SAN JUAN RIVER RECOVERY IMPLEMENTATION PROGRAM

SEVEN YEAR RESEARCH PROGRAM

BUDGET AND WORK PLAN

FISCAL YEAR 1996

PREPARED FOR
SJRRIP COORDINATION COMMITTEE
PREPARED BY
SJRRIP BIOLOGY COMMITTEE

9 April 1996

SAN JUAN RIVER SPECIMEN CURATION AND LARVAL FISH IDENTIFICATION
University of New Mexico, Albuquerque, New Mexico
Fiscal Year 1996 Work Plan

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; BOR-Lashmett; National Park Service]).

In 1995 we processed over 91,000 larval and juvenile fishes collected by the Utah Division of Wildlife Resources. During the course of verifying and cataloging these 1994 samples, we discovered two previously unidentified Colorado squawfish. One of these specimens was collected from near the Mancos River-San Juan River confluence and represents the most upstream record of a larval squawfish since 1987. We expect to receive the 1995 low-velocity habitat samples from the Utah Division of Wildlife Resources in November-December 1995 and will process them by the end of summer 1996. As in the past, any significant deviations in the species identifications of those samples will be noted and forwarded to the principal investigators.

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. Verify species identifications

4. 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

SAN JUAN RIVER SEVEN YEAR RESEARCH PROGRAM
BUDGET
FISCAL YEAR 1996

I.	Core Research	
	Adult Monitoring and Radio Telemetry (USFWS, R6)	$ 43,500
	Experimental Stocking of Razorback Sucker (USFWS, R6)	35,300
	Helicopter Flights (BR)	10,000
	Early Life Stage: Nursery Habitat Requirements (UDWR)	90,000
	Larval Drift (UNM)	30,000
	Secondary Channel Characterization (NMDGF)	88,000
	Nonnative Species Interactions (USFWS, R2)	50,000
	Lower San Juan River/Lake Powell Inflow (USBR, UDWR)	33,700
	Videography (USBR)	10,000
	Specimen Identification and Curation (UNM)	46,000
	Program Management (USBR)	30,000
	Program Coordination (USFWS, R2)	57,500
	Subtotal	$524,000
II.	Contaminant Research	
	Biological Effects (NBS)	110,000
	Subtotal	$110,000
III.	Other Research	
	Fish Health Studies (USFWS, R2)	10,000
	Study Integration (BIOWEST, Jicarilla)	30,000
	Subtotal	$ 40,000
IV.	Proposed Research	
	Peer Review (To Be Determined)	5,000
	Fisheries Database (USFWS, R2)	7,500
	Colorado Squawfish Habitat Use (Southern Ute, WJM)	20,000
	Subtotal	$ 32,500
	TOTAL	**$706,500**
Fund Sources:		
	USBR	400,000
	BIA/NIIP	130,000
	BIA/ALBUQUERQUE	50,000
	USFWS/R2	106,500
	Southern Ute	20,000
	TOTAL AVAILABLE	**$706,500**

OTHER BIA FUNDED RESEARCH

BIA/NIIP

Geomorphic Characterization	$ 21,600
River Channel Dynamics	191,400
Habitat Mapping and Resource Utilization	215,500
Flow/Habitat Modeling	83,800
River Operations Modeling	9,840
Water Temperature Monitoring	5,300
GIS Based Integrated Database Development	65,400
Subtotal	$592,840

GRAND TOTAL	**$1,299,340**

Adult Rare Fish Monitoring and Radio Telemetry Studies
Fiscal Year 1996 Project Proposal
Revised April 5, 1996

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.

Seventeen intensive electrofishing surveys conducted from 1991 to 1995, 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 were collected and PIT-tagged during these studies; 13 of the 17 Colorado squawfish were radio-tagged. Sixteen roundtail chub were collected, 11 of these were PIT-tagged. No wild razorback sucker were collected, however 27 experimentally stocked razorback sucker have been recaptured to date. Radio telemetry efforts located the primary range and probable staging and spawning areas of Colorado squawfish and documented dispersal patterns and habitat use of stocked razorback sucker. 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. Radio contact has not been made with it, or any other Colorado squawfish above this structure since that time.

Adult monitoring will continue with five trips in 1996 to measure fish community response to research flows from Navajo Dam and to monitor the dispersal of lentic predators (e.g.- largemouth bass, smallmouth bass, striped bass, and walleye) which have invaded the lower San Juan River since the June 1995 inundation of the waterfall at river mile 0.0, the confluence with Lake Powell. Sampling crews will consist of approximately 13 people. In support of objective #4 below, native fish in the Farmington to Hogback Diversion (New Mexico) reach will be FLOY-tagged during April 1996 sampling and monitored during subsequent trips to evaluate the impact of instream diversion structures in this reach of river on native fish movement. In support of objective #5 below, the stomachs from all lentic predators sampled during 1996 electrofishing studies will be analyzed to determine their predatory impact on native fish. Our sampling efforts in the lower 30 miles of the river will be closely coordinated with the National Park Service and Utah Division of Wildlife Resources' Lake Powell fish inflow study.

At present, all radio tags that were implanted in Colorado squawfish have expired. All new adult Colorado squawfish captured during 1996 adult monitoring trips will be implanted with radio tags and monitored as in years past. The purpose of this work will be to document movement and habitat utilization by adult Colorado squawfish and razorback sucker under low flow conditions. Adult monitoring will also sample for experimentally stocked razorback suckers and allow radio tracking of the same. Aerial searches for

radio-tagged fish were scheduled to continue on a regular basis in FY 96. Due to the difficulty of locating radio-tagged fish from an airplane, an aerial monitoring trip was conducted in December 1995 using a helicopter. The premise behind this flight was that a helicopter would allow researchers to track at slower speeds than in an airplane, yet still cover a large portion of the river in a single day. However, no radio-tagged fish were contacted on this flight and the further flights were cancelled due to the apparent low efficiency of this tracking method in obtaining data on weak-signalled razorback sucker radio tags. Aerial monitoring may be re-initiated later in 1996, either in conjunction with channel catfish radio telemetry efforts, or if numerous Colorado squawfish are radio-tagged in 1996. 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 (spawning and staging areas, habitat needs).

3. Monitor experimentally stocked razorback sucker (growth rates, dispersal patterns 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.

5. Monitor the upstream movement of lentic predatory fish species from Lake Powell. Preserve stomach contents for analysis to determine the impact these species are having on the native fish community (stomach analysis to be performed by U.S. Fish and Wildlife Service, Albuquerque).

Methods

Objectives 1-5: Five adult sampling trips will take place in 1996. The May and October trips will be from Hogback Diversion, New Mexico, to Mexican Hat, Utah. In June and August, the river will be sampled from Mexican Hat to Clay Hills, Utah. The river reach from Farmington, New Mexico, to Hogback Diversion will also be sampled in 1996. This will be done in conjunction with an April 1996 Colorado squawfish "hunt". 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 possibly during 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 with the exception of lentic predatory species, returned alive to the river. All lentic predatory species will be removed from the river, sacrificed, and have their stomach contents analyzed. Adult Colorado squawfish, roundtail chub, and wild razorback sucker will be PIT-tagged. Wild razorback sucker and new Colorado squawfish 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. Costs for cooperating agencies are not included in this budget.

Budget: FY-96

Personnel	
1 GM-13 Supervisor	$ 5,000
1 GS-9/11 Fishery Biologist	$ 15,000
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 1996 Project Proposal
Revised April 5, 1996

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 were stocked in October 1994, at the same three stocking sites. All radio-tagged 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). An additional 656 PIT-tagged fish were stocked, in November 1994, in even numbers at the above three sites as well as a fourth site near Hogback Diversion (RM 158.5). In September 1995, 16 radio-tagged razorback sucker (23-month AVM tags) were stocked at the Hogback Diversion site. Follow-up monitoring has begun and will continue on adult sampling trips, at least six ground monitoring trips through September 1996, and winter ground monitoring trips. Aerial tracking was conducted via helicopter in December 1995; however, this technique proved unsuccessful and has been discontinued. Radio-tracking will also be done during other research trips throughout the year.

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. 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

Personnel	
1 GM-13 Supervisor	$ 4,000
1 GS-9/11 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
SUBTOTAL	$ 35,300

EARLY LIFE STAGE: NURSERY HABITAT REQUIREMENTS
Utah Division of Wildlife Resources, Salt Lake City, Utah
Fiscal Year 1996 Work Plan

Background This component of research has been designed to characterize the early life stage habitat requirements of the ichthyofaunal community in the San Juan River 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 Juan 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 Juan River, much of the standardized sampling 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 Juan River.

2. To determine the quality and quantity of low-velocity habitats in the San Juan River for use by Colorado squawfish by experimentally stocking YOY fish.

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

4. To characterize nursery habitats and their use in the San Juan 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, 1994, and 1995 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 containers. A sample label will accompany the specimens, and the sample number, date, and San Juan 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.

Nursery Habitat - Five reaches will be sampled in the San Juan River to evaluate Colorado squawfish nursery habitat: Hogback (RM 165-160), Mixer (RM 131-126), Montezuma Creek (RM 89-84), Johns Canyon (RM 25-20), and Grand Gulch (RM 13-8). These areas 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 will experimentally introduce YOY Colorado squawfish in 1996 [see the San Juan River Experimental Stocking Plan for YOY Colorado Squawfish (Lentsch et al. 1995)]. In 1996, 100,000 YOY Colorado squawfish obtained from Dexter National Fish Hatchery will be marked with a unique tetracycline hydrochloride (TC) stain and stocked into the San Juan River. All of these fish will be approximately 30-50 mm in length, stocked in September, and 20,000 will be stocked approximately 1 km upstream from each of the four reaches (described above). The primary objective of experimental stocking is to determine if the quality and quantity of low velocity habitats in the San Juan River are sufficient to support retention and recruitment of YOY Colorado squawfish. All low-velocity habitats (i.e., backwaters, eddies, and shorelines) throughout the four geomorphic reaches will be sampled one week following the release of age-0 Colorado squawfish. This initial sampling will 1) determine if low-velocity habitats within each reach are retaining fish and 2) be in conjunction with current Colorado squawfish nursery habitat sampling (described above). After the first sampling, each reach will be sampled biweekly until deemed necessary. By sampling biweekly, the duration that fish are retained within low-velocity habitats in each reach will be determined. Late March/early April (1997) sampling will determine if there was any overwinter retention of stocked Colorado squawfish. In 1997, the same stocking procedures will be completed, allowing two years of data on YOY Colorado squawfish retention in low velocity habitats based on two flow patterns.

Budget

Personnel	$ 71,000
Travel	$ 6,000
Equipment	$ 13,000
TOTAL	$ 90,000

* Included in the budget is a subcontract with USU for study and travel. Travel budget with USU includes out-of-state expenses for Leo Lentsch.

SAN JUAN RIVER LARVAL FISH PASSIVE DRIFT-NETTING STUDY
University of New Mexico, Albuquerque, New Mexico
Fiscal Year 1996 Work Plan

Background

Beginning in spring 1995, personnel from the Division of Fishes, Museum of Southwestern Biology (MSB), at the University of New Mexico assumed responsibility for the San Juan River larval fish passive drift-netting study. This project, formerly conducted by the Utah Division of Wildlife Resources, 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 assumed 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

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.

Budget

Personnel	$18,500
Travel and Per Diem	4,000
Equipment and Supplies	3,000
Subtotal	25,500
Overhead (15%)	4,500
TOTAL	$30,000

SAN JUAN RIVER SECONDARY CHANNEL COMMUNITY DYNAMICS STUDY
New Mexico Department of Game and Fish, Santa Fe, New Mexico
Fiscal Year 1996 Work Plan

Background

Ichthyofaunal inventories of the San Juan River found differences between the fish community of secondary and primary channels. Differences were noted in species present, their relative abundances, and life stages present. These differences were hypothesized to be mediated in part by differences in habitats available at various river flows. Seasonal inventories of secondary channels were initiated in 1992. These inventories occurred from the Hogback Diversion or Shiprock, New Mexico downstream to Bluff or Mexican Hat, Utah and were conducted during spring(high flows), summer (low flows), and autumn (low to intermediate flows). In addition to detecting seasonal differences in community composition, the inventories found species-specific longitudinal abundance patterns within seasons. These findings prompted initiation (1993) of intensive studies on four secondary channels that, among them, were representative of the array of secondary channels in the San Juan River. These studies indicated that high spring flows serve to annually "reset" the fish community of secondary channels. During spring runoff the fish community is largely composed of native fishes. As runoff recedes, nonnative fishes progressively become more abundant and by late summer and early autumn numerically dominate, by a large margin, secondary channel fish communities. The most common nonnative fishes are red shiner and fathead minnow. With the onset of spring runoff, nonnative fishes decline in abundance. The reproductive biology of each species, the "preferred" habitat of each, relative resistance of each to displacement by elevated flows, thermal and oxygen-depletion stress tolerance, and/or food habits may influence documented changes in secondary channel fish community structure.

After cessation of spring runoff, secondary channel habitats are largely slow-velocity runs and shallow pools. Such habitats represent a low proportion of that associated with the primary channel. Low-velocity habitats, particularly backwaters, are believed to be essential to survival of Age 0 Colorado squawfish. To date, no young Colorado squawfish have been collected in secondary channel habitats. The extremely high abundance of nonnative species, such as red shiner, may be a factor or secondary channel habitats may lack some attribute necessary for young Colorado squawfish. Young roundtail chub, however, were collected in secondary channel habitats, indicating there is suitable habitat for this species. To test the influence of elevated summer flows on nonnative fishes in secondary channels, the Biology Committee requested that summer releases from Navajo Reservoir during 1995 be maintained at 800 cfs rather than the "normal" 500 cfs.

During fiscal 1995 (1 October 1994 - 30 September 1995), three secondary channel inventories between Shiprock, New Mexico and Bluff or Mexican Hat, Utah were made per previous work plans. In addition, four secondary channels were sampled at three week intervals from cessation of spring runoff through October. Between November and spring runoff sites were sampled every six weeks. Studies during 1995 were conducted to enable evaluation and characterization of the response of secondary channel fish communities to higher base summer flows.

Methods

During fiscal 1996, secondary channel monitoring will continue as in previous years with spring, summer, and autumn inventories conducted from Hogback

Diversion to Mexican Hat. Each of the four permanent secondary channel sites will be sampled on the same schedule as in previous years. Following spring runoff site visits, only two permanent sites will be subsequently sampled on a regular basis. These will be the sites at RM 134.9 and 128.6. The efficacy of mechanically modifying the inlet of the secondary channel at RM 128.6 to control flows in the channel will be evaluated. If modification is deemed feasible, a detailed proposal for such will be prepared. If inlet modification is feasible, this secondary channel would be used for detailed studies of effects of different flows (timing, duration, and volume) upon habitats and fish community dynamics. Alternatively, flow spikes via reservoir releases may be a more efficient way to achieve different flows in the secondary channel.

A report analyzing and summarizing the results of the intensive studies on four secondary channels will be prepared during 1996. At this time, continued seasonal monitoring of secondary channel fish communities is anticipated. Study methods for each aspect (seasonal inventories and permanent sites) of the secondary channel studies will remain as in previous years.

Personnel of NMGF also participate in adult monitoring (USFWS-CRFP), fish movement (USFWS-CRFP), and larval drift (UNM) studies.

BUDGET: (Includes participation in non NMGF directed studies.)

Personnel	$62,000
Travel/Per Diem	9,500
Equipment and Supplies	12,000
Subtotal	83,500
Indirect Costs	4,500
TOTAL	$88,000

NON-NATIVE SPECIES INTERACTIONS
U.S. Fish and Wildlife Service, Albuquerque, New Mexico
Fiscal Year 1996 Work Plan

Background

Introduced species have been implicated in the decline of several native fishes. In much of the Colorado River drainage, 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 fish 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 numerically dominated by common 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 habitats were investigated during 1994-1995. Few trends in differences in movement patterns were observed between native and non-native fishes at differing flows. Given the apparent lack of consistent differences in movement patterns, the study was concluded in favor of gaining greater definition of movements by channel catfish, a primary predator and competitor with the native fish community in the San Juan River.

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.

Activities under this 1996 workplan add a radio telemetry study of channel catfish to determine movement patterns related to reproductive activities and habitat use. Previous mark and recapture studies of channel catfish movements during this study have indicated limited movement patterns. Most literature, however, generally recognizes seasonal movements for reproductive purposes. The past studies have not identified such movements, probably due to inherent difficulties in the recapture of tagged fish (frequency of collection efforts, chance of recapture). A radio telemetry study of channel catfish will allow for greater definition of not only general movement patterns, but aspects regarding habitat use and relationship to rare native species habitat use patterns. Initiation of this study will also allow for the collection of data related to future conduct of winter low-flow studies.

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. Initiate studies to determine diel and seasonal movement patterns and habitat use of non-native channel catfish in relation to flow patterns in the San Juan River using radio telemetry.
4. Determine the distribution, abundance, and movement of channel catfish and common carp by tagging studies.

Methods

Channel Catfish and Common Carp Movement and Abundance

Sampling protocol - Conducted concurrently with the adult monitoring sampling from Hogback to Mexican Hat (May, October) non-native fish will be collected by electrofishing and trammel netting in one river mile increments. All non-native specimens collected will be identified, enumerated, and removed from the study area. At designated miles (every fifth mile) non-native specimens will also be measured (TL and SL), weighed, sexed, and removed. All recaptured channel catfish and common carp with floy tags from tagging efforts 1992-1996 will be measured and weighed and the tag number and capture location (i.e., river mile) recorded.

Sampling will be conducted from Mexican Hat to Clay Hills (June, August) in conjunction with adult monitoring sampling. An additional trip will be conducted during July. Channel catfish and common carp will be measured, tagged, capture location recorded, and released during the June and July trips at each designated mile and will be removed during the August trip. All other non-native fish species will be removed on all three trips (see food habits below).

All data analyses will be reported by river mile.

General Sampling requirements:

No. of trips:	2 (May, Oct), Hogback to Mexican Hat; 3 (June, July, Aug), Mexican Hat to Clay Hills
Duration:	5-10 days
Personnel/trip:	2-3

Channel Catfish Radio Telemetry

Sampling protocol - Adult channel catfish will be implanted with radio transmitters in three reaches of the San Juan River: RM 85-80 (Bluff), RM 100-105 (Aneth), RM 130-135 (Mixer) during August 1996. Six channel catfish will be implanted in each reach with three at 300-450 mm TL and three > 450 mm TL. Transmitter frequencies will be coordinated with rare fish telemetry studies to ensure non-overlap. Surgical procedures will be similar to those described by San Juan Researchers for rare fish studies and previous ictalurid studies. Movements will be determined by initiation of monthly flights by U.S. Fish and Wildlife Service fixed-wing aircraft in September 1996 and/or in conjunction with rare fish telemetry study flights . On the ground habitat use data collection will be initiated immediately after the first monthly flight (September) and continue on a seasonal basis thereafter (defined in 1997 workplan). Once an implanted channel catfish is located, observations will be made during early morning and late afternoon/evening for a period of one hour each. Data will be recorded for: date, river mile, time of day, water clarity, habitat used and time in that habitat, cover type within one meter, distance to shore. Habitat classifications will be those defined by Bliesner and Lamarra in geomorphology studies. At the completion of the hour-long observation period, the channel catfish will be disturbed to ensure that it is alive if it has not moved and each habitat used will be classified, measured for depth and current velocity, and associated cover defined. Data analyses will include an evaluation of the difference in movement and habitat use of the two size classes of channel catfish within and among the three study sub-reaches. These data will also be provided to rare fish studies as necessary for evaluation of similarities in patterns relative to season and flow.

General Sampling Requirements:

No. of trips:	1 (Aug) to implant fish, 2 (Sep, Oct) flights, 1 (Sep) habitat use
Duration:	1-6 days
Personnel/trip:	2-4

Food Habits

Sampling protocol - Food availability and use data will be collected in both main channel and secondary channel/backwater habitats at RM 134. 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 four times during the year. Sampling for food habits will be conducted four times during a 24 hour period (dawn, day, dusk, night) to assess diel feeding patterns during each sampling trip.

With the elimination of the barrier falls at Clay Hills Crossing and the subsequent capture of striped bass, walleye, and largemouth in 1995 between Mexican hat and Clay Hills, three electrofishing trips (Jun, Jul, Aug) will be conducted in this reach in 1996 to evaluate food habits of these three predators, as well as a sub-sample of channel catfish collected during August. These trips will be conducted in conjunction with the adult monitoring efforts (Jun, Aug) and non-native tagging efforts (Jul). Stomach contents of non-native lentic specimens will be examined for food habits.

At each collection locality, data will be recorded for date, time, and river mile sampled. Invertebrate samples will be preserved in 95% ethanol and stomach samples will be preserved in 10% formalin for later laboratory analyses. Food item categories and invertebrate taxa will be reported as in previous nonnative species reports. All data analyses will be reported as a function of river mile location and associated habitat features.

General Sampling Requirements:

No. of trips:	4 (Apr, Jul, Aug, Oct) for food availability and use, 3 (Jun, Jul, Aug) for lentic non-native species food habits
Duration:	4-6 days
Personnel/trip:	2-4

Budget: FY-96

Personnel	$30,000
Travel/per diem	$ 2,500
Equipment and Supplies	$10,000
Subtotal	$42,500
FWS Administrative Overhead (17.65%)	7,500
Total	$50,000

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

Utah Division of Wildlife Resources, Salt Lake City, Utah
U.S. Bureau of Reclamation, Durango, Colorado
Fiscal Year 1996 Work Plan

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 support the only known naturally occurring congregations of razorback sucker in the San Juan River Basin. In 1988 as Lake Powell receded from full pool (3700 ft. above mean sea level AMSL) the San Juan river cut a new channel through deposited sediments. The new water course fell over a rock ledge creating a 25-30 foot waterfall. The newly created waterfall became an effective barrier to fish migrations. During the summer of 1995 the lake again approached full pool (3694 feet AMSL) covering the waterfall. As a result the fish barrier was eliminated and once again non-native species were able to move from Lake Powell into the San Juan River. The reinvasion of nonnative species into the San Juan River may result in increased competition and predation pressure on native and endangered species.

Colorado squawfish - Sampling in the San Juan River since 1991 has resulted in the collection of young-of-year (YOY) Colorado squawfish from backwaters and larval fish in the mainstream drift (Table 1). Collections of YOY Colorado squawfish during this time 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 YOY 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	4/7	YOY[2]	11.7
	4/7	YOY[2]	11.7
	8/4	YOY	122.6
	8/12	YOY	25.2
	8/13	YOY	9.8
	8/13	YOY	9.8
	9/24	YOY	8.0

[1] No young fish found in collections during 1991
[2] 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 River 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:

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

- 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.).

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

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

- 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).

- 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).

- 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.).

- Fourteen adult razorbacks were collected (4 were recaptures) during April, 1990 in a joint effort by 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

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

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 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 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).

o One adult razorback was collected by USBR/NBS/NPS during March 1995 near Copper Canyon (RM -8). This razorback was captive reared and had been surgically implanted with a radio transmitter and released near Bluff Utah (Mueller 1995).

Intensive ongoing collections between 1990 and 1994 as part of a continuing research program and the San Juan Recovery Implementation Program (SJRRIP) 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 assumed that no significant recruitment of young fish is occurring. However, data is extremely limited.

Nonnative fishes - In 1988 when Lake Powell receded from full pool, the San Juan River cut a new channel through deposited sediments. The result was a 25-30 foot waterfall, which acted as an effective fish migration barrier by preventing nonnative species in Lake Powell from moving upstream into the San Juan River. For example, largemouth bass, striped bass, threadfin shad, and walleye were not seen in adult sampling trips in the lower San Juan River when the waterfall was present (Ryden 1995, personal communication). However, during the summer of 1995, the lake approached full pool and the waterfall (fish barrier) was eliminated. During an August 1995 adult sampling trip, the above species were present throughout the lower San Juan River (RM 52-2.9) (Ryden 1995, personal communication).

GOALS AND OBJECTIVES

The available information on Colorado squawfish and razorback sucker in the San Juan River demonstrates a need to monitor the lower San Juan River and upper inflow of Lake Powell for occurrence of young Colorado squawfish, adult and immature razorback sucker, and all life stages of nonnative species. Monitoring of these habitats will provide needed information on production of young Colorado squawfish in a given year and the potential importance of these habitats for recovery of the species. Monitoring of these habitats would provide information on the status of razorback sucker in the San Juan Arm of Lake Powell. Monitoring the fish community will also be important in assessing possible impacts that invading nonnative species will have on the native and especially, endangered fish species.

Goal

To provide an integrated approach to understanding population dynamics of Colorado squawfish, razorback sucker and invading nonnative fishes from Lake Powell 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.

3. Monitor the effects that inundation of the waterfall (fish barrier) will have on the fish community in the lower San Juan River.

METHODS

Colorado squawfish - The inflow area of the upper San Juan Arm of Lake Powell will be sampled using the same general methodologies as other early life stage studies of Colorado squawfish in the San Juan 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 and 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 & SJRRIP 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.

Nonnative Invasion - The nonnative community will be sampled monthly from March-October using seines, electrofishing, and netting. The most efficient sampling technique will be used depending on flow and sampling conditions. The species targeted during these trips will be largemouth bass, smallmouth bass, striped bass, threadfin shad, walleye, and green sunfish. The March sampling trip will be to inventory the river and inflow areas, specifically targeting pre-spawn adult nonnative fishes. Trips in April and May will document nonnative reproduction. Trips from June-October will document nonnative fish migrations and habitats they are utilizing. Depending on the results from the 1996 sampling trips, sampling in 1997 can be fine-tuned accordingly. The sampling will be within the Glen Canyon National Recreation Area beginning at its boundary on the San Juan River to the inflow of Lake Powell. Data will be collected in relation to the location, and habitat type at the site of capture. Also, length and weight data will be collected, as well as the condition of the fish captured. All endangered fish encountered which are large enough to be PIT tagged will be scanned for PIT tags. If a tag is not found the fish will be implanted with one and released.

ADMINISTRATION

Responsibility

Utah Division of Wildlife:

- Lead agency for ensuring that studies are coordinated
- Lead agency for ensuring that YOY Colorado squawfish sampling is consistent with nursery habitat studies in San Juan River
- Lead agency for ensuring that nonnative sampling is conducted
- 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 ($)	IN-KIND BOR ($)	IN-KIND TOTAL ($)	SJRRIP BOR ($)	SJRRIP UDWR ($)	SJRRIP TOTAL ($)	PROJECT TOTAL ($)
CSF:YOY							
PERSONNEL	3,500		3,500	4,800	4,200	9,000	12,500.00
EQUIPMENT	2,000		2,000	1,800	1,400	3,200	5,200.00
TRAVEL	2,000		2,000	1,400	1,300	2,700	4,700.00
SUB-TOTAL	7,500		7,500	8,000	6,900	14,900	22,400.00
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
NONNATIVE							
PERSONNEL					13,900		
EQUIPMENT					3,500		
TRAVEL					1,400		
SUB-TOTAL					18,800		
TOTAL	7,500	40,000	47,500	8,000	27,500	14,900	62,400.00

INSTREAM HABITAT QUANTIFICATION USING AIRBORNE VIDEOGRAPHY
U.S. Bureau of Reclamation, Denver, Colorado
Fiscal Year 1996 Work Plan

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 videographic data from different flow scenarios to 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 only, at time determined by BIA representative for intensive field mapping (BIA to provide funding for acquisition costs).

Methods

Objective 1. As in 1995, 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	$ 8,500
Agency overhead	1,000
Travel	500
TOTAL	$10,000

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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	$33,500
Travel and Per Diem	2,000
Equipment and Supplies	4,180
Subtotal	$39,680
Overhead (15%)	5,952
TOTAL	$45,632

PROGRAM MANAGEMENT
U.S. Bureau of Reclamation, Salt Lake City, Utah
Fiscal Year 1996 Work Plan

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.

Budget

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

PROGRAM COORDINATION
U.S. Fish and Wildlife Service, Albuquerque, New Mexico
Fiscal Year 1996 Work Plan

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	$35,000
Travel/Per Diem	3,000
Meetings, supplies	5,000
Printing/publication	5,000
Administrative Support	9,500
TOTAL	$57,500

BIOLOGICAL EFFECTS STUDIES
National Biological Survey, Yankton, South Dakota
Fiscal Year 1996 Work Plan

Background

Limited analyses of water, sediment, and tissue collected from the San Juan River have shown the presence of selenium and other inorganics and organics 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 and organics to threatened or endangered fish in the San Juan River is unknown. Information is needed to identify waterborne and dietary contaminants that may adversely affect the recovery of threatened or endangered fish. Acute tests should be conducted with individual inorganics and organics and with mixtures of inorganics and organics in their environmental ratios found at potentially harmful sites along the San Juan River used as nursery areas by endangered or threatened larval fish or staging areas by adults. Those inorganics and organics that show high toxicity in acute toxicity tests relative to their environmental concentrations should be further evaluated in long-term tests to determine sublethal effects and to delineate the relation between whole-body burdens and other biological effects. Long-term tests are needed with endangered adult fish to assess the potential for inorganic and organic contaminants to adversely affect reproduction.

Objectives

Determine the chronic effects on reproduction of adult Colorado squawfish (Ptychocheilus lucius) of combined waterborne exposure to a mixture of inorganics and a dietary exposure to organic selenium.

Methods

A long-term chronic toxicity test will be conducted according to standard methods, except that the water quality will simulate that in the San Juan River. The test species will be adult Colorado squawfish acquired from Dexter National Fishery, NM. The test will be conducted for 180 days with fish exposed to dietary selenium and a mixture of inorganics from a site with elevated concentrations that potentially could be adversely affecting endangered larval fish. The study will include three replicates each of a control and three treatments. After 180 days of exposure to dietary selenium and a waterborne mixture of inorganics simulating conditions in the San Juan River, adults will be induced to spawn and the resulting hatch larvae exposed to the inorganic mixture and dietary selenium for about 30 days post-hatch.

The water temperature and photoperiod will simulate conditions in the San Juan River. The water quality in chronic toxicity test will simulate that in the San Juan River in terms of the major cations and anions at Shiprock, New Mexico: hardness 150 mg/L, alkalinity 89 mg/L, Ca 43 mg/L, Mg 9.2 mg/L, Na 22 mg/L, Cl 5.9 mg/L, SO_4 89 mg/l (Beal, L.V., and R.L. Gold. 1986. Water Resources Data New Mexico Water Year 1986. USGS Water Data Report NM-86-1, Albuquerque, NM. Station ID 09368000, 11/05/85, Shiprock NM).

The biological measures in the test 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), 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).

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

Budget

Long-term reproduction test with adult Colorado squawfish.

Personnel	$36,140
Travel/Per Diem	1,000
Equipment and Supplies (chemicals, glassware)	4,100
Selenium diet	7,000
Neutron activation analysis (adult muscle	15,600
plug)	12,000
Neutron activation analysis (larval fish	25,000
Chemical analysis	
Subtotal	100,840
NBS Administrative Overhead - 19%	19,160
Proposed Budget FY96	$120,000
Redirected FY95 funding*	-10,000
TOTAL Proposed Budget FY96	$110,000

*The funding obligated in FY95 ($10,000) for toxicity tests with roundtail chub will be used in FY96 to reduce the budget request. No roundtail chub were available in FY95 for testing.

SAN JUAN RIVER FISH DISEASE SURVEY
U.S. Fish and Wildlife Service, Pinetop, Arizona
Fiscal Year 1996 Work Plan

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 above Hogback and below Mexican Hat in FY 96.

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 shocking boats for disease incidence (completed for 1991-August 1994).

Budget:

Personnel	$ 7,500
Per Diem/Travel	1,000
Equipment and supplies	1,500
TOTAL	$10,000

SUMMARY REPORT FOR SAN JUAN RIVER RIP BIOLOGY STUDIES
BIOWEST Incorporated, Logan, Utah
Jicarilla Apache Tribe
Fiscal Year 1996 Work Plan

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.

In 1995 an Integration Report was prepared that summarized the studies that had been conducted during the first four years of the Program. Actual integration of study data was limited during that first year since the major task involved compiling all the information collected to that time. Lack of a common database also made it difficult to integrate information. The intent of the Integration Report was that it would be updated annually to keep interested parties up to date with the Program, and that data integration would be emphasized more after the first year.

The Biology Committee determined during a meeting in March, 1996 to utilize a different approach in data integration and Program reporting. It was decided to initiate a detailed integration process involving subcommittees of researchers aimed at developing flow recommendations in 1998, a major milestone of the Program. In addition, the name of the Integration Report would be changed to Summary Report, and it would be updated each year based on the results of the annual research reports. The Summary Report would also include discussions of new directions being taken by the Program, and recommendations for changes in the Long Range Plan under the principals of adaptive management.

The goal and objectives of the Summary Report include:

Goal

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

Objectives

1. Develop a report that summarizes current research to determine how well the major goals of the San Juan RIP are being met by the biological studies being conducted under its auspices.

2. Detail proposed changes in direction by the Program and propose changes to the Long Range Plan.

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

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

Methods

The format of the report will remain the same as that used in 1995. Results from 1995 research activities will be included in the report and sections, as required, will be updated.

In addition to the annual updating, several specific milestones will be discussed in more detail. One of these areas is the integration framework that was

developed at the March 1996 meeting of the Biology Committee for the development of flow recommendations. Progress of the various subcommittees that were set up will be summarized, as will the schedule for future integration (LRP section 5.2.7). Another area to be discussed will involve a plan to expand Colorado squawfish populations into the San Juan River above some of the major diversions but below the mouth of the Animas River (LRP sections 5.2.9 and 5.3.8.2). This discussion will be in the form of a "white paper" that discusses the reasons for this proposal and the general methods for implementation. The third area that will be developed in more detail will be recommendations for changes in the Long Range Plan, if any (LRP section 5.7). The fourth area to be discussed in more detail will be the recommendations from the external Peer Review panel (LRP section 5.7) as part of the adaptive management process.

A draft report will be prepared and that report will be reviewed by the Biology Committee. A final report will incorporate comments from the Biology Committee. The final report will be printed for distribution to the Biology Committee, Coordinating Committee, and other interested individuals, agencies, etc. A presentation of the Final Report will be made to the Coordinating Committee and interested publics.

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

Budget

Personnel	$29,000
Travel	1,000
TOTAL	$30,000

PEER REVIEW
Panel To Be Determined
Fiscal Year 1996 Work Plan

Background

Research for the SJRRIP was initially guided by the Seven Year Research Plan developed by the Bureau of Reclamation in response to informational needs related to potential impacts caused by the Animas-La Plata Project, 1991-1992. With the initiation of the SJRRIP, the Long Range Plan (LRP) was subsequently developed to guide the collection of data designed to address recovery objectives. The LRP defines the process whereby data obtained through the SJRRIP will be used for the development of recovery recommendations designed to address the goals of the SJRRIP.

With the completion of 1995 work activities data are available from five years to initiate comprehensive integration of research results to assess progress towards identification of recovery objectives. This workplan is designed to initiate a technical review by non-SJRRIP researchers of research results to date. The initial stage of this review is designed to assess the knowledge available on limiting factors within the San Juan River and associated research objectives. The review process initiated in 1996 will be used by the Biology Committee to ensure that necessary research is conducted during the remainder of the Seven Year Research Program for development of initial flow recommendations in 1998.

A panel of qualified reviewers is proposed within this workplan to accomplish the initial review. The review panel will be provided the LRP, which will serve as an overview of the SJRRIP, including recovery goals and objectives, factors limiting native fish populations, and research objectives. In addition, annual research reports will be provided to the panel and available for use in assessing the applicability of research objectives. Secondarily, general assessment of methodologies and reported research results will be accomplished in specific areas of expertise by each panel member.

Objectives

1. Using the LRP as the basis, review the 1995 and 1996 summary reports to assess their overall effectiveness and accuracy in characterizing attainment of research objectives.
2. Review research methodologies and analytical techniques of each study.
3. Review appropriateness of associated research objectives in addressing factors limiting the native fish population (emphasis on Colorado squawfish, razorback sucker).
4. Develop recommendations for necessary changes to be reflected in 1997 workplan.
5. Develop review process for the completion of initial recovery recommendations in 1998.

Methods

A list of names of qualified experts in the fields of hydrology and geomorphology, fish ecology, and general aquatic biology (including water chemistry, fish health) will be developed. From this list, the Biology Committee will select a panel that includes one representative from each field. This selection will be based upon availability and willingness to participate in the process and will be reviewed and approved by the Coordination Committee. The panel selection process will be completed in July 1996. Appropriate review materials will be provided to the panel in July 1996.

A meeting of the panel and the Biology Committee will be convened in October, 1996. The purpose of the meeting will be to assess the appropriateness of research objectives in accomplishment of recovery goals for the Colorado squawfish, razorback sucker, and remaining native fish community. Each panel

member will provide to the Biology Committee written comments regarding results of the initial review prior to the meeting. These comments will be discussed at the meeting and used to incorporate any changes necessary during development of the 1997 workplan. The meeting will also determine the scope and process of a more intensive review process for the completion and implementation of initial recovery recommendations to be completed in 1998.

The results of the meeting will be reported and a draft workplan reflecting the results of this review will be submitted to the Coordination Committee in a meeting in November 1996. The purpose of this meeting will be to report on the accuracy of research objectives in attaining SJRRIP goals, any changes necessary in research objectives and/or methodologies, and development of a review process for completion and implementation of recovery recommendations to be completed in 1998.

Budget
Reported as total for three panel members.*

Document review, comments, meeting attendance	$ 3,000
Travel to one meeting	2,000
Total	$ 5,000

*Some prospective panel members have indicated that there would be no charge for peer review since this is considered an expected commitment to research.

DATA MANAGEMENT FOR FISHERIES DATA
U.S. Fish and Wildlife Service
Fiscal Year 1996 Work Plan

Background

During the period 1987-1993, all biological data related to the various fisheries surveys for the Seven Year Research Program of the San Juan River Recovery Implementation Program was compiled into a single computerized database. Most data collected during the 1994 study year is also included in the database, but data is lacking for two studies (early life history, secondary channels) and that data is scheduled to be included in the existing database. A single database was developed that includes all fields (character and numeric) necessary to accommodate all pertinent data pertaining to date, location, species, length, weight, sex, condition, food habits, habitat sampled, etc.

Funding was not sought for this endeavor during Fiscal Year 1995, but all relevant fisheries data has or is planned to be entered into the existing database. Efforts were initiated during 1995 to summarize current research findings into an integration report to assist in determining the status of the various research topics outlined. In that report, the development of a database that could be used to integrate all research findings was proposed. Due to the existing computerized database for the fisheries data, any efforts to establish such a database will be accelerated.

This workplan proposes to reinitiate and intensify efforts to compile all relevant fisheries biological data into a single computerized database for integration with other biological (contaminants-related) and physical habitat data.

Objectives

1. Compile all fisheries data into a computerized database compatible with existing contaminants and physical habitat databases.
2. Incorporate appropriate fisheries data collected prior to 1987.
3. Develop a database for fisheries data accessible by all SJR researchers.

Methods

The existing database will be updated to include all relevant fisheries data collected in 1994 and 1995 not currently in the database. All such data collected during 1996 will be entered in the database. The current database structure and format will be sent to all Biology Committee members and researchers and solicited for input on revisions and updating. This will ensure compatibility of the fisheries database to other biological and physical databases for the Seven Year Research Program.

Budget

Personnel	$5,000
Travel	-0-
Equipment and supplies	2,500
TOTAL	$7,500

ADULT COLORADO SQUAWFISH HABITAT USAGE
IN THE SAN JUAN RIVER, 1996
FISCAL YEAR 1996 WORK PLAN

Background

One element of the San Juan River Seven Year Research Plan is to determine the habitat requirements of the endangered species in the San Juan River. Determining habitat use is key to understanding the relationship between habitat availability and discharge at various times of the year. This relationship is critical in the recovery process for the endangered species. Understanding that relationship will help to determine if habitat is limiting the endangered species in the river. This work element is a continuation of the 1993 habitat use study. The study will consist of radio tracking implanted fish to determine both the location within a reach of river and the habitat use by those fish. Habitat studies are listed as one component of the adult monitoring studies. As such, there will be interaction between the adult monitoring studies and the squawfish habitat use studies. The habitat use information collected in this study and the physical habitat study information will aid in the determination of habitat-flow relationships for the river. Links to these other research elements will require integration of the research findings between the researchers.

The 1996 activities will include additional monitoring during the spawning period. The radio tracking will be conducted for three weeks during the summer of 1996. The methods will be the same as those used in the previous habitat use study. This study is contingent upon capture of Colorado squawfish during the April and May electrofishing activities.

Objective

The objective of the habitat study proposed here is to describe the habitat use of macro and micro habitats by Colorado squawfish (*Ptychochelus lucius*) in the San Juan River. This study will use radio telemetry to determine habitat use in the San Juan River during summer, with particular emphasis on locating spawning sites. The location of the spawning sites will be used to place larval drift nets immediately downstream of the sites during spawning. Placement of those nets will be conducted under the larval drift task.

Methods

The methods used in this study will be similar to those in previous habitat suitability studies. It will follow the procedures in Tyus (1988) and Wick and Hawkins (1989). We plan to use radio telemetry on fish that have been previously implanted during the adult monitoring research of the San Juan River Seven Year Research Plan. No additional fish will be captured or implanted during this study.

This study would monitor the fish for three weeks during the spawning season. It is most beneficial to gain the maximum amount of habitat use data during the spawning period. This study would have a sufficient number of observations on habitat usage to summarize the data with descriptive statistical techniques but probably not for any hypothesis testing. This study would provide additional information on location and use of specific habitat types within the river by squawfish.

Daily observations An observation schedule will be completed before field data collection begins. Each day scheduled for observation will be divided into four observation periods. The observation periods will be for six hours each and be determined by sunrise and sunset times.

Observations will be made during morning and late afternoon/evening everyday of a scheduled observation week. A random selection process will be used to determine which fish will be observed during each period. That fish will be located and tracked for a two hour period. Any locations where the fish spends more than 30 minutes will be marked and later measured for habitat variables. To gain data on habitat characteristics near the fish location, a detailed habitat map will be completed on overlays of aerial videography. This will allow some limited statistical testing of habitat usage.

The habitat usage data will include a sketch of the habitat where the fish is located with the position of the fish marked on the map. The data collected at the fish location will include date, time of day, weather conditions, time spent at each location, and any notes on movement during the observation period. The habitat data collected at each fish location will include total water depth, water velocity (mean column and bottom), substrate type, proximity to cover, description of cover at the location, general description of the site, measurements of the habitat type including length, width, bank features, shoreline vegetation, dominant substrate and cover for the habitat type. Other parameters measured will include water and ambient temperature, dissolved oxygen, conductivity, pH. Discharge will be obtained from the nearest USGS gaging station.

Data analysis No data analysis will be completed in FY 1996. All data analysis will be completed as a part of the winter habitat use study during the winter of 1996/1997.

Report No annual report for the study will be completed as part of the FY 1997 activities and not in FY 1996.

Personnel

The study would be conducted by Miller Ecological Consultants, Inc. (Miller) with assistance, as available, from the other San Juan River Researchers. Miller would be responsible for all personnel and equipment to complete the study, with the exception being the fish that are radio tagged by the USFWS.

The principal investigator for the study will be Dr. William J. Miller. Dr. Miller will be responsible for final study design, directing the data collection and analysis, and the final report. Dr. Miller will be assisted on the study by a field biologist whose primary responsibilities will be leading the field crew gathering the habitat data and be responsible for data analysis. The field biologist will be assisted by one field technician. This crew, with assistance from Dr. Miller, will gather the habitat use data.

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.

Table 1. Estimated costs for 1996 Colorado squawfish habitat use summer field work.

Labor	$13,400.00
Travel	3,345.00
Equipment & supplies	3,255.00
Total	$20,000.00

SAN JUAN HABITAT RESEARCH
Keller-Bliesner Engineering, Logan, Utah
Bureau of Indian Affairs, Farmington, New Mexico
Fiscal Year 1996 Work Plan

GEOMORPHIC CHARACTERIZATION

Background

In 1994, the San Juan River between Lake Powell and Navajo Dam was characterized into 8 geomorphically distinct reaches. In 1995, this characterization is being compared to selected reaches in the Colorado and Green Rivers where comparable data exist and are available. Geomorphic and habitat conditions are being compared to 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.

In addition, initial analysis of relationships between hydrology and geomorphology are being examined.

Objectives

1. Develop Hydrology/Geomorphology Relationships by Reach. Further development and refinement of hydrology/geomorphology relationships begun in 1995 will allow refinement of flow/habitat models for each reach, providing a geomorphic foundation for habitat/flow relationships and individual reach analysis.

2. 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, habitat and hydrology data from 1992-1995, relationships between geomorphic condition, habitat availability 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. (Ongoing task from 1995.)

2. Compare Upper Colorado River and San Juan River Basin Geomorphology. Utilizing data from item 1 above, from 1995 studies 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. (Continuation of task started in 1995).

Budget (Funded by BIA)

Labor	$ 17,600.00
Travel: per diem	0.00
Vehicle/Equipment use	1,000.00
Supplies	1,000.00
Overhead (10%)	2,000.00
TOTAL:	$ 21,600.00

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 1995. Many of the data collection tasks will continue for the duration of the research period.

Objectives

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

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

3. Cobble/Gravel Entrainment Analysis. Analyze cobble transport conditions at identified and potential spawning locations to determine flows required to form and maintain spawning bars.

5. Analyze Mechanism of Low Velocity Habitat Formation. Analyze conditions necessary to develop and maintain persistent, high quality backwaters.

Methods

1. River Geometry Analysis. The 13 cross-sections surveyed in 1993-19945 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 1995. 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.

2. 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.

3. Cobble/Gravel Entrainment Analysis. Potential spawning sites were identified in 1995. These sites as well as presently identified spawning sites will be surveyed and modeled to determine the hydraulic conditions necessary to develop and maintain these and similar sites in the river.

Series of cross-section surveys will be completed upstream of each reach and water surface profiles measured over a range of flows to determine transport conditions for cobble deposition. 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 flow rate at which cobble and gravel sizes found in suspected spawning locations are entrained at these locations. Initial shear stress calculations completed in 1995 will be verified with more detailed modeling of these reaches.

5. Analyze Mechanism of Backwater Habitat Formation and Maintenance. In 1995, backwaters that have persisted for more than 1 year and more than 2 years were identified and habitat quality parameters were measured. A representative sample of these persistent backwaters will be surveyed, along with the channel control necessary for their formation and maintenance and the hydraulics of the reaches characterized. Those conditions unique to these backwaters will be identified and the hydraulic conditions necessary to create and maintain them determined. The feasibility of augmenting backwater habitat by construction of similar features will be examined.

Budget (Funded by BIA)

Labor	$148,500.00
Travel: per diem	18,500.00
Vehicle/Equipment use	4,000.00
Supplies	3,000.00
Overhead (10%)	17,400.00
TASK IV TOTAL:	$191,400.00

HABITAT MAPPING AND RESOURCE UTILIZATION

Background

The documentation of habitat types within the San Juan River from RM 225 to RM 0 will be continued during FY96, although at a somewhat reduced scale. Sufficient data have been collected to develop habitat/flow relationships, with verification of stability with time and flow change. More emphasis will be placed on habitat quality assessment and its spacial and temporal variability.

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 -1995, the physical conditions within the spawning bar were investigated in detail. During FY96, 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 1995 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 1995 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 1995 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 1995, including identification of other locations exhibiting similar characteristics to the documented spawning bars, detailed sampling of the most comparable sites will be completed.

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. Two flow rates will be mapped (one base flow for analysis of change with time and one additional flow to be selected after analysis of the 1995 data).

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 1995 as most similar to the spawning bars will be sampled in detail for quantitative comparison and assessment. This is ongoing work to document the change in conditions with time and hydrologic conditions.

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	$176,000.00
Travel: per diem	10,900.00
Vehicle/Equipment use	5,000.00
Supplies	4,000.00
Overhead (10%)	19,600.00
TOTAL:	$215,500.00

FLOW/HABITAT MODELING

Background

With the accumulation of three additional habitat mapping data sets for the entire river, preliminary model development begun in 1994 and continued in 1995 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. This task was begun in 1995 and the strategies will be refined and updated in 1996.)

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	$ 66,200.00
Travel: per diem	4,000.00
Vehicle/Equipment use	4,000.00
Supplies	2,000.00
Overhead (10%)	7,600.00
TASK IV TOTAL:	$ 83,800.00

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	$7,840.00
Travel: per diem	0.00
Vehicle/Equipment use	1,100.00
Supplies	0.00
Overhead (10%)	900.00
TOTAL:	$9,840.00

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	$ 3,900.00
Travel: per diem	270.00

Vehicle/Equipment use	450.00
Supplies	200.00
Overhead (10%)	480.00
TOTAL:	$ 5,300.00

GIS Based Integrated Database Development

Background

One of the long term objectives is the development of an integrated database. To date, the data collected by various researchers has not been fully integrated. U.S. Fish and Wildlife Service is maintaining a database for some of the fisheries data, but not all. Habitat availability and quality data are maintained in a separate, geographic information system (GIS) based database. Habitat utilization, YOY fish data and contaminants data are not integrated into either of these databases.

The utility of the GIS database for habitat and geomorphic data has been demonstrated in the analysis of geomorphically distinct reaches and in identification of relative permanence of backwaters. With geographically referenced data from the other areas, the functionality of the GIS system would be greatly enhanced and the ability to integrate the data from the various studies for comparative analysis would be improved. The challenge is to develop a system that allows easy access to the data by all researchers. The GIS system allows direct access by any user with a compatible GIS system, and extraction of data into other database or spreadsheet formats is relatively easy once the data structure and query requirements are identified.

Objective

1. Identify Data Sets, Formats and Adaptability to GIS. The format of each data set must be determined and, where possible, standardized for incorporation into the database. For incorporation into the GIS system, the requirements to geographically reference the data must be identified and a method determined for completing the georeferencing.

2. Develop Integration Strategy. The data sets vary greatly in content and structure. Some data are site specific and can be identified with a particular point in space. Other data represent an integration over a particular area with a larger spacial representation. Some data are spacial in nature (e.g. habitat area) and others are not (e.g. number of fish per river mile). The nature of integration must be determined to allow incorporation and analysis.

3. Georeference Data. Before data can be included in the GIS, it must be geographically referenced. Habitat and geomorphic data are presently georeferenced. Habitat quality data is now being georeferenced for inclusion as coverages in the GIS system. Other appropriate data sets must also be georeferenced for inclusion in the system.

4. Develop User Access and Query Protocol. For the GIS system to be useful, a protocol for user access and query must be established. Once the types of data queries are identified, the user interface can be developed to allow relatively easy access to the data.

Methods

1. Identify Data Sets, Formats and Adaptability to GIS. Each researcher will be contacted and the data format of each data set identified. Samples of electronically stored data will be obtained and tested for integration and any necessary changes in format identified. The requirements for georeferencing will be determined for each data set.

2. Develop Integration Strategy. Once the data sets are identified, an inclusion strategy for each data set will be developed. It will be necessary to determine the nature of cross-integration required and it may be necessary to add or delete certain categories of data for reasonable integration. It is anticipated that the input of all researchers and common agreement as to the nature of integration will be necessary. A draft approach incorporating informal ideas from the group will be developed and circulated for more formal review before the strategy is tested. Samples of each data set will be incorporated into the GIS and tests completed to refine the integration process.

3. Georeference Data. Data sets that are in electronic format and are selected for incorporation will be georeferenced and included as coverages in the existing Habitat GIS system as time allows. It is anticipated that data collected by river mile would be attached to the center of the river mile. Site specific data such as YOY sampling sites, may require identification of the sites on aerial photos for incorporation. We would coordinate with each researcher for the most appropriate method of georeferencing. We will provide base maps for georeferencing, if the researchers can identify the sampling sites.

4. Develop User Access and Query Protocol. When initial georeferencing and incorporation of the databases is started, user access and query protocols can be developed and tested. A proposal with alternatives will be developed with the input of the researchers and circulated for review. The protocols will be tested and output data sets developed for trial use by individual researchers.

Budget (Funded by BIA)

Labor	$ 56,300.00
Travel: per diem	1,600.00
Vehicle/Equipment use	1,000.00
Supplies	600.00
Overhead (10%)	5,900.00
TOTAL:	$ 65,400.00