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APPENDIX A

Protocol For Handling Fish

BIO/WEST, Inc.

Resource Management
and Problem Solving Services

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APPENDIX A

Protocol For Handling Fish

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PROTOCOL FOR HANDLING FISH

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1.0 RAFTING/BOATING

BIO/WEST will use one SU-16 and three SH-170 Achilles sportboats powered by 40 hp Yamaha motors for conducting research activities. The SU-16 will be used as an electrofishing boat and the three SD-170 as radio-tracking and netting boats. An SH-170 with 40 hp Yamaha motor was used by BIO/WEST for conducting fisheries studies in Cataract Canyon. The boat/motor combination proved adequate in terms of hull design, power and weight carrying capabilities to perform all research tasks in the Cataract Canyon, including upstream movement in rapids. Similar performance is expected in the Grand Canyon.

All boats and frames will be designed for safety and functionality in addition to quick breakdown for transport on support rafts. Standard safety equipment will be provided with each boat including:

1. Standard First Aid Kit
2. 65' Throw Line
3. Throwable Floatation Device
4. Flip Lines
5. Fire Extinguisher
6. Extra Life Jacket
7. Spare Paddles Or Oars
8. Life Line

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9. Bow Line
10. Safety 'Overboard' Lanyard Motor Switch
11. Boat Patch Kit
12. Motor Repair Kit
13. Spare Motor
14. Q-beam and battery

The electrofishing boat will be designed to accommodate three biologists, an operator and one or possibly two netters. The boat will be equipped with one 5-kw generator, electrofishing apparatus, front electrofishing rail, internal live well, dry equipment storage compartments and spare gasoline in addition to the safety equipment listed above. Total maximum weight expected at one time in the electrofishing boat is an estimated 1200 pounds. The load capacity for this boat is 3210 pounds.

The tracking/netting boats will be designed to accommodate two to three biologists- an operator and two biologists to preform various research tasks such as setting nets or radio tracking. Each boat will be equipped with a live well, dry equipment storage compartments, radio-telemetry apparatus and a breakdown antenna extension boom in addition to the safety equipment listed above. Total maximum weight expected at one time in tracking netting boats is an estimated 800 pounds.

Principal BIO/WEST biologists with experience in operating research vessels will handle boats during most sampling activities. Maneuvering research vessels through rapids will done only by boatmen who possess qualifications outlined in the Colorado River

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Management Plan (CRMP) and/or a Commercial Operating Certification. All of BIO/WEST's biologists and personnel will be familiar with and adhere to the National Park Service's CRMP regulations regarding river safety, experience, and boating restrictions.

2.0 FISH CAPTURE

2.1 Electrofishing

Electrofishing will be used to sample most habitat types in the Grand Canyon. The technique is most effective for sampling the larger life stages, but smaller fish can also be captured depending on water conditions and habitats sampled. All electrofishing efforts will separated by major shoreline habitat type, i.e. sheer wall, tallus and sand beach. This will be accomplished by conducting discrete electrofishing runs within each habitat type.

The basic layout and schematic of the electrofishing boat that will be used for the Grand Canyon studies is presented in Figure A-1. The system will be powered by a 5000 watt Yamaha industrial grade generator, Model YG-500-D. Power from the generator will be routed through a Mark XXII Complex Pulse System (CPS) developed by Coffelt Manufacturing where the current is transformed from a 220 volt AC to pulsed DC current. The pulsed DC current is then supplied to the water through to one anode (+) mounted on a boom projecting from the front of the boat. A Wisconsin Ring assembly mounted on a boom that will be projecting from the rear of the boat will serve as a cathodes (-) to complete the circuit and create the electric field in the water around the boat.

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Output settings that will be used with the new Mark XXII electrofisher will range from 15 to 20 amperes and 300 to 350 volts as recommended by Coffelt Electronics for shocking in the Colorado River below Glen Canyon Dam (Pers. Comm. with Norm Scharber, October 9, 1990). Some trial and error will be required to determine the optimum output settings within these ranges that will be used during electrofishing in the Grand Canyon.

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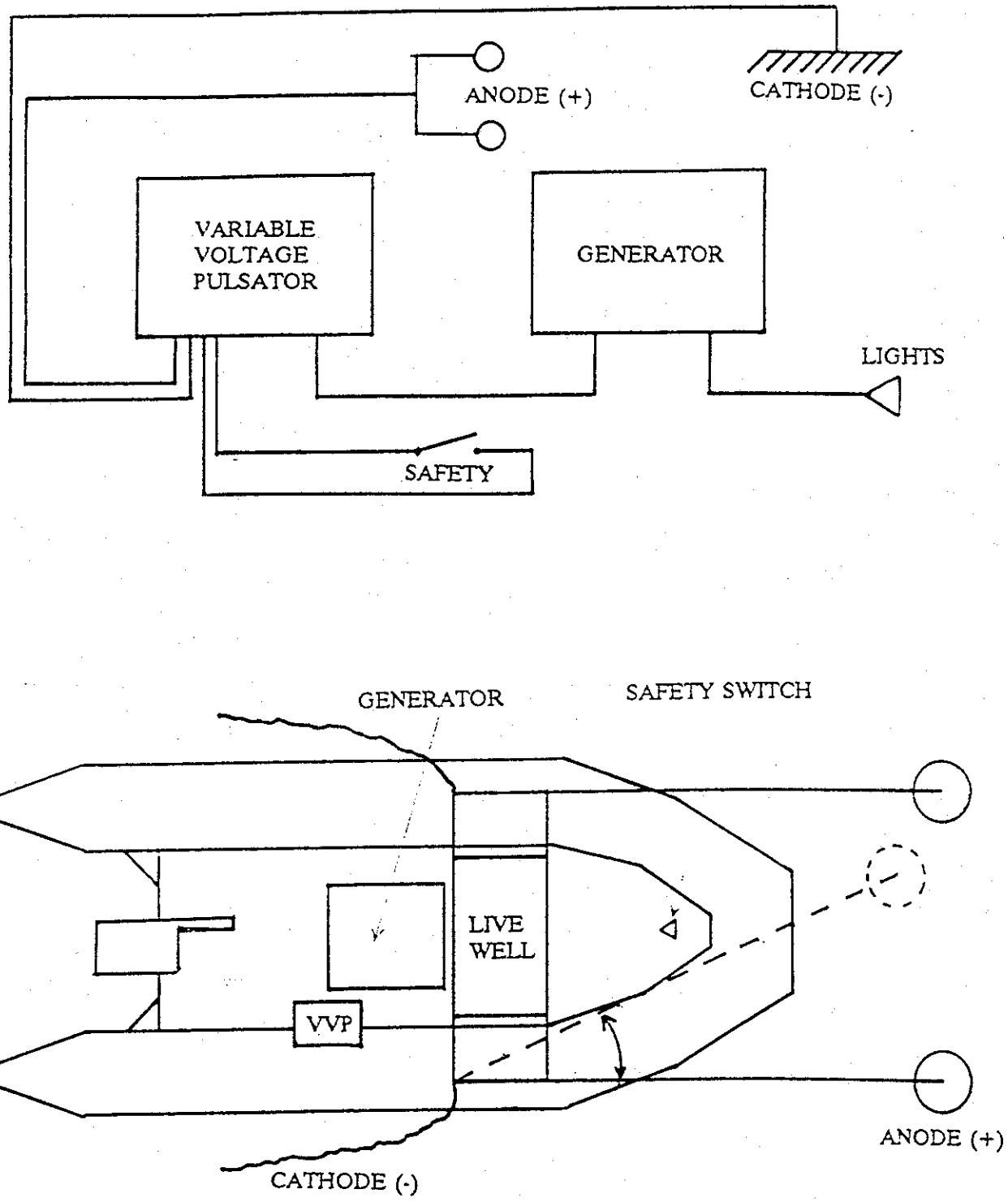

Figure A-1. Layout and schematic of electrofishing raft to be used in the Grand Canyon humpback chub studies.

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The anode (+) and cathode (-) will each consist of a "Wisconsin Ring" assembly at the end of a fiberglass boom. According to personnel at Coffelt Electronics (Pers. Comm. J. Scharber), "Wisconsin Ring" assembly with a ring diameter of 26 to 30 inches, will emulate a sphere in terms of the electrical field pattern, thus minimizing injuries to fish associated with electrofishing. It is anticipated that electroplating of various metals ions will occur on the cathode surface during all electrofishing. This will increase electrical resistance at the eletrode surface and decrease electrofishing efficiency. Consequently, the anode and cathode will be made so that they are easily interchangable, allowing for cleaning of the electrode surfaces by reversing the electroplating process. The anodes and cathodes will be switched each time 45 to 60 minutes of electrofishing has been conducted.

During electrofishing runs, one or two netters will be positioned in the bow of the boat to capture stunned fish. Dip nets used to capture fish will have an opening of 324 square inches (18"x18"), a bag depth of 24 inches and be constructed of 1/4 knotless mesh. One netter will be designated to operate a "deadman" foot switch which must be depressed for the system to be under power. The boat operator will also be able to quickly shut off power at the control unit. As fish are netted, they will immediately be placed into a live well which will be positioned just to the rear of the netters. Rubber gloves, rubber boots and insulated nets will be provided for all persons in the boat to minimize the chance of being shocked.

Individual electrofishing runs will be conducted for each designated shoreline habitat type, e.g. sheer wall shore line, talus shoreline or backwater. In the main channel,

electrofishing runs will generally be made running with the current, adjacent to shoreline, maneuvering the boat in and out among shoreline cover to adequately shock all possible areas used by fish as well as avoiding obstacles. Electronic clocks, built into the Mark XX electrofishing units will serve to keep track of time associated with each run.

During night time operation, power will be supplied by the generator to two 150 watt floodlights mounted on the electrofishing safety railing at the front of the boat. The operator will also have access to a battery operated 500,000 candlepower Q-beam spotlight to aid in navigating the boat.

All fish captured during electrofishing will be processed immediately upon completion of a run within a habitat type. All fish will be visually examined for evidence of injury associated with being shocked. Any fish showing obvious signs of injury will noted. Injured specimens may be collected if deemed necessary (See Section 3.3 for protocol on preserving specimens). Fish will be released immediately after being processed. It is anticipated that fish will be generally released within 0.1 to 0.2 mile of the point of capture. Details on data collection associated with electrofishing are presented in Appendix B, Sec. 1.11.

2.2 Netting

2.21 Gill Netting Techniques

Gill netting is a passive netting technique that will be conducted in all habitats types of the Colorado River in the Grand Canyon. Three types of gill nets will be used during the study including 1) standard 1 1/2" gill net; 2) standard 1" gill net and; 3)

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experimental gill nets consisting of four mesh sizes, 2",1 1/2",1",1/2", graduated from large to small mesh at 25 foot intervals. All nets will be constructed of double knotted #139 nylon multifiliment twine and be 100 feet in length by 6 feet in height. Float and lead line will consist of 1/2" diameter braided poly foamcore float line and 5/16" braided leadcore leadline, respectively. Mooring boat bumpers will be used as gill net marker/floats. Markers will be white for high visibility and labeled to alert other boaters of there purpose. Polypropylene mesh bags filled with rocks will be used as net weights.

Setting gill nets will be accomplished by anchoring one end of the float line to the shoreline or other secure object using a length of line long enough to allow the shore end of the net to reach into the water, but remain within a meter of the shore line. A net weight will be attached to the shoreline end of net to secure the leadline. When setting experimental gill nets, the small mesh end of the net is always attached to the shoreline. Nets will then be strung out to maximize their fishing efficiency according to conditions at the point of the net set. In areas with current, nets are generally strung out downstream, parallel with the current either along eddy lines, runs or pools. In areas with little or no current nets will be placed strategically according to anticipated fish movements. A net weight is attached to the distal end of the net using a length of line varying from 6" to 5' depending on conditions. A marker line is then attached to the float line and the net is lowered into the water until the weight has reached the bottom, at which point the marker/float is attached. Figure A-2 illustrates a typical gill net set.

Nets will be pulled from the water by grabbing the marker/float, pulling the distal

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net weight from the bottom and then hauling the net aboard the boat while slowing working into the shoreline or attachment point. If the distal net weight becomes lodged on the bottom it may be necessary to work from the shoreline out in order to free the weight. All fish are removed as they are encountered with priority to endangered species, native species, trout and other exotics in that order. The netting may have to be cut to remove endangered fish that are severely entangled, but only when necessary. Fish will be identified and enumerated to the data recorder as they are removed from the net and either placed in the live well or measured, weighed and released.

Net sets will be run for one to two hours, depending on debris and Cladophora accumulation. If nets are found with significant Cladophora accumulation, the net will be pulled and a clean one put in its place. In order to reduce netting stress and mortality, the maximum duration of a gill net set will be approximately 2 hours. Details on data collection associated with gill netting are presented in Appendix B, Sec. 1.11.

2.22 Trammel Netting Techniques

Trammel netting is generally considered a passive netting techniques and will be used in all habitats in the Colorado River through the Grand Canyon. Trammel nets can also be used actively by floating nets through areas where concentrations of fish are expected. This active technique may be used occasionally if conditions dictate, but generally trammel nets will be used passively.

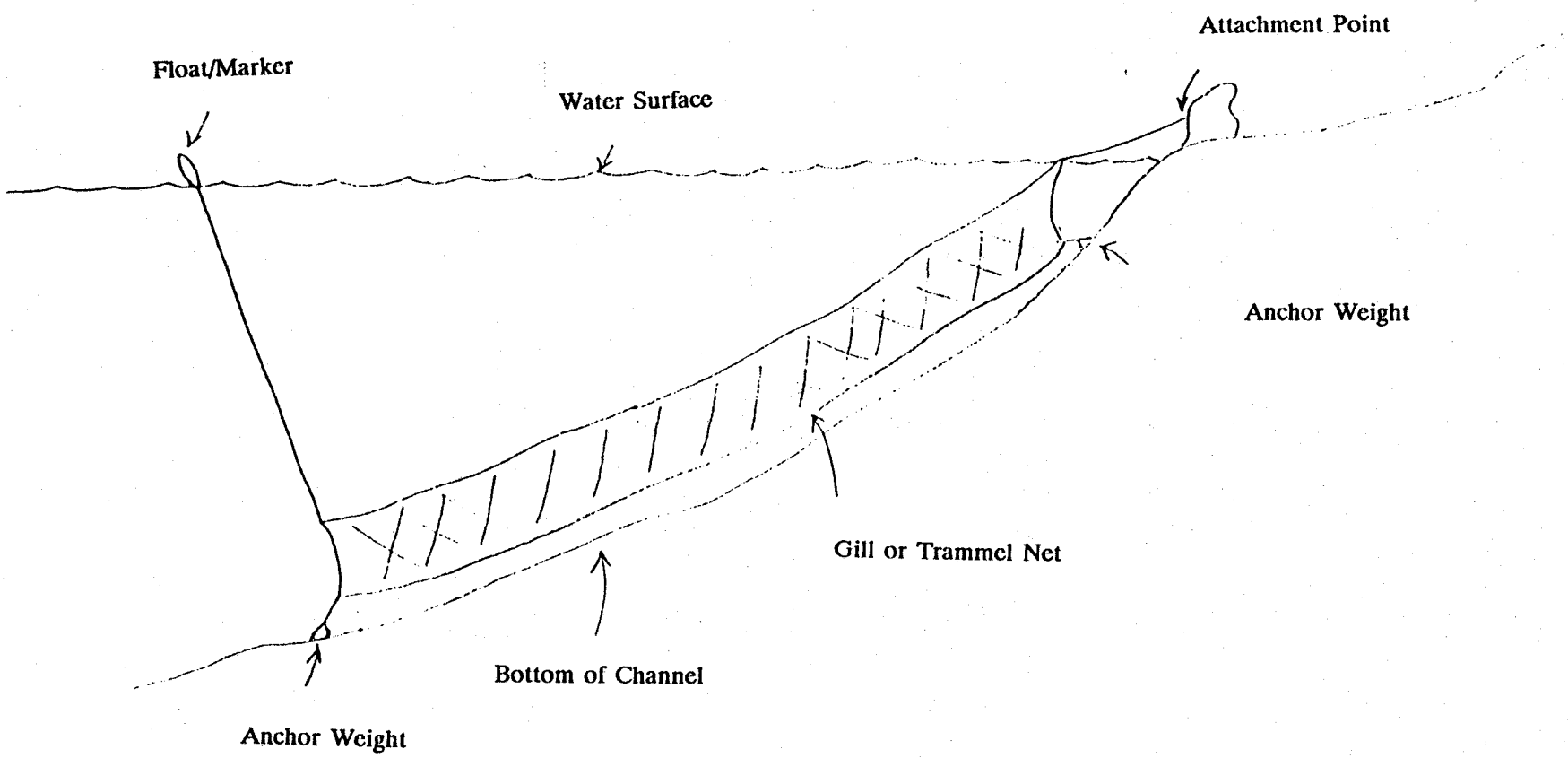

Figure A-2. Typical gill or trammel net set.

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Trammel nets consist of three panels of netting, two outer walls of large mesh and one inner panel of a small mesh netting. The outer walls on all trammel nets will consist of no. 139 multifiliment twine netting with a 12" mesh. The inner panel will consist of one of two different mesh sizes, either 1" or 1 1/2". All inner panels will be constructed of double knotted no. 139 nylon multifiliment twine.

Methods for setting and pulling trammel nets and handling fish are the same as those for gill nets (see Section 2.21). Details on data collection associated with trammel netting are presented in Appendix B, Sec. 1.11.

2.3 Seining

Seining is an active netting technique that will be used to sample various shoreline habitats in the Grand Canyon including runs, riffles, pools and backwaters. This techniques is especially effective for sampling younger age classes of fish, although larger fish are sometimes captured. Three sizes of seines will be used for this study including 30'x6'x1/4", 15'x6'x1/4" and 10'x4'x1/8" (length x height x mesh size). The top or float line will be constructed of 5/16 braided polypropylene with hard foam floats placed at 18" intervals. The bottom line will consist of braided polypropylene line with lead sinkers placed at 6" intervals.

Seining techniques vary with condition. In areas with current, the seine haul is generally taken in the same direction as the flow. A typical shoreline seine haul taken in a run is initiated by one man stretching the seine out from the shoreline perpendicular to

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the shoreline. The shore end of the seine is usually positioned either at the waters edge or within 1 meter from shore depending on conditions. Once the seine is in position, it is pulled with the current as quickly as possible with care taken that the bottom line is on the substrate. To end the seine haul, the shoreline man comes to a stop as the outside man quickly arcs the seine into shore while maintaining tension on the seine. Once the fish are trapped, the seine is gently pulled under the fish and they are lifted from the water.

Seining in backwaters is accomplished in essentially the same manner. However, without current the seine can be pulled in any direction in the water and is generally pulled in the most strategic manner in terms of corralling fish. Seining is only effective as long as both persons pulling the seine are able to walk firmly and relatively unimpeded on the bottom. Water deeper than 4 to 5 feet generally cannot be seined effectively and will be sampled using other techniques. Substrate consisting of deep silt or boulders also limit the effectiveness of the technique by either impeding the people pulling the seine or by snagging the seine. These areas will generally not be sample with seines.

The backwater will be checked for longitudinal thermal stratification prior to seining. If extreme temperature differences exist at different locations in the backwater, extreme care will be taken not to subject fish to thermal shock by pulling them across a wide temperature gradient.

Once fish are secured in the seine, it will remain suspended in the water while all endangered and native fishes are sorted out and placed into live wells (bail buckets).

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Again, it will be important to insure that water temperature in the live well is within a 1 or 2 degrees of the water where the fish were captured to avoid thermal shock or stress. Once endangered and native fish have been sorted from the haul, the seine will be beached. On the beach a second intensive search for endangered and native fish will be made very quickly. After all endangered and native fish have been removed the remainder of the fish will be placed in a live well. Fish being held will then be immediately processed with priority on endangered species, native species, trout and other exotic species in that order. Fish will be immediately returned to the location of capture after being processed. Details on data collection associated with seining are presented in Appendix B, Sec. 1.11.

2.4 Fish Traps

2.41 Minnow Traps

Minnow traps are a passive sampling technique that will be used to sample young age classes of fish in various slackwater habitats in the Grand Canyon such as backwaters and pools. Minnow traps used for the study will be standard Gee Minnow Traps, 17 1/2" long, 9 inches in diameter, constructed of galvanized wire and steel. Openings are located on both ends of the trap.

Traps will either be placed on the bottom or suspended in the water column depending on conditions. No bait will be used in the traps. Each trap will be tethered to a secure anchor point and flagged for easy location. Traps will be checked at a maximum of every 8 hours to minimize trap related stress and mortality.

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Fish captured in the traps will be transferred to a live well for processing. Fish will be processed immediately and released. Details on data collection associated with minnow traps are presented in Appendix B, Sec. 1.11.

2.42 Hoop Net Traps and Frame Nets

Hoop nets are a passive sampling technique that will be used in various low velocity habitats in the Grand Canyon such as slow runs, pools, backwaters shoreline indentations and side channels. Two sizes of hoop net traps will be used for the study including 2'X10'x1/2" and 4'x16'x1" (diameter x length x mesh size). Two wings made of 1" #15 nylon will be attached to the opening of the hoop nets. These wings will be 25' in length.

Hoop nets will be set in shallow slow velocity habitats. The net will be set by anchoring the rear of the net to the substrate with a length of rebar or fence post and then playing the net out so that the mouth is oriented in the desired direction. The wings are then extended out at an approximate 45°angle and attached to fence posts or rebar to hold tension on the net set. Generally hoop nets are set in anticipation of specific fish movements, e.g. into or out of a backwater or along a shoreline. Nets will be checked at least every 8 hours to minimize trap stress or mortality.

Frame nets are similar to hoop nets except for differences in the shape of the net frame and configuration of the lead (wing). Frame nets are set in the same manner as hoop nets.

Fish captured in the hoop net traps will be placed in a live well for processing. Fish will be processed immediately and released near the point of capture. Details on

data collection associated with minnow traps are presented in Appendix B, Sec. 1.11.

2.5 Angling

Angling is an active sampling technique that may be used under limited circumstances in the Grand Canyon. Angling has proven to be an effective method for capturing humpback chubs in the upper basin. Fish captured by angling will be processed immediately after being caught. Angling effort will be recorded as time spent with line in the water.

3.0 FISH HANDLING

3.1 Live Well Maintenance

Live wells will be used extensively to hold fish captured by the various sampling techniques in this study. Several types of live wells or containers will be used, each associated with a specific type of sampling method. These will range from 5 gallon buckets, for use during seining, to 40 gallon live wells mounted in the electrofishing boats.

Five gallon buckets will be used to hold fish captured in seines and net traps. Separate buckets will be used to hold endangered and native species. Water will be replaced in these containers for each seine haul, with care taken to insure that the temperature in the live well is within 1 or 2 °C of the temperature of the water where the fish are captured. All fish will be monitored continuously while being held in live wells to insure that no evidence of stress is being exhibited. Signs of stress include fish swimming near the surface, loss of equilibrium while swimming, change in coloration of individual

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fish.

Under conditions where fish will be held for prolonged periods, water will be exchanged in the live well every 15 minutes.

Larger live wells used in the boats to hold fish captured electrofishing or in nets will have a minimum capacity of 25 gallons. Water quality in the live wells will be maintained by exchanging water following each sample effort. Monitoring of fish and maintanence of water quality in the live well will be conducted as described above. Care will be taken not to overcrowd live wells, by making sure that fish are able to move freely while being held.

Live wells used in electrofishing boats will not be subjected to any electrical current since they will be mounted inside of the electrofishing raft.

3.2 Tagging and Marking

3.21 PIT Tagging

PIT tagging will be performed only by personnel designated by the Principle Investigator or Project Leaders. Key personnel will be trained in the use of PIT tagging apparatus during the first field trip. PIT tagging is relatively easy to learn, and can be quickly taught to biologists experienced with handling fish and with other tagging procedures such as radiotagging, Carlin tagging, and Floy tagging.

PIT tagging procedures will follow those described by Burdick et. al. and Minckley et. al. Only fish greater than 150 mm total length will be PIT tagged.

3.22 Fin Clipping

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Fin clipping is an easy, effective and relatively harmless method for the short term marking of fish. Much of the sampling for this study will take place in relatively specific river reaches and a certain amount of redundancy in sample effort expected within a given trip, particularly with gill and trammel netting. Light fin clipping (e.g. 2 to 3 mm taken from the lower caudal fin lobe) will allow a degree of insight into fish movement, abundance and redundant data collection on individual fish, for a given trip.

All juvenile and adult fish, except those PIT tagged or radiotagged, that are captured in an area that will be sampled intensively (more than one time or by multiple techniques) during a given trip, will be marked by a light fin clip of the lower lobe of the caudal fin. This mark is expected to be effective through the duration fo the trip in which the fish was marked.

3.3 Preserving Fish

Collection and preserving of fish in fixatives will only be done when absolutely necessary, unless collection for taxonomic reasons is prescribed by the ACT. Fish not able to be identified afield and incidental mortalities associated with sampling will be preserved in a 10% solution of formalin. A prescribed number of preserved specimens may be in taxonomic studies. These fish will be placed in uncrowded containers of 10% formalin solution for 2 to 3 days, then transfered to containers of 70% enthanol.

All fish collected with be placed in containers of adequate size and strength to prevent distortion or damage to specimens during collection and transportation. Care will be taken not to overcrowd specimens in containers. A small incision into the parietal

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cavity will be made on the right side of any specimen greater than 150 mm in length, to insure against decomposition. All collections will be labeled with sample #, date, RMI corresponding to that recorded on the data sheet for the sampling effort. Labeling will be done with permanent markers on the outside of the containers and/or in pencil on collection labels that will be placed in the preservative with the fish.

3.4 Stomach analysis

Stomach analysis techniques will follow Seaburg (1957).

3.5 Capture of a Razorback Sucker

In the event of capture of a razorback sucker the following proceedures will be followed unless otherwise modified by the ACT. Any razorback sucker will be handled with utmost care to reduce handling stress. Total length and weight of the fish will be recorded. Photographs of the fish will be taken with a 35 mm camera. The fish will be PIT tagged and and comments on condition or other pertinent observations will be recored. All other information, including location, date, habitat, etc. will be recorded on the associated sampling data form. The fish will then be released as near to the point of capture as possible.

4.0 RADIO-TELEMETRY

4.1 Fish Transport and Holding

Fish captured for radiotagging will be handled with the particular care and attention to minimize handling stress. This includes holding the fish in a separate live well for

transportation to the base camp or other locations where surgery will be performed. Fish will be constantly monitored while being held to insure that no signs of stress are evident.

Surgical equipment and working area in the base camp will be kept readily available to minimize set up and handling time when attempting to capture fish for radiotagging. A live car will also be set up and maintained to hold fish during preparation for surgery.

When fish are captured at locations that are distant from a permanent base camp, a field surgical station will be set up in the most convenient location close to the point of capture. Each research vessel used to capture fish for radiotagging will carry surgical apparatus including surgical tools, sterilizing agents and reservoirs, portable work area, necessary telemetry equipment and a live car. All attempts will be made to implant fish as soon as possible following capture to minimize handling time and stress.

4.2 Radio-tag Implanting

4.21 Telemetry Check

All radiotags will be checked at BIO/WEST facilities upon receipt from the factory. Actual frequency and pulse rate will be recorded for each transmitter. Frequency and pulse rate will again be checked and recorded just prior to implantation and immediately following release into the river. All telemetry check information will be recorded on Form 2 (Appendix B), as part of the telemetry log for each transmitter.

4.22 Surgical Procedures

Surgical techniques for implanting radio transmitters outlined in Yard et al. 1990 (Pilot Study to Determine the Feasibility of Employing Radiotelemetry in the Grand

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Canyon on the Endangered Species Humpback Chub) will be followed for this study. The principle investigator will be responsible for selecting individuals to be trained in

techniques for implanting radio transmitters in humpback chubs. These individuals will undergo training during Trip 1 of 1990.

4.3 Tracking

4.31 Aerial Radio-Tracking

Aerial tracking will generally be conducted prior to each field trip to provide field crews with preliminary data on locations of radiotagged fish. Aerial tracking will be conducted from a helicopter, flying at an altitude fo 500 to 1000 feet (depending on NPS regulations) and a speed of approximately 30 to 80 mph. A trial and error process will be required to determine the optimum elevation and speed for radio tracking.

Aerial radiotracking will employ the use of two radio receivers, one Model 2000 ATS programmable receiver and one Smith-Root SR-40 simultaneous scanning receiver. Two Larsen-Kulrod omni-directional whip antennae will be mounted to the skids of the helicopter. The antenna on the pilot's side will be connected to the Model 2000 ATS receiver. The antenna on the passenger's side will be connected to the SR-40 receiver. Output signals from both receivers will be routed through a switch box to two sets of headphones, one for the tracker and one for the pilot. This enables the tracker to switch back and forth between the two receiver outputs.

All current transmitter frequencies will be programed into the Model 2000 ATS

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programmable receiver prior to each aerial tracking effort. A list of all frequencies and pulse rates for active transmitters and the last known location of the transmitter will be readily available to the tracker. Surveilance flights will proceed in a downstream directionfor the entire length of the study area. Since the SR-40 has the capability of simultaneously scanning all frequencies, the chance of missing signals is minimized and tracking speeds will not be as restricted as if a cycling search receiver was being employed.

When a signal or signals are received by the SR-40, the pilot will be asked to remain stationary or circle the area slowly in a counter clockwise rotation so that the pilot side or programmable receivers antenna is located on the inside of the rotation. The tracker then tunes the programmable receiver to the most likely frequency in the area. The transmitter signal is then identified by switching back and forth between the programable reciever (ATS Model 2000 or Smith-Root RF-40) and the search receiver (SR-40), while tuning the programmable receiver to the most likely frequencies. When the signals match the transmitter can be identified by reading the frequency from the programable reciever. Since only three pulse rates will be used for transmitters the operator should also be able to quickly determine the general pulse rate (40, 60 or 80 pulses per minute. The location of fish can be estimated by listening to variation in signal strength as the pilot circles and the orientation of the entenna changes. Generally the 'on ground' resolution of the fish location is within 0.1 to 0.2 miles. Once a frequency has been confirmed, the fish location will be plotted on a map of the river that will be provided for each tracking trip.

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The aerial tracking will continue until all of the transmitters have been located or a reasonable search has been conducted.

Engine noise from the helicopter may cause interference with the ATS Model 2000 receiver's signal reception. Any problems associated with engine noise will be identified during the first aerial tracking effort and measures will be taken to rectify the problem.

4.32 Ground Radio-Tracking

Radio tracking from boats will be conducted during all downstream travel, beginning from Lee's Ferry and continuing to the take out point for each trip. Radio receivers will be stowed in water proof boxes during white water sections, but remain accessible so that tracking efforts may continue once rapids have been negotiated.

While tracking from the S-rig support boats, an omni-directional whip antenna will be mounted on a rocket box situated as high as possible on the rigging. The SR-40 receivers will be used to monitor for transmissions. Where possible, operators of the support boats will be asked to traverse opposite sides of the channel. However,for travel efficency most tracking from the support boats will be conducted from the center of the channel.

Depending on circumstances, radio contacts made while traveling on the S-rig will be handled as deemed appropriate. If it is possible for the researchers to return to the point of radio contact within a short period of time using SH-170 tracking boats, the location of the fish will be recorded and the support boats will continue on to the to base camp. Researchers will then immeadiately return to the point of radio contact and

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proceed with telemetry efforts. If a radio contact is made from the support boats at a location where a return trip would be considered impractical, the operator of the support boat will be asked to make an effort to land the boat, so that the location of the fish can be pinpointed. If possible, habitat measurements will be attempted from the support boats.

Radio tracking from the research tracking boats will involve two boats. Each boat will move along the opposite shoreline while tracking. Tracking efforts to locate radio-tagged fish will be made using the SR-40 receiver attached to an omni-directional whip antenna. The whip antenna will be mounted on a metal base plate, suspended above the boat by a frame apparatus.

Once contact is made with a fish, an attempt will be made to determine the general location of the fish from the boat using an ATS Model 2000 receiver and a directional loop antenna. After the general location of the fish is determined, the tracking boat will be landed on the appropriate shoreline, with care taken no to disturb the fish. An ATS Model 2000 programmable receiver and directional loop antenna will be used from shore to locate the position of the fish in the channel. Once the fish has been located in an area, it will be monitored for at least thirty minutes to determine if its position is static or dynamic. If the fish is stationary, its location will be triangulated and marked. The fish will then be monitored for an additional 1.5 hours to determine habitat use. Triangulation sightings will be marked for all locations where the fish remains stationary for 30 minutes or more during the 1.5 hour monitoring period.

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If the fish is moving, its movements will be monitored for an undetermined amount of time, to ascertain its behavior and or movement patterns in relation to various factors including: 1) stage changes; 2) local macrohabitats and/or; 3) other radiotagged fish in the area. If the fish becomes stationary, it will be monitored as described above for a stationary fish.

A detailed hand drawn map or a detailed map using mylar overlay of an aerial photo (depending on photo availability) will be prepared for each fish that is monitored (See Section 5.3). Distance and direction of all movements of the fish will be recorded on the map and in the telemetry log (Form 2) relative to time and stage of the river.

At the conclusion of monitoring, habitat measurements will be taken at all locations where the fish was stationary for at least 30 minutes. Habitat measurements taken at each point include depth, velocity, substrate, temperature, cover, and water quality. Procedures for measuring each of these microhabitat parameters are presented in Section 5.2.

5.0 HABITAT SAMPLING

Aquatic habitats will be quantified in conjunction with fish collections and radio telemetry studies. The purpose of habitat sampling will be to quantify micro and macrohabitats utilized by humpback chub, and to determine how variations in river stage affect habitat availability and its use by humpback chub. Types of data which will be collected include, river stage data, depth, velocity and substrate in microhabitats utilized

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by fish, macrohabitat features, and water quality.

5.1 FLOW/STAGE MONITORING

Variation in river stage at a location will be monitored primarily with temporary staff gages. River stage will be monitored at two levels of intensity. During specific sampling efforts, such as radio-telemetry monitoring or habitat mapping, staff gages will be emplaced as near as possible to the sample site and monitored a minimum of every 30 minutes or as deemed necessary. Additionally, temporary staff gages will be located at base camps to monitor overall river flucations (timing and relative magnitude) during the sampling trip. These measurements may be able to be correlated with USGS gaging information by using recording the time, date and relative magnitudes of observed flucations. These observations could then be related to stage measurements of the nearest USGS gaging sites both up and down stream of the base camp location.

River stage will be arbitrarily monitored each day throughout the period of time that sampling or telemetry work is being conducted in an area. An effort will be made to record river stage a minimum of 4 times daily (at 6 hr intervals) to document overall patterns of river stage during a sample trip. Particular effort will be made to record the relative high and low stage during each fluctuation cycle and the times of occurrance.

5.2 MICROHABITAT MEASUREMENTS

Microhabitat measurements will be taken in conjunction with radio telemetry

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observations to evaluate habitat use. In areas where the total depth exceeds the length of the metered rod, depth will be taken using a fathometer. Depth, velocity, substrate and cover measurements will be taken at locations utilized by humpback chub during resting periods. Procedures for determining the number and location of microhabitat measurements for resting fish are described in section 4.32.

Measurements of physical habitat will be taken either from a boat or by wading to the predetermined location. Depth will be measured to the nearest tenth of a meter. Measurements will be made with either a telescoping meter rod or a wading rod. Water velocity will be measured to the nearest tenth of a meter per second at the same location as the depth measurement. Velocity of the water column will be measured at 3 cm off the river bottom, and at two-tenths, six-tenths and 8-tenths of the water depth. In extremely deep water, an effort will be made to collect as many of the column velocities as possible. Selection of the depths of water velocity measurements will be made using a top setting wading rod to facilitate correct depth selections. In deep waters a manual operated system will be used to select proper depths for water velocity measurements. Velocity measurements will be made using a Swoffer current meter. When measurements are taken in an eddy or reverse river current, greater than 90 degrees from the main directional flow of the river velocities will be recorded as negative.

Substrate will be categorized as silt, sand, gravel, cobble, boulder or bedrock by visual observation, probing with depth rod, or physical examination of the substrate. Substrate categories are defined in Table A-1 . Primary substrates will also be categorized

as either dominant or subdominant. The substrate which accounts for the greatest surface area will be considered dominant. The second most commonly occurring substrate will be considered subdominant.

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Table A-1. Proposed Substrate Code.

Substrate	Description
Silt	fine material <.062 mm in diameter
Sand	coarse fines .062 - 2 mm in diameter
Gravel	particles 2 to 75 mm in diameter
Cobble	particles 75 to 300 mm in diameter
Boulder	particles >300 mm in diameter
Bedrock	substrate a solid rock shelf

Cover at the fish location will be characterized in terms of lateral, overhead and instream cover based on observations at the microhabitat sampling location. Overhead cover will be characterized as overhanging bank cover such as rock ledges, or cover provided by streamside vegetation. Lateral cover types include vertical rock walls and boulders. Instream covers types include boulder, log or debris jam, sand shoal, or rock jetty. For each type of cover there is also a designation for no cover.

5.3 MAPPING

Some habitats containing humpback chub will be intensively mapped to document

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changes in riverine habitat and use of those habitats by the fish under different river discharges and fluctuating discharges. Areas selected for mapping will be determined at a later date but will depend on availability of aerial photos, presence of tagged humpback chub, and the perceived importance of the area based on biological sampling.

Once a location is selected for mapping, base maps will be constructed from aerial photographs. Overlays of acetate sheets will then be used to draw in changing habitat features visible to the investigator at different river stages. Locations of fish for which telemetry data is available will also be plotted.

As part of the mapping effort cross-sectional profiles of the river section being mapped will be constructed using boat mounted fathometers. Bathymetric contours of the river section will be determined at a known flow so that relative depths at different flow levels can be approximated based on empirical observations. The number of cross-sectional profiles used to characterize the a river section will depend on the variability of the channel morphology. A minimum of three cross-sectional profiles will be used in each mapping section. Additional profiles will be used as necessary to describe channel conditions.

Supplemental photography will also be incorporated into the mapping effort. A photographic record will be made of conditions during each mapping effort. Photographs will be taken from an established photo point using the same film size and lenses with similar focal lengths to facilitate comparisons over time.

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5.4 WATER QUALITY

Basic water quality data will be collected to supplement physical habitat measurements. Parameters which will be recorded include dissolved oxygen, temperature, pH, conductivity, salinity, redox potential, and turbidity. All parameters except turbidity will be collected with a Hydrolab water quality monitor. Turbidity will be determined using a colorimeter and a Hach test kit. Water quality data will be collected at locations where fish are being observed by radio telemetry and also in conjunction with electrofishing, netting, and seining efforts on the mainstem river and at confluences with tributary streams.

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APPENDIX B

Protocol For Database Management

APPENDIX B - TABLE OF CONTENTS

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PROTOCOL FOR DATA MANAGEMENT

1.0 DATA COLLECTION

1.1 Field Data Forms

1.11 General Sampling

General sampling techniques include electrofishing, gill netting, trammel netting, hoop and frame net traps, minnow traps, seining and angling. Data collection associated with these techniques will be recorded on Form 1, Fish/Habitat Sampling, presented in Figure B-1. Data codes to be used in association with Form 1 are presented in Figure B-2. A detailed explanation of data fields are presented below.

Mandatory Fields

The following data fields must be completed for all types of sampling:

1. Sample No. - Sample number is a unique number that will be assigned to each sample taken during the study. The Sample No. will include information on the study year, trip number for the year, reach identification and unique serial sample I. D. number. E.G. the sample number 2083001 would represent the second year of the study (2 for 1992), the eighth trip (08), the lower reach (3), sample number 1 (001).
2. Date - date will be recorded as a six digit number with the first two digits representing year, the second two digits representing the month and the final two digits representing day of month. e.g. 920612 is June 12, 1992.
3. RMI - River Mile Index will be recorded as the number of miles downstream of Lee's Ferry. The River Runners Guide to the Grand Canyon by Stevens will serve

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FORM 1 *Page __ of __*

BIO/WEST GRAND CANYON STUDY

(Colorado River Mainstem)

Fish/Habitat Sampling

Sample No: _ _ _ _ _ _ _ *Date*: _ _ _ _ _ _ _ _ *RMI*: _ _ _ _ . _ Gear: _ _ *Start Time*: _ _ _ _

End Time: _ _ _ _ *Hours*: _ _ . _ *Seconds*: _ _ _ _ _ _ *Volts*: _ _ _ *Amps*: _ _ . _

Pulse Rate: _ _ _ *Pulse Width*: _ _ % *Hab1*: _ _ *Hab2*: _ _ *Depth*: _ _ . _ *m* *Sub1*: _ _

Sub2: _ _ *AirT(c)*: _ _ _ *McT*: _ _ . _ *HabT*: _ _ . _ *Turb*: _ _ _ *Weather*: _ _

Fish Pres (Y/N): _ *No. Bottles*: _ *Crew*: _ _ , _ _ , _ _ *Habitat Photo*: *Roll* _ _ *Frame* _ _

Fish Code	*LAR*	*YOY*	*JUV*	*ADU*	*Total*
_ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _
_ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _
_ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _
_ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _
_ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _
_ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _
_ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _
_ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _
_ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _
_ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _
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_ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _
_ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _
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_ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _
_ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _
_ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _
_ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _
_ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _
_ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _	_ _ _ _

Keypunched by: ____________ *Date*: ________ *Edited by*: ______________ *Date*: ___________
File Name: _ _ _ _ _ _ _ . _ _

RECORD INDIVIDUAL LENGTHS ON REVERSE SIDE AND CHUB DATA ON MERISTICS SHEET

Figure B-1. General fish/habitat data form to be used in the Grand Canyon humpback chub study (Form 1).

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DESCRIPTION OF FIELDS FOR DATA FORM 1
(Colorado River Mainstem)

Fish/Habitat Sampling

Field	*Width*	*Type*	*Description*
Sample No	*7*	*alphanumeric*	*1 = Year, 1992 = 2* *2 = Trip No. for Year (1-12)* *3 = Reach (1=LCR, 2=Granite, 3=Lower)* *4-6 = sequential sample no.*
Date	*6*	*numeric*	*1-2 = Year, 1992 = 92* *3-4 = Month, June = 06* *5-6 = Day of Month*
RMI	*5.1*	*decinumeric*	*1-5 = miles downstream from Lees Ferry*
Gear	*2*	*alphanumeric*	*1-2 = EL = electrofishing* *TR = trammel nets* *GP = exp gill net* *GN = gill nets* *FR = frame net* *HO = hoop net* *SA = 10'x3'x1/8" seine* *SB = 30'x4'x1/4" seine* *DL = larval fish drift net* *DR = invert drift net* *SU = surber* *AQ = aquarium net* *KS = kick screen* *CT = chub trap*
Start Time	*4*	*numeric*	*1-4 = start of sample time* *6am = 0600* *6pm = 1800*
End Time	*4*	*numeric*	*1-4 = end of sample time*
Hours	*4.1*	*decinumeric*	*1-4 = hours gear set between checks*
Seconds	*5*	*numeric*	*1-5 = total time from VVP-15 clock*
Volts	*3*	*numeric*	*1-3 = voltage setting for VVP-15*
Amps	*4.1*	*decinumeric*	*1-4 = amperage level from VVP-15*
Pulse Rate	*3*	*numeric*	*1-3 = pulse rate from VVP-15*
Pulse Width	*2*	*numeric*	*1-2 = pulse width from VVP-15*

Figure B-2. Descriptions of data fields for Form 1.

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Field	Width	Type	Description
Hab1	2	alphanumeric	1-2 = general habitat MC = main channel TS = tributary stream SC = side channel
Hab2	2	alphanumeric	1-2 = specific habitat BA = backwater ED = eddy RI = riffle RU = run SH = shoreline PO = pool
Depth	4.1	decinumeric	1-4 = depth at gear location
Sub1	2	alphanumeric	1-2 = dominant substrate SI = silt SA = sand GR = gravel CO = cobble BO = boulder BE = bedrock
Sub2	2	alphanumeric	1-2 = secondary substrate
AirT	3	numeric	1-3 = air temperature in °C
McT	4.1	decinumeric	1-4 = main channel temperature
HabT	4.1	decinumeric	1-4 = temperature of habitat sampled
Turb	3	numeric	1-3 = turbidity
Weather	2	alphanumeric	1-2 = weather condition CS = clear sunny OV = overcast RA = raining
Fish Pres	1	alphanumeric	1 = were fish preserved Y = yes N = no
No. Bottles	1	numeric	1 = number of bottles with preserved fish

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Field	Width	Type	Description
Crew	6	alphanumeric	1-2 = principal crew member 3-4 = recorder 5-6 = assistant i.e. RV = Rich Valdez BM = Bill Masslich LC = Larry Crist BL = Bill Leibfried HY = Helen Yard GD = Glen Doster BC = Bryan Cowdell
Photo: Roll	2	numeric	1-2 = photo roll number
Frame	2	numeric	1-2 = photo fram number
Fish Code	2	alphanumeric	1-2 = code for fish species HB = humpback chub SD = speckled dace CC = channel catfish FM = flannelmouth sucker BH = bluehead sucker RB = rainbow trout
LAR	4	numeric	1-4 = number of larval caught
YOY	4	numeric	1-4 = number of YOY caught
JUV	4	numeric	1-4 = number of juveniles caught
ADU	4	numeric	1-4 = number of adults caught
Total	4	numeric	1-4 = total number caught by species

as the standard map for this study.

River mile will be resolve to the closest 0.1 mile. This figure can easily be transformed into River Kilometer after it has been entered into the database.

4. Gear Type - This is a two letter code to indicate the gear type associated with the sample.

5. Start Time - Start time represents the time of day that sample was started. It will be recorded as military time in a four digit field.

6. Hab1 - General habitat sampled; will generally includes three types of habitat in the study area; main channel, side channel or tributary stream.

7. Hab2 - Specific habitat sampled; will include all types of habitat present in the study area. e.g. backwater, eddy and runs.

8. AirT(°C) - Air temperature in °C will be recorded at the start of each sampling effort.

9. McT - Main Channel temperature in °C will be recorded for each sampling effort. All water temperatures recorded in this field will be taken within 10 cm of the surface.

10. HabT - Water temperature of the habitat sampled in °C will be recorded for each sampling effort. All water temperatures recorded in this field will be taken within 10 cm of the surface. If thermal stratification is detected in the sampled habitat additional notation will be made in the margin of the data sheets.

11. Turbidity -

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12. Weather - Weather conditions during time of sample effort.

13. Fish Pres - Indicates whether fish were collected and preserved during sample effort.

14. No. Bottles - Number of containers used to store preserved specimens.

15. Crew - First and last initials of crew members participating in sample effort

16. Habitat Photo - Number of roll and frames for all photographs taken during sample effort.

17. Fish Code - Code for fish species

18. LAR,YOY,JUV,ADU,TOTAL - numbers of larval, young-of-year, juvenile, adult and total number of all life stages for each species captured.

Specific Fields

The following data fields will be completed for specific types of sampling:

1. Hours - Used to record duration of gill and trammel net sets, hoop and frame trap sets and minnow trap sets. Represents elapsed time between the two fields; Start Time and End Time

2. Seconds - Number of seconds of 'current on' electrofishing for the sample effort. Recorded from electronic timers on electrofishing units.

3. Volts - Average voltage output during an electrofishing sample effort.

4. Amps - Average amperage output during an electrofishing sample effort.

5. Pulse Rate - Pulse rate frequency setting during an electrofishing sample effort.

6. Pulse Width - Pulse width setting used during an electrofishing sample effort.

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7. Depth - Maximum depth of sample effort. Usually used for seining efforts, but may be applicable to all techniques where depth measurements are taken.

8. Sub1 - Dominant substrate at location of sample effort. Generally most prevalent substrate type or the substrate that has the greatest affect on the physical characteristic of the sample site. Generally used for seining efforts, but may be applicable to all techniques where substrate is determined.

9. Sub2 - Secondary substrate at location of sample effort. Generally second most prevalent substrate type or the substrate that has the second greatest affect on the physical characteristic of the sample site. Generally used for seining efforts, but may be applicable to all techniques where substrate is determined.

Reverse Side of Form 1 - Individual Fish Data

1. Fish No. - Unique serial number assigned to each fish measured during sample effort, beginning with 1.

2. TL - Total length in millimeters.

3. SL - Standard length in millimeters.

4. WT - Weight in grams.

5. PIT tag No. - Coded PIT tag number implanted in fish if applicable.

6. Recap (Y/N) - Y if fish represents a recapture, N if not.

7. Radiotag No. - Identification number of the radiotag implanted in fish if applicable.

8. Disp. - Disposition of fish. e.g. RA for released alive, DP for dead, preserved.

9. Surgeon - Initial of team member acting as surgeon during implanting of radiotag.

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1.12 Radiotelemetry

All information pertaining to radiotelemetry beginning when a fish is surgically implanted, will be recorded on Form 2, Radiotelemetry presented in Figure B-3. Data codes and explanations of codes to be used in association with Form 2 are presented in Figure B-4.

1.13 Humpback Chub Meristics

The capture and collection of data on the endangered humpback chub is the primary purpose of this study. Data collection associated with these fish is extensive and varies somewhat depending on life stage. In addition to length weight information that will be collected for all fish captured during the study (with possible exception to certain exotic species of minnow or shiners), data collected on individual humpback chub will generally include the following (by age class):

Note: all measurements in millimeters unless specified.

Larval stage	1. Total length - TL
(Yr 0, 10-70mm)	2. Observations on parasites or disease
	3. Photographs as necessary
Juvenile stage	1. Total length - TL
(Yr 1-5, 70-250mm)	2. Weight - WT (g)
	3. Observations on parasites or disease

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FORM 2 *Page __ of __*

BIO/WEST GRAND CANYON STUDY

(Colorado River Mainstem)

Radiotelemetry

Background Information

Sample No: _ _ R _ _ _ _ *<<< Locate:* _ *2H:* _ *24H:* _ *Test Flow:* _ *>>> Date:* _ _ _ _ _ _
Y Y M M D D

Start Time: _ _ _ _ *End Time:* _ _ _ _ *River:* _ _ *RMI:* _ _ _ . _ *Species:* H B

TL: _ _ _ *PITTag No:* _ _ _ _ _ _ _ _ _ *Radiotag Size:* _ _ *Radiotag No:* _ _ _ _ _

*Freq 1: 40 .*_ _ _ *Freq 2: 40 .* _ _ _ *Pulse 1(#/min):* _ _ *Pulse 2:*_ _

Habitat Measurements: *Habitat Map No:* _ _ _ _ _

Hab1: _ _ *Hab2:* _ _ *Depth:* _ _ . _ *m* *V 0.2:* _ . _ *m/s* *V 0.6:* _ . _ *m/s* *V 0.8:* _ . _ *m/s*

V Bottom: _ . _ *m/s* *AirT(c):* _ _ _ *McT:* _ _ . _ *HabT:* _ _ . _ *Sub1:* _ _ *Sub2:* _ _

<<< Cover: Over: _ _ *Lat:* _ _ *In:* _ _ *>>> DO:* _ _ *mg/l pH:* _ . _ *Cond:* _ _ _ _ *umhos/cm*

Turb: _ _ _ *Weather:* _ _ *Crew:* _ _ , _ _ , _ _ *Confidence:* _

Detailed Observations (Use reverse side to sketch fish movements)

Time	*RMI*	*Gage*	*Hab*	*Move*	*Remarks*

Figure B-3. Data form to be used for recording radio telemetry data for the Grand Canyon humpback chub studies (Form 2).

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DESCRIPTION OF FIELDS FOR DATA FORM 2
(Colorado River Mainstem)

Radiotelemetry

Field	*Width*	*Type*	*Description*
Sample No	*6*	*alphanumeric*	*1 = Year, 1992 = 2* *2 = Trip No. for Year (1-12)* *3 = LCR Crew (1,2 or 3)* *4-6 = sequential sample no.*
Mode:			
Locate	*1*		*1 = check mark next to correct monitoring mode; Locate fish hit no measurements* *2H = 2 hour monitoring; 24H = 24 hour monitoring, Test Flow = monitor during scheduled releases*
2H	*1*		
24H	*1*		
Test Flow	*1*		
Date	*6*	*numeric*	*1-2 = Year, 1992 = 92* *3-4 = Month, June = 06* *5-6 = Day of Month*
Start Time	*4*	*numeric*	*1-4 = start of sample time* *6am = 0600* *6pm = 1800*
End Time	*4*	*numeric*	*1-4 = end of sample time*
River	*2*	*alphanumeric*	*1-2 = location of radiotagged fish* *CO = Colorado River* *LC = Little Colorado* *HC = Havasu Creek*
RMI	*5.1*	*decinumeric*	*1-5 = miles downstream from Lees Ferry*
Species	*2*	*alphanumeric*	*1-2 = humpback chub*
TL	*3*	*numeric*	*1-3 = total length of fish in mm*
PIT Tag No.	*8*	*alphanumeric*	*1-8 = unique PIT Tag No.*
Radiotag Size	*2*	*numeric*	*1-2 = weight specifications* *09 = 9 grams* *11 = 11 grams* *16 = 16 grams*
Radiotag No.	*5*	*alphanumeric*	*1-5 = unique radiotag no.*
Freq 1	*3*	*numeric*	*1-3 = frequency of radiotag from manufacturer*
Freq 2	*3*	*numeric*	*1-3 = frequency of radiotag in field*

Figure B-4. Data codes and explanations to be used with Form 2.

Field	Width	Type	Description
Pulse 1	2	numeric	1-2 = pulse rate from manufacturer (#/min)
Pulse 2	2	numeric	1-2 = pulse rate in field
Hab1	2	alphanumeric	1-2 = general habitat MC = main channel TS = tributary stream SC = side channel
Hab2	2	alphanumeric	1-2 = specific habitat BA = backwater ED = eddy RI = riffle RU = run SH = shoreline PO = pool
Depth	4.1	decinumeric	1-4 = depth at gear location
V 0.2	3.1	decinumeric	1-3 = velocity at 0.2 depth at fish
V 0.6	3.1	decinumeric	1-3 = velocity at 0.6 depth at fish
V 0.8	3.1	decinumeric	1-3 = velocity at 0.8 depth at fish
V Bottom	3.1	decinumeric	1-3 = velocity at bottom at fish
AirT	3	numeric	1-3 = air temperature in °C
McT	4.1	decinumeric	1-4 = main channel temperature
HabT	4.1	decinumeric	1-4 = temperature of habitat sampled
Sub1	2	alphanumeric	1-2 = dominant substrate SI = silt SA = sand GR = gravel CO = cobble BO = boulder BE = bedrock
Sub2	2	alphanumeric	1-2 = secondary substrate
Cover-Over	2	alphanumeric	1-2 = overhead cover OB = overhanging bank SV = streamside vegetation NC = no cover

Field	Width	Type	Description
Lat	2	alphanumeric	1-2 = lateral cover VW = vertical rock well BO = boulders NC = no lateral cover
In	2	alphanumeric	1-2 = instream cover BO = boulder LG = log jam SS = sand shoal RJ = rock jetty NC = no instream cover
DO	2	numeric	1-2 = dissolved oxygen in mg/l
pH	3.1	decinumeric	1-3 = pH
Cond.	4	numeric	1-4 = conductance in umhos/cm
Turb	3	numeric	1-3 = turbidity
Weather	2	alphanumeric	1-2 = weather condition CS = clear sunny OV = overcast RA = raining
Crew	6	alphanumeric	1-2 = principal crew member 3-4 = recorder 5-6 = assistant i.e. RV = Rich Valdez BM = Bill Masslich LC = Larry Crist BL = Bill Leibfried HY = Helen Yard GD = Glen Doster BC = Bryan Cowdell
Confidence	1	numeric	1 = confidence rating on fish location 1 = high, excellent reception 2 = moderate, fair reception 3 = low, poor reception

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4. Principle fin ray counts, dorsal (D) and anal (A)
5. Photographs as necessary

Adult stage (Yr 5+, 250mm+)

1. Total length - TL
2. Fork length - FL
3. Standard length - SL
4. Weight - WT (g)
5. Sex
6. Reproductive Condition (Ripe)
7. Distance between base of pectoral and anal fins ($P_{1\text{-}P}2$)
8. Depth of nuchal hump - ND
9. Caudal peduncle length - CPL
10. Caudal peduncle depth (minimum) - CPND
11. Caudal peduncle depth (maximum) - CPMD
12. Head length - HL
13. Length of dorsal fin base - DFB
14. Snout length - SL
15. Body depth (maximum) - BD
16. Dorsal fin principal rays - D

17. Anal fin principal rays - A

18. Photograph

19. PIT tag No.

20. Stomach contents

21. Observations on disease and parasites.

Figure B-5 illustrates chub measurements corresponding to those described above.

1.14 Non-endangered native species

Total length and weight will be collected on all non-endangered native species captured during the study. Data on parasites, disease, breeding condition as well as other pertinent observations will be recorded as it applies for each fish. Photographs will be taken as necessary.

1.15 Trout

Total length and weight will be collected on all trout species captured during the study. Data on parasites, disease, breeding condition as well as other pertinent observations will be recorded as it applies for each fish. Photographs will be taken as necessary.

1.16 Other Exotics

Total length and weight will be collected on all exotic species captured during the study. Data on parasites, disease, breeding condition as well as other pertinent observations will be recorded as it applies for each fish. Photographs will be taken as necessary.

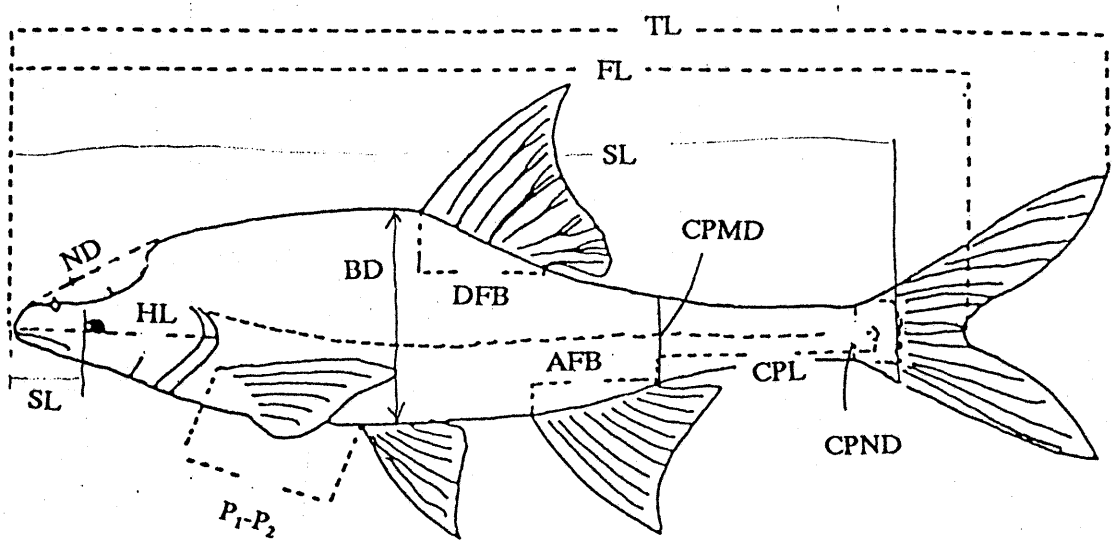

Figure B-5. Illustration of measurements used in humpback chub meristic data collection.

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2.0 DATA BASE MANAGEMENT

2.1 Accuracy and Quality Assurance

In an effort to maintain high levels of data accuracy, BIO/WEST will incorporate quality control checks at several stages in the collection and processing of data. These procedures have proven effective for us in the past and we anticipate producing a relatively error free data base for analyses used in this study.

To accomplish this goal, quality assurance measures will be applied at four levels; training of data collection personnel, in-field supervision of data collection and storage, standard format data entry, and a final evaluation of accuracy.

2.11 Personnel Training

BIO/WEST will train all key field personnel in the proper procedures for completing Fish/Habitat Sampling (FORM 1), Radiotelemetry (FORM 2), and Chub Meristics (FORM 3) data sheets prior to the collection of that data. Each team will have a copy of the data code sheet with descriptions of data fields and dictated responses in a clipboard alongside the data sheets. Additional space is provided on the data sheets for commentary on unusual situations or personal insights. The importance of recording all observations at the time of occurrence in a standard format will be stressed.

2.12 In-Field Supervision

The Team Leader from each team will be responsible for the security and accuracy of all data collected in the field until it is transferred to the data manager at BIO/WEST. All data will be recorded in pencil on water-resistant bond paper. These data sheets will

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be transferred to water tight containers located on the OARs support boats at the end of each work day. Each day, or more often if necessary, the Team Leader will check each data sheet for completeness, and clarity, and will correct any omissions or errors. Performing this step while in the field is of benefit since the day's events are still fresh and the input of other team members can be easily enlisted. At the end of the sampling trip the Team Leader will review the data once more to ensure that the sequence of sample numbers is consecutive, and that recorded data is legible and in the proper format. The data will be carried back to BIO/WEST and transferred to the Data Manager at the end of each trip.

2.13 Standard Format Data Entry

Data sheets transferred to the Database Manager will be photocopied and included with each trip report. The original copies will be stored for transfer to the Bureau of Reclamation/G.C.E.S. as an appendix to each annual report. The originals will be used to enter data into a computerized data management program, dBase III plus (Ashton-Tate 1985,1986). The BIO/WEST staff has used dBase III on several other projects and is familiar with all aspects of data entry, database searching, and programming. Several other agencies working in the Upper Colorado River Basin currently use dBase III (U.S. Fish and Wildlife Service, Colorado Division of Wildlife, and Utah Division of Wildlife Resources) for data management, transfer, and analyses.

BIO/WEST uses a standard data entry format that reduces error on the part of the keypunch staff. Our data entry format duplicates the order of fields and information on

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the data sheets. This speeds entry and improves accuracy. Data will be entered by personnel experienced in dBase III and familiar with our database format.

2.14 Final Data Accuracy Evaluation

After field data have been transferred to the Database Manager and have been entered into a dBase III plus database, a printed copy will be checked against the data sheets for accuracy. The Database Manager will be responsible for the accuracy and content of the final database and will personally conduct the final accuracy checks. In addition to a visual verification of accuracy, several program queries will be used to identify and eliminate errors. Programs that check for improper codes, or for inaccurate fish tallies will be applied to the database before any analyses are performed.

A detailed explanation of BIO/WEST's data codes, field types and lengths, and appropriate responses is presented in Figures B-1 through B-5 of Section 1.0 Field Data Forms.

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