determine flowrate at which cobble and gravel sizes found in suspected spawning locations are entrained at key locations. Collect detailed data from at least one suspected spawning location.

5. Analyze Mechanism of Low Velocity Habitat Formation. Continue data collection and analysis of formation of low velocity habitat in at least two reaches in the Lower River (RM 1-14 and RM 80-85).

Methods

1. Complete Historical Analysis. The literature search started in 1992 and expanded in 1994 will be updated. Further aerial photo acquisition and interpretation will be completed to fill data gaps in existing analyses. GIS overlays completed in 1994 will be compared and analyzed in relation to hydrology and other influences in the basin. If changes are seen that are not adequately explained, additional photography will be analyzed for intervening time periods to allow better understanding of the changes seen.

2. River Geometry Analysis. The 13 cross-sections surveyed in 1993-1994 will be surveyed pre- and post-runoff for analysis of annual change and compared to previous surveys to determine trends. The 10 cross sections established in 1994 in the key detail reaches (RM 0-15, RM 83-89 and RM 129-134) will continue to be surveyed as in 1994. Analysis of the change in cross-section geometry and substrate in relation to hydrographic conditions will be completed to provide data necessary for development of the system management plan.

3. Suspended Sediment Analysis. The sediment data collection program initiated in 1992 will continue. Sediment data collected will be compared to long term data to determine validity of data and comparative effects of test hydrographs on sediment transport during the runoff period.

4. Cobble/Gravel Entrainment Analysis. Substrate size distribution data collected in 1993 and 1994 at suspected spawning sites will be used in assessing the other cobble bars showing similar conditions that were mapped in 1994. Those that appear most similar will be sampled for quantitative comparison. GPS surveys will be completed at multiple flow-rates, in conjunction with depth surveys and boundary shear stress will be calculated through the test reaches and at key cobble bar locations. Using data on substrate size distribution, the boundary shear stress required to entrain the size cobble encountered will be determined and plotted against the available shear stress to determine flowrate at which cobble and gravel sizes found in suspected spawning locations are entrained at these locations. (These cobble entrainment studies were planned for 1994, but were not completed due to problems with GPS data acquisition and changes in spawning locations from 1993.)

5. Analyze Mechanism of Low Velocity Habitat Formation. The analysis of storm events with the associated sediment load and flowrate begun in 1994 will be continued to understand the flow conditions that might be expected

during the post-spawning period. Two cobble/sand bars in the RM88-RM83 reach and two sand bars at RM4 were analyzed in 1994 through the fall period with multiple events. These sites will be examined again during 1995 for a selected single event, if possible, and for multiple events. Pre- and post-storm runoff sampling will be completed, including mapping of the habitat, sampling sandbar grain size distribution and measuring change in sandbar shape. Channel geometry, sediment load, flow rate and water surface profiles before, during and after a storm event will be measured for later use in sediment transport modeling if it appears applicable. Primary emphasis will be on documentation of physical change and the effect on availability of low velocity habitat before, during and after the event.

Budget (Funded by BIA)

Labor	$125,600.00
Travel: per diem	19,320.00
Vehicle/Equipment use	6,400.00
Supplies	6,000.00
Overhead (10%)	15,730.00
TASK IV TOTAL:	$173,050.00

HABITAT MAPPING AND RESOURCE UTILIZATION

Background

The documentation of habitat types within the San Juan River from RM 158 to RM 0 will be continued during FY94, with expansion of the range from RM225-RM0. Three separate videographic flights will be mapped as part of this year's effort. Emphasis will be on intermediate flow rates in the range of 2,000 to 6,000 cfs where there is presently a data gap, in addition to high flow, it appears that the peak will exceed 8,000 cfs for a sufficient duration to allow mapping. Habitat quality measurements (depth, velocity, substrate, etc.) will be measured to expand the database started in 1994.

Habitat utilization information collected during the squawfish radio tracking studies in 1994 and 1995 will be correlated with the habitat distribution data. In a similar manner, y-o-y captures will also be correlated with habitat data.

In 1993 and 1994, the physical conditions within the spawning bar were investigated in detail. During FY95, these conditions will be verified and comparisons with other spawning bars in the Yampa and Colorado Rivers made.

Objectives

1. Main River Habitat Mapping. Map San Juan River habitat from RM 225 to RM 0. This objective is a continuation of the 1994 work.

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

3. Determine Habitat Quality. Determine habitat quality for each habitat mapping unit utilized in Objectives 1 and 2. Habitat quality will quantify specific physical features of each habitat type mapped. This objective is a continuation of 1994 work.

4. Correlate Habitat Utilization to Availability. Correlate and compare

detailed radio tracking data and y-o-y captures (habitat utilization) to habitat availability. This is a continuation of 1994 work.

5. Verify Spawning Bar Conditions. Verify physical habitat conditions and complexities within the documented squawfish spawning bar and identify other potential spawning locations. Utilizing data collected in 1994, including identification of other locations exhibiting similar characteristics to the documented spawning bars, detailed sampling of the most comparable sites will be completed. Comparative mapping of two spawning locations in the Colorado and Yampa Rivers will continue to compare change with time in the two systems.

6. Analyze Razorback Sucker Habitat Availability. Analyze potential Razorback habitat availability based upon habitat utilization from experimental stockings. Work will be closely correlated with the radio tracking data collection effort.

Methods

1. Main River Habitat Mapping. Habitat mapping will be accomplished by directly delineating habitat boundaries in the field utilizing color prints from airborne videography taken a few days prior to the field investigation.

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.

3. Determine Habitat Quality. For each habitat type mapped, depth, velocity and substrate will be determined for a wide distribution of habitat locations.

4. Correlate Habitat Utilization to Availability. Detailed habitat maps will be developed for each radio tracked fish during each observation utilizing the most current aerial photos or videography. Habitat utilization will be compared with habitat availability utilizing ArcCAD.

5. Verify Spawning Bar Conditions. Physical habitat conditions (substrate size, depth to embeddedness, interstitial volumes and topography survey) within the spawning bar complex will be measured. The cobble bars identified in 1994 as most similar to the spawning bars will be sampled in detail for quantitative comparison and assessment.

6. Analyze Razorback Sucker Habitat Availability. Razorback sucker habitat utilization will be determined by evaluating the habitat locations where radio-tagged fish are located.. In addition, a literature review of habitat preferences as noted by other Colorado River researchers will be summarized.

Budget (Funded by BIA)

Labor	$178,150.00
Travel: per diem	10,900.00
Vehicle/Equipment use	10,000.00
Supplies	6,000.00
Overhead (10%)	20,500.00
TOTAL:	$225,550.00

FLOW/HABITAT MODELING

Background

With the accumulation of three additional habitat mapping data sets for the entire river, preliminary model development begun in 1994 will be updated. Relationships between geomorphology, habitat and hydrology will be incorporated into the overall modeling strategy. This will involve correlation of habitat distribution, abundance and complexity by reach with flow and geomorphology.

Objectives

1. Coordination and Review of Other Studies. Review other ongoing mapping and modeling projects within the Colorado River.

2. Develop Habitat/Flow Relationships. Develop correlations between the distribution, abundance, and complexity of habitats in the San Juan River and flows by geomorphic reach.

3. Incorporate Geomorphic/Flow Relationships by Reach. Utilize geomorphic/flow relationships developed under Geomorphic Characterization for each reach identified to allow modeling by reach.

4. Develop Preliminary Management Strategies by Reach. Utilizing modeling results, identify management strategies for each geomorphic reach that would provide the best contribution to overall habitat availability for the flow conditions identified. Compare and integrate the management strategies for each reach into a preliminary overall management strategy. (This task is conceptual in nature, beginning the process of defining the management strategy due in 1997 by identifying flow/habitat/geomorphology interactions and how they can be manipulated to the best advantage of the endangered species. This preliminary structure will be available to the full research team as the management strategy is developed that incorporates all study results.

Methods

1. Coordination and Review of Other Studies. Interact with other researchers doing similar habitat mapping activities, and coordinate habitat types, definitions, and methodologies.

2. Develop Habitat/Flow Relationships. Utilizing data files developed within ArcCAD, analyze the spatial distribution of habitat types within the San Juan River. Based upon the river segments where mapping and flows were constant, develop correlations between habitat abundance and complexity with flow. Hysteresis (pre- versus post-runoff habitat conditions) will be analyzed to determine year to year effects. Analyses will be completed on a reach by reach basis for the reaches identified in 1994 and refined in 1995.

3. Incorporate Geomorphic/Flow Relationships by Reach. The geomorphology/flow relationships examined under Geomorphic Characterization will be incorporated into the flow/habitat model on a reach by reach basis. The geomorphology of a reach will be compared to habitat complexity and availability to identify the function of the reach in supplying habitat and how that function relates to flow manipulation. Reaches exhibiting different geomorphology will respond to hydrograph manipulation differently. The relationships will be examined stochastically as well as statistically to identify the most appropriate modeling relationship.

4. Develop Preliminary Management Strategies by Reach. The model developed

under steps 2 and 3 will be utilized to analyze potential management strategies for each reach. Management of flow to maximize the most beneficial characteristics of a reach (e.g. spawning, Y-O-Y, or adult habitat, or a combination) will be examined and the resulting impacts to other uses and other reaches explored. The management strategies for each reach will be combined to examine cumulative affects and identify limitations to individual reach management plans. These preliminary management strategies are only the first step in developing the overall management strategy that considers impacts other than habitat. They are intended to be conceptual, with verification and refinement coming in the succeeding 2 years of research as the full team works together to incorporate results of all studies into the development of the recommended management strategy.

Budget (Funded by BIA)

Labor	$ 79,900.00
Travel: per diem	4,000.00
Vehicle/Equipment use	5,600.00
Supplies	2,000.00
Overhead (10%)	9,150.00
TASK IV TOTAL:	$100,650.00

RIVER OPERATION MODELING

Background

The river operation modeling effort has been superseded by a larger modeling program initiated by USBR. The calibration efforts completed in 1994 will be made available to USBR as they develop their model. Work is limited to coordination with USBR on calibration.

Budget (Funded by BIA)

Labor	$ 7,860.00
Travel: per diem	0.00
Vehicle/Equipment use	1,100.00
Supplies	0.00
Overhead (10%)	900.00
TOTAL:	$ 9,860.00

WATER TEMPERATURE MONITORING

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

1. Collect Water Temperature Data at 9 locations

Methods

1. Collect Water Temperature Data at 9 locations. Temperature recorders are installed at Cedar Hill and Farmington on the Animas, and at Blanco, Bloomfield, Lee Acres, Farmington, Four Corners and Montezuma Creek on the San Juan. These recorders will be serviced twice and the data extracted and plotted for the annual report.

Budget (Funded by BIA)

Labor	$ 3,360.00
Travel: per diem	270.00
Vehicle/Equipment use	450.00
Supplies	200.00
Overhead (10%)	428.00
TOTAL:	$ 4,708.00

SAN JUAN RIVER FISH DISEASE SURVEY

Fiscal Year 1995 Workplan

Background:

There has been no fish health work accomplished on the San Juan River prior to 1992. This laboratory (Pinetop Fish Health Center) participated in October 1992, May 1993, May 1994, and October 1994 adult monitoring collection trips and collected disease samples from many fish species.

The purpose of this project is to collect and maintain a fish health data base on adult monitoring trips in FY 95.

Objectives:

1. Collect baseline data for health status of San Juan River fish.
2. Determine if flannelmouth suckers are reliable bioindicators of adverse environmental conditions.
3. Ascertain possible causes of infectious and non-infectious lesions and other abnormalities observed.
4. Determine prevalence of infectious and non-infectious pathogens and abnormalities.
5. Determine prevalence of possible electroshocking damage to fish.
6. Correlate disease incidence with water quality parameters.

Methods:

1. Every river mile (RM):
   a. record macro-pathology on all fish sampled
   b. only fish with gross pathology will be sacrificed and sampled for pathogens
   c. Colorado squawfish and other threatened or endangered species may be sampled with mucus and fecal swabs.
2. Every designated mile (DM):
   a. record macro-pathology on all fish sampled (internal and external, including possible electroshocking injury)
   b. sacrifice five flannelmouth sucker and perform complete necropsy sampling for bacterial, viral, protozoan, and cestode parasites.
3. Assist other San Juan River biologists by analyzing data collected from shcking boats for disease incidence (completed for 1991-August 1994).

Budget:

Personnel	$11,264
Per Diem/Travel	4,838
Equipment and supplies	3,898
TOTAL	$20,000

STUDY PROPOSAL TO EVALUATE THE EFFICACY OF MECHANICAL REMOVAL OF CHANNEL CATFISH (*Ictalurus punctatus*) FROM SELECTED REACHES OF THE SAN JUAN RIVER

FISCAL YEAR 1995 WORKPLAN

BACKGROUND:
The establishment of non-native fishes in lotic habitats of the Colorado River Basin of the American Southwest was widespread by the end of the nineteenth century. Coldwater sport fish, primarily salmonids, were introduced into high elevation streams resulting in negative impacts on native trout species (Miller, 1950; Minckley, 1973; Behnke, 1992; Propst and Hobbes, 1993). Warmwater species introduced into lower elevation streams also impacted resident native species, with predation by large piscivores such as channel catfish (*Ictalurus punctatus*), flathead catfish (*Pylodictis olivaris*), and largemouth bass (*Micropterus salmoides*) severely reduced formerly widespread distributions of native fishes (Minckley and Deacon, 1968; Marsh and Brooks, 1989; Tyus and Nikirk, 1990). Other non-native species introduced primarily as bait and food fish for non-native sport species (e.g., red shiner (*Cyprinella lutrensis*) and fathead minnow (*Pimephales promelas*) have exerted competitive, as well as predative pressures on native species (McAda and Kaeding, 1989; Rupert et al., 1993; Douglas et al., 1994). Finally, non-native species such as white sucker (*Catostomus commersoni*) hybridize with native sucker species (Hubbs et al., 1943; Miller et al., 1993; pers. obs.).

The result of widespread intentional and accidental stocking of non-native fish species in the western United States, particularly within the Colorado River Basin, is that non-native fish species outnumber native fish species in virtually all lentic (artificial) habitats. While native species tend to dominate fish communities in lotic habitats that maintain natural flow regimes (Minckley and Meffe, 1987; Meffe and Minckley, 1988), non-native species can still replace native fishes as is evidenced in the naturally flowing Salt River in central Arizona (Hendrickson, 1993). In the San Juan River, native species numerically dominate the mainstream fish community (Ryden and Pfeifer, 1993, 1994) while smaller non-native species are more abundant in secondary channel habitats and low-velocity habitats (Buntjer et al., 1993, 1994; Propst and Hobbes, 1993; Gido and Propst, 1994).

In the San Juan River Basin of Colorado, New Mexico, and Utah, at least thirty species of non-native fish have been reported (Platania, 1990; Sublette et al., 1990; Anderson et al., 1993; Brooks et al., 1994). Of these, four species (red shiner, common carp (*Cyprinus carpio*), fathead minnow, and channel catfish) are comparatively common and regularly collected in the warmwater reaches of the San Juan River downstream of Farmington, New Mexico to Lake Powell, Utah. Channel catfish is the only widely distributed piscivore (Ryden and Pfeifer, 1993, 1994). Brooks and Williams (1993) and Brooks et al. (1994) have reported on data for movement patterns, abundance, and food habits of channel catfish. Additional observations on habitat use by non-native fish species have been made, including those by Buntjer et al. (1993, 1994), Ryden and Pfeifer (1993, 1994), Propst and Hobbes (1993), and Gido and Propst (1994).

The earliest report of channel catfish in the San Juan basin is 1957 (University of New Mexico, Museum of Southwestern Biology collection), but it is likely the species arrived prior to this date. The establishment of channel catfish in the basin was the result of concerted stocking efforts by state and federal agencies (NMDFG and USFWS files). Although apparently well-established, irregular stocking of channel catfish in the rivers of the basin continued into the 1980's. While the New Mexico Department of Game and Fish ceased stocking the species in the river in the early 1980's (S. Henry, pers. comm.), it is still stocked in reservoirs in the basin (L.A. Ahlm, pers. comm.). There are no official records of its being stocked in the riverine portions of the basin in Utah, at least in the past 30 years (L. Lentsch, pers. comm.). In Colorado, few riverine habitats

are suitable for the species, but it does occur in several reservoirs where it continues to be stocked (M. Japhet, pers. comm.).

Although previously stocked upstream of the Four Corners Power Plant Diversion, channel catfish are uncommon in this reach of the San Juan River. Downstream of the Hogback Diversion, channel catfish are more abundant, usually being the third or fourth most common species collected during adult monitoring efforts (Ryden and Pfeifer, 1993, 1994). Although found in most habitats available, channel catfish tend to be more common in primary channel habitats. Few individuals are found in secondary channels during the summer low-flow period (Propst and Hobbes, 1993, 1994; Gido and Propst, 1994) and juveniles are only typically common in low velocity habitats in downstream reaches (Buntjer et al., 1993, 1994). Reproductive and recruitment success vary among years and appear to be at least partially dependent on flow regimes.

Within river reaches where it is comparatively common, the relative abundance of channel catfish is variable; several reaches consistently have rather high abundances of the species whereas in others it generally tends to be less common. The reasons for these patterns have not been determined. Although channel catfish have been reported to move upstream to spawn (Hubley, 1963; Welker, 1967; Dames et al., 1989), Brooks and Williams (1993) and Brooks et al. (1994) found no evidence of such in the San Juan River. Although this study was not exhaustive, and additional research on channel catfish movement is needed, it does suggest that under current environmental conditions, channel catfish in the San Juan River are comparatively sedentary.

Adult channel catfish prey upon a variety of fish species (Tyus and Nikirk, 1990; Brooks and Williams, 1993; Brooks et al., 1994). In at least one situation, intense predation by channel catfish was documented to have caused the failure of efforts to re-establish an endangered species (Marsh and Brooks, 1989). Thus, in preparation for augmentation of razorback sucker, *Xyrauchen texanus*, (and potential augmentation of Colorado squawfish) in the San Juan River, it may be desirable to evaluate the feasibility of locally reducing the abundance of channel catfish. Food habits of younger age classes of channel catfish are less well-documented, but those available (e.g., Brooks and Williams, 1993; Brooks et al., 1994; Propst and Hobbes, 1993 {Pecos}) indicate smaller individuals feed upon a variety of aquatic invertebrates. In habitats shared among young age classes of channel catfish and native fishes (particularly younger age classes of Colorado squawfish), there may be predation by channel catfish on native forms or competition for food. In addition to the problems associated with channel catfish predation upon native fishes, adult Colorado squawfish at least occasionally prey on channel catfish and sometimes to the detriment of the predator (McAda, 1983).

Given the apparent low abundance of Colorado squawfish and razorback sucker in the San Juan River, it is unlikely that direct evidence of channel catfish predation upon either of these species will be documented. However, channel catfish do prey upon the same species consumed by Colorado squawfish (flannelmouth sucker, *Catostomus latipinnis*, and bluehead sucker, *C. discobolus*). Although both prey species remain comparatively common in the San Juan, channel catfish predation, over time, may effect the entire native fish community and consequently reduce the forage base for Colorado squawfish. Regardless of the lack of direct evidence of channel catfish predation on endangered species in the San Juan River, there is substantial evidence of such predation from other basins where the species are sympatric and at least circumstantial evidence of the negative impacts of channel catfish on Colorado squawfish in the San Juan basin.

Studies on Colorado squawfish in the San Juan River indicate that a reach known as the "Mixer" is frequently used by adult Colorado squawfish, particularly during presumed spawning (Ryden and Pfeifer, 1993, 1994; Miller, 1994). Miller (1994) observed several Colorado squawfish in close association during the spawning season in a deep cobble-bottomed run near the mouth of Red Wash. In

fact, most adult Colorado squawfish captured (and recaptured or located by radio telemetry) during the past four years have been from a reach extending from the Cudei Diversion (RM 142) to the Four Corners Bridge (ca. RM 119). No larval or young-of-year (YOY) Colorado squawfish has been captured in this reach during the current study (Buntjer et al., 1993, 1994) but two specimens were captured near the mouth of the Mancos River (ca. RM 122.6) in 1987 (Platania, 1990; Platania, et al. 1991). Although larval Colorado squawfish from known spawning bars in the Yampa River have been documented to drift 150 km (on average) to backwater habitats in the Green River (despite apparently suitable backwater habitats in the intervening river reaches), there are usually some scattered among backwaters present between the spawning bar and primary nursery habitats (Tom Chart, pers. comm.). With few exceptions, nearly all YOY Colorado squawfish collected in the San Juan River have been downstream of Mexican Hat, Utah. Most recently (1993), two larval specimens were collected near Mexican Hat (Buntjer et al., 1994).

In a large river system such as the San Juan, means to control unwanted non-native species are limited. Chemical treatments, such as rotenone and antimycin A, are nondiscriminant and expensive. More exotic measures such as introduction of sterile males is an unproven technique. Flow manipulations may reduce spawning and recruitment success (and are currently being investigated), but long-term availability of sufficient water to provide needed flows at specific seasons is uncertain. In addition, flows harmful to channel catfish may also be detrimental to native fishes (although this connection has not been determined to date). With the technologies available at this time, mechanical removal in concert with other management tools (i.e., flow manipulation) appears to be a possible control technique for investigation.

Within the reach of the San Juan commonly used by Colorado squawfish (at least during the past four years), channel catfish are rather common. However, the impact their presence has upon the entire native fish community, including survival of endangered fishes, is unknown. The study proposed herein is designed to obtain information on this potential impact and determine possible corrective management strategies to improve the status of the native fish community. If augmentation of either endangered species is deemed desirable, it will likely be necessary to reduce the abundance of channel catfish to improve the success potential of augmentation.

GOAL

To determine if mechanical removal of channel catfish (the most common non-native predator) in a selected reach of the San Juan River in conjunction with flow manipulation and other management tools results in improved survivorship of native fishes, including Colorado squawfish, and if such control is a feasible management strategy.

OBJECTIVES

1. Compile all records of channel catfish to characterize historic and current distribution and abundance patterns (by size class).
2. Relate patterns of distribution and abundance to flow regimes.
3. Characterize seasonal and annual movements of channel catfish.
4. Collect and analyze additional information on food habitats of channel catfish, particularly smaller size classes.
5. Estimate the frequency, intensity, and timing of effort needed to suppress channel catfish abundance in experimental river reaches.
6. Characterize movement patterns of channel catfish in response to removal experiments.
7. Estimate density and population of channel catfish in study reach and extrapolate these data to the entire river.
8. Characterize response of all resident fish species, but particularly native species, to removal experiments.
9. Evaluate the efficacy of mechanical control of channel catfish and make management recommendations.

METHODS AND STUDY AREA

The study area will consist of the San Juan River from the Cudei Diversion (RM 142) downstream 33.6 km (21 mi) to a point about 2.5 km (RM 121) above the Four Corners bridge (RM 119.6). Within this reach, the river is characterized by extensive braiding and a variety of riverine habitats ranging from cobble-bottomed primary channel moderate velocity runs to silt-bottomed isolated backwaters with seasonally elevated water temperatures. A variety of secondary channels are present which provide habitats not present or uncommon (e.g., shallow cobble-bottomed riffles and small protected pools with extensive instream cover) in the primary channel. Three of the four permanent secondary channel study sites (Gido and Propst, 1994) are within the study reach. All fish species regularly collected in the San Juan River between the Hogback Diversion and Mexican Hat are found in the study reach.

The study reach will be divided into seven 4.8 km (3 mi) test reaches. Test reaches of 4.8 km length were selected because we believed analysis of data from shorter reaches may be compromised by random movements of fish and longer reaches would add considerably to logistic issues. Thus, selection of test reaches of 4.8 km was a decision that may necessitate later revision. Three removal test reaches were believed the minimum necessary for valid statistical analyses. This means there will be four capture, tag, and release reaches to account for movement from all contiguous reaches.

The research will require at least four, and perhaps five, field forays of 5 to 10 days each per year. The study duration will be three years.

Two principal methods of capture will be used; raft-mounted electrofishing and passive gear (baited hoop nets). Removal by electrofishing will be incorporated within the regularly scheduled spring runoff adult monitoring (usually in May) and the autumn adult monitoring efforts (usually in October). At least one additional electrofishing effort (during summer low-flows, typically August) will be made. This effort will be in conjunction with the secondary channel monitoring studies. A fourth electrofishing effort may be made, depending on available resources and perceived need for additional data, prior to spring runoff (usually April).

Baited hoop nets have proven an effective means to selectively capture channel catfish in the Mississippi drainage (Dames et al., 1989). Although their efficiency has not been investigated in the San Juan River, the literature suggests it will prove an effective technique. Within each test reach, three 10 m length by 1 m aperture baited hoop nets will be set parallel to the shoreline for 24-hour periods and run at 6-hour intervals. Hoop nets will be set between each electrofishing effort. Thus, nets will be set between the spring (May) electrofishing and summer low-flow (August) efforts during the descending phase of spring runoff (typically late June or early July) and in September during the late summer monsoonal season.

In the uppermost test reach, all captured channel catfish will be weighed (g), measured (total and standard length, mm), implanted with a uniquely numbered floy tag (only specimens $\geq$250 mm total length [TL]), and released. Specimens $\leq$250 mm TL will be weighed, measured, and released. This procedure of somatic measurements, tagging, and releasing will be followed in every other test reach for a total of four such reaches.

In the intervening reaches all channel catfish captured will be removed. A representative subsample of all specimens captured will be retained for food habits analyses. We propose to transport the remainder of captured channel catfish to reservoirs on the Navajo Indian Reservation or other suitable locations in the San Juan basin. Before this can occur, the cooperation and support of responsible resource agencies must be gained. This portion of the effort will require support in the form of hatchery trucks and personnel from

cooperating agencies (at least the Navajo Game and Fish Department, New Mexico Department of Game and Fish, and U.S. Fish and Wildlife Service; and perhaps the Colorado Division of Wildlife). In addition, questions and concerns of disease must be addressed and this will require the cooperation of the involved state, tribal, and federal resource agencies. The only alternatives to transporting channel catfish to intrabasin reservoirs is sacrifice of all specimens captured in the removal test reaches or transport of these fish to downstream reaches (which is really not a solution, but a transference of the perceived problem).

Appropriate uni- and multi-variate statistics will be used in the analyses of data collected in the proposed study. If necessary, consultation with biostatisticians will be sought. Reports on annual progress will be submitted which detail work accomplished, provide an overview of data collected, indicate salient findings, and make recommendations to adjustments in study protocols or design. The final report of the proposed study will be submitted within one year of the completion of field and laboratory research efforts. Outside (extra-San Juan Basin) review by individuals knowledgeable of predator-prey relationships, aquatic community dynamics, and non-native fish control methods will be sought. Suitable portions of the research will be compiled and synthesized for publication in appropriate scientific journals.

SCHEDULE

January-April 1995: Thorough review of pertinent literature, logistics resolution, and concurrence of cooperating resource agencies.
May 1995: Electrofishing removal
June-July 1995: Baited hoop net removal
August 1995: Electrofishing removal
September 1995: Baited hoop net removal
October 1995: Electrofishing removal
November-December 1995: Data compilation, analysis, and annual report preparation.

A similar schedule will be followed in each 1996 and 1997 except that literature review will be largely accomplished in 1995. April electrofishing trips may be added after 1995 if necessary. The final report will be scheduled for completion by November 1998.

BUDGET

Because all electrofishing removal efforts will be conducted in conjunction with ongoing adult and secondary channel monitoring studies, no specific costs were identified for the field portion of electrofishing removal. In addition, by combining removal efforts with monitoring studies we will be able to enhance removal efficiency.

The following provides an approximate breakdown of the costs (human resources, travel, and equipment) that will be required to accomplish this study.

Personnel:	$ 28,500
Travel/Per Diem:	2,000
Equipment and Supplies:	7,000
Fish Transport:	2,500
Total	$ 40,000

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INTEGRATION REPORT FOR THE
SAN JUAN RIVER RIP BIOLOGY STUDIES

FISCAL YEAR 1995 WORKPLAN

Background:

The San Juan River Recovery Implementation Program has been conducting biological studies on the San Juan system since 1991 as part of a Seven-year Research Program. The studies have been quite varied, including fishery studies, hydrology studies, habitat studies, etc., and they have been carried out by a fairly large group of agencies/researchers, including USFWS, Bureau of Reclamation, Park Service, State of New Mexico, State of Colorado, State of Utah, BIA, Southern Ute Tribe, and others. Annual Progress Reports have been prepared for each study and have been made available to the Coordinating Committee and other interested parties.

A considerable amount of very important information has been collected during the first four years of this research effort, yet no attempt has been made to condense and organized the studies into one integrated report. An integrated report that addressed the finding of the various studies as working toward common goals would be very useful to members of the Coordinating Committee, other interested parties, and, perhaps, to the researchers themselves. A summary report could help guide future research by developing the inter-study conclusions needed to meet the goals of the San Juan RIP.

Another role an integration report would serve involves another level of peer review. The San Juan RIP Draft Long Range Plan proposes an internal peer review process utilizing members of the Biology Committee. Development of an integration report by members of the Committee that are not involved in specific research will add another level of peer review to the Program.

An integration report has been discussed as part of the 1995 work plan by the Biology Committee, but the how and who has not been discussed. This proposal provides an outline of how this effort would be organized and proposes that Dr. Paul Holden of BIO/WEST and his staff would have major responsibility for completing it.

This study proposes to develop an integrated report for the San Juan biological studies including the 1991-1994 studies. It would be updated annually until the end of the Seven-year Research Program.

Goal:

Develop a summary report that accurately describes the results to date of the San Juan RIP research studies.

Objectives:

1.) Develop a summary report that addresses how well the various goals of the San Juan RIP are being addressed by the biological studies being conducted under its auspices.

2.) Develop a report more understandable by administrators and non-biologists associated with the San Juan RIP.

3.) Provide an additional level of peer review on the biology studies being conducted within the San Juan RIP.

Methods:

Four basic phases or steps would be conducted to complete this project. The first step would be to thoroughly read and evaluate the 1991-1994 research progress reports for each study, including project proposals. The second phase would be to sit down with the individual researchers to discuss their studies and the preliminary results of those studies. This will assure that each researcher will have their input into the report. Small groups of researchers may be gathered to discuss certain issues or ideas for data integration. Researchers may be asked to use their data and other data to make new comparisons not included in their reports. BIO/WEST would not be involved in data crunching, that would be left to the researchers. The third phase would be to write the report. This phase would be conducted primarily by BIO/WEST. Larry Crist of the Bureau of Reclamation has offered to assist with this phase. The fourth phase would be report preparation, which would involve a review of the draft report by the Biology Committee, and then completion of a final report. The final report would be printed for distribution to the Biology Committee, Coordinating Committee, and other interested individuals, agencies, etc.

The report outline would follow the biological Objectives of the Long Range Plan. By using this format, it will allow an annual evaluation of how well the studies are meeting these objectives, and what other studies may be needed. The Objectives of the Long Range Plan that would be included in the report are:

> Develop interim management objectives for San Juan River native fish community.
>
> Identify, Protect, and Restore habitats.
>
> Identify and manage the native fish community of the San Juan River basin to restore the endangered fish species.
>
> Determine roles of non-native fish species in the decline of native fish species and implement corrective actions.
>
> Determine the occurrence, extent, and role(s) of water quality degradation and contaminants in the decline of native fish species and identify and implement corrective actions.

The Draft Long Range Plan includes a listing of the various tasks included with each objective, as well as which tasks are milestones for the Program. Using this format for the Integration Report will allow for conclusions to be drawn regarding where the program stands, and how it is progressing.

All studies involved in the Program will be included in the Integration Report. Some studies will have been completed through 1994, others will just be starting. Therefore, conclusions from some studies will not be complete, but the knowledge that the study is being conducted, its goals, and how it fits into the overall program are important to include in this annual report.

In addition to the studies being conducted as part of the Seven Year Research program, information from earlier San Juan River research and from other upper and lower Colorado Basin studies would be included in the report. The attempt would be made to utilize all existing information to draw conclusions on where we stand on the San Juan RIP effort.

Personnel:

Dr. Paul Holden of BIO/WEST would be the Project Leader for the integration report. He would be assisted by Mr. Bill Masslich, as well as BIO/WEST's editorial, clerical, and cartographic support personnel.

Budget:

Personnel	$42,500	
Travel	$ 1,500	
Misc.	$ 1,000	
Total	$45,000	

Funding Sources:

State of Colorado	$ 3,000	
Bureau of Reclamation	$42,000	(Through existing contract with the Utah Division of Water Resources)