MONTANA FISH, WILDLIFE & PARKS
PROJECT PERFORMANCE REPORT

STATE:	**MONTANA**
GRANT TITLE:	**Native Prairie Fish Survey and Inventory (2003)**
GRANT AGREEMENT:	**T-2**
PERIOD COVERED:	**November 1, 2002 through December 31, 2003**
Prepared by:	**Ken McDonald, Montana Fish, Wildlife and Parks**

Introduction

An analysis of Montana Fish, Wildlife and Park's (FWP) Montana River Information System (MRIS) database revealed that more than 4,200 streams comprising more than 18,000 stream miles in the Montana database are unsurveyed. The overwhelming majority of these waters are small, warm water prairie streams located in the eastern half of Montana. With little potential for sport fish, there is a strong likelihood that many contain intact, diverse assemblages of native fish and amphibian species, at least during parts of the year. There is a need to survey this diversity of prairie stream and associated riparian/grassland habitats to gain a greater understanding of the fisheries fauna that occur there. This baseline information will be used to help develop the comprehensive fish and wildlife plan Montana Fish, Wildlife and Parks has agreed to develop in compliance with the State Wildlife Grants Program (SWiG). This baseline data will also help enable resource managers to better understand and manage prairie species and their habitats.

Objective

The objective of this project was to inventory and document the occurrence and distribution of native fish species in prairie streams of eastern Montana, and to gather baseline data to be used to develop Montana's comprehensive fish and wildlife plan.

Expected Results and Benefits

The expected benefits of this project include:

- Filling in data gaps on distribution and occurrence of native prairie fish.
- Determining where intact assemblages of native aquatic species occur.
- Increasing knowledge about the distribution of sensitive species.
- Gather information on the spatial and temporal use of prairie streams by native fish species.
- Gathering baseline data to be used to respond to resource pressures such as land management practices, coal bed methane extraction, and bait fish seining.

Methods

Field crews of 3 persons each were hired in each of Montana FWP's eastern administrative regions (Regions 4, 5, 6, 7), and were assigned to survey at least 60 sites each, with primary emphasis on streams that had never been surveyed before. At least half of those sites were from

a list of sites whose locations were randomly selected. Sampling occurred between May and September.

Random sites were selected based on a stratified random sample of unsurveyed locations, following the protocol described in **Appendix A**. Fish and habitat sampling occurred in wadeable streams (1^{st} – 4^{th} order streams) classified as perennial or intermittent, following a standardized protocol **(Appendix B**). For those sites that fell on private land, the landowners were contacted prior to sampling and asked permission to access the site. If a randomly selected stream did not contain water, investigators were instructed to move downstream up to one mile until water was located. If no water was found within one mile of the randomly selected site, an alternative site was used.

Staff from the Montana Fish Information System (MFISH) helped identify and select sites for survey, provided landownership information for sites selected, and provided database formats to ensure data was recorded and entered in a useable format. Survey teams contacted landowners prior to beginning surveys for permission to access private lands. If permission was denied, that site was dropped and the next site was attempted.

Fish were surveyed at each site by seining. The length of each sampling reach was 40 times the wetted stream width or 300 meters, whichever was greater. This length should ensure sampling 100% of the species present. Survey crews also did repeated surveys at some survey sites in each region to determine temporal differences in species occurrences. All fish captured were recorded by species, and lengths were recorded for each. Voucher specimens that could not be immediately identified were preserved for positive identification.

Visual encounter surveys (VES) were used to determine the relative abundance of amphibians and reptiles (Heyer et al. 1994). Two 300-m VES transects were established parallel to the stream banks (2 banks x 300 m), and all reptile and amphibian observations were recorded. In addition, all reptiles and amphibians observed during the fish sampling were recorded. Voucher specimens that could not be immediately identified were preserved for later positive identification. All amphibian larvae captured during fish seining were identified and counted.

Summary of Results

A total of 299 sites were visited between May 20 and August 28, 2004. The majority of these were on privately-owned lands. In general, landowners were very cooperative towards providing access, as well as information about where there may be suitable water on their lands. Of the 299 sites visited, 121 were dry, and another 51 had water, but no fish present, so fish were documented in 127 sites. The number of species per site that had fish ranged from 1 – 17, with a mean of 5.1 fish species per site (Fig. 1). At those sites, 46 different fish species were identified, totaling 39,693 individuals (See Appendix C for a site-by-site summary of survey results). In addition, 5 amphibian species were identified, as well as 10 reptile species (Table 1). The greatest number of fish species identified at a single site was 17 (Pumpkin Creek), followed by three sites where 13 fish species were collected (Armells Creek, Hanging Woman Creek, and Little Missouri River). The greatest number of individual fish species collected at a single site was 2,319 at the Teton River site. Fathead minnows were located at the most number of sites (93), followed by white suckers (73), lake chubs (58), and longnose dace (54) (Table 3). Fathead minnows were by far the most commonly collected species (13,585), followed by white suckers

(2,990), flathead chubs (2,974), and lake chubs (2,517) (Table 4). Northern leopard frogs were the most commonly encountered amphibian, with 443 being counted at 48 different sites.

Table 1. 2003 Prairie fish survey summary statistics

	R-4	R-5	R-6	R-7	Total
No. Sites where Access Denied	3	5	1	20	29
No. Sites not Visited because Landowner Indicated it was Dry	1	29*	11	0	41
No. Sites Visited	65	56	75	103	299
No. Sites that were Dry*	32	0	32	57	121
No. Sites with Water but no Fish	7	14	8	22	51
No. Sites w/ Water and Fish	26	42	35	24	127
Total No. Fish Species Identified	28	20	25	31	46
Total No. of Fish Identified	11,725	8,497	13,590	5,881	39,693

* Region 5 did not visit sites where the landowner indicated it was dry

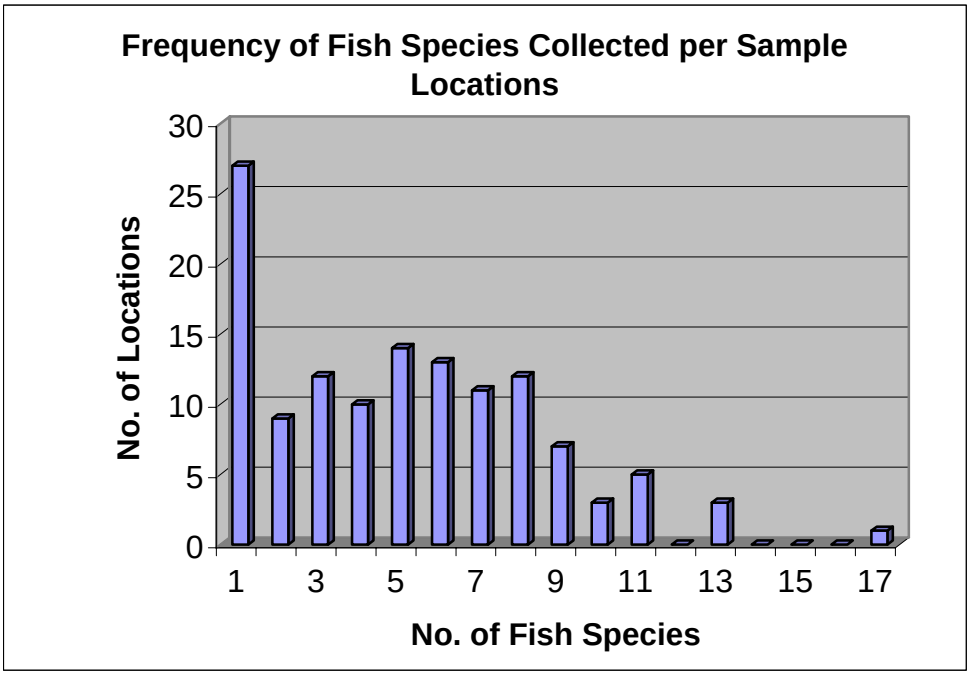

Table 2. Fish species identified, number of locations where they were located, and total number if individuals sampled during 2003 prairie fish surveys.

Common Name	Scientific Name	No. Locations where Sampled	No. of Individuals Sampled
Cyprinidae			
Common Carp	*Cyprinus carpio*	*31*	*1,652*
Longnose Dace	*Rhinichthys cataractae*	*54*	*2,092*
Lake Chub	*Couesius plumbeus*	*58*	*2,517*
Creek Chub	*Semotilus atromaculatus*	*5*	*37*
Flathead Chub	*Platygobio gracilis*	*34*	*2,974*
Emerald Shiner	*Notropis antherinoides*	*2*	*167*
Golden Shiner	*Notemigonus chrysoleucas*	*1*	*69*
Pearl Dace	*Margariscus margarita*	*1*	*2*
Nothern Redbelly Dace	*Phoxinus eos*	*14*	*1,065*
Spottail Shiner	*Notropis hudsonius*	*4*	*41*
Sand Shiner	*Notropis stramineus*	*26*	*1,848*
Fathead Minnow	*Pimephales promelas*	*93*	*13,843*
Western Silvery Minnow	*Hybognathus argyritis*	*16*	*1,749*
Plains Minnow	*Hybognathus placitus*	*14*	*2,415*
Brassy Minnow	*Hybognathus hankinsoni*	*14*	*751*
Hybbog spp.	*Hybognatus spp*	*8*	*2,622*
Plains Killifish	*Fundulus zebrinus*	*2*	*10*
Unknown Fish		*12*	*174*
Catostomidae			
Blue Sucker	*Cycleptus elongates*	*1*	*1*
River Carpsucker	*Carpiodes carpio*	*12*	*155*
Smallmouth Buffalo	*Ictiobus bubalus*	*2*	*16*
Bigmouth Buffalo	*Ictiobus cypinellus*	*1*	*2*
Shorthead Redhorse	*Maxostoma macrolepidotum*	*15*	*81*
White Sucker	*Catostomus commersoni*	*72*	*2,979*
Mountain Sucker	*Catostomus platyrhynchus*	*19*	*283*
Longnose Sucker	*Catostomus catostomus*	*19*	*220*
Unknown Suckers		*2*	*9*
Ictaluridae			
Stonecat	*Noturus flavus*	*6*	*15*
Channel Catfish	*Ictalurus punctatus*	*12*	*61*
Yellow Bullhead	*Ameiurus natalis*	*3*	*4*
Black Bullhead	*Ameiurus melas*	*20*	*372*
Gasterosteidae			
Brook Stickleback	*Culaea inconstans*	*16*	*708*
Esocidae			
Northern Pike	*Esox lucius*	*4*	*43*
Hiodontidae			

Goldeye	*Hiodon alosoides*	*6*	*22*
Common Name	**Scientific Name**	**No. Locations where Sampled**	**No. of Individuals Sampled**
Centrarchidae			
Smallmouth Bass	*Micropterus dolomieu*	*3*	*6*
Black Crappie	*Pomoxis nigromaculatus*	*1*	*4*
White Crappie	*Pomoxis annularis*		
Green Sunfish	*Lepomis cyanellus*	*18*	*403*
Pumpkinseed	*Lepomis gibbosus*	*5*	*109*
Bluegill	*Lepomis macrochirus*	*3*	*11*
Unknown Sunfish		*1*	*22*
Percidae			
Yellow Perch	*Perca flavescens*	*3*	*99*
Iowa Darter	*Etheostoma exile*	*6*	*181*
Walleye	*Stizostedion vitreum*	*2*	*12*
Sauger	*Stizostedion canadense*		
Salmonidae			
Yellowstone Cutthroat Trout	*Oncorhynchus clarki bouvieri*	*1*	*1*
Mountain Whitefish	*Prosopium williamsoni*	*1*	*6*
Brook Trout	*Salvelinus fontinalis*	*2*	*8*
Rainbow Trout	*Oncorhynchus mykiss*	*1*	*1*
Brown Trout	*Salmo trutta*	*2*	*8*
Reptiles			
Spiny Softshell	*Trionyx spiniferus*	*1*	*1*
Painted Turtle	*Chrysemys picta*	*15*	*24*
Short-Horned Lizard	*Phyrnosoma douglasi*	*2*	*2*
Western Rattlesnake	*Crolatus viridis*	*3*	*3*
Racer		*4*	*5*
Western Terrestrial Garter Snake	*Thamnophis elegans*	*7*	*10*
Plains Garter Snake	*Thamnophis radix*	*12*	*22*
Common Garter Snake	*Thamnophis sirtalis*	*14*	*21*
Gopher Snake	*Pituophis catenifer*	*12*	*17*
Amphibians			
Tiger Salamander	*Ambystoma tigrinum*	*22*	*143*
Western Chorus Frog	*Pseudacris maculata*	*10*	*18*
Northern Leopard Frog	*Rana pipiens*	*48*	*443*
Spotted Frog		*3*	*7*
Woodhouse's Toad	*Bufo woodhousii*	*14*	*19*
Unknown Tadpoles		*19*	*>776*

Table 3. Fish and herp. Species collected in 2003, sorted by number of locations where sampled.

Common Name	Scientific Name	No. Locations where Sampled		No. of Individuals Sampled
Bigmouth Buffalo	*Ictiobus cypinellus*	1	<1%	2
Black Crappie	*Pomoxis nigromaculatus*	1	<1%	4
Blue Sucker	*Cycleptus elongates*	1	<1%	1
Golden Shiner	*Notemigonus chrysoleucas*	1	<1%	69
Mountain Whitefish	*Prosopium williamsoni*	1	<1%	6
Pearl Dace	*Margariscus margarita*	1	<1%	2
Unknown Sunfish		1	<1%	22
Yellowstone Cutthroat Trout	*Oncorhynchus clarki bouvieri*	1	<1%	1
Bluegill	*Lepomis macrochirus*	2	<2%	10
Brook Trout	*Salvelinus fontinalis*	2	<2%	18
Brown Trout	*Salmo trutta*	2	<2%	8
Emerald Shiner	*Notropis antherinoides*	2	<2%	167
Plains Killifish	*Fundulus zebrinus*	2	<2%	10
Rainbow Trout	*Oncorhynchus mykiss*	2	<2%	3
Smallmouth Buffalo	*Ictiobus bubalus*	2	<2%	16
Unknown Suckers		2	<2%	9
Walleye	*Stizostedion vitreum*	2	<2%	12
Smallmouth Bass	*Micropterus dolomieu*	3	2.3%	6
Yellow Bullhead	*Ameiurus natalis*	3	2.3%	4
Yellow Perch	*Perca flavescens*	3	2.3%	99
Northern Pike	*Esox lucius*	4	3.1%	43
Spottail Shiner	*Notropis hudsonius*	4	3.1%	41
Creek Chub	*Semotilus atromaculatus*	5	3.9%	37
Pumpkinseed	*Lepomis gibbosus*	5	3.9%	109
Goldeye	*Hiodon alosoides*	6	3.9%	22
Iowa Darter	*Etheostoma exile*	6	3.9%	181
Stonecat	*Noturus flavus*	6	3.9%	15
Hybbog spp.	*Hybognatus spp*	8	3.9%	2,622
River Carpsucker	*Carpiodes carpio*	11	8.7%	147
Unknown Fish		12	9.4%	174
Channel Catfish	*Ictalurus punctatus*	12	9.4%	61
Brassy Minnow	*Hybognathus hankinsoni*	14	11%	751
Northern Redbelly Dace	*Phoxinus eos*	14	11%	1065
Plains Minnow	*Hybognathus placitus*	14	11%	2,456
Shorthead Redhorse	*Maxostoma macrolepidotum*	16	12.6%	91
Brook Stickleback	*Culaea inconstans*	16	12.6%	708
Western Silvery Minnow	*Hybognathus argyritis*	16	12.6%	1,749
Green Sunfish	*Lepomis cyanellus*	18	14.2%	403
Mountain Sucker	*Catostomus platyrhynchus*	20	15.7%	299
Longnose Sucker	*Catostomus catostomus*	19	15%	220
Black Bullhead	*Ameiurus melas*	20	15.7%	372
Sand Shiner	*Notropis stramineus*	26	20.5%	1,848
Flathead Chub	*Platygobio gracilis*	34	26.8%	2,974

Common Name	Scientific Name	No. Locations where Sampled		No. of Individuals Sampled
Longnose Dace	*Rhinichthys cataractae*	*54*	*42.5%*	*2,092*
Lake Chub	*Couesius plumbeus*	*58*	*45.7%*	*2,517*
White Sucker	*Catostomus commersoni*	*73*	*57.5%*	*2,990*
Fathead Minnow	*Pimephales promelas*	*93*	*73.2%*	*13,585*
TOTAL				39693
Reptiles				
Spiny Softshell	*Trionyx spiniferus*	*1*		*1*
Short-Horned Lizard	*Phyrnosoma douglasi*	*2*		*2*
Western Rattlesnake	*Crolatus viridis*	*3*		*3*
Racer	*Coluber constrictor*	*4*		*5*
Snapping Turtle	*Chelydra serpentina*	*6*		*8*
Western Terrestrial Garter Snake	*Thamnophis elegans*	*7*		*10*
Gopher Snake	*Pituophis catenifer*	*12*		*17*
Plains Garter Snake	*Thamnophis radix*	*12*		*22*
Common Garter Snake	*Thamnophis sirtalis*	*14*		*21*
Painted Turtle	*Chrysemys picta*	*15*		*24*
Amphibians				
Spotted Frog	*Rana luteiventris*	*3*		*7*
Western Chorus Frog	*Pseudacris maculata*	*10*		*18*
Woodhouse's Toad	*Bufo woodhousii*	*14*		*19*
Unknown Tadpoles		*19*		*>776*
Tiger Salamander	*Ambystoma tigrinum*	*22*		*143*
Northern Leopard Frog	*Rana pipiens*	*48*		*443*

Table 4. Fish species collected in 2003, sorted by number of individuals collected.

Common Name	Scientific Name	No. Locations where Sampled	No. of Individuals Sampled	
Fathead Minnow	*Pimephales promelas*	93	13,585	37%
White Sucker	*Catostomus commersoni*	73	2,990	8%
Flathead Chub	*Platygobio gracilis*	34	2,974	8%
Hybbog spp.	*Hybognatus spp*	8	2,622	7%
Lake Chub	*Couesius plumbeus*	58	2,517	7%
Plains Minnow	*Hybognathus placitus*	14	2,456	7%
Longnose Dace	*Rhinichthys cataractae*	54	2,092	6%
Sand Shiner	*Notropis stramineus*	26	1,848	5%
Western Silvery Minnow	*Hybognathus argyritis*	16	1,749	5%
Common Carp	*Cyprinus carpio*	31	1,652	5%
Northern Redbelly Dace	*Phoxinus eos*	14	1065	3%
Brassy Minnow	*Hybognathus hankinsoni*	14	751	2%
Brook Stickleback	*Culaea inconstans*	16	708	2%
Green Sunfish	*Lepomis cyanellus*	18	403	1%
Black Bullhead	*Ameiurus melas*	20	372	1%
Mountain Sucker	*Catostomus platyrhynchus*	20	299	1%
Longnose Sucker	*Catostomus catostomus*	19	220	1%
Iowa Darter	*Etheostoma exile*	6	181	<1%
Unknown Fish		12	174	<1%
Emerald Shiner	*Notropis antherinoides*	2	167	<1%
River Carpsucker	*Carpiodes carpio*	11	147	<1%
Pumpkinseed	*Lepomis gibbosus*	5	109	<1%
Yellow Perch	*Perca flavescens*	3	99	<1%
Shorthead Redhorse	*Maxostoma macrolepidotum*	16	91	<1%
Golden Shiner	*Notemigonus chrysoleucas*	1	69	<1%
Channel Catfish	*Ictalurus punctatus*	12	61	<1%
Northern Pike	*Esox lucius*	4	43	<1%
Spottail Shiner	*Notropis hudsonius*	4	41	<1%
Creek Chub	*Semotilus atromaculatus*	5	37	<1%
Goldeye	*Hiodon alosoides*	6	22	<1%
Unknown Sunfish		1	22	<1%
Brook Trout	*Salvelinus fontinalis*	2	18	<1%
Smallmouth Buffalo	*Ictiobus bubalus*	2	16	<1%
Stonecat	*Noturus flavus*	6	15	<1%
Walleye	*Stizostedion vitreum*	2	12	<1%
Bluegill	*Lepomis macrochirus*	2	10	<1%
Plains Killifish	*Fundulus zebrinus*	2	10	<1%
Unknown Suckers		2	9	<1%
Brown Trout	*Salmo trutta*	2	8	<1%
Mountain Whitefish	*Prosopium williamsoni*	1	6	<1%
Smallmouth Bass	*Micropterus dolomieu*	3	6	<1%
Black Crappie	*Pomoxis nigromaculatus*	1	4	<1%
Rainbow Trout	*Oncorhynchus mykiss*	2	3	<1%
Bigmouth Buffalo	*Ictiobus cypinellus*	1	2	<1%
Pearl Dace	*Margariscus margarita*	1	2	<1%

Common Name	Scientific Name	No. Locations where Sampled	No. of Individuals Sampled	
Blue Sucker	*Cycleptus elongates*	*1*	*1*	<1%
Yellowstone Cutthroat Trout	*Oncorhynchus clarki bouvieri*	*1*	*1*	<1%
TOTAL			39,693	

Discussion

Work completed in 2003 resulted in a better documenting the distribution of 46 different fish species, but did not result in any highly unusual or unexpected discoveries. This work begins to fill in data on fish, amphibian, and reptile distribution in eastern Montana's prairie streams that was very much lacking, and highlights the diversity of aquatic species that inhabit Montana's prairie streams. Nonnative fish species, especially carp, sunfish, and black bullheads were surprisingly prevalent. Their impact on the native fish and amphibian assemblages in drainages where they overlapped is unknown.

Sampling was hampered by unusually dry, hot conditions that resulted in numerous sample locations being dewatered. Because many of these prairie streams are seasonal, the time of year when sampling occurs could affect results. It appears that many of these prairie streams are important to river species that move up into them to spawn, and then move back downstream into the larger rivers and tributary streams before they become dewatered. For example, a stream that is dry in August may be an important spawning stream in late spring when runoff occurs and these streams are flowing. Because of this, it is recommended that some of these streams be re-sampled in future years at different times of the year to determine temporal differences.

Crews only sampled on lands on which they had permission to sample on. A lot of their time was spent attempting to determine ownership of different lands, and then contacting landowners for permission to access. Most of the time that permission was granted, once personnel explained what they were doing and why. Several landowners were surprised to learn that their streams actually had fish in them. Others did not consider the minnow species that the field crews were sampling to be fish, rather, they were minnows (fish being the larger sport fish species). Some landowners were reluctant to allow access for fear that the data would be used to justify listing a species under the Endangered Species Act or force them to change land management practices, and some denied access due to past differences with the agency.

It is recommended that this survey be continued in order to continue to fill in large data gaps pertaining to prairie stream fish, amphibian, and reptile distribution. It is also recommended that a subset of streams be re-sampled in order to learn about temporal variation within and between years.

This project was funded by Montana Fish, Wildlife and Parks and the State Wildlife Grants program administered by the U.S. Fish and Wildlife Service.

Appendix A. Protocol for randomly selecting previously unsampled sites.

Appendix B. Fish and Habitat Sampling Protocol for Prairie Streams

The following protocol was prepared by Dr. Bob Bramblett from the Montana Cooperative Fisheries Research Unit for use by the Montana Prairie Stream Survey project (January, 2003).

1. ***Site location*** - Locate the sampling site using GPS for random sites, or by convenience for non-random sites. The GPS location will be the center of the reach, this is where you place the "F" flag (see Step 2). If the site is dry, shift the reach up or downstream to capture the most wetted channel possible on the parcel of land where you have permission for sampling.

2. ***Laying out the sample reach*** - Lay out a 300 m sample reach using a measuring tape and a set of 11 pin flags (labeled A-K). Follow the curves in the stream channel with the measuring tape; do not cut across curves. Place a flag every 30 m. The "A" flag will be at the downstream end, the "K" flag will be at the upstream end of the reach. The "F" flag will go in the center of the reach.

3. ***Block nets*** - Place block nets (these can be old seines, 1/4 " mesh) at the upstream (K flag) and downstream (A flag) ends of the sample reach if the water in the channel is continuous, deeper than 25 cm, and relatively clear. This prevents fish from leaving the sample reach.

4. ***Seining*** - Select the seine based on the size of the stream to be sampled. The seine length to be used should be approximately equal to or slightly greater than the stream width, and the seine height should be about 1.5 to 2 times greater than the depth of the stream. Dip nets can be used in very shallow, small habitats. Seining begins at the upstream end (K flag) and proceeds downstream to the A flag. Seining is performed by two people, one on each end of the seine. In pools, the seine is pulled down the stream channel, using the shore and other natural habitat features as barriers. Begin with the seine rolled up on each seine braille. The seine is typically set perpendicular to shore and hauled downstream parallel to shore. As you proceed, let out enough seine so that the seine forms a "U" shape, but not so much that the net is hard to control. Adjust the length of the seine by rolling or un-rolling net on the seine braille. The speed of seining should be fast enough to maintain the "U" shape, but not so fast that the floats become submerged, or that the seine's lead line come way up off the bottom of the stream. If rocks or other snags are on the bottom, the seine can be lifted off the bottom for a moment to avoid the snag, or one of the netters can bring the seine around the snag to avoid it, all the while maintaining the forward progress of the seine. Similarly, areas of dense aquatic vegetation can be avoided. It is important not to stop the forward progress, because fish will swim out of the seine. It is better to avoid a snag while keeping moving than to become snagged, which will allow fish to escape. In "snaggy" waters, keep more of your seine rolled up for better control.

   Proceed downstream while seining. In narrow streams, the entire channel width is spanned with the seine. In wider streams, one person walks along the shore, while the other wades through the channel. The length of each seine haul will depend on the natural features of the stream channel and shoreline, but seine hauls should not normally be more than 60 or 90 m long. Side channel bars or the end of a standing pool are good areas to haul out or "beach" the seine. Where a large bar or end of a standing pool is present both netters can simply run the net up on the shore. In streams with steep banks or lack of obvious seine beaching areas the "snap" technique can be used. At the end of the haul, the person near shore stops, while

the person farthest out turns into shore, quickly, until the seine is up against the bank. The two netters then walk away from each other, taking the slack uot of the seine, and keeping the seine's lead line up against the bank.

In riffles, with moderate to fast current, the seine is held stationary in a "U" shape, while the other team member disturbs the substrate immediately upstream of the net. Then the net is quickly "snapped" out of the water by both team members using an upstream scooping motion.

Seine the entire 300 m reach, covering the linear distance at least once. If part of the 300 m is dry, just skip it. If the stream is much wider than your seine, do extra seine hauls in the large pools to cover the extra width. Sample all habitat types (shoreline, thalweg, side channels, backwaters).

After each seine haul, place fish in a bucket. If the water is warm, or you have captured many fish, place fish in a fish bag to keep them alive until seining is completed. If you have to work up fish before seining is completed, release processed fish in an area that has already been seined, as far away from the area remaining to be seined as possible (or outside of the block nets). Large fish such as northern pike, common carp, white sucker, shorthead redhorse, or channel catfish, can be measured, given a small clip to the lower caudal fin and released immediately.

5. ***Processing captured fish*** - Record the species of each fish captured, and measure 20 "randomly" selected fish to the nearest millimeter, total length. If the species of fish is unknown, try to at least record it as Unknown type 1, Unknown type 2, etc. Keep track of and record the minimum and maximum length of each species.

   For each species, preserve a subsample of at least 10 individuals per site to serve as voucher specimens. Record a small letter "v" next to the recorded length of the fish that is vouchered to allow for later validation. For Hybognathus spp., voucher up to 20 individuals per site. Kill the fish to be vouchered by placing them in a small bucket or 1000 ml nalgene jar with an overdose solution of MS-222. After fish processing is completed, drain the MS-222 solution and place the fish in a 1000 ml nalgene jar with a 10% solution of formalin (in clear water, if possible). For specimens longer than 150 mm, an incision should be made on the right ventral side of the abdomen after death, to allow fixative to enter the body cavity. The volume of formalin solution should be approximately equal to the twice the volume of fish tissue to be preserved, and the fish volume should be considered water when concentrations are determined. For example, if the fish take up 250 ml of the 1000 ml volume, you need about 500 ml of 10 % formalin solution (75 ml formalin and 425 ml water) in the 1000 ml nalgene jar. If necessary, use a second jar to accommodate all of the specimens. Use safety glasses and gloves when pouring formalin. Do not let the fish "cook" in the sun for a while and preserve them later, do it as soon as possible. Label all jars inside and out with Site, Site Number, Lat/Long, Date, Collectors names. Use pencil on Write-In-the-Rain or high rag paper for inside labels (just put the label right in with the fish), use a sticker label on the outside, cover it with clear ScotchPad high performance packing tape pad 3750-P). Fish specimens should be left in formalin solution for at least 2-7 days. Fish specimens must have formalin solution soaked out before being handled extensively. Specimens should be soaked in water for at least 2 days, and water should be changed at least four times during this

period. After soaking out the formalin, the fish specimens should be placed in either 70% ethanol or 40% isopropanol for long-term storage.

6. ***Habitat survey*** - Channel width, depth of water, and substrate will be measured at 11 transects perpendicular to the stream channel (located at Flags A-K), and along the thalweg in 10 thalweg intervals between transects (deepest part of channel). Stream width is measured to the nearest 0.1 m, depth is measured to the nearest cm, and substrate sizes and codes are on the data sheet. One person will be in the stream taking measurements while the other records data. Record the Latitude and Longitude (in digital degrees) of the F flag, the stream name, site number, the date, the flow status (flowing, continuous standing water, or interrupted standing water) and the names of the crew members on the data sheet. Take photographs of the site, capturing as much of the sampling reach as possible. Make sure the date feature on the camera is turned on, to allow for later identification of site photographs.

   Transects.-Start on the left bank (facing downstream) at Flag A. Measure and record the wetted width of the channel to the nearest 0.1 m. Measure and record (separated by a comma on the data sheet) five equally spaced depth and substrate measurements across the wetted stream channel:

   1. Left Bank-5 cm from the left bank;
   2. Left Center-halfway between the Center and the Left Bank;
   3. Center-center of the wetted stream;
   4. Right Center-halfway between the Center and the Right Bank;
   5. Right Bank-5 cm from the right bank

   Thalweg.-Begin by recording the depth and substrate 3 m upstream of the transect, in the deepest part of the channel (thalweg). Proceed up the thalweg to Flag B, recording depth and substrate every 3 m along the thalweg. You will record a total of 10 depths and substrates between each pair of transects. If the stream channel is dry, record a 0 for depth, and record the substrate. The last thalweg measurement point should fall on the next upstream transect. The 3 m interval can be estimated, and it is helpful if the data recorder helps to keep the person in the stream from "squeezing" or "stretching" the thalweg measurements.

Repeat this procedure until all 11 transects and 10 thalweg intervals are completed.

Gear List

- 20', x 6' x ¼" heavy delta seines
- 15' x 4' x ¼" heavy delta
- 30' x 6' x ¼" heavy delta (or delta) with 6' x 6' x 6' bag
- Fish bags: nylon diver's bags, ¼" mesh 18" x 30"
- Mudders – 109.00 at Ben Meadows
- Block nets, Tent stakes
- Stream Conductivity meter
- Thermometer
- Turbidity meter (LaMotte, Ben Meadows 224805, $795.00-might try the ""transparency tube" Ben Meadows 224196, $52.95)
- Waders (breathable waders are essential for this work-Cabelas has them for about $100/pair)
- Lug sole wading boots (Cabelas)

- Habitat pole (I make habitat poles out of 1.0” OD PVC pipe. 1.5 m long including caps. Score the pipe every 10 cm with a pipe cutter, then use a Sharpie to mark rings around the pole at the scores, and label the pole 10, 20, 30, etc. 5 cm marks are made between the 10 cm rings, you can visually estimate between the 5 cm marks to get to the nearest cm. Spray or brush a Urethane finish on the pole or your marks will come off fast with sunscreen and bug dope.)
- Metric 30 m tape (Ace Hardware actually carries a tape with metric on one side)
- Measuring boards, one short 300 mm (half a 6” PVC works well for Hybognathus “fin flotation”, one long, ~0.5-1 m, you can just use a meter stick for the odd big fish)
- Hand lens
- Small 1 gallon red bucket from Ace for doping fish
- 5 gallon buckets
- MS-222
- Labels and tape pads for fish samples
- 1000 ml Nalgene jars
- Formalin (buffered is great, but more expensive-I throw a Rolaids in each jar of fish to neutralize the acidity)
- Clip board
- 11 Pin flags labeled A-F