SAN JUAN RIVER RECOVERY IMPLEMENTATION PROGRAM

SEVEN YEAR RESEARCH PROGRAM

DRAFT BUDGET AND WORK PLAN

FISCAL YEAR 1997

PREPARED FOR
SJRRIP COORDINATION COMMITTEE

PREPARED BY
SJRRIP BIOLOGY COMMITTEE

COMPILATION AND SYNTHESIS OF INFORMATION COLLECTED ON SAN JUAN RIVER FISHES DURING 1990, NEW MEXICO AND UTAH

1997 Work Plan

New Mexico Department of Game and Fish

Background:

During 1987 through 1989, the New Mexico Department of Game and Fish, Utah Division of Wildlife Resources, U.S. Fish and Wildlife Service, and University of New Mexico conducted ichthyofaunal studies (funded by U.S. Bureau of Reclamation) of the San Juan River between Farmington, New Mexico and Piute Farms Marina, Utah. Data collected during this study were compiled and synthesized in Platania (1990).

During 1990, New Mexico Department of Game and Fish, Utah Division of Wildlife Resources, and U.S. Fish and Wildlife Service continued seasonal monitoring of the San Juan River fish community. In New Mexico, this involved spring, summer, and autumn sampling efforts between Shiprock and Four Corners. Similar efforts were made in Utah. Funding to support these efforts, however, was limited and the work was not as thorough as that accomplished between 1987 and 1989.

No data collected on the fish communities of the San Juan River in 1990 have been compiled or synthesized. Currently, this information resides in field notes, museum records, and trip reports.

Proposed Work:

Data collected by Utah Division of Wildlife Resources and New Mexico Department of Game and Fish personnel on San Juan River fish communities during 1990 will be compiled and synthesized. Likely data sources are field notes, preserved specimens, laboratory specimen identification records, trip reports, museum accession records, and federal-aid reports.

Data will be tabularized in format suitable for inclusion in the computerized San Juan Fish Database. Minimally, this will include sampling technique, effort, species, and number of specimens per species per river mile (RM) per season. All physicochemical data recorded will be reported by date and RM. If data, such as specimen length and weight and capture/recapture records, are available, these will be presented and summarized in format suitable for inclusion in the San Juan Fish Database. All other information deemed relevant to enhancing the 1990 data set and its use by San Juan River researchers will be summarized. In addition to being a compilation of all relevant data from the 1990 monitoring studies, the report will include a summary of the data.

Fund Sources:

USBR	$400,000
BIA/NIIP	130,000
BIA/ALBUQUERQUE	50,000
BIA (Study Integration Contract - Bio West)	27,000
USFWS/R2	126,500
TOTAL AVAILABLE	**$736,500**
TOTAL REQUESTED	**$735,965**

OTHER RESEARCH AND FUNDING SOURCES

SOUTHERN UTE FUNDED RESEARCH

Research Integration (Miller/Southern Ute)	$ 25,920

BUREAU OF LAND MANAGEMENT FUNDED RESEARCH

Polynuclear Aromatic Hydrocarbon Study	$ 45,000

OTHER BIA FUNDED RESEARCH

BIA/NIIP	
Data Integration	$ 73,645
River Channel Dynamics	136,390
Habitat Mapping and Resource Utilization	286,573
Flow/Habitat Modeling	57,835
River Operations Modeling	54,670
Water Temperature Monitoring	5,293
GIS Based Integrated Database Development	13,722
Subtotal	$628,128
TOTAL	$699,048

GRAND TOTAL **$1,435,013**

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Adult Rare Fish Monitoring and Radio Telemetry Studies
Fiscal Year 1997 Project Proposal
U.S. Fish and Wildlife Service, Region 6

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. Integration of adult fish community monitoring data with data from Colorado squawfish macrohabitat studies, razorback sucker experimental stocking studies, tributary and secondary channel studies, fish health studies, contaminants studies, habitat mapping studies, and non-native species interaction studies, will help to provide flow recommendations for reoperation of Navajo Reservoir as well as helping address objectives 5.1 through 5.5 in the San Juan River Long Range Plan.

To date twenty intensive electrofishing surveys conducted from 1991 to 1996 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. Nineteen Colorado squawfish were collected and PIT-tagged during these studies; 13 of the 19 Colorado squawfish were radio-tagged. Eighteen roundtail chub were collected, 13 of these were PIT-tagged. No wild razorback sucker were collected, however 38 experimentally stocked razorback sucker have been recaptured to date. Radio telemetry efforts located the primary range and probable staging, spawning, and rearing 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. FLOY-tagged native suckers have yielded preliminary data about the movement of these species in relation to four instream diversion structures in the area of Farmington, New Mexico.

Adult monitoring will continue with four trips in 1997, 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) and stocked razorback sucker 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 10-13 people. In support of objective #4 below, all fish collected in the Farmington to Hogback Diversion (New Mexico) reach will continue to be FLOY-tagged and monitored during 1997 sampling 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 1997 electrofishing studies will be analyzed to determine their predatory impact on native fish. Our sampling efforts in the lower 38 miles of the river will be closely coordinated with the National Park Service.

At present, all radio tags that were implanted in Colorado squawfish have expired. All new adult Colorado squawfish captured during 1997 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 and afterwards, as well as to evaluate the impact of instream diversion structures on these species. 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 canceled due to the apparent low efficiency of this tracking method in obtaining data on weak-signaled 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 and endangered razorback sucker from Lake Powell. Preserve stomach contents of lentic predators 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: Four adult sampling trips will take place in 1997. The May and October trips will be from Farmington, New Mexico to Mexican Hat, Utah. In June the Farmington to Hogback Diversion, New Mexico will be sampled, and in August, the river will be sampled from Mexican Hat to Clay Hills, Utah. Electrofishing will be the primary sampling technique, although seining and trammel netting may also be employed. Radio tracking will be conducted on all adult monitoring trips (and 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. All adult fish captured in the Farmington to Hogback Diversion, New Mexico reach of river will also be FLOY-tagged before release. 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-97

Personnel costs	
1 GM-13 Supervisor	$ 5,000
1 GS-11 Fishery Biologist	$15,000
1 GS- 7 Administrative Support	$ 3,000
Data Integration Costs	$ 5,000
Travel-Per Diem	$ 7,000
Equipment and Supplies	$ 7,000
Subtotal	$42,000
Service Administrative Overhead (17.65%)	$ 7,400
TOTAL	$49,400

Experimental Stocking of Razorback Sucker
Fiscal Year 1997 Project Proposal
U.S. Fish and Wildlife Service, Region 6

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. Integration of razorback sucker experimental stocking data with data from adult fish community monitoring studies, Colorado squawfish macrohabitat studies, contaminants studies, habitat mapping studies, and non-native species interaction studies, will help to provide flow recommendations for reoperation of Navajo Reservoir as well as helping address objectives 5.1 through 5.5 in the San Juan River Long Range Plan.

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 just below Hogback Diversion (RM 158.5). In September 1995, 16 radio-tagged razorback sucker (23-month AVM tags) were stocked at the Hogback Diversion site. On October 3, 1996, 237 PIT-tagged razorback sucker, including ten additional radio-tagged fish, were stocked at RM 158.5. To date, 5.0% (48) of stocked razorback sucker have been recaptured. In addition, one PIT-tagged razorback sucker that was stocked on August 8, 1995 at Piute Farms (RM 0.0) by the Utah Division of Wildlife Resources, was recaptured on May 21, 1996 at RM 58.0. Also, as many as eight of the 30 sonic-tagged razorback sucker stocked on November 1 & 2, 1995 (Lake Powell miles 24.0 and 43.0) by National Biological Service were contacted in the lower 38 miles of the San Juan River during the 1996 field season. Follow-up monitoring will continue on adult sampling trips and at least six ground monitoring trips through September 1997. 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 and opportunistically during fixed-wing aerial flights for channel catfish.

Objectives:

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

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

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

Methods:

Objective 1.) Electrofishing, seining, trammel netting and radio telemetry will be used to determine what types of habitats stocked razorback sucker are using. Detailed habitat information on substrate, depth, cover, velocity, and relation of this habitat to other habitats (riffle, pools, main and secondary channels, backwaters, shore, etc.) will be recorded. Water quality parameters including dissolved oxygen, water temperature, conductivity, and pH will be measured at each location. Growth, reproductive status, and health information will be collected as well. General movement patterns will be determined through radio telemetry.

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

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

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

Budget: FY-97

Personnel	
1 GM-13 Supervisor	$ 4,000
1 GS-11 Fishery Biologist	$13,000
1 GS- 7 Administrative Support	$ 2,000
Data integration costs	$ 5,000
Travel-Per Diem	$ 5,000
Equipment and Supplies	$ 6,000
Subtotal	$ 35,000
Service Administrative Overhead (17.65%)	$ 6,200
TOTAL	$41,200

Development of Augmentation Plans for Razorback Sucker and Colorado Squawfish in the San Juan River
Fiscal Year 1997 Project Proposal
U.S. Fish and Wildlife Service, Region 6

Background:

Colorado squawfish and razorback sucker, are both federally-listed endangered fish native to the San Juan River. The capture of low numbers of Colorado squawfish of all life stages over the past ten years has confirmed that a small, but reproducing population of Colorado squawfish still exists in the San Juan. Razorback sucker were a confirmed member of the San Juan River native fish fauna as late as 1988. However, intensive electrofishing surveys conducted in the San Juan River from 1991 to 1996 have failed to capture any wild razorback sucker in the reach between Farmington, New Mexico and Lake Powell. No larval or juvenile razorback sucker have ever been scientifically documented in the San Juan River. From this data, it is assumed that the San Juan River's wild razorback sucker population consists of only a few, old adult fish. Consequently, an experimental stocking study for razorback sucker began in 1994. The purposes of this study were to evaluate whether habitat capable of sustaining razorback sucker still exists in the San Juan River, what the habitat needs of this species in the San Juan River were, and determining the feasibility of using hatchery-reared fish in an artificial augmentation effort in the San Juan River. At present, approximately six percent of all experimentally stocked fish have been contacted either through radio telemetry or electrofishing recapture. From data obtained in this study, it is apparent that stocked, hatchery-reared razorback sucker can survive in the San Juan River.

The need for artificial propagation and augmentation of these two species in the San Juan River is apparent for several reasons. The small numbers of individual Colorado squawfish found in the river make using these fish to answer specific research questions problematic. There is also a danger of waiting too long to artificially augment and losing the genetic diversity contained in the San Juan River population to old age, angling mortality, or unforeseen catastrophe. A catastrophic event could be especially devastating given the small numbers of adult Colorado squawfish, and their close spatial proximity to one another in the river. Experimentally-stocked adult razorback sucker appear to be doing well in the San Juan River and have provided valuable data about this species in the wild. Augmentation of these two species would increase population numbers, provide more individuals for research purposes, add genetic diversity to the existing gene pool, and provide a riverine refugia population that would, hopefully, remain stable until further research can identify factors limiting successful recruitment of these species in a highly modified river system. The San Juan River Long Range Plan identifies the need to assess the feasibility of, and then implement the augmentation of razorback sucker and Colorado squawfish. Development of stocking plans for these two species in the San Juan River will provide the necessary guidance for augmentation efforts as well as directly fulfilling objective 5.3.8.2 of the San Juan River Long Range Plan. These plans will discuss broodstock availability, potential to get razorbacks from Lake Mohave, grow-out locations, and associated genetic concerns.

Objectives:

1) Develop a 5-year augmentation plan for razorback sucker in the San Juan River

2) Develop a 5-year augmentation plan for Colorado squawfish in the San Juan River

Methods:

Objectives 1 and 2: Based on research performed over the last six years in the San Juan River and available genetic information from both the San Juan River and the rest of the Upper Colorado River Basin, augmentation plans will be developed for both Colorado squawfish and razorback sucker. Plans will include specifics on origin of stocked fish, time of release, the number of fish to be stocked, size of fish to be stocked, stocking locations, and recommendations for follow-up monitoring.

Deliverables: Draft augmentation plans for both species will be submitted to the Biology Committee for review and refinement by May 1997.

Budget: FY-97

Personnel Costs	
1 GS-11 Fishery Biologist	$ 9,000
1 GS- 7 Administrative Support	$ 1,000
Subtotal	$10,000
Service Administrative Overhead (17.65%)	$ 1,765
Equipment and Supplies	
PIT Tags	$ 7,500
TOTAL	$19,265

Early Life Stage: Nursery Habitat Requirements
1997 Work Plan
Utah Division of Wildlife Resources

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 for FY97:

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 determine the effects of diversion canals on YOY Colorado squawfish drift/movement (e.g., stranding, etc.).
4) To characterize the early-life stage icthyofaunal community in low-velocity (nursery) habitats.
5) To characterize nursery habitats and their use in the San Juan River system.
6) To determine overwinter survival of experimentally stocked age-1 sized (approximately 50-55 mm) Colorado squawfish.
7) To determine what habitats juvenile Colorado squawfish utilize.

Methods:

Fish Community/Young-of-the-Year Monitoring

One Fall (September) sampling trip will be conducted to characterize the fish community in low-velocity habitats river wide (Table 1). This trip will start at the Hogback diversion in New Mexico (RM 158.6) and terminate at RM 0. Two backwaters in each 5 mi reach will be sampled. Protocols will be consistent with 1992, 1993, 1994, 1995, and 1996 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: Below Hogback (RM 157-152), Mixer (RM 131-126), Montezuma Creek (RM 89-84), Johns Canyon (RM 25-20), and Grand Gulch (RM 13-8). The Clay Hills reach (RM3-RM0) that was being sampled under the UDWR project Ichthyological Community Monitoring of the Lower San Juan River and Lake Powell Inflow Area will be added in 1997, as well. These areas will be sampled in late-March/ early-April, late August, and September (Table 1). 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.

Experimental stocking of YOY Colorado squawfish

To enhance the ability to evaluate nursery habitat we will experimentally introduce YOY Colorado squawfish in 1997 [see the San Juan River Experimental Stocking Plan for YOY Colorado Squawfish (Lentsch et al. 1996)]. In 1997, 100,000 YOY Colorado squawfish obtained from Dexter National Fish Hatchery will be marked with a unique tetracycline hydrochloride (TC) stain and/or chemical spray mark and stocked into the San Juan River. All of these fish will be approximately 20-40 mm in length, stocked in August, and 20,000 will be stocked approximately 1 km upstream from each of the five reaches (described above, not including the Clay Hills reach). For the upper most reach, Colorado squawfish will be stocked just below the Hogback Diversion.

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 five geomorphic reaches will be sampled one week following the release of YOY 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) (Table 1). After the first sampling, each reach will be sampled

biweekly until deemed necessary. We feel that the most information (e.g., the duration that fish are retained within low-velocity habitats in each reach) will be gained within the few weeks following stocking for the following two reasons: 1) the numbers of fish in the system may quickly decrease following stocking (e.g., fish may quickly move downstream) and/or 2) captures will quickly decrease because of natural dispersal. Three sampling trips will be completed for this experimental stocking (see Table 1). Additional trips will be completed if the number of fish caught in the third trip warrants additional trips; this will be the judgement of UDWR and the San Juan Program. If this project is funded in FY98, an additional trip will be competed in late March/early April 1998 to determine if there was any overwinter retention of the stocked YOY Colorado squawfish.

A secondary objective is to determine the effects of diversion canals on Colorado squawfish movement and survival (e.g., stranding, etc.). By stocking Colorado squawfish above the upper most nursery habitat reach (Below Hogback), we will be able to determine the affect of Cudei diversion (RM 142) on YOY fish movement and survival (e.g., stranding). Field work for this objective will take place immediately following the stocking of YOY Colorado squawfish below Hogback (the first two weeks). Methods for this objective include the placement of drift nets and or hoop nets at the entrance of the diversion and at the exit of the diversion (where the diversion exits back to the river). This will allow us to determine the relative number of Colorado squawfish entering the diversion, as well as the relative number that may be transported back to the river. Drift nets and/or hoop nets also will be placed in the river channel parallel to the diversion to determine the relative number of Colorado squawfish that proceed downstream (e.g., fish that do not enter the diversion).

Experimental stocking of juvenile Colorado squawfish

Note: this component was covered under FY96 funds. On November 4, 1996, 100,000 juvenile sized Colorado squawfish (50-55 mm TL) obtained from Dexter National Fish Hatchery were stocked into the San Juan River. The otoliths of these fish were previously marked with a tetracycline hydrochloride (TC) stain in late May/early June 1996. Half (50,000) of these fish were stocked at the Shiprock Bridge and 50,000 at Mexican Hat. These reaches were chosen to represent two different habitat types. The two lots of fish were spray marked in October 1996 to allow field researchers to differentiate between the two stocking groups. The spray mark colors were blue and magenta and these colors should last into the spring/summer of 1997, when sacrificing fish may be necessary to determine between stocked (e.g., looking for a TC mark) vs wild. The primary objectives of this experimental stocking is to determine 1) overwinter survival of experimentally stocked age-1 sized (juvenile sized) Colorado squawfish. This stocking will allow us to determine overwinter survival during a low flow winter and 2) what habitats juvenile Colorado squawfish utilize. This information is lacking in the San Juan River system as well as the entire upper basin. Very little information is available for juvenile (50 mm) Colorado squawfish and the San Juan River offers the opportunity to determine the habitat requirements of this size of Colorado squawfish and fill a data hole for this species. The first two sampling trips looking for these fish have been completed and are summarized below.

November 18-24, 1996

This trip began on November 18th, two weeks following the stocking. Two crews were used to complete this trip. One crew sampled the river from Shiprock to Sand Island. The first five miles below Shiprock as well as the other UDWR nursery habitat reaches (Mixer and Montezuma Creek) were intensively sampled (i.e., low-velocity habitats, backwaters, eddies, and shorelines). Less intensive sampling (at least two habitats per 5 mile reach) was completed on the remainder of the river. A total of 110 Colorado squawfish were caught with the following distribution: 67 in first five miles, 10 between RM 143-131, 9 between RM 131-126, 22 between RM 126-89, 2 between RM 89-84, and none between RM 84-78 (Table 2). These fish were mainly in flow through type backwaters and secondary channel pools. Only one Colorado squawfish was caught in a backwater, however, few backwaters existed and the ones that did, were shallow in this reach. The other crew sampled the river from Mexican Hat to Lake Powell with the methods described above. A total of 399 stocked Colorado squawfish were collected in the lower reach with the following distribution: 141 between RM 52-42, 72 from RM 42-25, 84 from RM 25-20, and 102 from RM 13-7 (Table 2). All but one of these fish were collected with shoreline and low velocity habitat seine hauls. When "classic" nursery habitats (backwaters) were available, Colorado squawfish used them. The remainder of the fish were collected on shallow shoreline benches. The fish averaged 55.2 mm. Fluorescent pigment was detected on approximately ½ of the fish encountered. Several fish encountered in the lower reach were released at Shiprock. One Colorado squawfish was found 140 river miles below its release site.

December 9-15, 1996

Reach	RM's	Dates
Crew 1	148-76	12/08/96-12/15/96
Crew 2	53-0	12/08/96-12/14/96

Effort: The first five miles below the stocking sites (Shiprock bridge RM 148 and Mexican Hat RM 53) were intensively sampled with seine and electrofishing gear. A total of 13 different habitats were sampled by the upper crew in this reach resulting in 27 samples. Crew 2 sampled 21 different habitats resulting in 25 samples, in the first five miles. All habitats encountered in the four nursery habitat sections were also intensively sampled. Throughout the remainder of the river, one secondary channel and one flow-through backwater per 5 river miles were sampled by Crew 1. Crew 2 sampled two low-velocity sites (this consisted primarily of seining backwaters and low-velocity flow-throughs) per 5 river miles throughout the remainder of the river. A total of 154 samples were collected by Crew 1 and 160 by Crew 2. Ten Colorado squawfish from each of the intensively sampled reaches were preserved in 95% ethanol for stomach analysis, lipid content evaluation, and to determine the presence of the tetracycline mark. High turbidity reduced electrofishing effectiveness.

Results - Crew 1: One hundred and ten Colorado squawfish were collected by Crew 1 (Table 2). Colorado squawfish were collected in 43 separate samples. In 24 samples, more than one Colorado squawfish was collected. Colorado squawfish were collected in flow-through backwater type habitats, shorelines, and secondary channels. The majority of Colorado squawfish were captured in small secondary channel pools with depths greater than 1.0 ft (0.3m). At most sites, the first two or three pools were sampled; the majority contained Colorado squawfish.

Many of these channels had very little flow at the top, and many would become isolated if flows declined. Twenty-eight Colorado squawfish were collected from a site at RM 127.7 in a secondary channel pool, with a depth of 4 feet.

Results - Crew 2: Two hundred and sixty seven Colorado squawfish were collected by Crew 2 (Table 2). Colorado squawfish were collected in 53 separate samples. In 31 of these sites, more than 1 Colorado squawfish was captured. Ten or more Colorado squawfish were caught in 7 samples. Six of these seven sites had depth greater than 1.5 feet. In one large backwater at RM25, 58 Colorado squawfish were caught in a single parallel seine haul. This is the first big, deep backwater below Mexican Hat. This backwater is the same backwater that produced a wild YOY Colorado squawfish in 1994. A total of eight marked individuals released at Shiprock were caught by Crew 2. Colorado squawfish were collected in backwaters, low-velocity flow-through, and along shorelines. Below RM 42, backwaters begin to become more prevalent. Sampling was concentrated in these habitats, but was not limited to them.

Preliminary data suggests that the highest Colorado squawfish densities are associated with the deeper and likely more persistent habitats.

Mark retention: Spray marks were observed on 21 of 122 (17%) Colorado squawfish captured by Crew 1. Crew 2 encountered 35 (17%) marked individuals. Most spray marks that were present could be seen with the naked eye, however, most of these were not detectable until close examination. Handling each individual YOY Colorado squawfish while looking for a spray mark next summer will result in high mortalities.

Habitat utilization: In the upper reaches, habitat use by Colorado squawfish was very similar to that of trip 1. Many of the secondary channels contained Colorado squawfish. Colorado squawfish habitat use in the lower reaches was also similar to trip 1 with one notable difference. Crew 2 found far fewer Colorado squawfish in the first 25 miles of sampling. This may be a reflection of the lack of persistent low-velocity habitat in the canyon section.

Habitat availability: Habitat availability during trip two was very similar to that observed during trip 1. Flows since the last trip have been fairly stable in the San Juan River. An increase of nearly 300 cfs was experienced by crew 2 during this trip. Crew 2 was moving down the river behind the spike. The spike may have displaced some fish, but was not likely a major factor in habitat persistence.

Additional sampling during the calendar year 1997 will then be coordinated with the regularly scheduled UDWR nursery habitat trips (late March/early April, late August, and September) (Table 1).

Studies Related to this SOW

Two components of additional research may be completed at Utah State University if time permits. This research includes 1) lipid work on stocked Colorado squawfish and 2) determining stomach contents of stocked Colorado squawfish. To date stocked Colorado squawfish have

been collected from nursery habitat reaches during the two trips completed to evaluate stocking. The same fish can be used for both research questions. Invertebrate work that has been completed as part of the UDWR nursery habitat study has demonstrated that productivity tends to be higher in the upper nursery habitat reaches than the ones down lower in the system. This is especially true for the Grand Gulch reach; this reach is the lowest in productivity, however this is the reach were most wild YOY Colorado squawfish have been captured. This work will determine if stocked Colorado squawfish incur more lipids higher in the San Juan system and if so, will this benefit these fish through overwinter survival.

Integration

We will be integrating all research UDWR has completed on the San Juan River. We will be incorporating pertinent results from our Upper Basin projects into the integration as well. One project in particular that we will be using results from is the Management Objectives project which will be completed in May of 1997. The information gained from this project will be pertinent for all Upper Basin research including the San Juan. Travel will entail attending all subcommittee meetings. UDWR is the lead on the Early Life History for Native Fishes subcommittee.

BUDGET*

Personnel	$ 85,000
Travel	$ 7,000
Equipment	$ 13,000
Integration	$ 10,000
TOTAL	$120,000

* 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.

Table 1. Sampling trips required in calendar year 1997 for the Early Life Stage: Nursery Habitat Requirement SOW. Note: As described here, a total of six sampling trips will be needed to complete all four project components. Additional trips may be added for the YOY experimental stocking if the number of fish caught in the first three trips warrant additional trips. If funded in FY98, an additional YOY experimental stocking trip will be completed in late March/early April.

Project Components	Number of Sampling Trips	Dates of Sampling Trips	River Miles
Fish Community Monitoring	1	1st week of September	RM 158.6-RM0
Nursery Habitat	3	late March/early April, late August**, mid-September*	RM157-RM0
Experimental stocking of YOY Colorado squawfish	3	late August**, mid-September*, late September/early Oct.	RM157-RM0
Cudei Diversion YOY monitoring	1	mid-August (1 week)	RM 142
Experimental stocking of juvenile Colorado squawfish	3***	late March/early April, late August**, mid-September*	Shiprock Bridge - RM0

* One September trip will encompass all three project components.

** The late August trip will encompass nursery habitat and experimental stocking of YOY and juvenile fish.

*** All three trips will be coordinated with regularly scheduled nursery habitat trips.

Table 2. Number and location of Colorado squawfish caught during both sampling trips.

Crew	RM	Number caught during Trip 1	Number caught during Trip 2
1	148-143	67	21
1	143-131	10	9
1	131-126	9	54
1	126-89	22	21
1	89-84	2	10
1	84-76		5
2	52-42	141	3
2	42-25	72	13
2	25-20	84	119
2	20-13		5
2	13-07	102	126
2	07-00		1
Total		519	387

SAN JUAN RIVER LARVAL FISH PASSIVE DRIFT-NETTING & LIGHT-TRAPPING STUDY 1997 WORK PLAN

Division of Fishes
Museum of Southwestern Biology
Department of Biology
University of New Mexico

Background:

Beginning in spring 1995, personnel from the Division of Fishes, Museum of Southwestern Biology (MSB), at the University of New Mexico assumed responsibility for the San Juan River larval fish passive drift-netting study. This project, formerly conducted by the Utah Division of Wildlife Resources, continued with only minor changes in sampling protocol. Data collected from this research activity provided several discrete types of information on the fishes of the San Juan River. Data that can be obtained on the endangered fishes of the river include determining approximate spawning period, identifying approximate location of spawning sites, and assessing 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.

Since assuming responsibility for this phase of the research program, we have collected three larval Colorado squawfish. Two larval Colorado squawfish were taken at Mexican Hat during the 1995 larval fish passive drift-netting study. The first specimen, 9.5 mm TL mesolarvae (MSB 26187) was taken between 2114-2310 hours on 2 August 1995. The next morning (3 August 1995) between 0531-0800 hours, a second Colorado squawfish, 9.0 mm TL mesolarvae (MSB 26191) was collected. The first larval Colorado squawfish from the Mixer site was collected on 2 August 1996 (MSB 29717). These specimens were collected during years with extremely different flow regimes.

A comparison of 1995 morning versus evening drift-net sampling indicated no significant differences. However, the supplemental data produced by evening sampling provided additional resolution to questions concerning drift patterns. Given the relative rarity of target species in the San Juan River and the extremely limited number of larval Colorado squawfish and roundtail chub collected, we will propose to redesign passive drift-netting protocol for 1997 so that sampling can be conducted during both morning and evening.

In 1994, a total of 672 razorback sucker were stocked in the San Juan River between Bluff, Utah and the Hogback, New Mexico. Mean length and mass of those individuals, at the time of stocking, was about 400 mm TL and 710 g, respectively. In 1995, 13 of the recaptured razorback sucker were tuberculate males and six of those individuals were ripe. In their 1995 report of

activities, Ryden and Pfeifer (1996) suggested that the majority of the experimentally stocked San Juan River razorback sucker reached sexual maturity in 1995-96 and that spawning of these individuals might begin in the next two years.

At the November 1996 San Juan River Biology Committee integration meeting, it was suggested that we expand a portion of our larval fish drift study to allow for documentation of razorback sucker spawning. In other portions of the Colorado River basin this species reproduces at least one month prior to Colorado squawfish. We know, from other Upper Colorado River basin researchers, that one of the best means of collecting larval razorback sucker is through the use of a passive collector that makes use of the fact that larval fish are attracted to light. The traps (light traps) are set after dark and retrieved before dawn. The light is barely visible as it is only 2.25 Volts and takes only two D-cell batteries to provide illumination. Once submerged, only the styrofoam top of the trap remains visible. For these traps to operate efficiently, they need to be set in very still waters (as opposed to drift nets which require flow).

If this additional collecting effort is approved, we plan to set light traps at every other night in low-velocity habitats at or near both the Mixer and Mexican Hat sites. These traps would be set after dusk and retrieved about four hours later. Fish taken under this portion of the study will be preserved and identified at a later date. As spawning of razorback sucker begins in spring, sampling for this species could not be done concurrent with Colorado squawfish sampling.

Sampling for razorback sucker will begin around April 1 and continue into May. We will our sampling efforts with the Grand Junction office of U.S. Fish and Wildlife Service. Ryden and Pfeifer will be tracking radio-tagged razorback sucker and be able to assess their reproductive status. In addition, we will use information gained from spring razorback sucker tracking to determine the best site to establish light-trap stations. Light-traps will be set every other night and the catch will be quantified based on catch per minute. We anticipate setting between 2-4 light traps per site depending upon trap availability and physical characteristics of the study site. Putative razorback sucker will be sent to Darrel E. Snyder, Colorado State University, for verification.

Objectives:

1. Determine the temporal distribution of San Juan River ichthyoplankton in relation to the hydrograph
2. Provide comparative analysis of the reproductive success of San Juan River fishes
3. Attempt to characterize downstream movement of ichthyoplankton
4. Attempt to validate presumed spawning period of Colorado River squawfish
5. Attempt to identify localities in the immediate proximity of the presumed Colorado squawfish spawning bed for placement of drift nets in 1997.
6. Collect light-trap samples of larval fish at two sampling localities to determine if razorback sucker reproduced in the San Juan River in 1997.

Methods:

1. Collect daily drift samples at two predetermine localities (Four Corners and Mexican Hat) starting in June and continuing until the end of August. Nets will be set each day at dawn and dusk 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. 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 drift nets.

3. Light-traps will be set at two sites on the San Juan River. Sampling with this passive collecting device will begin in early April and continue into May. Traps will be set after dusk in a low-velocity non-mainstream habitat and remain there for about four hours. Traps will be set every other night. Catch rate will be determined as the number of fish collected per time sampled. Selection of collection sites will be based, in part, on the spring 1997 distribution of radio-tagged razorback sucker. We will attempt to locate the sampling stations in close proximity (downstream) to concentrations of razorback sucker.

4. 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 (1996 samples). Specimens will be distinguished and compared by residence status (native versus non-native) and catch rate over-laid with the annual hydrograph.

5. Prepare a comprehensive synthesis and comparison of 1991-1996 drift net sampling. Minimally, this integration report will include analysis of catch by species across years and differing flow regimes.

6. Coordinate with San Juan River researchers who are tracking the movements of Colorado squawfish and identify the putative spawning area for that species. Examine reaches in close proximity of the spawning area for their potential to become drift-net sampling stations in 1997.

BUDGET

Personnel	30,000
Travel and Per Diem	6,000
Equipment and Supplies	4,500
Light-traps	3,000
Integration (1991-1996 Larval Fish Drift)	5,000
Subtotal	48,500
Overhead (15%)	7,275
TOTAL	55,775

SAN JUAN RIVER SECONDARY CHANNEL COMMUNITY DYNAMICS STUDY
1997 WORK PLAN
New Mexico Department of Game and Fish, Santa Fe, New Mexico

Background:

Ichthyofaunal inventories of the San Juan River found differences between the fish communities of secondary and primary channels. Differences were noted in species present, their relative abundance, and life stages present. These differences were hypothesized to be mediated in part by differences in habitat 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 tolerances, and 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 summer 1996, flows were average to below average.

During fiscal 1996 (1 October 1995-30 September 1996), three secondary channel inventories between Shiprock, New Mexico and Bluff, Utah were made. All sampling was done per protocols outlined in previous work plans. Lateral movement of the primary channel eliminated the permanent secondary channel study site located near Bluff, Utah. Regular sampling of the other three permanent secondary channel study sites, however, continued per study protocol.

Field work for this study (permanent secondary channel study sites) was completed in September 1996. Data collected between July 1993 and November 1994 from permanent study secondary channel study sites have been compiled, analyzed, and presented in one published manuscript and another that is in preparation. Data collected from secondary channel permanent sites since November 1994 will be combined with that obtained during the initial phase. This information will be synthesized into a single report on secondary channel fish community dynamics.

Methods:

During fiscal 1997, secondary channel monitoring will continue as in previous years with spring, summer, and autumn inventories conducted from Hogback Diversion to Mexican Hat. Secondary channel sampling protocols will be the same as in previous years. In addition to sampling secondary channel fish communities, the near-shore fish community of the primary channel will be sampled at each sampled secondary channel during each inventory. Because channels are not evenly distributed within the study area, at least one primary channel sample will be made at each River Mile (RM). During the spring inventory, electrofishing is the primary sampling technique in both secondary and primary channel habitats. In addition to data obtained from spring adult monitoring efforts, additional information on the primary channel fish community will be obtained by seining near-shore primary channel habitats. In other seasons (summer and autumn) seining will be the primary sampling method. A minimum of 10 seine hauls will be made at each primary channel sample site. All near-shore habitat types (excluding backwaters and secondary channel mouths) in the vicinity of the site will be sampled. Total surface area of each seine haul will be determined. Data obtained during 1997 will be used to assess the relative similarity of secondary and primary channel fish communities.

Data obtained in the "side-by-side" study of near-shore primary channel fish community and that of secondary channels will be compiled and synthesized. Data obtained in this study of near-shore primary channel fish communities and that of secondary channel communities will be compiled and synthesized.

Specific study objectives of the seasonal secondary channel inventories are:

1. Characterize fish fauna of secondary channels
   a) seasonally
   b) longitudinally (including defined geomorphic reaches)
   c) in relation to annual, seasonal, and specific event flows
   d) relative to secondary channel dimensions
   e) relative to primary channel fish community
   f) relative to in situ fish community
   g) identify potential "conflict" species (those species who might compete with or prey upon native fishes, including Colorado squawfish, razorback sucker, and roundtail chub)
   h) identify potential management actions to mitigate impact of problem nonnative species.

2. Characterize physical attributes of secondary channels
    a) seasonally
    b) longitudinally (including by geomorphic reaches)
    c) relative to overall dimensions
    d) relative to physical attributes of primary channel

3. Evaluate potential of secondary channels to provide habitats needed/used by native fishes, particularly Colorado squawfish and razorback sucker.
    a) do current biotic and abiotic attributes of secondary channels diminish or enhance their suitability for native fishes?
    b) do secondary channels provide "essential" habitat for specific life stages of native and nonnative fishes?
    c) identify potential management actions to enhance suitability of secondary channels for native fishes.

In addition to data collected by NMGF personnel, data from 1) secondary channel emigration/ emigration studies (USFWS-NMFRO); 2) adult monitoring studies (USFWS-CRFP); 3) razorback and Colorado squawfish telemetry (USFWS-CRFP, Miller Assoc.); 4) early life history studies (UDWR, UNM); 5) nonnative food habits studies (USFWS-NMFRO); 6) geomorphic characterization (K-B); 7) river channel dynamics (K-B); 8) habitat mapping and resource utilization studies (K-B); and 9) flow/habitat modeling (K-B) will be used in preparation of report on biotic and abiotic seasonal and longitudinal characterization of San Juan River secondary channels fish communities. Appropriate univariate and multivariate statistical procedures will be used in data analysis.

While the secondary channel inventory work was designed to investigate fish communities from a system level, the permanent sites study was a finer-scaled study. To accomplish this, sampling frequency and intensity was greater than that for the characterization study. The permanent site study also involved collection of habitat use and availability information.

Specific study objectives of the secondary channel permanent site study were:

1. Characterize dynamics of the fish community in four representative secondary channels. One channel had surface flow throughout the year; a second had interrupted surface flow; the third had no surface flow during flow-flow periods and habitat consisted only of isolated pools; and the fourth was mainly standing-water habitat during low flow periods but often had surface flow during and following storm events in the low-flow season.
    a) characterize the fish community of each permanent site in relation to season and flow regime
    b) characterize habitat-use patterns of each fish species (including by life stage) present at each permanent site
    c) characterize life history strategies of each fish species in secondary channels
    d) characterize species interactions in secondary channel habitats.

2. Characterize habitat of four representative secondary channels
    a) Characterize habitats seasonally and in relation to flow regime .
    b) Relate habitat availability to composition of the fish community and its dynamics.

3. Identify potential management actions that might enhance secondary channel habitats for native fishes.

In addition to data obtained by NMGF and UNM personnel, appropriate data from 1) secondary channel emigration/immigration studies (USFWS-NMFRO); 2) early life history studies (UDWR, UNM); 3) habitat mapping and resource utilization (K-B); and 4) Videography (USBR-Denver) will be used in preparation of report on fish community dynamics in secondary channel permanent sites. Appropriate univariate and multivariate statistical procedures will be used in data analysis.

Specific objectives of the side by side study are:

1. Characterize the fish community of low-velocity, near shore primary channel habitats longitudinally and by geomorphic reach.
2. Compare and contrast and composition of near-shore primary channel fish communities with that of the adjacent secondary channel(s).
3. Characterize the near-shore fish community in relation to near shore habitats.
4 Use data obtained in this study to recommend management actions that might enhance native fish status in the San Juan River.

In addition to data obtained by NMGF personnel, appropriate date from 1) secondary channel emigration/immigration studies (USFWS-NMFRO); early life history studies (UDWR, UNM); adult monitoring (USFWS-CRFP); and geomorphology (K-B) will be used in preparation of the "side-by-side" fish community report. Appropriate parametric and nonparametric statistical procedures will be used in data analysis.

A major activity during fiscal year 1997 will involve compilation, analysis, and synthesis of data collected from seasonal secondary channel inventories (1992 through 1997) and of data collected from the secondary channel permanent sites community dynamics studies (1993 through 1996). This information will be presented in two major reports. A third report on the "side-by-side" studies will be prepared.

Secondary channels of the San Juan River provide considerable low-velocity habitat. During much of the year these habitats are occupied and numerically dominated by several nonnative fish species. Several of these nonnative species (particularly red shiner and channel catfish) have been implicated in the decline of native fish species. Information obtained from secondary channel fish community studies will be used to evaluate the efficacy of flow manipulations to control nonnative fish species, to determine (in part) the importance of various flow levels in maintenance of different low-velocity habitats, to evaluate the need for and value of mechanical manipulations of secondary channel habitats to improve their quality for native fishes, to characterize life history attributes of nonnative fishes and relate this information to potential control measures and to characterize potential competition among native and nonnative fishes for limiting resources.

Integration:

The San Juan river Recovery Implementation Program Biology Committee has developed a tentative schedule and assigned tasks for the integration of various research activities conducted on the San Juan River during the past 6 years. Among the objectives of this integration effort is the development of flow recommendations for a variety of conditions. Essential to the development of flow recommendations is the synthesis of data from a variety of research endeavors that will serve to provide biological basis for these recommendations. Accomplishment of this objective will require attendance at various subcommittee meetings, acquisition of data from other research activities, integration of these data into documents supporting particular flow recommendations, and synthesis of reports and documents.

Budget[1]

Secondary Channel Community Monitoring	
Personnel	$ 4,500
Travel and Per Diem	4,000
Final Report Preparation	
Personnel	20,000
Integration of Research	
Personnel	40,000
Travel and Per Diem	6,000
Administrative Support	5,500
Total	80,000
Indirect Costs	8,000
TOTAL	**$ 88,000**

[1]Budget does not include in-kind contributions.

NON-NATIVE SPECIES INTERACTIONS
1997 Work Plan
U.S. Fish and Wildlife Service, Region 2

Background:

Introduced species have been implicated in the decline of several native fishes. In 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 species that are potential predators of adult and juvenile native fishes 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 native flannelmouth sucker.

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.

A radio telemetry study of channel catfish was initiated in 1996 to determine seasonal movement patterns related to habitat use and reproductive activities. Prior mark-recapture data of channel catfish during this study indicated limited movement. Most literature, however, generally recognize seasonal movement for reproductive purposes. Because of probable inherent difficulties in the recapture of tagged fish (i.e., frequency of collection efforts, chance of recapture) previous efforts have not identified such movements. The 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. This study will also allow for collection of data related to winter low-flow studies. The purpose of this research ultimately is to provide flow/management recommendations that will reduce the abundance of non-natives in the San Juan River.

Objectives:

1. Determine seasonal movement patterns and habitat use of channel catfish in relation to flow patterns in the San Juan River.
2. Validate channel catfish movement data collected using Floy tags.
3. Determine food habits and food availability of native and non-native fishes in backwaters and secondary channels and evaluate for dietary overlap.

Methods:

Channel Catfish Radio Tracking

Sampling protocol

Radio tracking flights will be conducted October 1996 through September 1997 to monitor movement of 16 channel catfish implanted with radio transmitters in September 1996. For each channel catfish contacted the date, time, river mile, latitude and longitude, and general habitat type will be recorded. In addition to channel catfish, aerial tracking for razorback sucker will be done opportunistically.

General Sampling Requirements:

No. of flights: 16 (one per month October - March, September: two per month April- August)
Duration of each flight: 4-5 hrs
Personnel/flight: 1-2

The radio tracking flights will be followed by intensive on-ground radio telemetry trips to monitor channel catfish habitat use. Channel catfish will be tracked monthly (October 1996 through September 1997) by boat or raft. For each fish contacted, the date, time, river mile, and habitat type occupied will be recorded. Radio contact will continue at 15-20 minute intervals for a minimum of four contacts (i.e., approximately one hour) per fish. During each contact, the location and habitat type occupied will be recorded onto an aerial videography sheet (over-layed in polypropylene) of the San Juan River. Concurrent with the radio tracking, the habitat type 100 m upstream and downstream of the most frequent location will also be mapped on each of the videography sheets to determine habitat availability. Habitat type classifications will follow those defined by Bliesner and Lamarra in geomorphology studies. In addition to mapping, habitat data including water depth, velocity, substrate, temperature, salinity, dissolved oxygen, conductivity, proximity and type of cover available will also be recorded.

General Sampling requirements:

No. of trips: 12 (one trip per month October through September)
Duration of each trip: 4-5 days
Personnel/trip: 2-3

Food Habits

Sampling protocol

Processing of food availability and food habit samples collected from main channel and secondary channel/backwater habitats in 1996 will be completed in FY '97. Processing will include identification of fish (collected via seines) and invertebrate samples (collected via surber, Hess, and dredge samples) in the laboratory. In addition, stomach contents of randomly selected native and non-native specimens will be examined for food habits and dietary overlap. Invertebrate samples are preserved in 70% ethanol and stomach samples are preserved in 10% formalin.

General Sampling Requirements:

Food habits: subsample of specimens collected from the FY '96 SC/MC fish movement and adult sampling trips.

Budget: FY 97

Personnel (GS-9)	$41,748
Technician (GS-7)	$ 6,150
Travel/per diem	$10,020
Radio Tracking Flights	$ 8,080
Data Integration	$10,000
Equipment and Supplies	$ 6,402
TOTAL	$ 82,400

SAN JUAN RIVER SPECIMEN CURATION
AND LARVAL FISH IDENTIFICATION
1997 WORK PLAN AND BUDGET

Division of Fishes
Museum of Southwestern Biology
Department of Biology
University of New Mexico

Background:

Personnel from the Division of Fishes, Museum of Southwestern Biology (MSB), at the University of New Mexico are responsible for two inter-related programs on the San Juan River. The Fish Division is the repository for specimens collected and retained by researchers. Fish taken under these programs are initially sorted by the principal investigator, held until they have submitted their yearly-progress report, and then received by MSB personnel. The collection is accessioned, specimens transferred from formalin to alcohol, identifications verified, individuals enumerated, length ranges recorded (largest and smallest specimen in a collection), collection data verified and transferred to wet labels, and incorporated into a database. Changes in species identifications are noted and returned to the principal investigator along with the entire dataset (listing of collection locality, collectors, date, original field number, species, number of specimens, length ranges, and museum catalog number). In addition to performing duties associated with collections curation, we are also responsible for complete processing (sorting, identifying, counting, curating, and reporting) of selected San Juan River collections (larval drift, some secondary canal and miscellaneous collections made by various San Juan River researchers [lower San Juan River collections; U.S.B.R.-Lashmett; National Park Service]).

In 1996 we processed almost 100,000 larval and juvenile fishes collected by the Utah Division of Wildlife Resources and University of New Mexico. No previously unidentified Colorado squawfish were found in the collections from the Utah Division of Wildlife Resources. We expect to receive the 1996 low-velocity habitat samples from the Utah Division of Wildlife Resources in December 1996 and will process them by the end of summer 1997. As in the past, any significant deviations in the species identifications of those samples will be noted and forwarded to the principal investigators. Funds are not required for integration as any work for that project can be accomplished under our existing contract.

Objectives:

1. Provide a permanent repository for San Juan River fish collections, field notes, and associated data
2. Verify species identifications
3. Assist principal investigators with collection sorting and 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 he 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 the principal investigator for inclusion in reports. In the past, this work has had to be done on relatively short notice.

3. Larval drift collections are received unsorted and processed as stated above. In addition to recording the length ranges for each species in each collection, we also note the presence of larval, juvenile, and adult specimens in the samples. Starting in 1995, the annual report for the larval fish portion of the study will be prepared by UNM personnel.

BUDGET

Personnel	33,500
Travel and Per Diem	2,000
Equipment and Supplies	4,000
Subtotal	39,500
Overhead (15%)	5,925
TOTAL	45,425

PROGRAM MANAGEMENT
1997 Work Plan
U.S. Bureau of Reclamation

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 1996 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
1997 Work Plan
U.S. Fish and Wildlife Service, Region 2

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 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.

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 Long range 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 Long range 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	$28,000
Travel/Per Diem	2,500
Meetings, supplies	2,000
Printing/publication	7,500
Administrative Support	10,000
TOTAL	$50,000

SAN JUAN RIVER CONTAMINANT STUDIES
1997 WORK PLAN
U.S. Fish and Wildlife Service, Regions 2 and 6

Background:

Field work for a synoptic survey of trace metals and inorganic constituents in the San Juan River was completed in 1994 and the analytical chemistry results were completed 1995. A progress report was completed in 1995 but did not include detailed analysis pending receipt of all data for the samples collected and determination of potential needs for integration with other studies being completed under this program.

During 1997 we intend to complete reporting of the synoptic study results, and assist in the integration process. We also plan to have a few archived samples analyzed to complete the data set as needed, based on recaptures of endangered fish in 1996 and 1997, and to opportunistically obtain trace element data on salvaged fish as available. Funding requested is to partially offset the direct undetermined costs of analytical needs, final summary report and integration activities, and associated travel.

Objectives:

1. Incorporate data received since last progress report, interpret and prepare final report on the synoptic studies.

2. Analyze a small quantity, as yet undetermined, of samples for trace metals as determined by recaptures of marked endangered fish, and opportunistic sampling of wild endangered fish.

3. Assist in integration activities to assure that issues raised due to contaminant data are evaluated across all studies.

Methods:

1. A final report will be prepared as per our milestone.

2. Coordinate with researchers on adult monitoring and razorback release studies to capture opportunities and complete data sets, acquire samples, contract analysis and report results.

3. Provide evaluation of possible issues/areas where contaminants may be impacting endangered fish and attend meetings or provide further assessments as required to assure integration of contaminant issues with other program studies.

Budget:

Analytical - UT		$ 1,000
Personnel	FWS/ABQ	4,000
	FWS/UT	3,000
Travel	FWS/ABQ	1,000
	FWS/UT	1,000
TOTAL		$10,000

SAN JUAN RIVER BIOLOGICAL EFFECTS STUDIES
FISCAL YEAR 1997 PROJECT PROPOSAL

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 Fish Hatchery & Technology Center, NM. The test will be conducted for 180 days with fish exposed to dietary (0, 5, & 10 μg/g) and waterborne (0 & 5 μg/liter) selenium. The study will include three replicates each of a control and five treatments. After 180 days of exposure to dietary and waterborne selenium, adults will be induced to spawn and the resulting hatch larvae exposed to dietary and waterborne selenium for 30 days post-hatch. Tissue residues of selenium in adults will be monitored before spawning and for 60 days after spawning when adults are held in clean water and fed control diet to determine depuration rates.

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 (samples collected at 15-day intervals), dietary residues of selenium (samples collected from each bag of diet), tissue residues of selenium (muscle plug samples, includes depuration), survival (recorded daily -- no adults are expected to die during the study), growth (length and weight measured), 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 (samples collected at 15-day intervals), dietary residues of selenium (samples collected from each bag of diet), 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), 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 and dietary selenium to adversely affect threatened or endangered fish in the San Juan River.

Budget:

(Some funding obligated in FY96 ($25,000) has been incorporated into the FY97 budget -- the adjusted figures are given below.)

Long-term reproduction test with adult Colorado squawfish.

(cost share between SJRRIP and NIWQP[1])	SJRRIP	NIWQP
Personnel	$21,600	10,800
Travel/Per Diem	2,000	1,000
Equipment and Supplies	4,000	2,000
Selenium diet	7,000	3,500
Neutron activation analysis (adult muscle plug)	14,400	7,200
Neutron activation analysis (larval fish)	6,000	3,000
Chemical analysis	16,000	8,000
Tanks, remodel diluter, delivery lines, etc.	0	6,000
Subtotal	71,000	41,500
NBS Administrative Overhead - 19%	13,500	7,900
Proposed Budget FY97	$84,500	49,400

[1]SJRRIP: San Juan River Recovery Implementation Program.
NIWQP: National Irrigation Water Quality Program.

FISH HEALTH STUDIES
1997 Work Plan
Pinetop Fish Health Center
U. S. Fish and Wildlife Service

Background:

There was no fish health work accomplished on the San Juan River prior to 1992. Since October 1992, this laboratory (Pinetop Fish Health Center) has participated on adult monitoring and various smaller sampling trips. We have collected fish health samples from many different fish species. There has been a decline in the number of lesions seen, until May, 1996 when a significant increase in lesion incidence level was found.

We propose to collect and maintain a fish health data base on adult monitoring trips in FY-97. Smaller trips will provide more histopathological samples for the analysis of the unknown material found in the fish lesions.

Objectives:

1) Collect baseline data for health status of San Juan River fish.
2) Ascertain possible causes of infectious and noninfectious lesions and other abnormalities observed.
3) Determine prevalence of infectious and non-infectious pathogens and abnormalities.
4) Monitoring the prevalence of possible electrofishing damage to fish with histopathology
5) Analysis of unknown substance found in fish lesions and other tissues.
6) Correlate disease incidence with water quality parameters.

Methods:

1) Every river mile (RM):
   a) record macro-pathology on all fish sampled.
   b) only selected fish with gross pathology will be sacrificed and sampled for pathogens. Non-lethal sample methods will be utilized whenever possible.
   C) Colorado River squawfish and razorback suckers 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 electrofishing injury).
   b) sacrifice five *Catostomus latipinnis* and perform complete necropsy, sampling for epizootic fish pathogens.
   c) assist other San Juan River biologists by analyzing data collected from shocking boats for disease incidence.

Budget:

Histopathology	$ 5,000
TOTAL	$ 5,000

* Other FWS funding will be contributed to support other work plan objectives.

INTEGRATION REPORT FOR SAN JUAN RIVER RIP BIOLOGY STUDIES
1997 Work Plan
BIO/WEST, Inc, Logan, Utah
Jicarilla-Apache Tribe

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 Coordination 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 within the context of the objectives of the Long Range Plan. 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 data. But results of the ongoing studies were combined with other information from the Upper Colorado River Basin where appropriate to detail progress on the Long Range Plan objectives. 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.

In 1996 the Integration Report was updated with information from the 1995 field research efforts, and was renamed the Summary Report.

In 1997 the Biology Committee has agreed to not prepare annual progress reports since this will be the last year for most of the field research. Five subcommittees have been formed to integrate the information collected during the past 6-10 years to answer the various objectives and milestones of the Long Range Plan for the Program. We propose to complete an Integration Report in 1997 that will incorporate pertinent new information from 1996 studies, 1997 peer review results, and progress and results from the integration effort.

The goal and objectives of the Integration Report include:

Goal:

Develop a report that accurately describes the major results to date of the San Juan RIP research studies to meet the adaptive management and reporting objectives of Section 5.7 of the Long Range Plan.

Objectives:

1) Develop a report that summarizes results and/or progress of the integration subcommittees in relation to the major goals of the San Juan RIP, and report on significant research results from 1996 and 1997 studies.
2) Develop a report more understandable by administrators and non-biologists associated with the San Juan RIP.
3) Provide an additional level of peer review on the biology studies being conducted within the San Juan RIP.

Methods:

The format of the report will remain the same as that used in 1996. The outline of the Long Range Plan showing objectives and milestones will form the basic report outline. But rather than a summary of the various research being conducted to answer each objective, the results and/or progress of the integration effort to meet those objectives will be discussed. Significant results from 1996 research activities will be included in the report and sections, as required, will be updated.

Another area to be discussed in more detail will be the recommendations from the external Peer Review panel that was developed in early 1997. This panel of 3 or 4 scientists from outside the Program will provide input as to whether or not the Program appears to be on course, and any suggestions they may have for improvements to the Program. The results of this process will be summarized in the Integration Report.

A draft report will be prepared and that report will be reviewed by the Biology Committee during a meeting in late 1997. A final report will incorporate comments from the Biology Committee and will be completed by December 31, 1997. The final report will be printed for distribution to the Biology Committee, Coordination Committee, and other interested individuals, agencies, etc. A presentation of the Final Report will be made to the Coordination Committee and interested publics.

Budget:

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

SAN JUAN RIVER SEVEN YEAR RESEARCH PROGRAM
BUDGET
FISCAL YEAR 1997

I.	Core Research		
	Adult Monitoring and Radio Telemetry (USFWS, R6)		$ 49,400
	Experimental Stocking of Razorback Sucker(USFWS,R6)		41,200
	Augmentation Plans (USFWS,R6)		19,265
	Early Life Stage\Lower SJR and Lake Powell(UDWR)		120,000
	Larval Drift and Light Trapping(UNM)		55,775
	Secondary Channel Characterization (NMDGF)		88,000
	Nonnative Species Interactions (USFWS, R2)		82,400
	Specimen Identification and Curation (UNM)		45,425
	Program Management (USBR)		30,000
	Program Coordination (USFWS, R2)		50,000
	Videography (USBR)		20,000
		Subtotal	$601,465
II.	Contaminant Research		
	Contaminant Studies (USFWS, R2 and R6)		$ 10,000
	Biological Effects (NBS)		84,500
		Subtotal	$ 94,500
III.	Other Research		
	Fish Health Studies (USFWS, R2)		$ 5,000
	Study Integration (BIOWEST, Jicarilla)		30,000
		Subtotal	$ 35,000
IV.	Proposed Research		
	1990 Data Summarization (NMDGF)		$ 5,000
		Subtotal	$ 5,000
		TOTAL	**$735,965**

Budget:

Data acquisition[1]	
Personnel	$ 1,000
Data compilation	
Personne	12,000
Report preparation	
Personnel	1,000
Administrative Support	500
Subtotal	4,500
Overhead (10%)	500
Total	$ 5,000

[1]Assumes that all collected specimens have been identified and enumerated.

LITERATURE CITED

Platania, S. P. 1990. Biological summary of the 1987 to 1989 New Mexico-Utah ichthyofaunal study of the San Juan River. NMGF Contract Rept. (No. 78-516.6-01) and USBR Cooperative Agreement (No. 7-FC-40-05060). New Mexico Department of Game and Fish, Santa Fe, NM.

INTEGRATION OF RESEARCH RESULTS
1997 Work Plan
Miller Ecological Consultants, Inc.

Background:

This is a continuation of the task started in 1995. The research being conducted on the San Juan River is now entering its seventh year. Some tasks have been completed and others have several years of data collected. This effort is needed to determine limiting factors for the endangered fish in the river.

A new Seven Year Research Study component, initiated by Dr. Paul Holden, was the integration of the results of all studies conducted to date. This study will require interaction with all researchers.
Objective:

The objective of this task will include interactions with other researchers and interaction with Dr. Holden. This will require both in-house analysis of Colorado squawfish habitat use data and San Juan River basin tributary fish data. This task will also require considerable travel and meetings with subcommittees during the year to integrate the data and assist in producing a final integration report for the Seven Year Research Project.

Costs:

Estimated costs for FY97 are listed below. This budget was submitted to the Southern Ute Tribal Council in February of 1996. The Council approved the task and has submitted the request for funding. Cost for this effort will be from the Tribe to Miller as in-kind support to the Recovery Program.

Table 1. Estimated costs for FY1997.

Proposed costs for Miller Ecological FY 1997 San Juan River		
	Data integration	
Labor	$	
Travel	$	
Equipment &		
Total	$	

POLYNUCLEAR AROMATIC HYDROCARBON STUDY
1997 Work Plan
U.S. Bureau of Land Management

Objectives:

1. Continue river water and sediment sampling.

2. Continue well water sampling.

3. GPS identification.

4. Reporting.

Methods:

Samples will be collected on the San Juan, Animas and La Plata rivers at 30 locations in the spring and fall. These samples will be collected in spring in order to try to determine if there has been contaminant deposition during the winter months and during late fall after irrigation is terminated.

Well water will be tested to determine presence of contaminants and will be based upon 1996 results and will include wells that have not been remediated and now have lined disposal pits.

BLM has purchased a GPS that will be used to accurately determine the exact location of each location sampled. This information will be provided for the Biology Committee for input into the GIS data file.

The annual report will be prepared and submitted for review by the Biology Committee by March 15,1998.

Budget:

Personnel	$15,000
Sample analyses	30,000
TOTAL	$45,000

SAN JUAN HABITAT RESEARCH
1997 Work Plan
Keller-Bliesner Engineering / Ecosystems Research Institute

DATA INTEGRATION

Background:

Four subcommittees of the biology committee have been formed for the purpose of data integration and completion of flow recommendations. Keller-Bliesner Engineering and Ecosystems Research Institute are participants on each of these subcommittees. Tasks listed are those required for participation in the integration activities to meet the milestones of the Long Range Plan scheduled for 1997.

Objectives:

1. Provide Hydrology/Geomorphology/Habitat Input to the Integration Process.

Methods:

1. Analyze Hydrology/Geomorphology/Habitat Data in Relation to Biological Data Sets. (New Task) Inter-relationships between hydrology/geomorphology/habitat and data collected by other researchers will be analyzed. Those potential inter-relationships will be identified in committee.

2. Participate in Committee Meetings to Review and Discuss Integration Issues. (New Task) It is assumed that 2-3 meetings of each subcommittee will be held to discuss results, integrate data and exchange ideas.

Budget (Funded by BIA)

Category	Cost
Labor	$60,000.00
Travel, per diem	$9,710.00
Vehicle/Equipment Use	$0.00
Supplies	$900.00
Overhead	$3,035.00
TOTAL:	$73,645.00

RIVER CHANNEL DYNAMICS

Background:

An understanding of river channel dynamics is the second step (after geomorphic characterization) 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 1996.The basic data collection tasks will continue this year, with concentration on data interpretation and predictive analysis.

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 1993-1996 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 1996. 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 sites with similar characteristics were surveyed ad modeled in 1996. An additional survey will be completed in 1997 to characterize response of the sites to differing hydrologic conditions.

Using data on substrate size distribution, the boundary shear stress required to entrain the size cobble encountered will be determined and plotted against the available shear stress to determine flowrate at which cobble and gravel sizes found in suspected spawning locations are entrained at these locations.

5. Analyze Mechanism of Backwater Habitat Formation and Maintenance. In 1995 and 1996, 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 for a second year, 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):

Category	Cost
Labor	$110,020.00
Travel, per diem	$17,020.00
Vehicle/Equipment Use	$2,650.00
Supplies	$6,000.00
Overhead	$700.00
TOTAL:	$136,390.00

HABITAT MAPPING AND RESOURCE UTILIZATION

Background:

The documentation of habitat types within the San Juan River from RM 180 to RM 0 will be continued during FY97, although at a 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 temperal 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 where possible.

Objectives:

1. Main River Habitat Mapping. Map San Juan River habitat from RM 180 to RM 0 at sub-sample locations in January and the full range during September-October. This objective is a continuation of the 1996 work at a reduced scale.

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 and biological features of riffle, run and low velocity habitats. This objective is a continuation of 1996 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 1996 work.

5. Verify Spawning Bar Conditions. Verify physical habitat conditions and complexities within the documented squawfish spawning bar and for other potential spawning locations. Utilizing data collected in 1995 and 1996, 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. Habitat mapping (San Juan River and Colorado River). The documentation of habitat types within the San Juan River from RM180 to RM-2 will be continued during FY97. Two separate videographic flights will be mapped as part of this year's effort. Emphasis will be on winter low flow and summer base flow. 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. Mapping methodologies (habitat types) will be the same as previous studies. Special emphasis will be placed on the Lake Powell/San Juan River interface. Processing of the data in the GIS system produces coded polygons for which the surface area is computed and stored individually. The surface areas of major habitat types (eg., riffle, run, slackwater, eddy, backwater, etc.) and an index of habitat complexity (Shannon-Weiner) will be summarized by river mile and geomorphic reach. Our objectives are to continue with a program designed to determine the spatial, temporal (baseflow comparisons from year to year), and discharge-related variations in habitat abundance and complexity.

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. Habitat quality characterization is intended to describe the physical and, chiefly, biological characteristics of low velocity habitat types within the San Juan River. The distribution and productivity of these types of habitats may influence the distribution of various life stages of fishes which utilize them. Backwater habitats will be sampled at 18 sites in the lower six geomorphically defined reaches (3 sites per reach). Samples will be collected in April, August, September and October. The intent will be to assess the condition and productivity of these habitats just prior to runoff and then after runoff during the period when storm events are most intense and sensitivity of squawfish YOY to disturbances is greatest. Additional samples may be collected in backwaters where UDWR finds stocked YOY Colorado squawfish and requests such sampling. As a control, six backwaters will be selected in the lower Colorado and Green Rivers (12 total) to compare the biological productivity of backwaters in known Colorado squawfish nursery areas with San Juan backwater habitats. Habitat quality will consist of measuring physical (water depth,

sediment, light penetration and temperature), chemical (nutrients - N/P, dissolved oxygen, pH, conductivity, turbidity and TSS) and biological (periphyton, phytoplankton, sediment organic content, detritus, zooplankton and benthic macroinvertebrates) parameters. We will test the following hypotheses: (1) Primary and secondary productivity of backwaters habitats declines longitudinally; and (2) Productivity, as a measure of stability, of San Juan River backwaters is lower than in reaches of the Colorado and Green Rivers where YOY squawfish are relatively abundant. A third hypothesis, whether fish abundance and/or biomass within backwater habitats is positively correlated with these other measures of productivity, will rely on data collected by UDWR and will be addressed during the integration process.

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. Depending upon the hydrograph and the availability of radio tagged squawfish, physical habitat conditions (substrate size, depth to embeddedness, interstitial volumes and topography survey) within the spawning bar complex on the San Juan River 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. As a control, the spawning bar at RM16.5 in the Yampa River will be investigated in 1997.

6. Analyze Razorback Sucker Habitat Availability. Razorback sucker habitat utilization will be determined by evaluating the habitat locations where radio-tagged fish are located based upon habitat preference data provided by other researchers.

Budget (Funded by BIA):

Category	Cost
Labor	$221,366.00
Travel, per diem	$27,190.00
Vehicle/Equipment Use	$6,250.00
Supplies	$7,250.00
Overhead	$21,517.00
TOTAL:	$286,573.00

FLOW/HABITAT MODELING

Background:

With the accumulation of two additional habitat mapping data sets for the entire river, preliminary model development begun in 1994 and continued in 1995 and 1996 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. Incorporation of the hydrology/geomorphology relationships into the model developed under step two will be attempted to add predictive capability to the model.

4. Develop Preliminary Management Strategies by Reach. Preliminary management strategies will be developed by reach as a first step in determining the flow requirements for the fish. These strategies will be refined and incorporated with flow/biological responses in determining the overall management strategy.

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 and 1996.

3. Incorporate Geomorphic/Flow Relationships by Reach. The geomorphology/flow relationships examined under river channel dynamics 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. Initial strategies developed in 1996 will verified and refined in cooperation with the full team of researchers to incorporate results of all studies into the development of the recommended management strategy.

Budget (Funded by BIA):

Category	Cost
Labor	$53,910.00
Travel, per diem	$0.00
Vehicle/Equipment Use	$0.00
Supplies	$1,200.00
Overhead	$2,725.00
TOTAL:	$57,835.00

RIVER OPERATION MODELING

Background:

The USBR PRYSM river operation model is being used to model the river. Currently, the modeling effort is about 1.5 years behind schedule in the San Juan. The model is to be used to analyze the capability of the system to produce particular hydrographic conditions in the river below Navajo Dam. Assistance will be provided to USBR to review natural flows, calibrate the model and prepare for simulation runs on a weekly time step.

Objectives:

1. Review Natural Flow Studies, Calibrate Model & Prepare for Simulation Runs. Natural flow studies presently being completed will be the basis for the model operation. A committee has been formed for review and verification of the results. The model is presently configured with a monthly time step and must be converted to weekly or daily.

2. Complete Simulation Runs. Once configured, the model will be used to simulate reservoir operation to meet objectives defined in the research under various development scenarios.

Methods:

1. Natural Flow Study Review, Model Calibration and Preparation for Simulation Runs. Results of the natural flow study to be completed December 1996 will be reviewed and comments provided to USBR. Long term monthly natural flow at Bluff and Archuleta will be correlated to 1974-85 natural flow at other key sites in the basin and long term records at these sites generated using the correlation to the long term gages. Pseudo-daily and pseudo-weekly data will be generated from the monthly data utilizing long term daily gaged records for improved resolution of hydrograph shape. All data will be provided to USBR for inclusion in the model.

2. Complete Simulation Runs. Utilizing the configured PRYSM model for the San Juan Basin, reservoir operation will be simulated to analyze the deliverability of flow requests and define future reservoir management rules.

Budget (Funded by BIA):

Category	Cost
Labor	$34,920.00
Travel, per diem	$7,750.00
Vehicle/Equipment Use	$10,000.00
Supplies	$1,000.00
Overhead	$1,000.00
TOTAL:	$54,670.00

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):

Category	Cost
Labor	$4,623.00
Travel, per diem	$270.00
Vehicle/Equipment Use	$200.00
Supplies	$200.00
Overhead	$0.00
TOTAL:	$5,293.00

GIS Based Integrated Database Maintenance

Background:

The GIS database developed in 1996 requires quarterly updating. This maintenance function is provided by this task. All updates will be coordinated through FWS-Region 2, the main repository for the data.

Budget (Funded by BIA):

Category	Cost
Labor	$12,122.00
Travel, per diem	$0.00
Vehicle/Equipment Use	$0.00
Supplies	$1,000.00
Overhead	$600.00
TOTAL:	$13,722.00