Montana Fish, Wildlife & Parks

Fisheries Division Report
State Project Numbers: *3412; 34912*
Project Title: Prairie streams survey 2003

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March 2004

Executive summary

A survey of 62 sites on 59 Region 4 streams was conducted as part of a Montana prairie stream inventory. This was the first time the majority of the streams had been sampled. Most sites were randomly selected, based on stream length, 4th Code Hydrologic Unit (HUC), and lack of previous sampling. However, 16 sites were chosen based on professional judgment of local fisheries staff. Of the 62 sites surveyed, 33 were dry, 7 held water but no fish, and 22 had fish. At least one site was sampled in nineteen HUCs. Fish were not found in 7 of the sampled HUCs. Sites were sampled with seines, or a backpack electrofishing unit and on the Musselshell River, with experimental gill nets. A backpack electrofishing unit was used to sample 5 of the 62 sites. A total of 11,799 fish including 31 species in 9 families were captured. Twenty-two species were native to Montana and 9 were introduced. The fathead minnow and the longnose dace had the greatest distribution at 14 sites each. The plains minnow and the fathead minnow were the most abundant with 2,472 and 1,617 individuals captured respectively. Brook stickleback and freshwater drum were the least common species, with only one specimen captured. Goldeye, emerald shiner, mountain whitefish, brook stickleback, freshwater drum, Iowa darter and yellow perch were each found at one site. The Teton River and the Musselshell River had the greatest species diversity with 12 and 13 species. Five streams, Chip Creek, Pike Creek, Lake Creek, Daisy Dean Creek and Little Elk Creek had one species – either fathead minnows or brook trout. Most streams had a typical prairie fish assemblage of several minnow and sucker species. However, trout were sampled in 5 streams, Daisy Dean, Little Elk, Smith River, Belt and Hound Creek. The majority of species in previously sampled streams, including the South Fork McDonald Creek, Musselshell River, Sacagawea River and the Judith River were similar to previous years. Eight different reptile species in 4 families including 2 turtles and 6 snakes were observed. All were native to Montana. The spiny softshell turtle was the most abundant of the turtles. Of the snakes, the racer was the most abundant and well distributed. Six amphibian species in five families, including 3 species of frogs, two types of toads and one salamander species, were observed. The tiger salamander and the northern leopard frog held the greatest distributions and abundance.

Sampled streams were 8 to 341.9 miles long. Longer streams were more likely to have water. Streams over 38 miles long contained water either at or near the sample site. Of the 48 streams sampled that were less than 38 miles long, only 15 had water. Habitat data including depth, substrate size, width, temperature and conductivity were collected at sites with water. Instantaneous water temperature ranged from 46.4°F to 81.8°F. Measured conductivity ranged from 183.3 µS to 14,090 µS, with a mean of 3,092 µS. One site, an unnamed tributary to Muddy Creek (Sun drainage), had a conductivity exceeding 19,999 µS; it was out of range of the conductivity meter. This stream was fishless, though it was mostly wetted. Mean conductivity was 2,626 µS on streams that contained fish. Fathead minnows were sampled in the stream with a conductivity of 14,090 µS. The pH ranged from 7.52 to 9.72 with a mean of 8.42 for all sites surveyed. For streams with fish, the pH ranged from 7.52 to 9.13 (mean of 8.32). The most common substrate was fines. We documented fine substrate at every site except the Judith River and Smith River Site 1.

In future years, additional fish identification training for prairie fish crews would be helpful. We also recommend that crews from different regions spend time sampling together early in the season to assist in standardization of methods, fish identification and problem solving.

This was the third year of a major drought in northcentral Montana; all counties in Region 4 were in extreme drought by late summer (Palmer index). It is likely that additional streams would have contained water and fish during normal precipitation years. Streams with a longer drainage length were more likely to contain water, so it is appropriate to continue to bias random samples by stream length to maximize fish sampling on prairie streams.

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Introduction

A survey of 59 streams, including 62 sites was conducted in 2003 in Region 4 (Figure 1 and Appendix A). This survey was part of an inventory to document the occurrence and distribution of fish species in the prairie streams of Regions 4, 5, 6, and 7. Most streams were randomly selected and had not been previously surveyed. Habitat surveys and visual assessments of the amphibians and reptiles were conducted on site.

Methods

Site generation and access. - Steve Carson, Programmer/Analyst for Montana Fish Wildlife and Parks (MFWP), randomly generated 164 survey sites for streams that had not previously been sampled in Region 4, based on stream length and 4th code Hydrologic Unit Codes (HUCs). See Appendix B for the procedure used. In Region 4 these 164 sites were in 21 HUCs and were described by latitude and longitude. We visited at least one site in 19 of the HUCs. Two of the HUCs were not sampled this year, due to access issues on Blackfeet Tribal land. Random site selection was based on stream length to increase the probability of finding water in the stream. Both dry and wet sites were visited. Wetted sites underwent the full survey described below, while dry sites were photographed and interesting features noted such as human development or recent moisture (muddy channels).

Non-random, longitudinal, and seasonal sites were sampled. Sites were chosen based on access and professional judgment of local fisheries staff. The Montana Natural Resource Information System (NRIS) Topofinder (http://nris.state.mt.us/) was used to locate sample sites. The Montana GIS Cadastral web site (http://gis.doa.state.mt.us/) was used to determine land ownership. The random sites sampled were based on HUC, landowner permission, logistics and judgment of fisheries staff. Generally two sites less than 30 miles apart were sampled each field day. Sites were chosen in the same area to minimize driving distance. To further reduce travel time, sites that had a road within 2 miles were preferentially selected. Of the 62 sites visited (Figure 1), 46 were from randomly chosen sites. Only 16 sites were non-random and chosen by the local fisheries staff. The streams sampled longitudinally, Arrow Creek, Musselshell River and the Smith River, were not random. Five streams were re-sampled one month after the initial visit. Three of these seasonal sites were non-random, Arrow Creek Site 1, Arrow Creek Site 2 and the Sacagawea River (Crooked Creek) and two sites, Blake Creek and Coffee Creek were originally chosen as random sites. Revisits were done near the same site as the original sample.

For random sites a primary site and an alternate site were generated. If access was denied at the primary site we attempted to access the alternate site. If neither landowner allowed access the closest public land was sampled where applicable. If a site was dry, we followed the criteria in Dr. Bramblett's protocol (Appendix C) to locate a wetted reach; we searched for water one mile up and downstream at both the primarily and alternate sites. If we located water we found the closest residential location and inquired about access and landownership. Appendix A lists survey site location information. Site descriptions used in this document often use river miles from DNRC (1979).

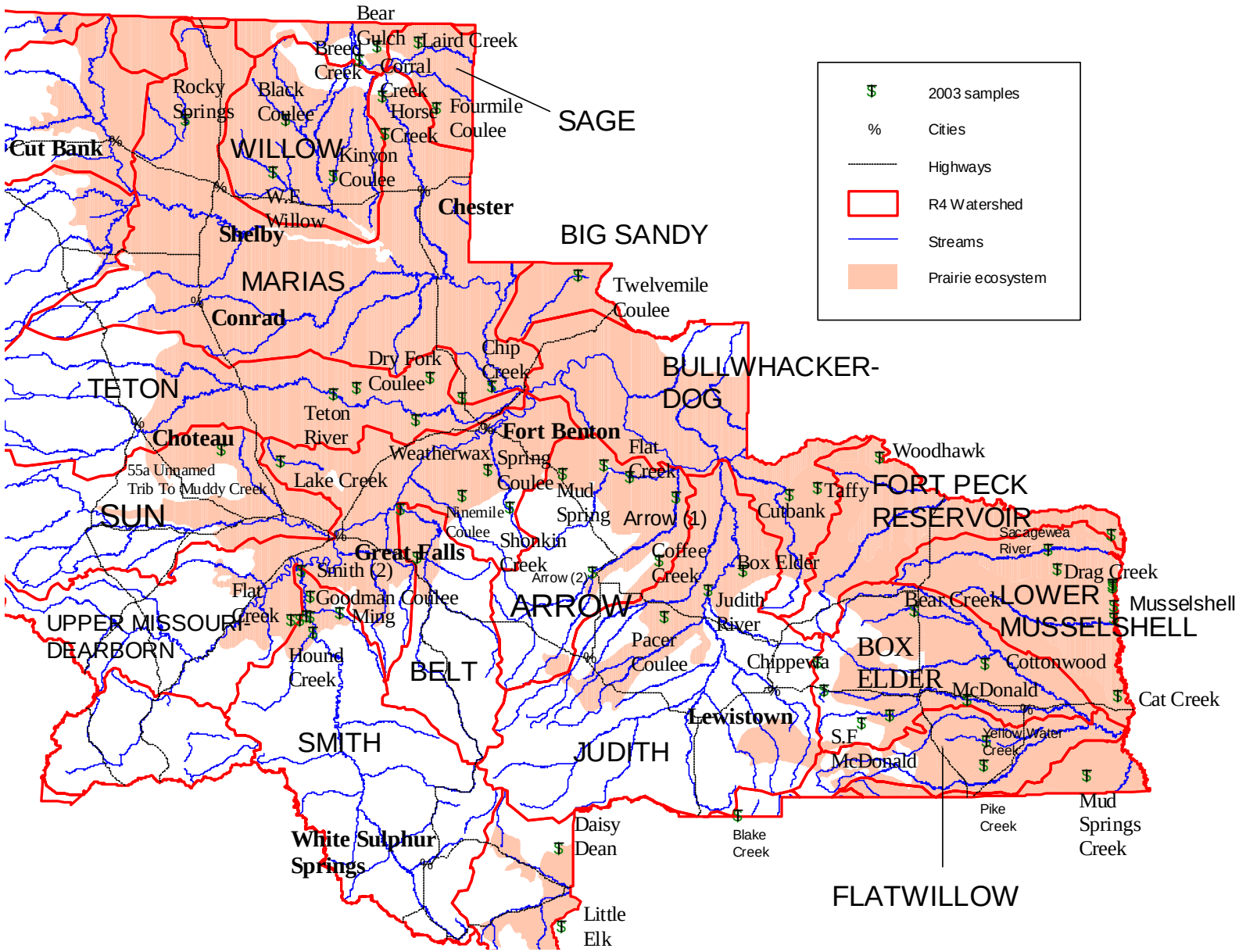

Figure 1. Sites sampled during prairie fish survey in Region 4, 2003.

Site sampling – We followed the protocol (Appendix C) and used data sheets (Appendices D and E) devised by Dr. Robert Bramblett for prairie stream surveys. A Garmin® eTrexVista™ GPS unit was used on-site to find the randomly selected latitude/ longitude which was used as the center (Flag F) of the 328 yard reach. Flags A-E were located at 33-yard intervals upstream and flags G-K were located at the same intervals downstream from F. On non-random sites, F was established as the A-K intervals were paced out. For streams that were partially wetted we often adjusted the survey site to include the most wetted portion of the stream. Sites were moved 33 yards from bridge crossings or diversion dams to reduce the possibility of human influence on habitat unless the wettest reach of the stream fell within the man made habitat.

Fish survey- Sites were sampled with seines, a backpack electrofishing unit and on the Musselshell River, with experimental gill nets. A backpack electrofishing unit was used to sample 5 of the 62 sites. It was used at the sites that were ineffective to sample with seines, due to characteristics such as heavy brush, very shallow water, or rocky streambeds. Seining or electrofishing began at the A-flag and proceeded downstream to the K-flag. Block nets were not used. We used 3 sizes of seines; 20 ft x 6 ft x 0.25 inch heavy delta, 15 ft x 4 ft x 0.25 inch heavy delta or 30 ft x 6 ft x 0.25 inch heavy delta with 6 ft x 6 ft x 6 ft bag. Stream morphology determined the seine selected. The backpack electrofishing unit was a battery operated Smith Root Model 12B. All fish captured during a single pass were sorted by species. On the Musselshell River, experimental gill nets were set at six locations over about a 20-mile stream reach. Total length of 20 specimens was measured in millimeters. In this report all measurements have been converted to English units. Ten fish were typically kept as voucher specimens and preserved in 10% formalin. Voucher specimens were used to validate field identification with the assistance of Dr. Robert Bramblett, Montana State University, Bozeman, MT. If validation determined that some individuals were incorrectly identified in the field, total numbers were adjusted on a percentage basis. Fish less than 2 inches long were often identified only to family, since small size precluded identification to species.

Reptile/ Amphibian survey- All reptiles and amphibian sightings were recorded during each site visit and en-route to the site. Ryan Rauscher, wildlife biologist with MFWP, provided training and identified tadpoles. Reichel and Flath (1995) was used for identification.

Water quality/Habitat survey- Habitat surveys were completed at most wetted or partially wetted sites. Channel width, depth of water, substrate composition and water quality data were collected. Each flag (A-K) represented a separate transect of the 328 yard reach. Stream widths (meters) were taken at each flag. Five depth (centimeters) and substrate measurements were taken across each transect. Between each transect (A-B, B-C, etc.) 10 thalweg measurements of depth and substrate were taken. The percent wetted reach was determined by counting the depths >0 and dividing by the total number of depths taken and rounding to the nearest percent. Conductivity (µS, mS), pH, and temperature (˚C) were measured on each reach with an Oakton® Portable pH/CON 10 waterproof meter. Conductivity measurements were temperature compensated to 25˚ C. Due to startup costs, turbidity data was not taken as described in the protocol (Appendix C).

Substrate was classified into 10 generic types, including bedrock, boulder, cobble, course gravel, fine gravel, sand, fines, hardpan, woody debris, and other (Appendix C). "Other" was used when none of the defined substrate types were applicable. "Other" was typically grass, submerged aquatic vegetation mats or in a few cases, man-made debris. Man-made debris included; tires, car parts, cement, and pump parts. Substrate percentage was calculated by dividing the number of times each substrate was found by the total number of substrate measurements at the site.

Results and Discussion

Fish survey- Thirty-one different fish species in 9 families were captured (Table 1). See Holton and Johnson (2003) for species descriptions and preferred habitat. Of the species captured, 22 were native to Montana and 9 were introduced. The abundance and distribution of fish captured in each stream are discussed in detail below. The fathead minnow and the longnose dace had the greatest distribution at 14 sites each. Goldeye, emerald shiner, mountain whitefish, brook stickleback, freshwater drum, Iowa darter and yellow perch were each found at one site. There were no species of special concern captured, but 5 species of uncertain status (Iowa darter, brassy minnow, plains minnow, northern red-belly dace, and brook stickleback) were sampled. We were denied access 3 times. The reason given by the respective landowner was: just planted spring wheat and does not want vehicles on property, landowner does not grant access permission to anyone, and that the "Fish and Game" was chasing elk with helicopters off of his property to an adjacent ranch so they were not going to cooperate.

A total of 11,799 fish (Table 1) were captured from 22 sample sites in 12 HUCs. Five sites were sampled with a backpack shocker, 16 were seined and the Musselshell River was gill-netted and seined (Table 2). The brook stickleback and freshwater drum were the least common species with only one specimen captured (Table 1). The plains minnow and the fathead minnow were the most abundant with 2,472 and 1,617 individuals captured respectively. Common carp were the most common non-native with 1,155 individuals captured at 4 sites. The Teton River and Musselshell River had the greatest species richness with 12 and 13 species. Only one species was captured in Chip Creek, Daisy Dean Creek, Lake Creek, Little Elk Creek and Pike Creek (Table 2).

Most streams were sampled once. Exceptions included; Arrow Creek, Smith River and the Musselshell which were longitudinally sampled. Arrow Creek, Blake Creek, Coffee Creek, and the Sacagawea River were re-sampled seasonally once near the original site. Gill nets were set on the Musselshell River over about 20 stream miles and were combined as one fish sample (Table 2). To verify field identification up to 20 voucher specimens of each species were taken from each stream. Therefore, species diversity and abundance for seasonally sampled streams were likely influenced by removal of voucher specimens.

Reptile/Amphibian Survey – Eight different reptile species in 4 families that included 2 turtles and 6 snakes were observed (Table 3, Figure 2). Table 3 lists all reptiles and amphibians seen by the Region 4 prairie fish crew; several of which were not found at sampling sites. Appendix F lists the species captured at each sampling site. All were native to Montana. The spiny softshell turtle was the most abundant of the turtles. Of the snakes, the racer had the highest abundance and distribution. The common garter and plains garter can be difficult to identify in the field and therefore most sightings are listed as garter snake species (Table 3). This does not include the distinctly marked Western Terrestrial garter snake. Six amphibian species in five families, including 3 species of frogs, two types of toads and one salamander species, were observed (Table 3). The tiger salamander and the northern leopard frog held the greatest distributions and abundance (Table 3).

Water Quality Survey- Of the 62 sites surveyed 33 were dry, 7 held water but no fish, and 22 held both water and fish (Table 4). At least one site was sampled in 19 HUCs. Fish were not found in 7 of the sampled HUCs. Table 4 lists water quality and hydrologic characteristics by stream. Streams were 8 to 341.9 miles long (Table 4). Longer streams were more likely to have water. Streams over 38 miles long contained water either at or near the sample site. Of the 48 streams less than 38 miles long, only 15 held water. The mean stream width was 19.5 yards. The mean thalweg and transect depths were 22.9 and 16.1 inches respectively. The reaches that contained fish were mostly wetted, except for Chip Creek (<1% wet) and McDonald Creek (45% wet).

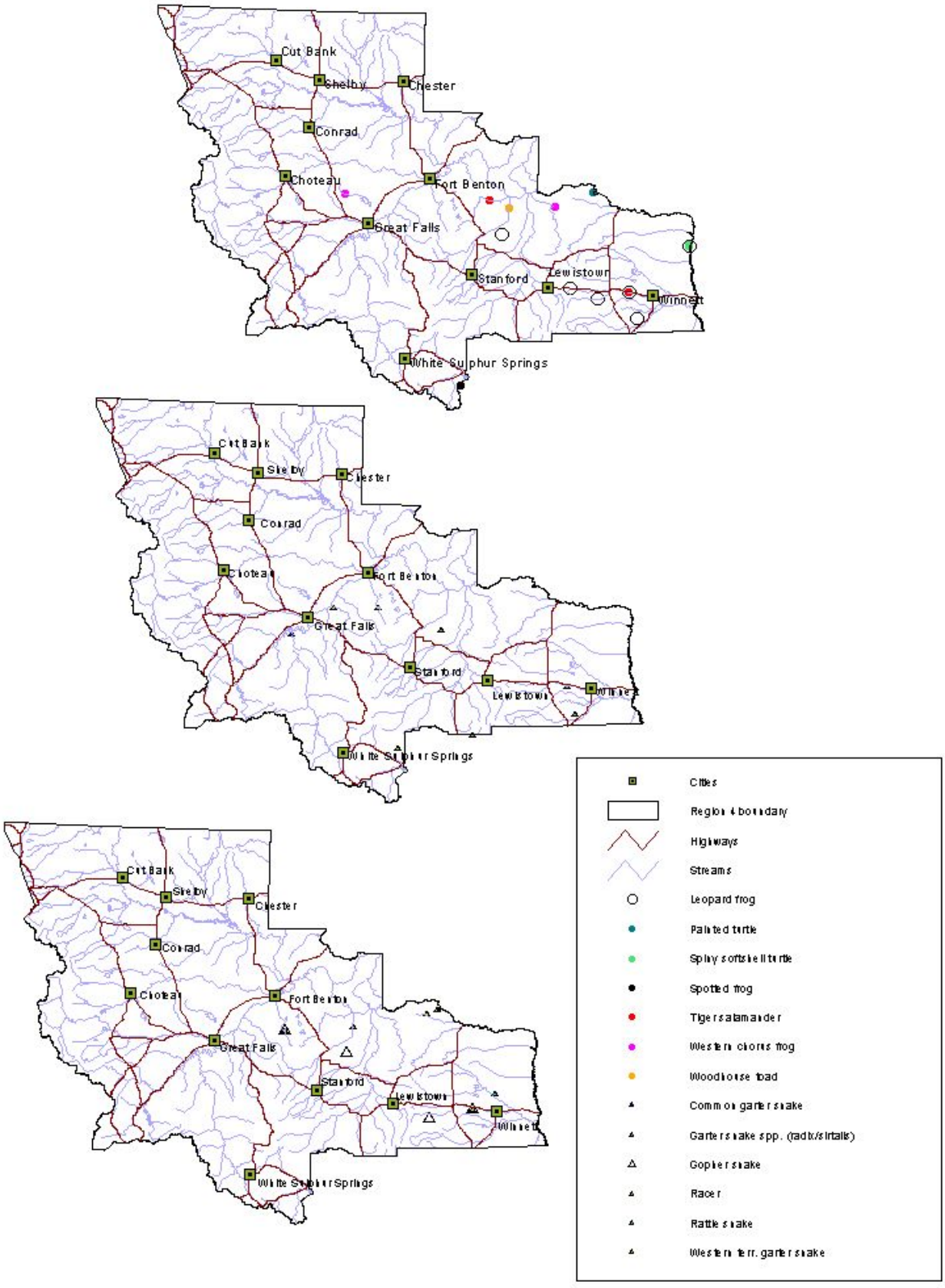

Figure 2. Reptile and amphibian observations during prairie fish surveys May – September 2003.

Measured conductivity ranged from 183.3 µS to 14,090 µS, with a mean of 3,092 µS. One site, an unnamed tributary to Muddy Creek, had a conductivity exceeding 19,999 µS; it was out of range of the conductivity meter. This stream did not contain fish though it was mostly wetted. Streams that contained fish had a mean conductivity of 2,626 µS. Fathead minnows were sampled in the stream with a conductivity of 14,090 µS. The pH ranged from 7.52 to 9.72 with a mean of 8.42 for all sites surveyed. For streams with fish, the pH ranged from 7.52 to 9.13 and the mean was 8.32. The Musselshell River had a high conductivity of 9,460 µS but contained a wide variety of fish species (Table 2). Of the seven sites that were wetted but contained no fish, most were sampled early in the field season and were likely ephemeral. Four of the wet but fishless sites had conductivities exceeding 5,000 µS even though they were sampled during run-off. One site was likely too saline for fish as it exceeded 19,999 µS. Trout were sampled in 5 streams, Daisy Dean, Little Elk, Smith River, Belt and Hound Creek. Conductivity was less than 500 µS in all of these streams.

Water quality varied at different sampling sites on Arrow Creek; conductivity was nearly twice as high (3470 µS) at Site 1, compared to 1754 µS at Site 2, 48 miles upstream. In contrast the conductivity at the two sites on the Smith River located 16 miles apart, were within 1µS of each other (380 µS). There was not much longitudinal difference in pH in either stream (Table 4). Seasonal water quality data was taken on Blake Creek and Coffee Creek, but not on Arrow Creek or the Sacagawea River. The conductivity dropped from the initial visit at Blake and Coffee Creeks. At Blake Creek it dropped by 26 µS (4%) and at Coffee Creek it dropped by 620 µS (13%). Small changes in pH occurred in both streams (Table 4.)

The water temperature ranged from 46.4°F to 81.8°F during the sampling season. The mean temperature was 63.7°F. For streams with fish the mean water temperature was 65.4°F. The mean temperature was 56°F in May, 61.6 °F in June, 65.5°F in July and 67.8°F in August. Water temperatures were taken at different times of the day, during a wide variety of air temperatures and seasons, so the values do not reflect tolerances of the fish species present. Temperature was taken twice at two sites, Blake Creek and Coffee Creek. At Coffee Creek the water temperature increased by nearly 20 °F, which suggests the limitations of spot-checking temperature.

Habitat survey- Table 5 details the substrate at surveyed sites. The most common substrate was fines. We documented fine substrate at every site except the Judith River and Smith River Site 1. The least common substrate was hardpan, which was only found on South Fork McDonald Creek. Cobble, course gravel, fine gravel, and sand substrates were documented at approximately 20 sites each. Wood or woody debris were usually from beaver dams. Occasionally wood substrate was a single tree or an accumulation broken limbs. "Other" was usually grass or aquatic vegetation mats on the stream bottom. In a few sites including as Ming Coulee, McDonald Creek, and Lake Creek other was man-made debris, such as, tires, car parts, cement, and pump parts. The two Arrow Creek sites generally had similar substrate compositions (Table 5). Arrow Creek site 2 had a greater percent of fine gravel and fine substrate than Site 1. Site 1 had large boulders that were not found at Site 2. Heavy cattle use was noted at site 1 during the second visit. We did not note grazing at Site 2. The Smith River sites varied greatly in their substrate composition (Table 5). Site 2 was 97% sand substrate and site 1 was primarily, course gravel and cobble. Recent grazing was not noted at either site.

Major findings by HUC **-** See Table 2 for detailed species descriptions for each stream and Table 4 for water quality and hydrology information.

Upper Missouri/Dearborn (HUC 10030102) – Five sites were sampled in this HUC, but only two, Lake Creek, and Shonkin Creek contained water. In Lake Creek, one fathead minnow was the only fish captured. Shonkin Creek likely contained fish, but was likely not effectively sampled with a seine. Previous sampling (MFWP 1989) found abundant brook trout in this reach of stream.

Smith River (HUC 10030103) – Seven sites were sampled in this HUC. The two Smith River sites and the Hound Creek site had water and fish. Ming Coulee had water and the other 3 sites were dry. On the Smith River, sampling was completed at river mile 4 (site 2) and at river mile 20 (site 1). Water was flowing at both sites. White sucker was the dominant species at both Smith River sites and at Hound Creek. Longnose sucker and longnose dace were also found at all three sites. On the Smith River the downstream site held more of a warm-water fish assemblage and contained fathead minnows, yellow perch and flathead chubs. Trout were not sampled at the downstream site. In contrast, brown trout and mountain whitefish were sampled at the more upstream site. The Hound Creek site was located within 0.5 miles of the Smith River. Hound Creek enters the Smith about 4 miles upstream from site 1, so it is not surprising that these sites had many fish species in common. In addition to brown trout, rainbow trout were captured in Hound Creek. The single temperature taken at each site indicates water temperatures may have been warm for trout at the downstream Smith River site. Conductivity measurements at the two Smith River sites were very similar, about 380 µS.

Sun (HUC 10030104) – Only one stream was sampled, an unnamed tributary to Muddy Creek. The conductivity was extremely high; it exceeded 19,999 µS, and no fish were found.

Belt (HUC 10030105) – Belt Creek and Red Coulee were sampled in this HUC. Belt Creek was sampled immediately upstream of the Salem Bridge (approximately river mile 2) and had a diverse fish assemblage of 10 species (Table 2). The fish were primarily the minnows and suckers characteristic of Montana prairie streams, but 2 rainbow trout were captured. Red Coulee was sampled very near its headwaters and did not have any water when sampled in mid August (Table 4).

Marias (HUC 10030203) – Five streams were sampled in July or August and only one, Chip Creek, held water (Table 4). Chip Creek had the highest measured conductivity (14,090 µS) and pH (9.72) for streams containing fish. Only one fish species, the fathead minnow, was sampled from a single pool formed at the end of a culvert. The Chip Creek sample site was located about 6 river miles from the Marias River.

Willow (HUC 10030204) – The three streams sampled in mid-August were all dry (Table 4).

Teton (HUC 10030205) – Four tributaries to the Teton were all dry when sampled in August (Table 4). A wide variety of minnow species, sucker species and channel catfish were collected from the main Teton River north of Great Falls off of the Bootlegger trail (Table 2).

Bullwhacker/Dog (10040101) – Two streams, Taffy Creek and Cutbank Creek were sampled in May. Both streams had water, but no fish during this run-off period.

Arrow Creek (HUC 10040102) – Five streams and a total of 6 sites were sampled in this HUC. Arrow Creek and Coffee Creek held water and fish. Flat Creek had water but no fish. Mud Spring Coulee and a tributary to Flat Creek were dry (Table 4).

Arrow Creek – Two sites were sampled twice; site 1 was at approximately river mile 12 and site 2 was at river mile 60. Flathead chub was the most abundant species at both sites. The least abundant species (n=1) per site were longnose dace (site 1), lake chub (site 1) and longnose sucker (site 2). At the downstream site, Arrow Creek conductivity was nearly twice as high (3,470 µS) as at the Arrow Creek site (1754 µS) 48 miles upstream. There was not much longitudinal difference in pH (Table 4).

Site 1 was mostly riffles and runs with one deep pool. The pool at site 1 was dry by the second visit. Site 1 had the most dramatic change in species richness between visits. Six species were captured during the first visit but only 2 species were caught on the revisit. The two species captured, flathead chub and plains minnow, were also the two most abundant species per visit (Table 2). This site was reduced to one, shallow pool by the second visit, which may explain the loss of 4 species. Furthermore, though Arrow Creek had a small amount of flow during the initial visit, most specimens of the other 4 species may have been removed as voucher specimens. Nearly all of the fish sampled on the second visit were less than 2 inches long (Table 2).

We captured four fish species at site 2 that were not present at site 1 (Table 2). Site 2 had a large deep pool and several smaller ones. Judging from the size of the white suckers, longnose suckers, and goldeye captured, the pool at site 2 either has not dried up during drought conditions in recent years or fish migrated about 60 miles from the Missouri River during high spring flow and remained in this deep pool. Goldeye are a large river fish (Holton and Johnson 2003), which implies that Missouri River fish may make large seasonal movements up Arrow Creek.

Six species were sampled in Coffee Creek. White suckers, four minnow species, and a single brook stickleback were captured during the initial visit. Small *catostomid sp.* were captured on the second visit.

No fish were sampled in Flat Creek about 16 miles upstream of the mouth. It was sampled during June and had a high conductivity of 8,360 µS. Flat Creek was spot sampled in July 2002, about 6 miles downstream and 5 different species were captured including fathead minnow, lake chub, longnose sucker, plains minnow and white sucker (Yerk et al., 2004). A spring enters Flat Creek immediately upstream of the 2002 sampling site.

Judith (10040103) – Three streams were sampled and only the Judith River had fish. Pacer Coulee contained water near Denton, but fish were not found. Box Elder Creek was dry about 4 miles upstream from the mouth. The Judith was sampled on the Beckman Game Range and only 5 species were captured compared to 11 sampled on the game range in 2001 (Yerk et al. 2004). The 2001 sampling involved less intense sampling at several sites in the game range, and was done 2 weeks earlier.

Fort Peck Reservoir (10040104) – Woodhawk Creek was the only stream sampled and was dry, during May, less than one mile from its confluence with the Missouri River.

Upper Musselshell (10040201) – All three streams sampled in the Upper Musselshell contained fish. Two, Daisy Dean Creek and Little Elk Creek only contained brook trout (Table 2). Blake Creek contained minnows. The revisit to Blake Creek produced an interesting change in species abundance. On the first visit, the northern redbelly dace was the most abundant species followed by lake chubs at 198 fish and 4 fish respectively. The return visit produced only 1 northern redbelly dace and 6 lake chubs. The species composition also changed. One brassy minnow was captured on the first visit and three longnose dace were captured on the second visit. Neither was captured on both visits.

Middle Musselshell (10040202) – Mud Springs Creek was the only water sampled and it was dry.

Flatwillow (10040202) – Two streams were sampled. Pike Creek, with 2 fathead minnows, was the only stream with fish.

Box Elder (10040204) – Three of the six streams sampled had fish. Suckers and a variety of minnow species were found in McDonald Creek and its tributaries. Electrofishing was used to sample the North and South Forks of McDonald Creek but conductivities of 984 µS and 1,745 µS were quite high for effective electrofishing, so it is likely many fish were not sampled. The South Fork McDonald Creek was sampled about 3 miles upstream in 1999 (Lewistown data files). Conductivity was similar at 1,660 µS and the fish species were slightly different; longnose suckers and mottled sculpin were only sampled in 1999, while fathead minnows were sampled in 2003 but not in 1999. Black spot (a superficial parasitic infection) was noticed on fish both years.

Lower Musselshell (10040205) – Two of five sampled streams, the Musselshell River and the Sacagawea River (Crooked Creek) had fish. The other 3 streams, Cat Creek, Cottonwood Creek and Drag Creek were dry.

The Musselshell River had a high conductivity of 9,460 µS near the mouth (river mile 7.5), but contained a wide variety of fish species (Table 2). A total of 13 species were collected with seining and gill nets. The fish fauna was slightly different in 2000, when the Musselshell River was also seined near river mile 7.5 (Hill et al. 2000). In 2000, crappie, sauger, flathead chub, longnose dace and fathead minnows were captured. Walleye, sand shiners and green sunfish were captured in 2003 but not in 2000. Seining captured a wider variety of species than gill netting. Freshwater drum was the only species not captured by seines, while several species were not caught in gillnets (Table 2). In recent years the Lower Musselshell has been severely dewatered during drought and has generally lacked flowing water throughout the summer months. The stream is intensely managed for irrigation. In 2002, fish kills were reported upstream of this sampling site and were assumed to be from the high salinity of the water (Ken Frazer, MFWP-Billings, personal communications).

Nine different species were captured n the Sacagawea River. The plains minnow and common carp were the most abundant species captured during each visit. The green sunfish was least abundant. The flathead chub was the only species not captured during both visits. Only 15 of the 796 minnows counted were kept as voucher specimens but all vouchers were validated as plains minnow. Small plains minnow and flathead chub can be difficult to differentiate in the field. Due to possible misidentification and a minimal voucher sample, some of 796 plains minnows could have been flathead chubs. The species distribution was similar to what Bramblett and Zale (2000) found in 1999, several miles downstream. Plains minnows were the most abundant species both years. Black bullheads were found in 2003 but not in 1999. Bramblett and Zale sampled channel catfish and river carpsucker in 1999. These are large river species that we did not find further upstream in 2003.

Upper Milk (10050002) – Two streams were sampled and only Breed Creek held fish. This is the only stream where the Iowa darter was sampled, but it has a limited distribution in MFWP Region 4. The Iowa darter has been previously reported from many tributaries in the upper Milk (Holton and Johnson, 2002), so it was not surprising to find it here. All other tributaries to the Milk that were sampled (Big Sandy, Sage Creek HUCs) were dry.

Big Sandy (10050005) – Only one stream, Twelve-mile coulee, was sampled in this HUC. It was dry.

Sage Creek (10050006) – Lair Creek and Fourmile Creek in this HUC were both dry when visited in late August.

Recommendations

We recommend additional training time for fish identification prior to fieldwork. This would help greatly in the identification of minnows. We suggest splitting the lab time into two days and to schedule smaller groups to allow better access to fish specimens. It would be helpful for new crewmembers to spend at least one day working with a seasoned crew prior to conducting their own survey. We found it beneficial to spend at least one day sampling with other regional crews early in the season. This assisted with problem solving, fish identification and standardization of methods between regions.

It was helpful to have at least one 50-gallon cooler with 2 or 3 bubblers to provide oxygen for the captured fish. Without this extra equipment, minnows often died in buckets, which may have added to the changes in fish populations noted on repeat seasonal surveys. When fish are difficult to identify the crew should measure only the fish they are keeping as specimens. This would assist in calculating the percent of species present and likely reduce the number of "unknowns." Fish smaller than 2 inches do not preserve well and often cannot be characterized to species. Some minor modifications are necessary to the fish data sheets, including additional fields for; gear type, start and stop times and ambient air temperature. Weather may be important to note as well. Also, some typographical errors need to be fixed on the data sheets. Water quality parameters and time sampled need to be added to the habitat data sheet. Turbidity sampling as recommended by the protocol would be beneficial and is planned for 2004. To get an understanding of changes in water volume and water chemistry, habitat surveys would be worthwhile to complete during each seasonal visit. Use of GPS and good field descriptions would be useful to delineate re-survey areas. On streams where electrofishing is used, either sampling in an upstream direction or use of a downstream block net is recommended.

We recommend the amphibian/reptile survey remain an integral part of the prairie stream survey. It may be worthwhile to expand this part of the survey. Montana has limited information on the distributions of reptiles and amphibians; recording observations required little additional time and therefore little additional cost.

We found that longer streams were more likely to contain water and fish. Therefore choosing streams based on drainage length appears to be beneficial. This was northcentral Montana's third consecutive year of drought. By mid-summer 2003 drought indices, such as the Palmer Index found central Montana in severe drought (NRIS web site nris.state.mt.us.drought/states/droughtstatusmpas.html; 2/10/04). This survey did not evaluate topographic features that could potentially limit movement or provide refuge in drought. A survey of ponds, dams, irrigation diversions and other features may be useful to evaluate how such features influence prairie stream fish distribution. Schrank et al. (2001) found impoundment density to be a significant factor for the Topeka shiner in Kansas and Winston et al. argued that abundance of the plains minnow and 3 other minnow species were reduced above an impoundment due to fish passage issues and predator fish in the dam's pool.

Acknowledgements

Thanks to the landowners for access. Steve Leathe, Bill Gardner, George Liknes, Steve Carson, Ken Farthing, Chris Luby-Brown and Fred Roberts (Bureau of Land Management) answered countless questions. Dr. Robert Bramblett provided invaluable assistant with fish identification. Mike Vaughn and Fawn Kirkland assisted with equipment purchases. Ryan Rauscher gave important advice on reptiles and amphibian identification. Nate Allen assisted all aspects of the field surveys and thanks to Mark Frank for volunteering to help on the large streams. Jim Boyd assisted with data summaries and maps.

Water Codes Referred to in this Report

14-0280	Black Coulee
14-0920	Corral Creek
14-1400	Dry Fork Coulee (Choteau)
14-1440	Dry Fork Coulee (Choteau)
14-2040	Fourmile Creek
14-2440	Horse Creek
14-6000	Teton River
14-6440	Weatherwax Coulee
14-6520	West Fork Willow Creek
1500AB	Breed Creek
15-2040	Laird Creek
15-4200	Twelvemile Coulee
16-0140	Arrow Creek
16-0460	Box Elder Creek
16-0820	Chip Creek
16-0860	Coffee Creek
16-0970	Sacagawea River
16-1060	Cutbank Creek
16-1560	Flat Creek (Choteau)
16-1800	Judith River
16-3220	Salt Creek
16-3780	Taffy Creek
16-4240	Woodhawk Creek
17-0544	Belt Creek
17-0928	Boston Coulee
17-3024	Goodman Coulee
17-3600	Hound Creek
17-4832	Ming Coulee
17-5216	Ninemile Coulee
17-6272	Rocky Springs Coulee
17-6656	Shonkin Creek
17-6816	Smith River
17-7088	Spanish Coulee
17-7152	Spring Coulee
18-0270	Bear Creek (Fergus/Petroleum)
18-0480	Blake Creek
18-1050	Cat Creek
18-1110	Chippewa Creek
18-1410	Cottonwood Creek
18-1590	Daisy Dean Creek
18-1665	Drag Creek
18-3540	Little Elk Creek
18-3780	McDonald Creek
18-4260	Mud Springs Coulee
18-4320	Musselshell River
18-4590	North Fork McDonald Creek
18-4980	Pike Creek
18-5640	South Fork McDonald Creek
18-6930	Yellow Water Creek
20-4850	Red Coulee
No #	Bear Creek (Gulch) (Fergus)
No #	Bear Gulch (Liberty)
No #	Flat Creek (Cascade)
No #	Kinyon Coulee
No #	Lake Creek
No #	Pacer Coulee
No #	Unnamed trib of Flat Creek
No #	Unnamed trib of Muddy Creek
No #	Unnamed trib of Teton River

Table 1. Fish species captured during Region 4 prairie fish survey, May- August 2003.

Family	Species	Native or Introduced	# of Fish	# Sites
Mooneye	***Hiodontidae***			
Goldeye	*Hiodon alosoides*	Native	7	1
Sucker	***Catostomidae***			
River carpsucker	*Carpiodes carpio*	Native	13	2
Longnose sucker	*Catostomus catostomus*	Native	127	6
White sucker	*Catostomus commersoni*	Native	1614	13
Mountain sucker	*Catostomus platyrhynchus*	Native	166	5
Shorthead redhorse	*Moxostoma macrolepidotum*	Native	14	5
Unidentified sucker		Native	13	
Minnow	***Cyprinidae***			
Lake chub	*Couesius plumbeus*	Native	837	10
Common carp	*Cyprinus carpio*	Introduced	1155	4
Western silvery minnow	*Hybognathus argyritis*	Native	992	3
Brassy minnow	*Hybognathus hankinsoni*	Native	80	5
Plains minnow	*Hybognathus placitus*	Native	2472	5
Flathead chub	*Platygobio gracilis*	Native	1034	6
Emerald shiner	*Notropis atherinoides*	Native	160	1
Sand shiner	*Notropis stramineus*	Native	276	4
Northern redbelly dace	*Phoxinus eos*	Native	241	2
Fathead minnow	*Pimephales promelas*	Native	1617	14
Longnose dace	*Rhinichthys cataractae*	Native	870	14
Unidentified minnow		Native	13	
Trout	***Salmonidae***			
Rainbow trout	*Oncorhynchus mykiss*	Introduced	3	2
Mountain whitefish	*Prosopium williamsoni*	Native	6	1
Brook trout	*Salvelinus fontinalis*	Introduced	18	2
Brown trout	*Salmo trutta*	Introduced	8	2
Bullhead Catfish	***Ictaluridae***			
Black bullhead	*Ameiurus melas*	Introduced	10	2
Channel catfish	*Ictalurus punctatus*	Native	14	3
Stonecat	*Noturus flavus*	Native	5	2
Stickleback	***Gasterosteidae***			
Brook stickleback	*Culaea inconstans*	Native	1	1
Sunfish	***Centrarchidae***			
Green sunfish	*Lepomis cyanellus*	Introduced	8	2
Smallmouth bass	*Micropterus dolomieu*	Introduced	4	2
Drum	*Sciaenidae*	Native	1	1
Freshwater drum	***Aplodinotus grunniens***			
Perch	***Percidae***			
Iowa darter	*Etheostoma exile*	Native	8	1
Yellow perch	*Perca flavescens*	Introduced	4	1
Walleye	*Sander vitreum*	Introduced	8	2

Table 2. Statistics of fish captured on each stream during prairie fish survey, May- August 2003 by HUC.

Water Date	HUC (Drainage)	Species	Total length (inches) *N*	Min	Max	Mean
Lake Creek 8/21/2003 Seine	10030102 Upper Missouri Dearborn	Fathead minnow	1	3.0	3.0	3.0
Hound Creek	10030103	Brown trout	3	3.0	3.3	3.2
8/8/2003	Smith	Fathead minnow	1	1.9	1.9	1.9
Seine		Longnose dace	3	1.1	1.4	1.3
		Longnose sucker	11	1.8	4.4	3.9
		Rainbow trout	1	2.1	2.1	2.1
		White sucker	71	1.5	4.3	7.4
Smith River Site 1	10030103	Brown trout	5	7.0	9.0	8.0
8/7/03	Smith	Longnose dace	63	0.9	2.9	1.9
Seine		Longnose sucker	55	1.6	5.6	2.2
River mile 20		Mountain whitefish	6	3.0	3.2	3.1
		White sucker	131	1.3	4.5	1.9
Smith River Site 2	10030103	Flathead chub	53	1.4	6.0	2.0
8/13/03	Smith	Fathead minnow	1	2.1	2.1	2.1
Seine		Longnose dace	4	1.1	1.6	1.3
River mile 4		Longnose sucker	50	1.3	2.4	1.9
		Unknown cyprinid species	3	1.2	1.5	1.4
		White sucker	660	1.4	2.2	1.6
		Yellow perch	4	2.6	2.6	2.6
Belt Creek	10030105	Lake chub	41	2.2	4.4	2.8
7/30/2003	Belt	Longnose dace	63	1.8	3.4	2.3
Seine		Longnose sucker	3	2.7	4.5	3.7
		Mountain sucker	13	1.5	2.8	2.3
		Rainbow trout (n=1)	2	2.0	2.0	2.0
		Sand shiner	4	1.8	2.0	1.9
		Shorthead redhorse	1	3.2	3.2	3.2
		Stonecat	4	0.9	2.8	1.8
		White sucker	13	1.2	3.9	1.9
		Unknown catostomid species	2	0.9	1.0	0.9
Chip Creek 8/6/2003 Seine	10030203 Marias	Fathead minnow	480	1.6	2.6	1.9

Table 2 - continued

Water Date	HUC (Drainage)	Species	Total length (inches) *N*	Min	Max	Mean
Teton River	10030205	Channel catfish	2	1.7	1.7	1.7
8/15/03	Teton	Common carp	1	1.7	1.7	1.7
Seine		Fathead minnow	4	1.7	2.0	1.9
		Flathead chub	694	1.8	4.9	2.6
		Lake chub	1	3.6	3.6	3.6
		Longnose dace	85	1.5	2.5	1.9
		Mountain sucker	31	1.2	4.4	2.7
		Plains minnow	852	2.6	5.0	3.5
		River carpsucker	8	1.3	4.2	1.9
		Sand shiner	249	1.5	2.3	1.8
		Shorthead redhorse	3	1.6	2.0	1.8
		White sucker	397	1.5	8.8	3.1
Arrow Creek Site 1	10040102	Fathead minnow	11	2.2	2.2	2.2
6/19/03	Arrow	Flathead chub	74	2.5	5.4	3.2
Seine		Lake chub	1	4.4	4.4	4.4
River mile 12		Longnose dace	1	2.5	2.5	2.5
		Plains minnow	21	3.2	3.4	3.3
		Western silvery minnow	11	4.5	4.5	4.5
7/29/03		Flathead chub	75	1.4	1.9	1.8
		Plains minnow	8	1.6	2.1	1.9
Arrow Creek Site 2	10040102	Brassy minnow	9	1.7	2.6	2.2
6/19/03	Arrow	Fathead minnow	23	1.6	2.5	2.0
Seine		Flathead chub	28	2.2	4.6	3.1
River mile 60		Goldeye	2	11.1	12.8	12.0
		Lake chub	7	2.6	3.7	3.4
		Longnose dace	20	2.1	3.0	2.5
		Longnose sucker	1	17.7	17.7	17.7
		Plains minnow	5	2.9	3.0	2.9
		Western silvery minnow	3	3.8	3.8	3.8
		White sucker	4	3.5	8.4	5.7
7/29/03		Brassy minnow	4	2.4	2.6	2.5
Seine		Fathead minnow	5	1.9	2.5	2.2
		Flathead chub	24	1.4	6.0	3.9
		Goldeye	5	11.3	12.3	11.7
		Lake chub	13	1.4	4.5	3.4
		Longnose dace	9	1.2	3.2	2.2
		Plains minnow	3	2.8	3.0	2.9
		Unknown Cyprinid Species	10	2.4	3.8	2.9
		Western silvery minnow	11	2.2	2.8	2.7
		White sucker	38	1.3	4.9	3.0

Table 2 - continued

Water	HUC			Total length (inches)		
Date	(Drainage)	Species	*N*	Min	Max	Mean
Coffee Creek	10040102	Brassy minnow	1	2.8	2.8	2.8
5/19/2003	Arrow	Brook stickleback	1	2.2	2.2	2.2
seine		Fathead minnow	18	1.7	2.4	1.9
		Lake chub	20	2.0	3.2	2.5
		Longnose dace	2	2.2	2.4	2.3
		White sucker	19	1.8	7.2	2.9
6/17/2003		Brassy minnow	3	2.0	2.3	2.2
seine		Fathead minnow	15	2.0	2.8	2.3
		Lake chub	170	2.4	4.4	3.2
		Longnose dace	21	2.2	3.2	2.5
		Unknown catostomid species	3	0.8	1.0	0.9
		White sucker	19	2.6	7.6	3.9
Judith River	10040103	Flathead chub	30	1.5	3.7	2.4
8/28/2003	Judith	Longnose dace	14	0.9	2.1	1.3
seine		Longnose sucker	7	2.1	3.3	2.5
		Plains minnow	1	3.4	3.4	3.4
		Shorthead redhorse	3	2.3	2.8	2.5
		Stonecat	1	1.7	1.7	1.7
Blake Creek	10040201	Brassy minnow	1	2.6	2.6	2.6
6/17/2003	Upper Musselshell	Lake chub	4	2.7	4.6	3.9
Backpack unit		Northern redbelly dace	198	2.1	2.7	2.3
7/23/2003		Lake chub	6	3.3	4.7	3.9
Backpack unit		Longnose dace	3	2.9	3.4	3.3
		Northern redbelly dace	1	2.2	2.2	2.2
Daisy Dean Creek	10040201	Brook trout	7	4.8	7.0	5.5
6/11/2003	Upper Musselshell					
Backpack unit						
Little Elk Creek	10040201	Brook trout	11	4.6	8.9	6.6
6/12/2003	Upper Musselshell					
Backpack unit						
Pike Creek	10040203	Fathead minnow	2	2.3	2.3	2.3
8/19/2003	Flatwillow					
seine						
McDonald Creek	10040204	Brassy minnow	60	1.6	1.7	1.6
8/12/2003	Box Elder	Fathead minnow	157	.8	2.3	1.3
seine		Lake chub	107	1.3	2.2	1.6
		Longnose dace	4	1.4	1.8	1.7
		Mountain sucker	10	1.2	5.6	1.9
		White sucker	15	2.1	2.9	2.5

Table 2 - continued.

Water	HUC		Total length (inches)			
Date	(Drainage)	Species	*N*	Min	Max	Mean
North Fork McDonald Creek	10040204	Fathead minnow	99	1.2	2.3	1.7
7/24/2003	Box Elder	Longnose dace	14	.8	2.6	1.2
Backpack electrofishing		Northern redbelly dace	42	1.0	2.1	1.4
		White sucker	3	1.1	1.2	1.1
South Fork McDonald Creek	10040204	Fathead minnow	7	1.7	2.2	2.0
7/25/2003	Box Elder	Lake chub	2	2.1	2.1	2.1
Backpack electrofishing		Longnose dace	157	1.1	2.5	1.9
River mile 14		Mountain sucker	2	4.4	4.9	4.7
		White sucker	40	1.3	10.8	3.9
Musselshell River	10040205	Channel catfish	4	8.3	30.5	18.4
8/22/2003	Lower Musselshell	Common carp	78	2.2	31.0	19.2
Seine (river mile 7.5)		Emerald shiner	160	2.4	3.1	2.8
		Green sunfish	3	1.2	1.6	1.4
		River carpsucker	5	2.1	10.9	6.0
		Sand shiner	1	2.1	2.1	2.1
		Shorthead redhorse	2	5.0	6.8	5.9
		Smallmouth bass	1	11.0	11.0	11.0
		Walleye	6	6.0	11.0	7.3
		Western silvery minnow	967	2.8	3.6	3.2
		White sucker	1	2.5	2.5	2.5
Musselshell River	10040205	Black bullhead	1			7.7
7/8 and 7/15/03	Lower Musselshell	Channel catfish	8	7.6	26.0	14.0
6 overnight gill net sets		Common carp	16	6.5	27.5	15.8
(six different sites from		Freshwater drum	1			14.0
Rivermile 7.5 - 25		Shorthead redhorse	5	9.0	11.6	10.3
		Smallmouth bass	3	8.5	10.1	9.2
		Walleye	2	10.0	12.0	11.0
Sacagawea River	10040205	Black bullhead	6	3.0	8.8	5.2
7/2/2003	Lower Musselshell	Common carp	716	1.3	17.6	2.1
seine		Fathead minnow	305	1.5	2.4	2.0
		Green sunfish	2	3.3	3.4	3.4
		Lake chub	162	1.5	5.0	2.9
		Plains minnow	796	2.5	4.0	2.8
		Sand shiner	6	2.1	2.3	2.2
		White sucker	33	1.3	10.4	2.8
8/4/2003		Black bullhead	3	3.4	9.6	6.0
seine		Common carp	344	1.4	18.4	3.3
		Fathead minnow	94	1.4	2.5	1.9
		Flathead chub	56	5.2	5.2	5.2
		Green sunfish	3	3.4	3.9	3.7
		Lake chub	117	1.3	5.2	2.5
		Plains minnow	786	1.9	3.1	2.8
		Sand shiner	16	1.9	2.3	2.1
		White sucker	10	2.5	3.0	2.7

Table 2 - continued

Water Date	HUC (Drainage)	Species	Total length (inches) *N*	Min	Max	Mean
Breed Creek	10050002	Brassy minnow	2	2.6	2.7	2.6
7/31/03	Upper Milk	Fathead minnow	394	2.0	2.7	2.3
seine		Iowa darter	8	2.0	2.3	2.1
		Lake chub	186	1.5	4.1	2.6
		Longnose dace	407	1.1	3.2	1.7
		Mountain sucker	110	2.0	4.5	2.6
		Unknown catostomid species	8	1.7	2.0	1.9
		White sucker	160	1.6	6.3	2.1

Table 3. Reptile and amphibian observations, May – August 2003 in northcentral MT.

Family	Species	Total	Number of Sites
Ambystomatidae			
Tiger Salamander	*Ambystoma tigrinum*	38	4
Pelobatidae			
Plains Spadefoot	*Scaphiopus bombifrons*	8	1
Bufonidae			
Woodhouse's Toad	*Bufo woodhousii*	1	1
Hylidae			
Western Chorus Frog	*Pseudacris maculata*	8	3
Ranidae			
Northern Leopard Frog	*Rana pipens*	58	7
Spotted Frog	*Rana pretiosa*	2	1
Emydidae			
Painted Turtle	*Chrysemys picta*	1	1
Trionychidae			
Spiny Softshell	*Aplaone spiniferus*	3	1
Colubridae			
Racer	*Coluber constrictor*	15	11
Gopher Snake	*Pituophis catenifer*	11	7
Common Garter Snake	*Thamnophis sirtalis*	1	1
Plains Garter Snake	*Thamnophis radix*	1	1
Western Terrestrial Garter Snake	*Thamnophis elegans*	7	4
Garter Snake Species[1]	*Thamnophis spp*	6	4
Viperidae			
Western Rattlesnake	*Crotalus viridis*	8	8

[1] Either *T. radix* or *T. sirtalis.*

Table 4. Water quality data collected during prairie stream surveys, May – August 2003 by HUC.

Water Date	Stream Length (miles)	Water Quality Conductivity (µS)	Temperature (°F)	pH	Mean Width (yds.)	Mean depth (inches) Thalweg	Transect	Percent wetted[1]
Upper Missouri Dearborn HUC 10030102								
Flat Creek 6/24/2003	13.1	Dry	Dry	Dry	Dry	Dry	Dry	0
Lake Creek* 6/24/2003	18.7	777	65.5	8.93	3.8	31.4	24.3	100
Ninemile Coulee 8/14/2003	16.8	Dry	Dry	Dry	Dry	Dry	Dry	0
Shonkin Creek[2] 5/22/2003	52.0	291	53.4	8.78	7.4	17.4	15.3	100
Spring Coulee 8/14/2003	14.5	Dry	Dry	Dry	Dry	Dry	Dry	0
Smith HUC 10030103								
Boston Coulee 6/24/2003	13.9	Dry	Dry	Dry	Dry	Dry	Dry	0
Goodman Coulee 6/24/2003	13.2	Dry	Dry	Dry	Dry	Dry	Dry	0
Hound Creek* 8/8/2003	25.2	416	62.1	8.25	11.5	31.4	21.4	100
Ming Coulee 6/24/2003	32.0	967	53.6	8.16	1.2	4.6	3.3	100
Smith River Site 1* 8/7/2003	121.1	382	63.0	8.22	15.6	29.0	17.0	100
Smith River Site 2* 8/13/2003	121.1	381	68.7	8.38	22.7	21.1	12.7	100
Spanish Coulee 6/24/2003	12.7	Dry	Dry	Dry	Dry	Dry	Dry	0
Sun HUC 10030104								
Unnamed Trib to Muddy Creek 8/21/2003	13.4	>19,999	61.9	9.72	0.5	1.12	0.9	100

* Streams with fish; 1 to nearest %; 2 likely contains fish, not effectively sampled with seine;

Table 4 - continued

Stream Water Date	Length (miles)	Water Quality: Conductivity (µS)	Water Quality: Temperature (°F)	Water Quality: pH	Mean Width (yds)	Mean depth (inches): Thalweg	Mean depth (inches): Transect	Percent wetted[1]
Belt Creek 10030105								
Belt Creek* 7/30/2003	88.3	447	68.5	8.25	12.5	17.4	10.0	100
Red Coulee 8/14/2003	10.9	Dry	Dry	Dry	Dry	Dry	Dry	0
Marias 10030203								
Chip Creek* 8/6/2003	23.5	14090	72.7	9.13	0.6	0.7	1.9	<1
Corral Creek 7/31/2003	18.7	Dry	Dry	Dry	Dry	Dry	Dry	0
Dry Fork Coulee 8/6/2003	21.6	Dry	Dry	Dry	Dry	Dry	Dry	0
Horse Creek 7/31/2003	24.9	Dry	Dry	Dry	Dry	Dry	Dry	0
Rocky Springs Coulee 8/27/2003	23.9	Dry	Dry	Dry	Dry	Dry	Dry	0
Willow HUC 10030204								
Black Coulee 8/27/2003	17.5	Dry	Dry	Dry	Dry	Dry	Dry	0
Kinyon Coulee 8/27/2003	23.9	Dry	Dry	Dry	Dry	Dry	Dry	0
West Fork Willow Creek 8/27/2003	36.3	Dry	Dry	Dry	Dry	Dry	Dry	0
Teton 10030205								
Dry Fork Coulee 8/14/2003	22.4	Dry	Dry	Dry	Dry	Dry	Dry	0
Teton River* 8/15/2003	184.3	1878	66.6	8.41	9.8	15.7	7.9	100
Unnamed Trib to Teton River 8/14/2003	17.0	Dry	Dry	Dry	Dry	Dry	Dry	0
Weatherwax Coulee 8/14/2003	13.6	Dry	Dry	Dry	Dry	Dry	Dry	0

*Streams with fish; 1 to nearest %

Table 4 - continued

Water Date	Stream Length (miles)	Water Quality: Conductivity (µS)	Water Quality: Temperature (°F)	pH	Mean Width (yds)	Mean depth (inches): Thalweg	Mean depth (inches): Transect	Percent wetted[1]
Bullwhacker/Dog 10040101								
Cutbank Creek 5/20/03	16.0	9710	66.0	8.63	3.9	11.4	5.7	100
Taffy Creek 5/20/03	19.9	10120	60.1	8.77	4.1	13.8	10.8	100
Arrow Creek HUC 10040102								
Arrow Creek Site 1* 6/19/2003	101.6	3470	72.5	8.38	5.3	13.3	10.6	100
Arrow Creek Site 2* 6/19/2003	101.6	1754	79.7	8.40	5.8	10.9	9.5	100
Coffee Creek* 5/19/2003	46.0	4650	52.3	8.63	3.2	14.5	8.8	100
6/17/2003		4030	72.1	8.47				
Flat Creek 6/4/2003	58.0	8360	56.3	8.83	3.6	6.6	6.0	99.95
Flat Creek, unnamed Trib to 5/22/2003	8.0	Dry	Dry	Dry	Dry	Dry	Dry	0
Mud Spring Coulee 5/22/2003		Dry	Dry	Dry	Dry	Dry	Dry	0
Judith 10040103								
Box Elder Creek 6/25/2003	14.8	Dry	Dry	Dry	Dry	Dry	Dry	0
Judith River* 8/28/2003	127.1	818	59.4	8.47	27.2	26.0	17.4	100
Pacer Coulee 5/19/2003	9.4	5950	48.0	8.27	2.6	7.1	4.2	100
Fort Peck Reservoir 10040104								
Woodhawk Creek 5/20/2003	24.3	Dry	Dry	Dry	Dry	Dry	Dry	0

*Streams with fish; 1 to nearest %

Table 4 - continued.

Water Date	Stream Length (miles)	Water Quality: Conductivity (µS)	Water Quality: Temperature (˚F)	pH	Mean Width (yds)	Mean depth (inches): Thalweg	Mean depth (inches): Transect	Percent wetted[1]
Upper Musselshell 10040201								
Blake Creek* 6/17/2003	16.5	685	62.2	8.32	3.7	7.46	5.2	100
7/23/2003		659	60.8	8.39				
Daisy Dean Creek* 6/11/2003	28.2	379	46.4	7.9	3.1	12.7	9.1	100
Little Elk Creek* 6/12/2003	21.6	183.3	50.0	8.06	7.3	14.4	7.3	100
Middle Musselshell 10040202								
Mud Springs Creek 8/20/2003	25.1	Dry	Dry	Dry	Dry	Dry	Dry	0
Flatwillow 10040203								
Pike Creek* 8/19/2003	27.3	692	77.2	7.94	1.5	5.2	3.8	61
Yellow Water Creek 8/20/2003	19.9	Dry	Dry	Dry	Dry	Dry	Dry	0
Box Elder 10040204								
Bear Creek 6/26/2003	35.7	Dry	Dry	Dry	Dry	Dry	Dry	0
Bear Creek (Gulch) 7/24/2003	10.0	Dry	Dry	Dry	Dry	Dry	Dry	0
Chippewa Creek 6/26/2003	27.7	Dry	Dry	Dry	Dry	Dry	Dry	0
McDonald Creek* 8/12/2003	72.2	3000	73.8	8.03	2.5	8.6	4.4	45
North Fork McDonald Creek* 7/24/2003	28.5	984	55.2	7.93	1.2	4.1	4.0	100
South Fork McDonald Creek* 7/25/2003	37.6	1745	65.5	7.52	6.0	21.6	15.0	100

*Streams with fish; 1 to nearest %;

Table 4- continued.

Water Date	Stream Length (miles)	Water Quality: Conductivity (µS)	Water Quality: Temperature (˚F)	pH	Mean Width (yds)	Mean depth (inches): Thalweg	Mean depth (inches): Transect	Percent wetted[1]
Lower Musselshell 10040205								
Cat Creek 6/5/2003	21.6	Dry	Dry	Dry	Dry	Dry	Dry	0
Cottonwood Creek 6/5/2003	22.4	Dry	Dry	Dry	Dry	Dry	Dry	0
Drag Creek 6/16/2003	21.9	Dry	Dry	Dry	Dry	Dry	Dry	0
Musselshell River* 8/22/2003	341.9	9460	74.7	8.81	9.7	13.5	9.5	100
Sacagawea River* 7/2/2003	92.9	2990	81.1	8.57	3.8	12.0	10.8	87
Upper Milk 10050002								
Bear Gulch 7/31/2003	13.9	Dry	Dry	Dry	Dry	Dry	Dry	0
Breed Creek* 7/31/2003	20.8	407	61.9	8.1	2.4	8.0	3.9	100
Big Sandy 10050005								
Twelvemile Coulee 8/26/03	23.1	Dry	Dry	Dry	Dry	Dry	Dry	0
Sage Creek 10050006 Laird Creek 8/26/2003	21.1	Dry	Dry	Dry	Dry	Dry	Dry	0
Fourmile Creek 8/26/2003	19.9	Dry	Dry	Dry	Dry	Dry	Dry	0

*Streams with fish; 1 to nearest %;

Table 5. Percent substrate composition for wetted stream reaches, from region 4 prairie fish survey, May – August 2003 by HUC.

Water Date	Substrate Types (%)									
	Bedrock	Boulder	Cobble	Course Gravel	Fine Gravel	Sand	Fines	Hard-pan	Wood	Other
Upper Missouri 10030102										
Lake Creek* 6/24/2003					16	32	51			1
Shonkin Creek 5/22/2003		25	46	2		7	17		2	
Smith 10030103										
Hound Creek* 8/8/2003			20	36	23	14	8			
Ming Coulee 6/24/2003							97		1	2
Smith River Site 1* 8/7/2003		2	36	52	8	2				
Smith River Site 2* 8/13/2003				1		97	1		1	
Sun 10030104										
Unnamed Trib to Muddy Creek 8/21/2003				95	4	1	1			
Belt 10030105										
Belt Creek* 7/30/2003		42	52	4		2	1			
Marias 10030203										
Chip Creek* 8/6/2003		1		17	6	32	5			39
Teton 10030205										
Teton River* 8/15/2003			4	19	24	43	10			
Bullwhacker/Dog 10040103										
Cutbank Creek 5/20/03	12	6	14	39	14		14		1	
Taffy Creek 5/20/03							100			

Table 5 – continued.

Water Date	Substrate Types (%)									
	Bedrock	Boulder	Cobble	Course Gravel	Fine Gravel	Sand	Fines	Hard-pan	Wood	Other
Arrow 10040102										
Arrow Creek Site 1* 6/19/2003		3	19	18	6	5	48		1	
Arrow Creek Site 2* 6/19/2003			17	19	26	14	35		2	
Coffee Creek* 5/19/2003		3	11	19	14	2	49		2	
Flat Creek 6/4/2003		1		1	8	22	61		3	2
Judith 10040103										
Judith River* 8/28/2003	32	14	34	19						
Pacer Coulee 5/19/2003			1	25			68			3
Upper Musselshell 10040201										
Blake Creek* 6/17/2003			4	10	12	10	60		4	1
Daisy Dean Creek* 6/11/2003		1	8	28	17	8	35		2	
Little Elk Creek* 6/12/2003			46	30	4	5	9		7	
Flatwillow 10040203										
Pike Creek* 8/19/2003					9		68			23
Box Elder 10040204										
McDonald Creek* 8/12/2003			6	2	7	15	46		5	6
North Fork McDonald Creek* 7/24/2003		1	5	1	3	28	56		2	5
South Fork McDonald Creek* 7/25/2003		3	28	23	15	11	10	2	4	1
Lower Musselshell 10040204										
Musselshell River* 8/22/2003							99		1	
Sacagawea River* 7/2/2003			6	10	14		70			
Upper Milk 10050002										
Breed Creek* 7/31/2003			37	28	8	10	14		1	

*Streams with fish

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Appendix A. Name and location of Prairie Stream sample sites in Region 4 by HUC.

Sample Site	Site #	Latitude	Longitude	Township Range Section #	County	BLM Map
			Upper Missouri Dearborn 10030102			
Flat Creek	48	47.251515	111.487165	T17N R2E S4	Cascade	Great Falls South
Lake Creek	2	47.71264	111.5495	T23N R1E S25	Choteau	Great Falls North
Ninemile Coulee	3	47.622708	110.759284	T22N R8E S31	Chouteau	Fort Benton
Shonkin Creek	81	47.59077	110.55554	T21N R9E S10	Chouteau	Fort Benton
Spring Coulee	4	47.696922	110.654797	T22N R8E S1	Chouteau	Fort Benton
			Smith 10030103			
Boston Coulee	50	47.260414	111.402770	T17N R3E S6	Cascade	Great Falls South
Goodman Coulee	51	47.321310	111.408862	T18N R3E S7	Cascade	Great Falls South
Hound Creek	93	47.215260	111.393420	T17N R3E S19	Cascade	Great Falls South
Ming Coulee	49	47.271570	111.276460	T18N R4E S31	Cascade	Great Falls South
Smith River Site 1	91	47.261590	111.420650	T17N R2E S1	Cascade	Great Falls South
Smith River Site 2	92	47.393660	111.449550	T19N R2E S14	Cascade	Great Falls South
Spanish Coulee	52	47.251894	111.447553	T17N R2E S2	Cascade	Great Falls South
			Sun 10030104			
Unnamed Trib To Muddy Creek	55a	47.74052	111.80545	T23N R2W S24	Teton	Great Falls North
Belt Creek 10030105						
Belt Creek	90	47.582150	111.030190	T21N R5E S13	Cascade	Great Falls North
Red Coulee	57	47.438436	110.951769	T19N R6E S3	Cascade	Belt
			Marias 10030203			
Chip Creek	5	47.942690	110.640590	T25N R8E S12	Chouteau	Fort Benton
Corral Creek	6	48.781629	111.144765	T35N R4E S24	Liberty	Sweet Grass Hills
Dry Fork Coulee	8	47.907276	110.767032	T25N R7E S24	Chouteau	Fort Benton
Horse Creek	9	48.674582	111.128052	T34N R5E S30	Liberty	Sweet Grass Hills
Rocky Springs Coulee	11	48.698870	112.008677	T34N R3W S16	Toole	Sweet Grass Hills/ Cutbank
			Willow HUC 10030204			
Black Coulee	14	48.708283	111.565737	T34N R1E S14	Toole	Sweet Grass Hills
Kinyon Coulee	15	48.545545	111.351746	T32N R3E S9	Toole	Sweet Grass Hills
W.F. Willow Creek	17	48.552830	111.615034	T32N R1E S4	Toole	Sweet Grass Hills
			Teton 10030205			
Dry Fork Coulee	18	47.968029	110.907909	T26N R6E S36	Chouteau	Fort Benton
Teton River	94	47.911060	111.327980	T25N R3E S22	Teton	Great Falls North
Unnamed Trib To Teton River	20a	47.931082	111.230814	T25N R4E S9	Chouteau	Great Falls North
Weatherwax Coulee	21	47.842333	110.967684	T24N R6E S16	Chouteau	Fort Benton
			Bullwacker/Dog 10040103			
Cutbank Creek	23	47.633470	109.347370	T22N R18E S36	Fergus	Winifred
Taffy Creek	26	47.65017	109.22418	T22N R19E S25	Fergus	Winifred
			Arrow 10040102			
Arrow Creek Site 1	83	47.625640	109.835620	T21N R15E S5	Fergus	Winifred
Arrow Creek Site 2	84	47.406590	110.198620	T19N R12E S16	Fergus	Belt
Coffee Creek	67	47.438740	109.906770	T19N R14E S2	Fergus	Lewistown
Flat Creek	66	47.68292	110.03671	T22N R13E S11	Chouteau	Fort Benton

Appendix A - continued.

Sample Site	Site #	Latitude	Longitude	Township Range Section #	County	BLM Map
Arrow 10040103 continued						
Unnamed Trib To Flat Creek	71	47.716034	110.151476	T23N R12E S26	Chouteau	Fort Benton
Mud Spring Coulee	70	47.690323	110.326690	T22N R11E S4	Chouteau	Fort Benton
Judith 10040103						
Box Elder Creek	75	47.411014	109.546432	T19N R17E S15	Fergus	Lewistown
Judith River	96	47.354180	109.700850	T18N R16E S4	Fergus	Lewistown
Pacer Coulee	76	47.274860	109.884680	T18N R14E S36	Fergus	Lewistown
Fort Peck Reservoir 10040104						
Woodhawk Creek	27	47.740974	108.956958	T23N R21E S21	Fergus	Winifred
Upper Musselshell 10040201						
Blake Creek	77	46.696320	109.569760	T11N R17E S22	Fergus	Big Snowy Mountains
Daisy Dean	28	46.59994	110.33085	T10N R11E S27	Meagher	White Sulpher Springs
Little Elk Creek	82	46.37179	110.31329	T7N R11E S14	Meagher	Ringling
Middle Musselshell 10040202						
Mud Springs Creek	31	46.80285	108.08377	T12N R29E S16	Petroleum	Musselshell
Flatwillow Creek 10040203						
Pike Creek	32	46.840130	108.520630	T13N R25E S35	Petroleum	Musselshell
Yellow Water Creek	34	46.908507	108.512537	T13N R25E S11	Petroleum	Musselshell
Box Elder 10040204						
Bear Creek	35	47.290982	108.811639	T18N R23E S29	Fergus	Winnett
Bear Creek (Gulch)	89	46.965500	109.042900	T14N R21E S22	Fergus	Big Snowy Mountains
Chippewa Creek	37	47.144505	109.227523	T16N R20E S17	Fergus	Lewistown
McDonald Creek	88	47.03115	108.59293	T15N R25E S30	Petroleum	Winnett
N.F McDonald Creek	86	47.05956	109.2039	T15N R20E S16	Fergus	Lewistown
S.F McDonald Creek	87	46.98966	108.92281	T14N R22E S10	Fergus	Musselshell
Lower Musselshell 10040205						
Cat Creek	39	47.034140	107.946340	T15N R30E S29	Petroleum	Sand Springs
Cottonwood Creek	40	47.137591	108.511853	T16N R29E S21	Petroleum	Winnett
Drag Creek	41	47.407805	108.196323	T19N R28E S18	Petroleum	Winnett
Musselshell River	95	47.35991	107.95792	T19N R29E S36	Petroleum	Sand Springs
Musselshell River		Various			Petroleum	Sand Springs
Sacagewea River	85	47.46426	108.23535	T20N R27E S26	Petroleum	Winnett
Upper Milk 10050002						
Bear Gulch	42	48.929110	111.172480	T37N R4E S26	Liberty	Sweet Grass Hills
Breed Creek	43	48.888600	111.249690	T36N R4E S8	Liberty	Sweet Grass Hills
Big Sandy 10050005						
Twelvemile Coulee	44	48.269965	110.272048	T29N R11E S14	Chouteau	Lonesome Lake
Sage Creek 10050006						
Fourmile Coulee	45	48.753513	110.900536	T35N R6E S36	Liberty	Chester
Laird Creek	46	48.944057	110.990405	T37N R8E S19	Liberty	Sweet Grass Hills/ Chester

Appendix B

Procedure to determine Eastern Montana Prairie streams to sample.
Steve Carson, FWP Information Services Unit, 11-19-01.

Goal: Select 160 eastern Montana streams by HUC that have not been sampled before and fall within the Northern Plains area ecoregion.

Data Layers used:
Bailey's Ecoregions layer-Great Plains polygon, too gross a scale for analysis
Climax vegetation layer-from Natural resources Information System (NRIS), represents the same Great Plains Prairie area as Bailey's but at a finer scale.
100,000K stream routes-MFWP-built on the National Hydrography from the named streams
4th code hucs- from Natural resources Information System (NRIS)
Montana Rivers Information System (MRIS) database-for determining sampled streams

Steps:
Intersected the Prairie area (climax veg layer) with the 4th code HUCs to find hucs that fell within the prairie. Dropped those HUCs that are less than 50% Prairie. *(In region 4, streams in prairie regions of some HUCs that were less than 50% prairie were randomly selected at the request of Region 4 fisheries personnel).*
Determined the number of streams to sample in each HUC by dividing the amount of prairie in each HUC by the total amount of Prairie in Eastern Montana and then multiplying by 160(the total number of streams to be sampled).
Generated a list of streams that are sampled within the HUC's in step 1.
Intersected the remainder of streams (the unsurveyed with the Prairie Area) to remove streams that were in a HUC but not in an area of Prairie.
Sorted these unsurveyed streams by HUC and descending by length.
Selected the number of streams to sample for each HUC(from step2) starting with the longest streams. The alternatives were selected by taking the next consecutive streams in the list (approximately twice the number of sample streams). Length was chosen as the criteria as the perennial-intermittent stream category was not useable.
A random river mile was derived from each selected stream. A Lat-long was determined for each point and whether that point fell within public land.

The Numbers:

52 HUC's determined to fall within the Prairie ecoregion.
4207 unsurveyed streams in these 52 HUC's.
367 streams surveyed in these 52 HUC's

<u>1-9 streams selected to sample in each HUC – state wide.</u>
160 samples, 264 alternates, total of 424 streams selected
84% if the streams have some public access along them
21% of the selected sample points fall in public land

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.
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. To avoid spooking fish, walk along the bank, not in the stream. 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.
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.
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 out of the seine, and keeping the seine's lead line up against the bank.

In riffles, with moderate to fast current, the "kick seine" technique can be used. 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.

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.

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:
Left Bank-5 cm from the left bank;
Left Center-halfway between the Center and the Left Bank;
Center-center of the wetted stream;
Right Center-halfway between the Center and the Right Bank;
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), hip boots are usually too low
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

Appendix D. Habitat sampling sheet used in 2003.

Site: Date: water flowing

Lat/Long: Observers: continuous standing water

interrupted standing pools

Transect Cross Section

Transect	Width (XX.X m)	Left Bank depth, sub	Left Center depth, sub	Center depth, sub	Right Center depth, sub	Right Bank depth, sub
A						
B						
C						
D						
E						
F						
G						
H						
I						
J						
K						

BR = Bedrock (> 4000 mm) (larger than a car)
BL = Boulder (250 to 4000 mm) (basketball to car)
CB = Cobble (64 to 254 mm) (tennis ball to basketball)
CG = Coarse Gravel (16 to 64 mm) (marble to tennis ball)
FG = Fine Gravel (2 to 16 mm) (ladybug to marble)
SA = Sand (0.06 to 2 mm) (gritty - up to ladybug size)
FN = Silt/Clay/Muck (not gritty)
HP = Hardpan (FIRM, CONSOLIDATED, Fine Substrate)
WD = Wood (any size)
OT = Other (describe in comments)

Thalweg Profile

Station	A - B depth, sub	B - C depth, sub	C - D depth, sub	D - E depth, sub	E - F depth, sub	F - G depth, sub	G - H depth, sub	I - J depth, sub	J - K depth, sub
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

Comments/Observations:

Appendix E: Fish data sampling sheet used in 2003.

Site:	Date:	water flowing?	
Page _____ of _____	Observers:	continuous standing water?	
Lat/Long:		interrupted standing pools?	

Species		Total lengths (mm)					
	total count						max length
							min length
	total count						max length
							min length
	total count						max length
							min length
	total count						max length
							min length
	total count						max length
							min length
	total count						max length
							min length

Appendix F. Amphibian and reptile observations from Region 4 prairie fish sampling sites in 2003. Does not include observations while driving to the sites.

HUC	COUNTY	SITE	LAT	LONG	TRS	DATE	SPECIES	N
10030102 UPPER MISSOURI DEARBORN	TETON	LAKE CREEK	47.712640	111.549500		8/21/2003	WESTERN CHORUS FROG	6
	CHOUTEAU	SHONKIN CREEK	47.590770	110.555540	T21NR9ES1	5/22/2003	GOPHER SNAKE	4
	CHOUTEAU	SHONKIN CREEK	47.590770	110.555540	T21NR9ES1	5/22/2003	RACER	2
	CHOUTEAU	SHONKIN CREEK	47.591000	110.555160	T21NR9ES1	5/22/2003	WESTERN TERRESTRIAL GARTER SNAKE	1
10030103 SMITH	CASCADE	MING COULEE			T18NR4ES31	6/24/2003	RACER	1
	CASCADE	SMITH RIVER site #2	47.393660	111.449550		8/13/2003	COMMON GARTER	1
10030105 BELT	CASCADE/ CHOUTEAU	BELT CREEK	47.582150	111.030190		7/30/2003	WESTERN TERRESTRIAL GARTER SNAKE	4
	CASCADE	RED COULEE			T19NR6ES3	8/14/2003	GOPHER SNAKE	1
10040101 BULLWACKER DOG	FERGUS	CUTBANK CREEK	47.633470	109.347370	T22NR18ES36	5/20/2003	WESTERN CHORUS FROG	1
10040102 ARROW	FERGUS/ CHOUTEAU	ARROW CREEK site #1	47.625640	109.835620	T21NR15ES5	6/19/2003	WOODHOUSE TOAD	1
	FERGUS	COFFEE CREEK	47.439350	109.905430	T19NR14ES1	5/19/2003	PLAINS GARTER SNAKE	1
	FERGUS	COFFEE CREEK	47.439350	109.905430	T19NR14ES1	5/19/2003	GOPHER SNAKE	1
	FERGUS	COFFEE CREEK	47.438740	109.906770	T19NR14ES1	6/17/2003	LEOPARD FROG	2
	FERGUS	COFFEE CREEK	47.438740	109.906770	T19NR14ES1	6/17/2003	GOPHER SNAKE	1
	CHOUTEAU	FLAT CREEK	47.68292	110.03671		6/4/2003	TIGER SALAMANDER	17
10040104 FORT PECK RESERVOIR	FERGUS	WOODHAWK CREEK	47.742440	108.949360		5/20/2003	RACER	1
	FERGUS	WOODHAWK CREEK	47.742440	108.949360		5/20/2003	PAINTED TURTLE	1
10040201 UPPER MUSSELSHELL	FERGUS	BLAKE CREEK	46.696320	109.569760		6/17/2003	GARTER SNAKE (SPP.)	1
	MEAGHER	DAISY DEAN CREEK	46.60098	110.3314		6/11/2003	WESTERN TERRESTRIAL GARTER SNAKE	1
	MEAGHER	LITTLE ELK CREEK	46.371790	110.313290		6/12/2003	SPOTTED FROG	1
10040203 FLATWILLOW	PETROLEUM	PIKE CREEK	46.840130	108.520630		8/19/2003	GARTER SNAKE (SPP.)	1
	PETROLEUM	PIKE CREEK	46.840130	108.520630		8/19/2003	LEOPARD FROG	6

Appendix F. Continued.

HUC	COUNTY	SITE	LAT	LONG	TRS	DATE	SPECIS	N
10040204 BOX ELDER	**FERGUS**	**BEAR CREEK (GULCH)**	**46.965500**	**109.042900**	**T14NR21ES22**	7/24/2003	GOPHER SNAKE	1
	PETROLEUM	**MCDONALD CREEK**	**47.031150**	**108.592930**	**T15NR25ES30**	8/12/2003	TIGER SALAMANDER	1
	PETROLEUM	**MCDONALD CREEK**	**47.031150**	**108.592930**	**T15NR25ES30**	8/12/2003	GARTER SNAKE (SPP.)	2
	PETROLEUM	**MCDONALD CREEK**	**47.031150**	**108.592930**	**T15NR25ES30**	8/12/2003	RACER	1
	PETROLEUM	**MCDONALD CREEK**	**47.031150**	**108.592930**	**T15NR25ES30**	8/12/2003	GOPHER SNAKE	1
	PETROLEUM	**MCDONALD CREEK**	**47.031150**	**108.592930**	**T15NR25ES30**	8/12/2003	LEOPARD FROG	29
	FERGUS	**N.F. MCDONALD CREEK**	**47.059560**	**109.203900**		7/24/2003	LEOPARD FROG	13
	FERGUS	**S.F. MCDONALD CREEK**	**46.989660**	**108.922810**		7/25/2003	LEOPARD FROG	2
10040205 LOWER MUSSELSHELL	**PETROLEUM**	**DRAG CREEK**			**T19NR28ES18**	6/16/2003	GARTER SNAKE (SPP.)	2
	PETROLEUM	**DRAG CREEK**			**T19NR28ES18**	6/16/2003	TIGER SALAMANDER	17
	PETROLEUM	**DRAG CREEK**			**T19NR28ES18**	6/16/2003	UNKNOWN TADPOLES	17
	PETROLEUM	**MUSSELSHELL RIVER**	**47.35081**	**107.96251**		7/8/2003	LEOPARD FROG	1
	PETROLEUM	**MUSSELSHELL RIVER**	**47.35044**	**107.96230**		7/15/2003	SPINY SOFTSHELL	3
	PETROLEUM	**SACAGEWEA RIVER**			**T20NR27ES26**	7/1/2003	PLAINS SPADEFOOT (TADPOLES)	8
	PETROLEUM	**SACAGEWEA RIVER**			**T20NR27ES26**	7/2/2003	TIGER SALAMANDER	3
	PETROLEUM	**SACAGEWEA RIVER**			**T20NR27ES26**	7/2/2003	LEOPARD FROG	5