FINAL PROJECT REPORT

for

PROFESSIONAL SERVICES CONTRACT

with the

STATE OF NEW MEXICO

INTERSTATE STREAM COMMISSION

and

WESTERN NEW MEXICO UNIVERSITY

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DEPARTMENT OF NATURAL SCIENCES

I. Scope of Work - Summary Report

A. *Tasks*. The primary task assigned is clearly "creating a database and related files for the Gila River Fisheries". This task was completed and the database and all directly related files were sent to Orrin Myers for statistical analyses.

1. *Meetings/Guidelines/Reports:*

A. Met with the ISC, February 2006 in Albuquerque and reviewed Gila River Fishery Data, identified objectives, potential analyses, and received guidance from the ISC staff as well as from Orrin Myers.

B. Professional Reports. Final Project Report was submitted in June. Professional Reports, Manuscripts and resulting publications that discuss Gila River fisheries, habitats, and analyses will be an ongoing project using the statistical analysis that Orrin Myers will be providing. This process will occur over the next two or more years.

2. *Gila Fisheries River Data*:

The entire data sets of Dennis Miller's and John Rinne's research on the Gila River was entered into Microsoft Excel spreadsheet and then transferred to Microsoft Access database files. Both sets were provided to the ISC through Orrin Myers. A CDROM with all files for the entire project is included with this report.

The database includes 80,666 fish and a total of 1,237,171 or 1.2 million data entries in five separate but linked databases. The details can best be explained in the breakdown of field descriptions for the database included in the following pages. Some of the more notable details are:

- Spikedace made up 10595 of these fish or 13%
- Loach Minnow made up 5499 fish or 7%
- Together, the two threatened species make up 20% of the fish
- 94% are native fish to the river, 6% non native

FIELD DESCRIPTIONS FOR "FISH DATA" DATABASE

Specimen Number	HabitatKey	Date	SiteName	MacrohabitatNo	Macrohabitat Name	Species	Length	Sex	AgeClass	NativeNon
Number assigned to each fish sampled. Serves as Key field to database.	Habitat Key for Physical Database. This number corresponds to the Habitat Key in the Physical Data Database and links fish data to all physical data	Date fish data was collected	Specific Site Name used throughout database. Matches site name in Physical Data database. This is listed again in this fish database to ensure correct data entry.	Specific Macrohabitat number used throughout database. Matches site name in Physical Data database. This is listed again in this fish database to ensure correct data entry.	Specific Macrohabitat Name used throughout database. Matches site name in Physical Data database. This is listed again in this fish database to ensure correct data entry.	Specific species name of fish	Overall or total length of fish in millimeters from tip of nose to tip of caudal fin	Males were recorded in species where sexual dimorphism occurs and only if in breeding colors to clearly determine this factor. This data is used only to determine the number of breeding males present. If not clearly male, then specimens are listed as either females or juvenile males.	This field is to separate young of year (YOY) from non YOY fish.	This field labels which species are native and which are non-native.

FIELD DESCRIPTIONS FOR "PHYSICAL DATA" DATABASE – next three pages

MasterHabitatKey	Date	SiteName	MacrohabitatNo	MacrohabitatName	MHSpecifics	ZoneNAD27	GPSEasting	GPSNorthing	Elevation
This number is the key to link all data in all sheets. Each fish, flow rate, etc. has this number linked with it to connect to physical data	Date of sampling	Specific site name	Macrohabitat division of site in column C	Specific macrohabitat name of number in column D	Any specifics such as shallow, deep, woody debris, etc. that could be used to sort different types of macrohabitats further. All are data noted while collecting at the site.	GPS Zone used for all GPS data	Numeric GPS reading. This will be refined in 2006 sampling by listing GPS reading from both the bottom and the top of each site.	Numeric GPS reading. This will be refined in 2006 sampling by listing GPS reading from both the bottom and the top of each site.	Elevation from topo maps. Will be refined from GPS readings during 2006 sampling.

FIELD DESCRIPTIONS FOR "PHYSICAL DATA" DATABASE (continued)

Legals	RiverRegion	Seconds	CollMethod	TempC	MeanVelocity	MeanVelocity Method	HabitatLength	Length Recorded	HabitatWidth
Township, Range, Section, and quadrant info	Gila river has been divided into 5 regions with #1 being the upper area around the forks, #2 the canyon bound wilderness, #3 the transition zone into the Cliff valley, #4 Cliff,Gila valley,	Readings from electrofishing shocker to be used to calculate CPUE (catch per unit effort) which is the number of fish per minute or second. Numbers listed here are in seconds.	To be able to list "zero" seconds in areas that electroshocking was not used and a seine was pulled to collect fish. In order to calculate CPUE, the sites without "shocked" in this column should be not included in any calculations.	Temperature recorded at sample site on day of sampling. Due to variability of temp during any given day, this data is not as useful, but has been recorded, so reported.	Each macrohabitat at each site each year has between 9 and 15 velocity recordings that have been averaged in the "VelocityDepth" spreadsheet. They have been transferred manually to this column.	Some sites do not have velocity data, so this column allows those to be separated out and NOT be included in any analysis of velocity. The "digital direct" denotes velocities have been recorded.	Measured length of each macrohabitat. To be used for length of habitat calculations, surface area calculations, and volume of water calculations. Can be used for fish per unit of area comparisons.	Some sites do not have length data, so this column allows those to be separated out and NOT be used in any calculations of length, area or volume. Any value of "NO" in this column shows a zero value in column R.	Measured width of each macrohabitat. To be used for surface area calculations, and volume of water calculations. Can be used for fish per unit of area comparisons.
	and #5 the middle box through the lower river up from the Arizona line. Separated by geomorphology and fish populations		No CPUE can be calculated for "pull seine" samples		Data is in units of meters per second.	"No data" denotes that velocities were NOT recorded at that site that year. Due to needing to not leave any fields blank in ACCESS, a zero value was entered in column P.	Data is in meters		Data is in meters

FIELD DESCRIPTIONS FOR "PHYSICAL DATA" DATABASE (continued)

Sampled Width	Width Recorded	Mean Depth	Depth Recorded	SurfaceArea Sampled	Volume Sampled	Gradient	Gradient Recorded	RiverBottom Width	Canyon Width	Highest StreamFlow	Annual RiverFLow
In most cases if electro-fishing was used, then this number is the same as column S because the entire width was sampled. If a pull seine technique was used then this width is the width of the seine.	In some cases widths were NOT recorded. Due to again needing to not leave any fields blank in ACCESS, a zero value was entered, so this column shows which do not have any lengths and widths measured.	Each macrohabitat at each site each year has between 9 and 15 depth recordings that have been averaged in the "VelocityDepth " spreadsheet. They have been transferred manually to this column.	Some sites do not have depth data, so this column allows those to be separated out and NOT be included in any analysis of depth	This is the results of the calculation of width X length.	This is the results of the calculation of width X length X depth.	Measured with laser level, this is the percentag e of drop in gradient or slope.	Some sites do not have gradient data, so this column allows those to be separated out and NOT be included in any analysis of gradient. A "NO" value here results in a zero value in column AA	Determined by Topo USA maps. Width was measured from first contour line on one side of the river to the first contour line on other side of the river. This relative difference is for comparing general river canyon width. River Bottom widths are in miles.	Determined by Topo USA maps. Width was measured from first MAJOR contour line on one side of the river to the first MAJOR line on other side of the river. This relative difference is for comparing general geo-morphology of canyon bottom. Canyon. Widths are in miles.	From Gila NM gauge station. Number represents the highest stream flow recorded from July to June of the year of sampling. Sampling is done in late May and June.	From Gila NM gauge station. Number represents the annual stream flow recorded from July to June of the year of sampling. Sampling is done in late May and June.
This width should be used for calculating fish per surface area or fish per volume of water. Data is in meters	If this value is listed as "NO", then a zero value appears in column T and U.	Data is in meters	Due to again needing to not leave any fields blank in ACCESS, a zero value was entered, so this column shows which do not have any depths measured.	Calculation is in square meters.	Calculatio n is in square meters.		Due to again needing to not leave any fields blank in ACCESS, a zero value was entered, so this column shows which do not have any gradients measured.				Data is in Cubic feet per minute.

FIELD DESCRIPTIONS FOR "SUBSTRATE DATA" DATABASE

SortKey	HabitatKey	Date	SiteName	MicrohabitatNo	MicrohabitatName	RawData
Number assigned to allow sorting back to original order of data entry.	Habitat Key for Physical Database. This number corresponds to the Habitat Key in the Physical Data Database and links fish data to all physical data	Date that data was collected	Specific Site Name used throughout database. Matches site name in Physical Data database. This is listed again in this fish database to ensure correct data entry.	Specific Macrohabitat number used throughout database. Matches site name in Physical Data database. This is listed again in this fish database to ensure correct data entry.	Specific Macrohabitat Name used throughout database. Matches site name in Physical Data database. This is listed again in this fish database to ensure correct data entry.	Separate pebble count measurements in millimeters.

FIELD DESCRIPTIONS FOR "SUBSTRATE SUMMARIES DATA" DATABASE

MasterHabitat Key	Date	SiteName	Macrohabitat#	MacrohabitatName	SubstrateType	Sand%	Gravel%	Pebble%	Cobble%	Boulder%
Habitat Key for Physical Database. This number corresponds to the Habitat Key in the Physical Data Database and links fish data to all physical data	Date that data was collected	Specific Site Name used throughout database. Matches site name in Physical Data database. This is listed again in this fish database to ensure correct data entry.	Specific Macrohabitat number used throughout database. Matches site name in Physical Data database. This is listed again in this fish database to ensure correct data entry.	Specific Macrohabitat Name used throughout database. Matches site name in Physical Data database. This is listed again in this fish database to ensure correct data entry.	Substrate type determined by data in columns G through K. This data is for sites where specific pebble count measurements are not available, but the summaries were available.	Percent of substrates measured that were 2 millimeters or less.	Percent of substrates measured that were between 3 and 54 millimeters	Percent of substrates measured that were between 55 and 127 millimeters	Percent of substrates measured that were between 128 and 256 millimeters	Percent of substrates measured that were over 256 millimeters
					Entry in this data field is determined by the following criteria: 50% or more 1st label; 25% or more 2nd label; more than twice as much as the next highest, only one label used; when numbers are equal then just a space separates labels instead of a "/".	These size classifications of sand, gravel, pebble, cobble, and boulder are based on the Bevenger and King method of Pebble Count Procedure, USDA Forest Service Research Paper RM-RP-319,				

FIELD DESCRIPTIONS FOR "VELOCITIES DEPTHS DATA" DATABASE

SortKey	HabitatKey	Date	SiteName	Microhabitat#	MicrohabitatName	VelocityDepthRecorded	Velocity	Depth
Number assigned to allow sorting back to original order of data entry.	Habitat Key for Physical Database. This number corresponds to the Habitat Key in the Physical Data Database and links fish data to all physical data	Date that data was collected	Specific Site Name used throughout database. Matches site name in Physical Data database. This is listed again in this fish database to ensure correct data entry.	Specific Macrohabitat number used throughout database. Matches site name in Physical Data database. This is listed again in this fish database to ensure correct data entry.	Specific Macrohabitat Name used throughout database. Matches site name in Physical Data database. This is listed again in this fish database to ensure correct data entry.	Some sites do not have velocity and depth data, so this column allows those to be separated out and NOT be included in any analysis of gradient. A "NO" value here results in a zero value in column H and I. Due to again needing to not leave any fields blank in ACCESS, a zero value was entered, so this column shows which do not have any gradients measured.	Velocity recorded in meters per second.	Depths recorded in meters.

3. *Fisheries Data*:

Files were established and all fisheries data has been entered into the database described above in #2 *Gila Fisheries River Data* including location, dates, fish standard length, number of fish, species, effort per pass, size of reach and other metrics identified by ISC.

4. *Discharge Data*:

Files were established from two USGS gauges, Gila River near Gila, New Mexico and Gila River near Red Rock, New Mexico. The following discharge data files were established for each of these two sites:

- Daily discharge data from 1930 to June14, 2006 which included 27,648 daily discharges for over 75 years
- Daily discharge statistics from 1963 to 2005
- Monthly discharge statistics from 1962 to 2005
- Annual discharge statistics from 1963 to 2005
- Peak discharge statistics from 1905 to 2004

These data files have been copied on to CD-ROM and are included with this report.

5. *Habitat Data:*

Files were established and all habitat data has been entered into the database described above in #2 *Gila Fisheries River Data* including microhabitats (macrohabitats), substrate types, flow rates, and depths and also including GPS data, elevation, water temperature, gradients, and specific pebble counts. Also included was a data set on the geomorphology of the canyon bottom of each site.

6. *Gila Fishery Reports*:

All documents, reports and maps that were provided to us by the Gila National Forest were scanned into Adobe PDF files.

On April 10, 2006 a meeting took place with Jerry Monzingo and Art Tellez of the Gila National forest regarding the scanning of documents in their files for the Interstate Stream Commission. We discussed which data was relevant, which is to be scanned and how to scan them. The decision was made by Art Tellez that the documents should not leave the building and the best way to get them scanned is to bring in our own laptop and scanner. They provided a desk in an office to use for that purpose. On April 11, 2006 Jerry and I met once again to go through the files and decide what documents to scan. Upon arriving Jerry had already gone through the file and had a stack of what they were allowing me to scan. We placed these in a box and placed them on the table we were provided. Came in over the next three weeks and scanned all documents and copied them to a CD-ROM. This CD was given to Peter Wilkinson at the May ISC Technical Subcommittee meeting in Silver City. Another copy of this CD is included with this report.

B. *Contract Manager; Work Orders:*

Peter Wilkinson has been the Contract Manager throughout this contract. Open communication occurred regularly and he was contacted on numerous occasions about the project. A written permission was given to allow the database to be turned in after the March 31st deadline due to both the recognition of the enormity of the job and the fact that the contract was not finalized and the order to begin work was delayed for over two months. No communication of concerns about the date of the database being turned in were received.

Work Orders Completed.

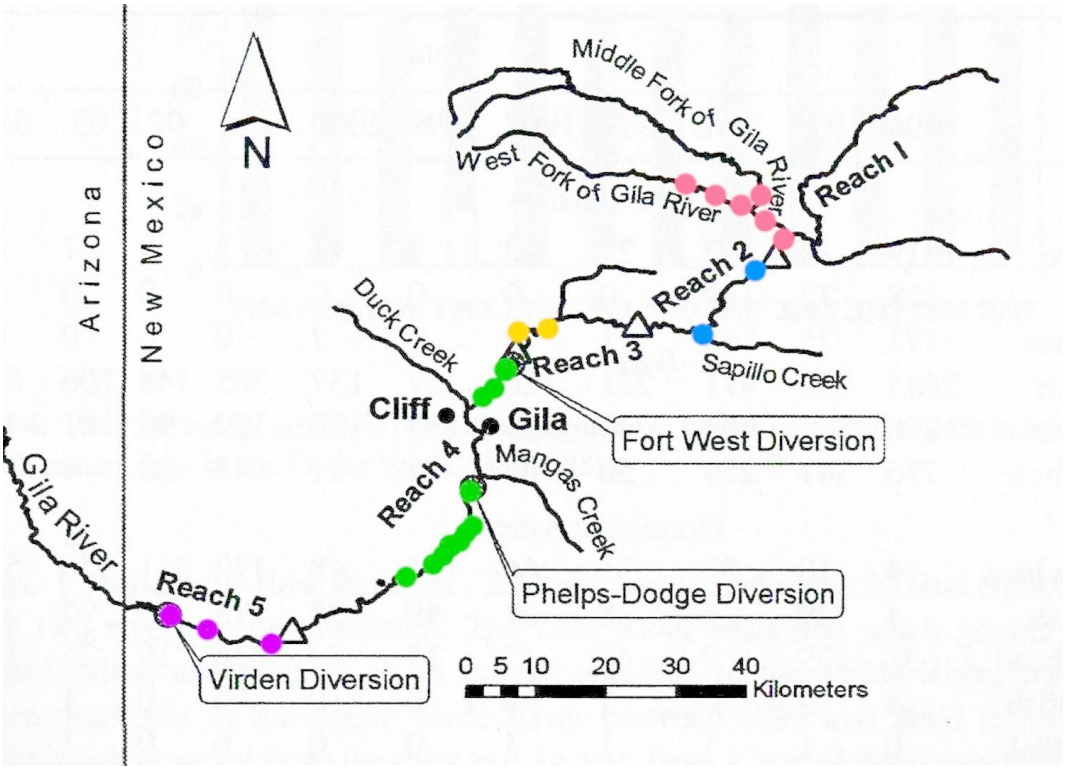
2. Compensation.

Josh Saffel, Grants Officer for the Office of Business Affairs for Western New Mexico University was contacted the day this report was submitted (June 21, 2006) and was informed that the tasks in the contract were completed and the billing for the contract should occur as soon as possible in order to meet the June 30 deadline.

RECOMMENDATIONS RESULTING FROM THE GENERATION OF THE DATABASE

As the work on this database progressed it became obvious at a certain point that there were some recommendations that could be given. As the data was being entered holes in the data were revealed. These are listed here as suggestions for possible research in the near future. Recent studies have show that the research data revealed in the few years after a major flood are extremely important and should not be passed up. The recommendation is that these should be implemented if possible the summer of 2006.

- The map below shows our twenty four sites on the Gila. As you can see, the river is broken into 5 reaches with the Reach 1 being the upper forks area and is characterized by having Speckled Dace and Headwater Chub, Reach 2 is the main stem of the upper Gila that is almost all canyon bound and within the Gila Wilderness. It is also characterized by having very few fish and no Spikedace or Loach Minnow. Reach 3 is a transition zone where the river comes out of the canyon bound areas and is moving out into the very wide Cliff Gila Valley. This area has very few fish and seems like it should. No Spikedace or Loach Minnow either. The physical data collected this year may be interesting. Reach 4 is the main Cliff Gila Valley that has wide open river plain and high populations of Spikedace and Loach Minnow. Reach 5 is the lower Gila in New Mexico and is the area from the Middle Gila Box to the Arizona border. This area has few Spikedace or Loach Minnow and has high non native fish populations.



The problem is that we have very few sites in some of these reaches. If you look at this map, Reach 1 has 6 sites, Reach 2 has 2 sites, Reach 3 two sites that were sampled in 1999 and only this year has been added to our permit to sample regularly (along with one of the sites in Reach 2). Reach 4 has plenty of sites, 11 total and eight of those are near the Gila Birding Area. Reach 5 has three sites, which seems adequate. But the deficit is Reach 2 and Reach 3. Most of the data set has sites with eight to ten years of data. Reach 2 and Reach 3 only have one site with that history which is Allum Camp downstream from the confluence with the East Fork. One more site was added this year in Reach 2, a site at the confluence of Sapillo Creek that was sampled once in 1999. Two more sites were added as well to Reach 3 at two sites that once again had been sampled once in 1999. Even with the three new sites Reach 2 has large expanses with no sites, that are difficult to get into, and would need to be added to our NMGF permit to sample. Reach 3 is left with only 2 sites at the lower end of it.

The specific recommendation is that we add four more sites to Reach 2 and three more sites to Reach 3. These would be determined by the accessibility and the ability to find funding for trips that would involve packing in equipment each year by mule. This would get us a bit closer to having adequate coverage of fish research on the river.

- The evidence is building that ash flows, even moderate to low ash flows have severe detrimental effects on most fish species. The amount of research done in the Gila River on the effects of fires on fishes is almost non existent. But, whether it be naturally caused by lightning, a human caused arson, or a prescribed burn, the data collected when opportunities present themselves could be invaluable to managers of the lands. All twenty four sites we have presently set up could be used as fire effects sites once the ash flows occur. The base data is there, years of it! The funding once again would have to be in place for the ability to go out to these sites at a moments notice after an ash flow has occurred.

The specific recommendation is that funding be acquired to be able to institute this system wide fire study.

QUESTIONS TO POSSIBLY BE ANSWERED BY THIS DATABASE

For Loach Minnow/Spikedace or any species:

- How have the populations changed?
- Has the length of fish varied?
- What habitat are they found in?
- What flow rates are they found in?
- What substrate are they found in?
- What elevation are they found in?
- What river region are they found in?
- What velocities are they found in?
- What depths are they found in?
- What gradient are they found in?
- What canyon width are they found in?
- What highest stream flow do they have?
- What annual streamflow do they have?

Population comparisons:

- catch per unit effort
- surface area of water
- volume of water

- What habitat differences are there in areas that have Spikedace or Loach Minnow and those that don't?
- Do the changes in flow regime affect changes in fish populations?

Habitat changes/differences: changed from year to year, different in one area to another

- Has the number of microhabitats changed?
- Has the length of microhabitats changed?
- Has the area of microhabitats changed?
- Has the volume of microhabitats changed?
- Has the substrate changed?
- Has the temperature changed?
- Has the flow rate changed?
- Has the flow regime changed? (overall flow data from gauging stations)
- Is there a difference in broad geomorphology like width of river valley?