MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS
FISHERIES DIVISION

JOB PROGRESS REPORT

STATE: MONTANA **PROJECT TITLE: Statewide Fisheries Investigations**

PROJECT: F-78-R-5 **STUDY TITLE: Survey and Inventory of Warmwater Streams**

JOB NO: III-B **JOB TITLE: Southeast Montana Warmwater Streams Investigations**

PROJECT PERIOD: July 1, 1998 through June 30, 2005

ABSTRACT

The Yellowstone River fish assemblage was sampled each autumn with boat-mounted electrofishing equipment. Sampling occurred in the following four 1 to 5 mile-long trend areas: Forsyth (below Cartersville Diversion), Miles City (above and below the Tongue River confluence), Fallon (above and below the O' Fallon Creek confluence), and Intake (below Intake Diversion). All species encountered were collected, enumerated, measured, and, excepting cyprinids, weighed. An index of abundance (catch per effort) was calculated for all species captured. Catch per effort was also calculated by trend section for sauger, channel catfish, and smallmouth bass. Indices of population structure (incremental relative stock density) and condition (relative weight) were calculated for sauger, channel catfish, smallmouth bass, shovelnose sturgeon, burbot, and walleye. Environmental conditions varied widely during the study period; average flows occurred during 1998 and 1999 and extreme drought conditions and low flows occurred during 2000 to 2004. The fish assemblage appeared to withstand current drought conditions surprisingly well. A total of 35 species were captured and abundances of commonly collected species from all trophic guilds remained stable. Catch rates of many species declined coinciding with the onset of drought conditions but subsequently rebounded. Average sauger abundances increased to historical levels, although catch rates are still low in trend areas upstream of Miles City where smallmouth bass replaced sauger as the most abundant top predator. Blue sucker abundances were stable during the study period. Excellent angling opportunities currently exist for sauger, channel catfish, smallmouth bass, and shovelnose sturgeon.

STUDY AREA

The study area consists of the 473 km of the Yellowstone River downstream of the confluence with the Big Horn River (Figure 1). Mean annual discharge at the USGS gauging station in Miles City, Montana, is 323 m^3/s and mean annual peak discharge is 1480 m^3/s (Figure 2). River geomorphology varies throughout the study area in direct response to valley geology; straight, sinuous, braided, and irregular-meander channel patterns occur (Silverman and Tomlinsen 1984). The channel is often braided or split and long side channels are common. Islands and bars range from large vegetated islands to unvegetated point and mid-channel bars (White and Bramblett 1993). Substrate is primarily gravel and cobble upstream of river kilometer 50 and is primarily fines and sand below (Bramblett and White 2001). The fish assemblage is comprised of 49 species from 15 families, including eight state-listed Species of Special Concern and one federally listed endangered species (White and Bramblett 1993; Carlson 2003). The primary deleterious anthropogenic effect on the fish assemblage is water withdrawal for agriculture and associated entrainment of fish (White and Bramblett 1993). About 90% of all water use on the Yellowstone River is for irrigation, which corresponds to annual use of 1.5 million acre-feet (White and Bramblett 1993). Six mainstem low-head irrigation diversions dams occur in the study area. The largest and downstream-most of these, Intake Diversion, diverts about 38 m^3/s and entrains about 600,000 fish of 34 species during the mid-May to mid-September irrigation season (Hiebert et al. 2000).

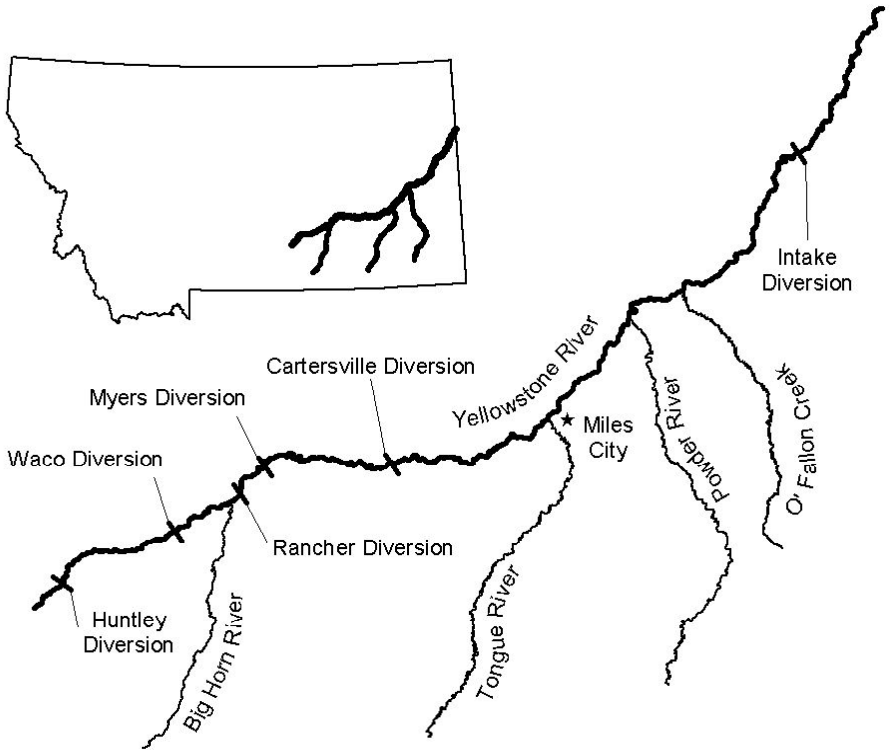

Figure 1. The Yellowstone River, its major tributaries, and diversion dams.

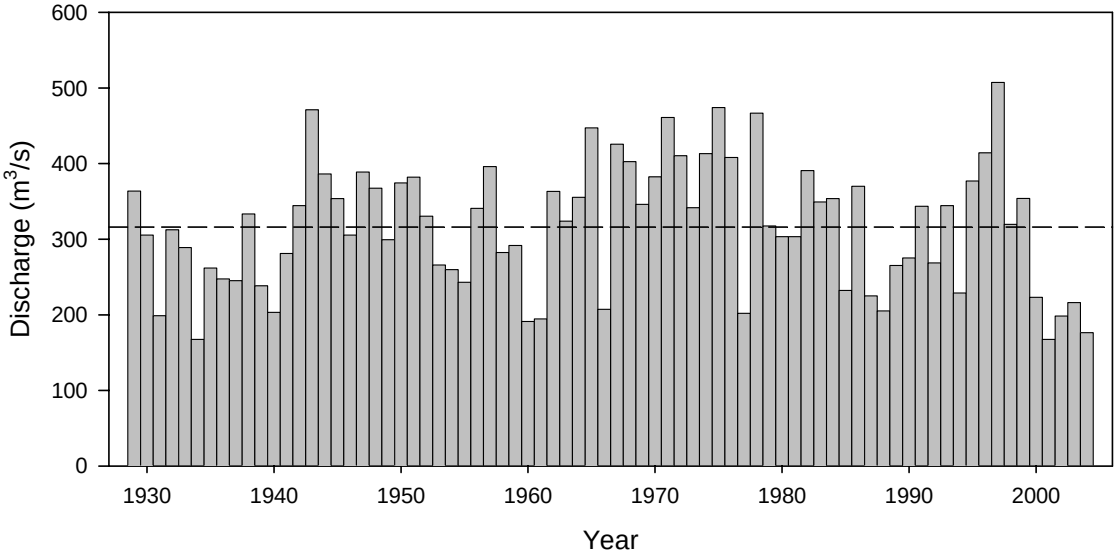

Figure 2. Mean annual discharge of the Yellowstone River at Miles City, 1929-2004. Dashed line represents overall mean annual discharge for the period of record.

METHODS

The Yellowstone River fish assemblage was sampled each autumn with boat-mounted electrofishing equipment. Sampling occurred in the following four 1 to 5 mile-long trend areas: Forsyth (below Cartersville Diversion), Miles City (above and below the Tongue River confluence), Fallon (above and below the O' Fallon Creek confluence), and Intake (below Intake Diversion). In 2003 and 2004 a fifth trend area downstream of Rancher Diversion was sampled. All species encountered were collected, enumerated, measured (fork length for sturgeon and total length for all other species), and, excepting some cyprinids, weighed.

An index of abundance (catch per effort) was calculated for all species captured. Catch per effort was also calculated by trend section for sauger, channel catfish, and smallmouth bass. Indices of population structure (incremental relative stock density) and condition (relative weight) were calculated for sauger, channel catfish, smallmouth bass, shovelnose sturgeon, burbot, and walleye (Anderson and Neuman 1996). Population structure and condition for these species were described using 1.) only data from autumn trend sampling (autumn trend data) and 2.) all data collected during a given year (all data). Autumn trend data are less biased and provide the best insight into variation in population structure and condition among years because of consistent timing, location, and methodology. However, low catch rates of some species during autumn trend surveys preclude making inferences. In these instances inclusion of all data was helpful.

RESULTS AND DISCUSSION

A total of 35 species were captured. Catch by section is summarized in Appendix 1. Conditions varied widely during the study period; average flows occurred in 1998 and

1999 and extreme drought conditions and low flows occurred during 2000 to 2004 (Figure 2). The fish assemblage appeared to withstand current drought conditions surprisingly well. Abundances of commonly collected species from all trophic guilds remained stable or increased. Catch rates of some species declined coinciding with onset of drought conditions but subsequently rebounded. Population structure and size-specific condition of sauger, channel catfish, smallmouth bass, and shovelnose sturgeon were consistent among years. Nonetheless, it is possible a lag period exists before the effects of drought conditions manifest themselves. Inferences should be made cautiously because of low catch rates for many species and the possibility of variation in sampling efficiency between average and low flow years.

Sauger

Sauger were the most commonly observed game fish and catch rates averaged over 8 fish per hour from 1998 to 2004 (Figure 3). Catch rates averaged about 12 fish per hour in the 1970s and 1980s but declined to about 2 fish per hour from 1990 to 1997, leading to the listing of sauger as a Species of Special Concern in Montana (McMahon and Gardner 2001). Catch rates have improved to near pre-decline levels. Catch rates of over 10 fish per hour were observed in two of the last seven years and the population is trending steadily upwards. Catch rates of about 10 fish per hour support a good sauger fishery (McMahon 1999). However, the high average catch rates observed were inflated by the trend area downstream of Intake Diversion; catch rates downstream of Intake Diversion were about 23 fish per hour compared to about 4 fish per hour in the other trend areas from 1998 to 2004 (Figure 4).

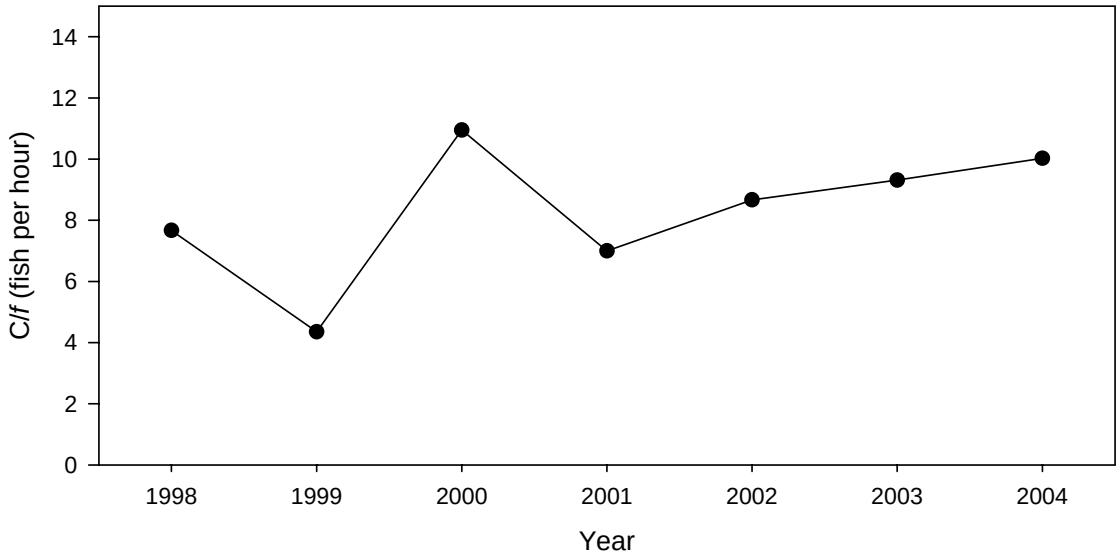

Figure 3. Catch per effort of sauger in the Yellowstone River, 1998 to 2004.

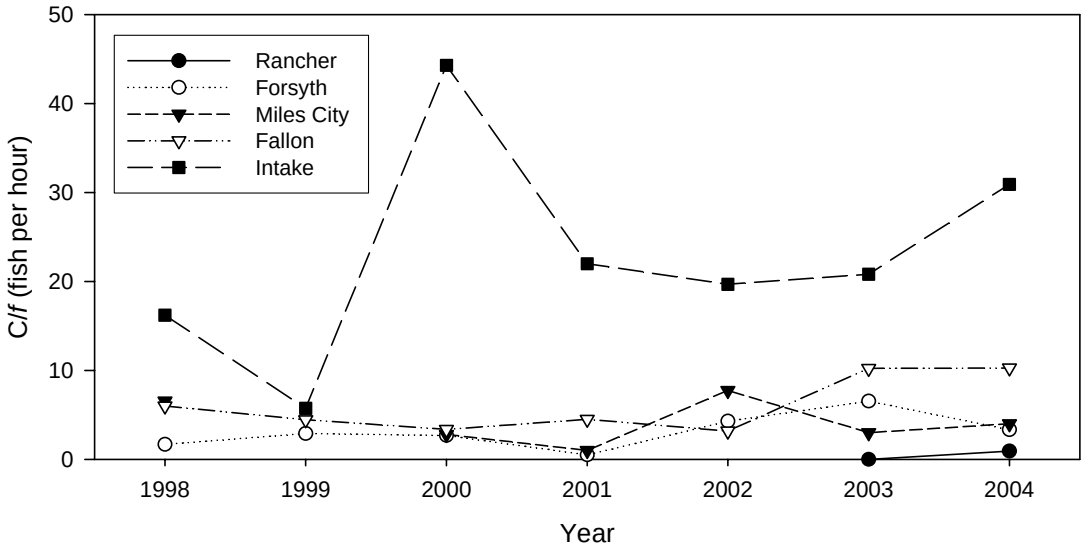

Figure 4. Catch per effort of sauger in the Yellowstone River by trend area, 1998 to 2004.

Population structure was balanced from 1998 to 2004 but skewed towards larger fish (Figure 5 A, C). Fall trend data suggest that the relatively low proportion of smaller size-classes may result from recruitment of strong year-classes from previous years (first appearing in 1999, 2001, 2002) into larger size-classes (Figure 5 A). It is also likely that this sampling regime is proportionally biased towards larger size-classes. Sauger length is positively correlated with Yellowstone River kilometer such that larger fish are found further upstream (Jaeger 2004) and most juvenile sauger likely rear downstream of Intake Diversion (Penkal 1992). Catch rates of sauger downstream of Intake Diversion averaged over 23 fish per hour and average length was stock to quality (265.05 mm). Proportionately low representation of smaller size-classes may simply result from proportionately low effort in rearing areas downstream of Intake Diversion. It is also possible that relatively low proportions of smaller size-classes result from consistently poor year-class strength or recruitment of juveniles to stock to quality size fish as suggested when all data for a given year are analyzed (Figure 5 C). However, most additional data were collected during early spring efforts to capture spawning sauger and are biased proportionally towards large fish. Because catch rates are high and increasing, size-specific weights are stable among years (Figure 5 B, D), about half of the sampled population is comprised of sexually mature individuals each year, and catch rates of young sauger downstream of Intake Division are consistent and high, the observed population structure is likely typical of this sampling regime and acceptable.

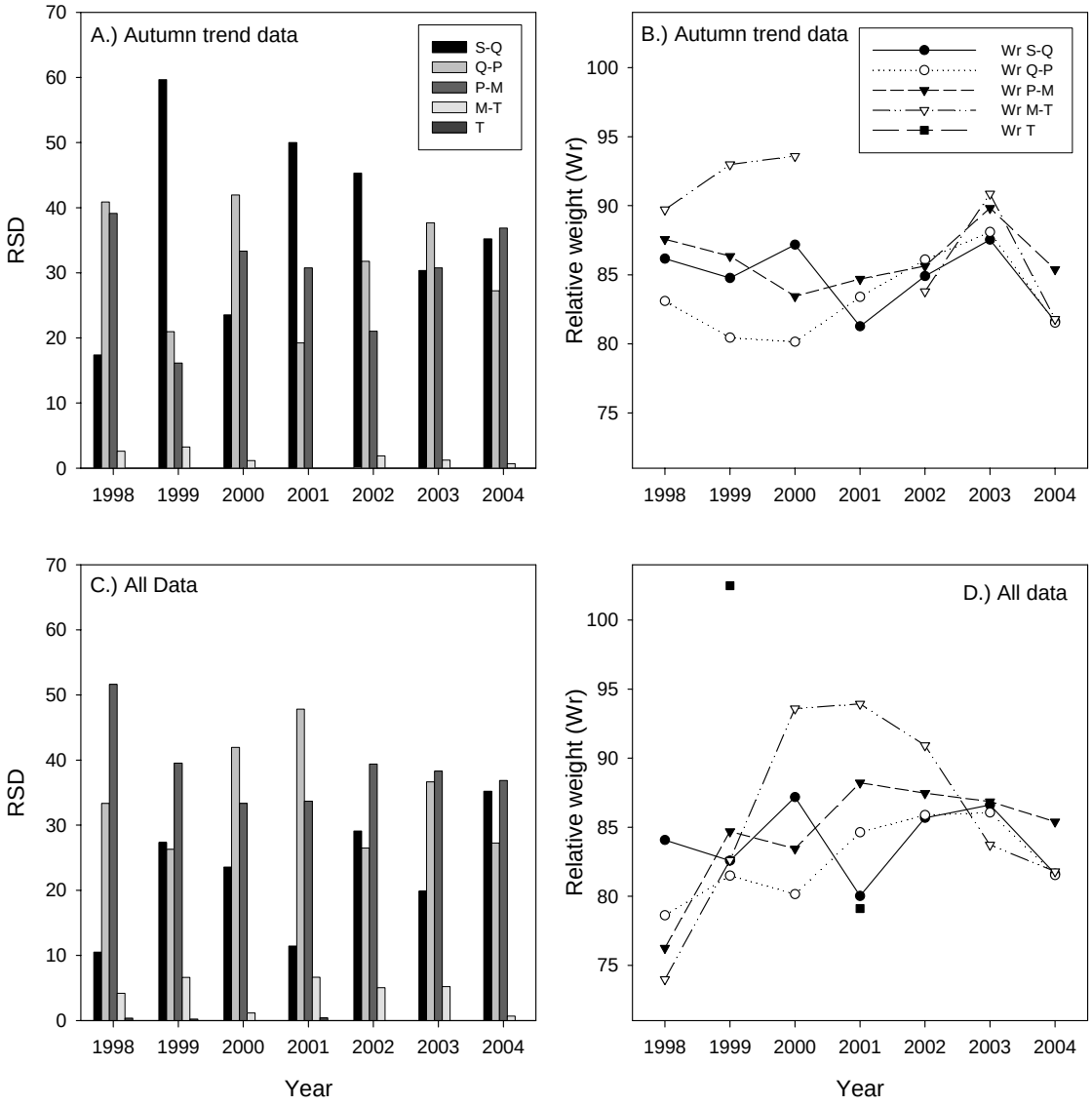

Figure 5. Incremental relative stock density (RSD) and relative weight (Wr) by length category of sauger captured in the Yellowstone River, 1998 to 2004.

Although this population should continue to be closely monitored, it appears abundances are rebounding to levels that provide a suitable recreational fishery. However, consistently low catch rates in the Forsyth and Miles City trend areas are cause for concern. It is possible that there is simply a lag in recovery in these upstream areas; increased catch rates in the Fallon trend area lagged behind increases observed downstream of Intake Diversion (Figure 4). Nonetheless, efforts should be made to boost abundances in the Miles City and Forsyth trend areas. Exploitation (18.6%) is unlikely to significantly affect this population during most years but is high enough that angler harvest should be monitored (Jaeger 2004). Because survival of adult fish is high (70.4%), increasing recruitment of juveniles to the adult population would further increase adult abundances barring compensatory responses (Jaeger 2004). The positive

effects of increased recruitment to the adult population can be observed by tracking the strong year-class first appearing in 2000 as it recruited into upstream trend areas (Figure 4). Increasing recruitment of juveniles to the adult population can be best achieved by eliminating entrainment in Intake Canal. About 67,000 sauger, most of which are juveniles, are entrained in Intake Canal each year (Hiebert et al. 2000). This corresponds to a loss of over 13,000 five-fish angler limits annually.

Expanding populations of nonnative smallmouth bass may adversely affect sauger abundances. Sauger abundances are significantly negatively correlated with smallmouth bass abundances ($P = 0.019$; Figure 6) and smallmouth bass have replaced sauger as the most common top predator in the Forsyth and Miles City trend areas (Figures 4 and 11). Although direct competition is thought to be unlikely because of dissimilar habitat preferences, anthropogenic alteration of natural sediment, discharge, and temperature regimes favor smallmouth bass over sauger. Smallmouth bass replaced sauger as the most common top predator in the Tongue and upper Missouri rivers following impoundment and resultant decrease in turbidity and alteration of natural hydrographs (McMahon and Gardner 2001). Loss of the natural hydrograph and warm, turbid prairie stream character of the Big Horn River combined with increasing prevalence of stream bank armoring of the Yellowstone River likely create conditions that favor smallmouth bass over sauger. Current drought conditions exacerbate these losses and observed increases in smallmouth bass abundances coincide with low flows. Future research should address competition between sauger and smallmouth bass.

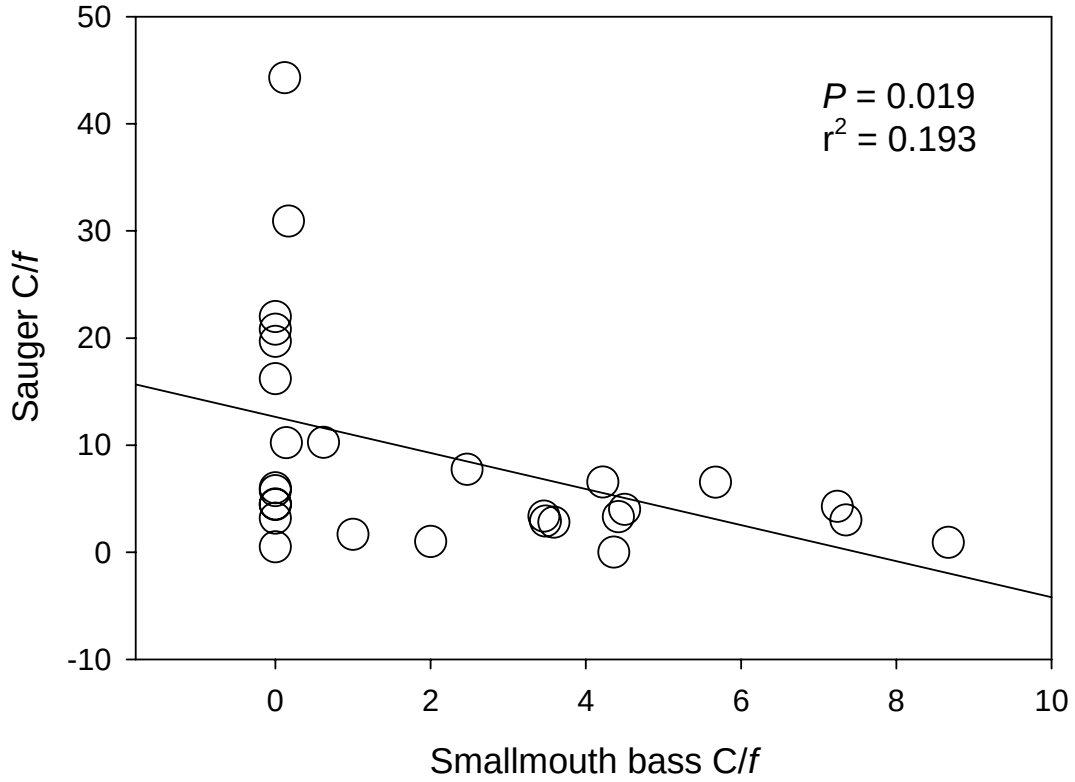

Figure 6. Relationship between sauger abundance and smallmouth bass abundance, Yellowstone River 1998 to 2004.

Channel catfish

Channel catfish were the second most commonly sampled game fish. Catch rates increased overall, but were lower from 2000 to 2002 (Figure 7). Declines coincided with the onset of drought conditions in 2000 but increases also occurred during periods of low flows. Catch rates were similar among trend areas and were consistently highest in the Rancher and Forsyth trend areas (Figure 8).

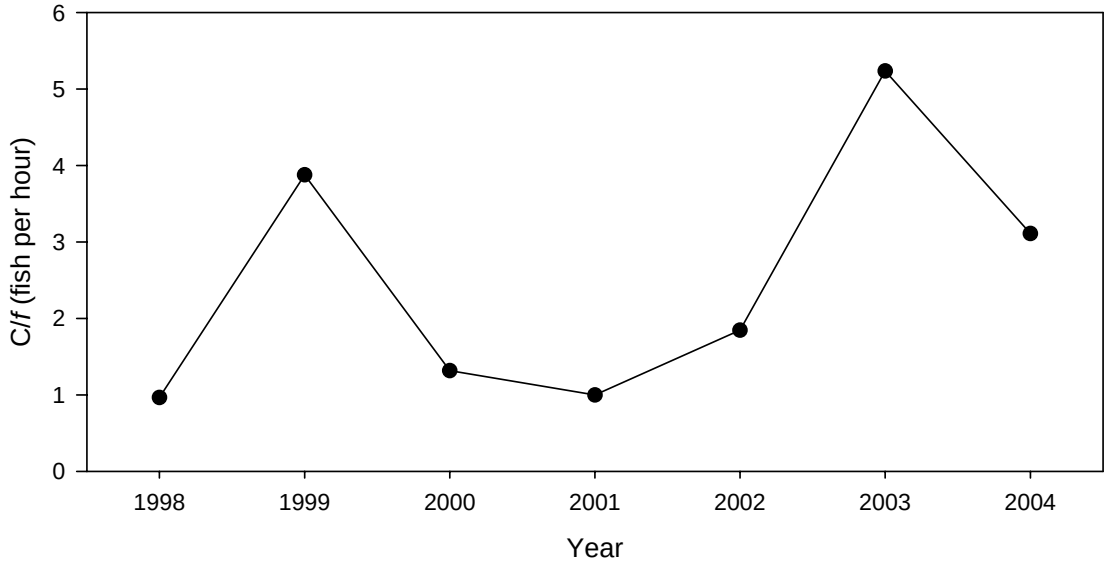

Figure 7. Catch per effort of channel catfish in the Yellowstone River, 1998 to 2004.

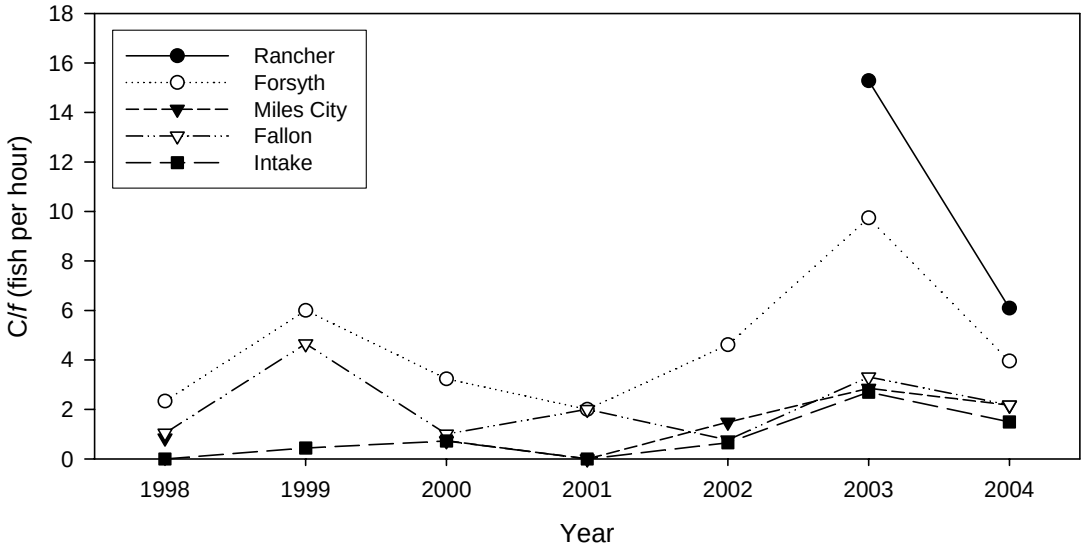

Figure 8. Catch per effort of channel catfish in the Yellowstone River by trend area, 1998 to 2004.

Condition of fish was relatively high during all years but mirrored trends in abundance and declined from 2000 to 2002 (Figure 9 B, D). Population structure was somewhat unbalanced but very stable from 1998 to 2004 (Figure 9 A, C). Low proportions of stock to quality size fish suggests that smaller size classes had not fully recruited to the sampling gear (i.e. larger fish are more susceptible to electrofishing) or rear in unsampled areas (i.e. deep pools, tributaries). Nonetheless, the stability of the observed population structure suggests that recruitment is not limiting. Fish were predominately quality to preferred size (410-610 mm) but about 25% were preferred to memorable (610-710 mm) and 5 to 10% were memorable to trophy size (710-910 mm).

Because of the relatively high abundances, large average size, and high length-specific weights of channel catfish, the Yellowstone River provides a unique and high quality fishery for this species, especially in upstream reaches.

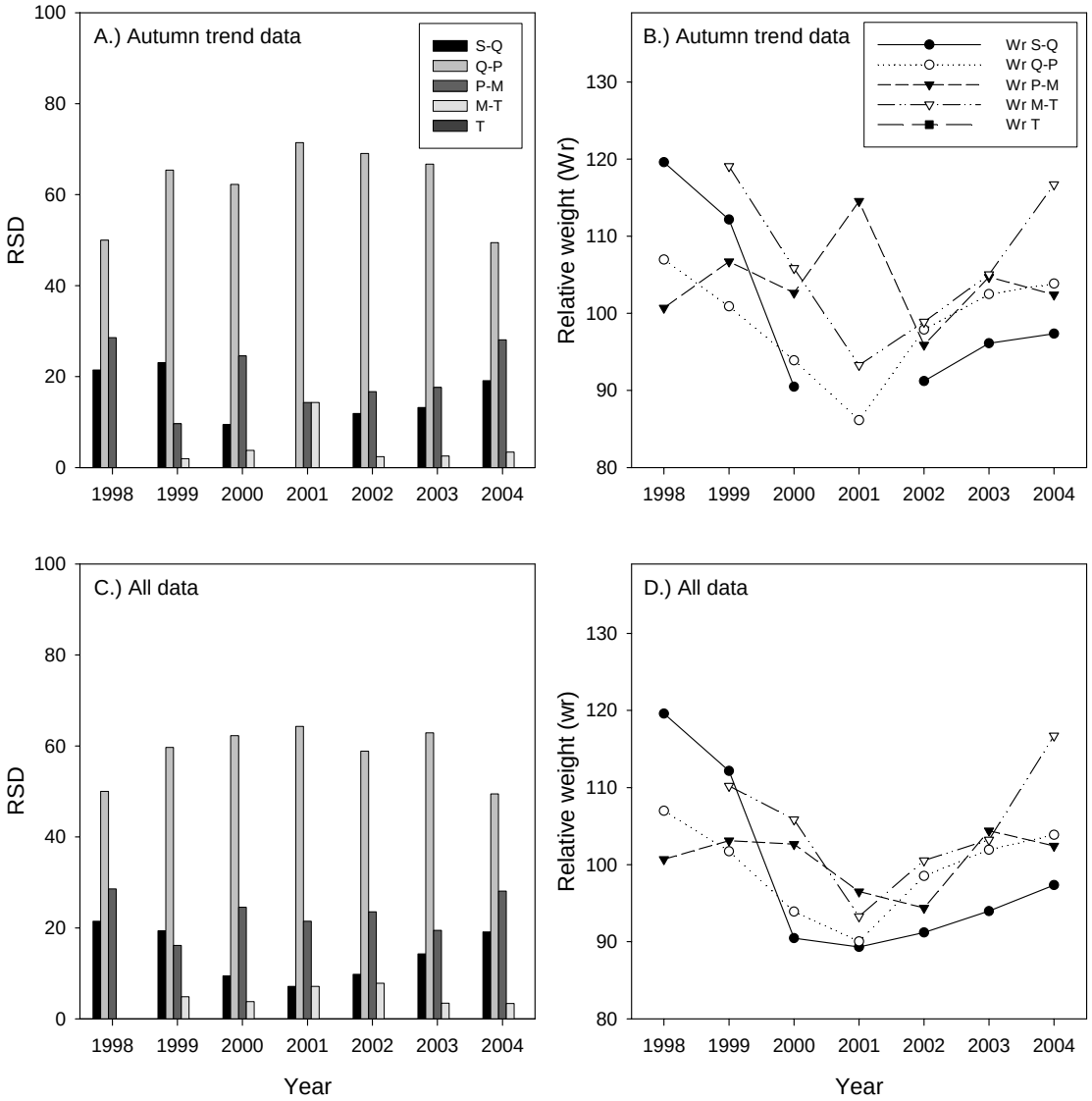

Figure 9. Incremental relative stock density (RSD) and relative weight (Wr) by length category of channel catfish captured in the Yellowstone River, 1998 to 2004.

Smallmouth bass

Smallmouth bass catch rates doubled from 1998 to 2004 and continue to trend upwards (Figure 10). Increases in abundance coincided with the onset of drought conditions that likely favor smallmouth bass. Smallmouth bass were the third most frequently encountered game species overall despite only being commonly observed in the trend sections upstream of Miles City (Figure 11). Smallmouth were the most abundant game species observed in the Forsyth and Miles City trend areas.

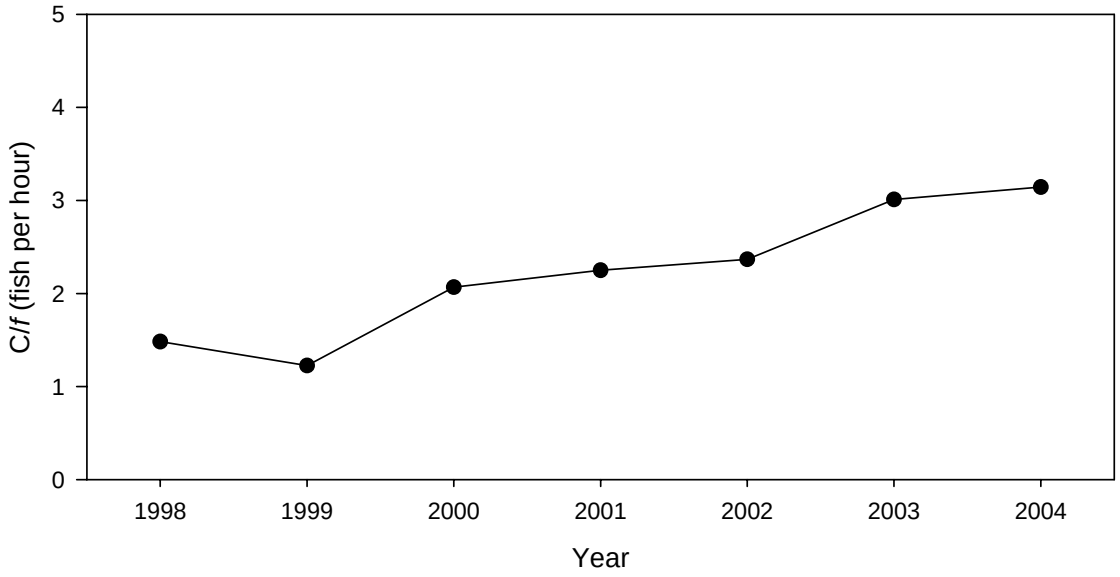

Figure 10. Catch per effort of smallmouth bass in the Yellowstone River, 1998 to 2004.

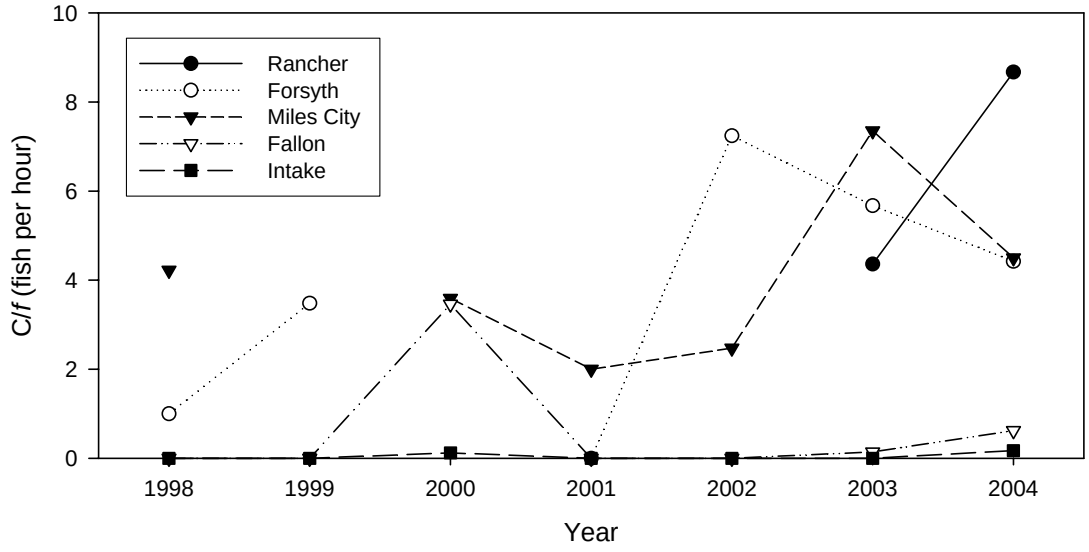

Figure 11. Catch per effort of smallmouth bass in the Yellowstone River by trend area, 1998 to 2004.

Population structure was very well balanced but appears to be skewing towards smaller size classes in recent years (Figure 12 A, C). Condition of smallmouth bass in the Yellowstone River was consistently high for all size-classes (Figure 12 B, D).

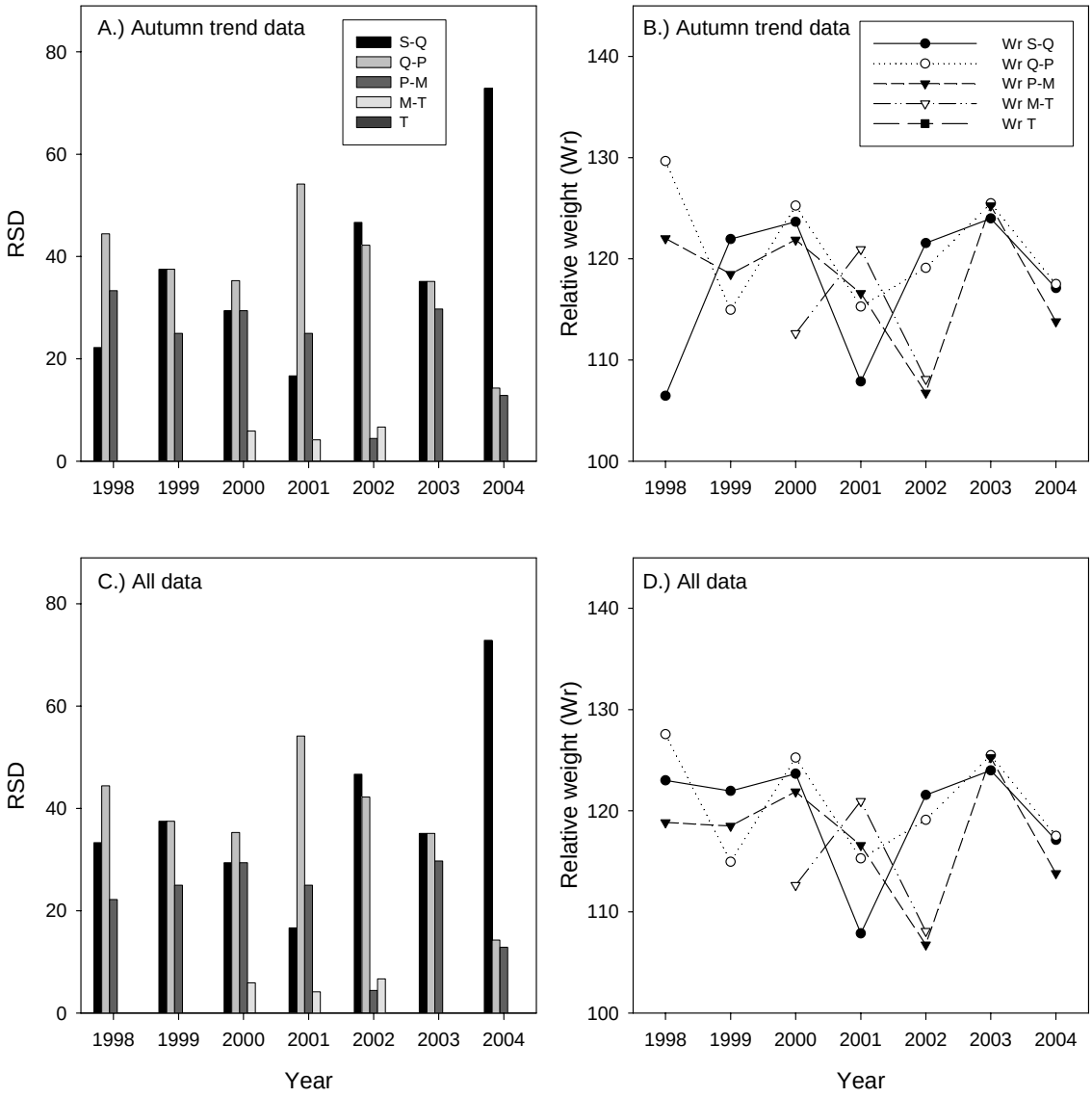

Figure 12. Incremental relative stock density (RSD) and relative weight (Wr) by length category of smallmouth bass captured in the Yellowstone River, 1998 to 2004.

Increasing abundances and considerable length-specific weight of smallmouth bass in the Yellowstone River provide an excellent angling opportunity upstream of Miles City. However, populations of native fishes, specifically sauger, should be closely monitored as nonnative smallmouth bass expand in range and abundance.

Shovelnose sturgeon

Shovelnose sturgeon abundances increased during the study period (Figure 13); however, limited inferences can be drawn from these data as electrofishing is likely a relatively inefficient sampling method for this species. Trend sampling using more efficient gears, such as drifting trammel nets (e.g. Backes and Gardner 1994), would allow more robust estimates of population trends. Nonetheless, current trend sampling and incidental netting efforts suggest that shovelnose sturgeon are abundant and widespread downstream of Cartersville Diversion.

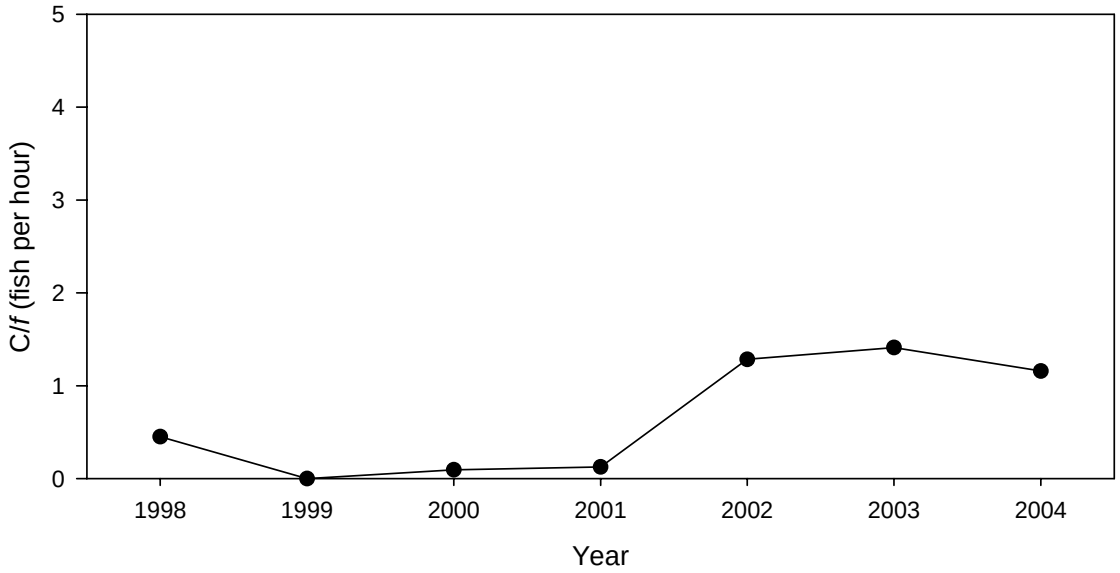

Figure 13. Catch per effort of shovelnose sturgeon in the Yellowstone River, 1998 to 2004.

Highly variable catch rates during trend sampling resulted in limited population structure and condition information (Figure 14 A, B). However, combining all available data for each year suggested that population structure is stable and balanced (Figure 14 C). Size-specific condition was stable among years and increased as fish length increased (Figure 14 D).

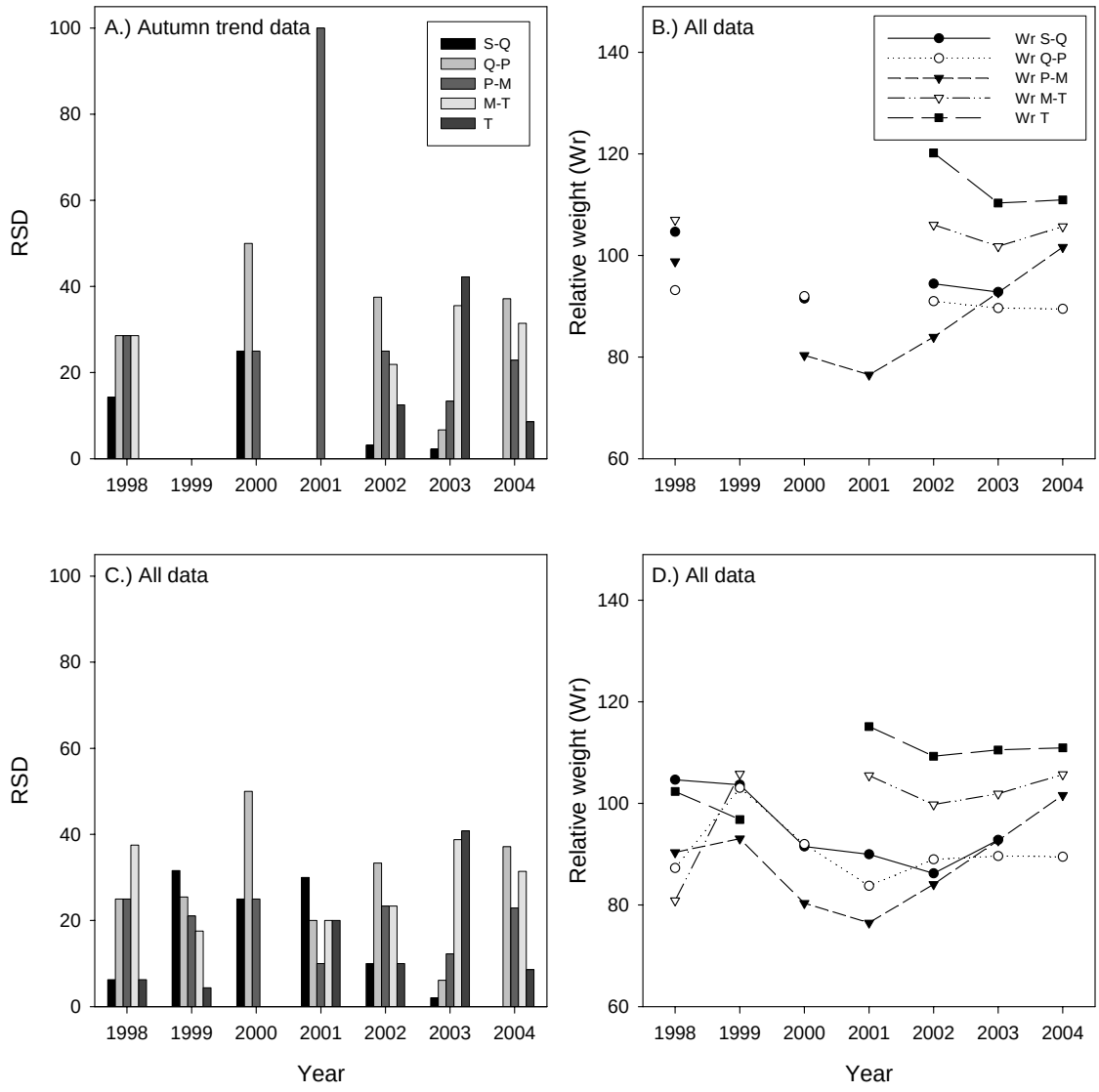

Figure 14. Incremental relative stock density (RSD) and relative weight (Wr) by length category of shovelnose sturgeon captured in the Yellowstone River, 1998 to 2004.

Burbot

Burbot catch rates were consistently low (Figure 15). Low catch rates were likely related to the timing and gear used for sampling; burbot are most effectively sampled with baited hoop nets in the early spring and late autumn (Jones-Wuellner and Guy 2004). Because electrofishing is a relatively inefficient method for capturing burbot these data can likely be used only to provide an indication of presence or absence.

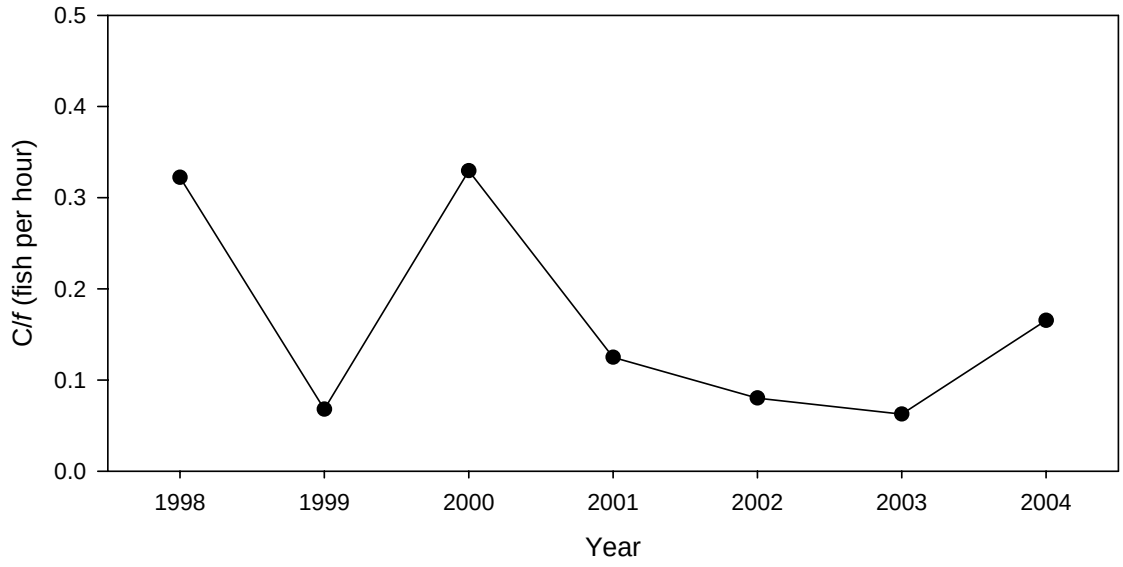

Figure 15. Catch per effort of burbot in the Yellowstone River, 1998 to 2004.

Low catch rates also limit inferences related to population structure and condition. Most captured burbot were relatively small and of poor condition (Figure 16). Although they were rarely captured, larger burbot consistently exhibited better weight-specific condition.

The Yellowstone River burbot population is likely relatively stable based on the limited information available. Different gear types and sampling times are likely necessary to obtain an adequately large sample size to characterize abundances, structure, and condition of this population. However, it is also possible that burbot are limited by the relatively high summer temperatures of the lower Yellowstone River (e.g. Nikcevic et al. 2000) and the low catch rates observed accurately reflect relatively low abundances.

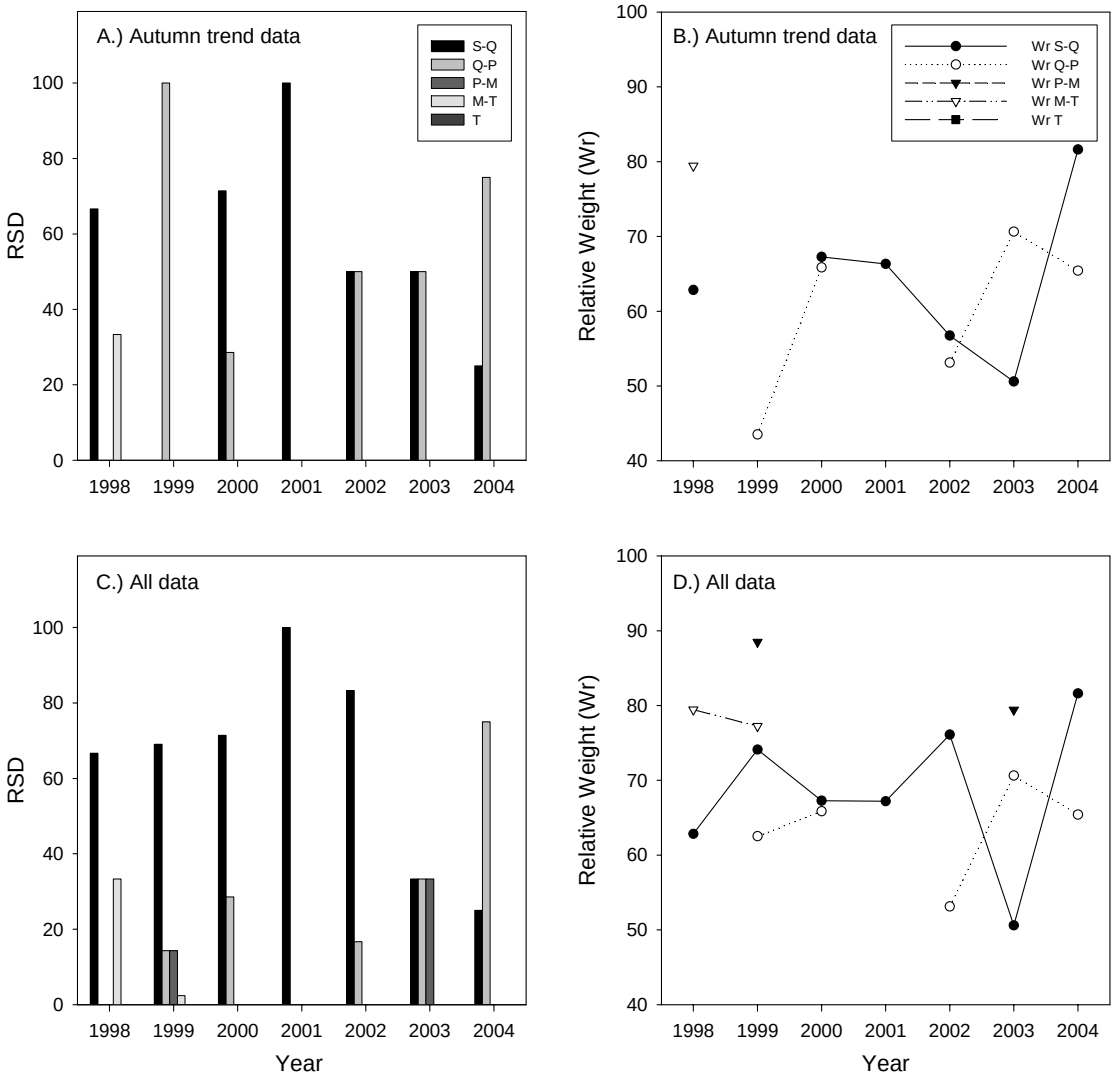

Figure 16. Incremental relative stock density (RSD) and relative weight (Wr) by length category of burbot captured in the Yellowstone River, 1998 to 2004.

Walleye

Catch rates of walleye were consistently low (Figure 17) and population structure was unbalanced and skewed towards smaller fish (Figure 18 A, C). Size-specific condition was slightly higher than that observed for sauger (Figure 18 B, D).

Most walleye in the Yellowstone River are thought to be part of an adfluvial population residing in Sakakawea Reservoir (Penkal 1992). Adults move into the Yellowstone from late autumn to early spring, spawn during April, and return to the reservoir (Penkal 1992). Although adult walleye are captured year-round in the Yellowstone River their autumn abundances remain low suggesting that they remain only seasonally abundant.

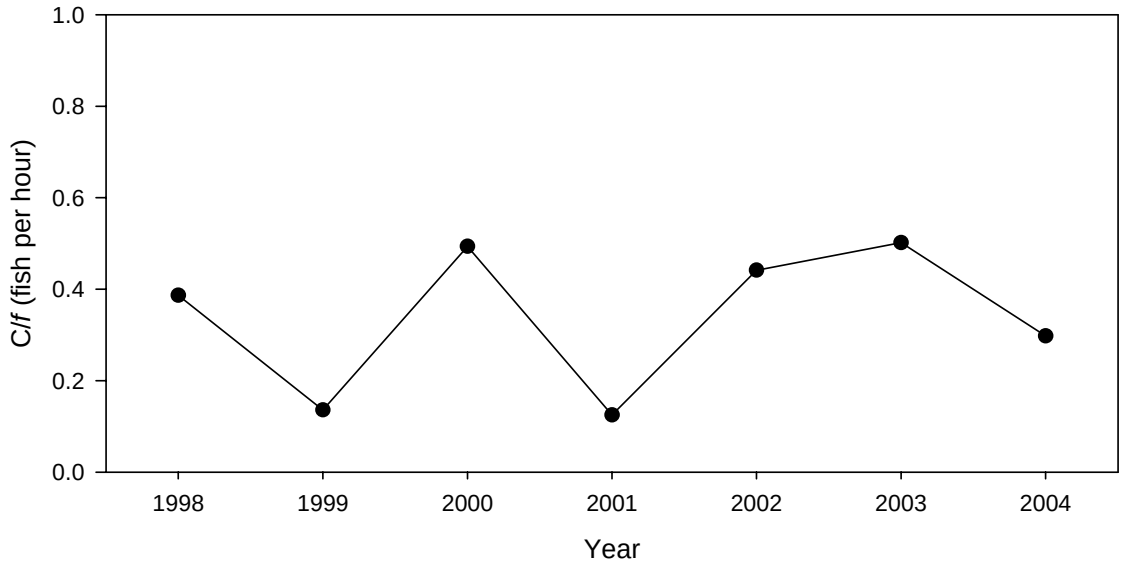

Figure 17. Catch per effort of walleye in the Yellowstone River, 1998 to 2004.

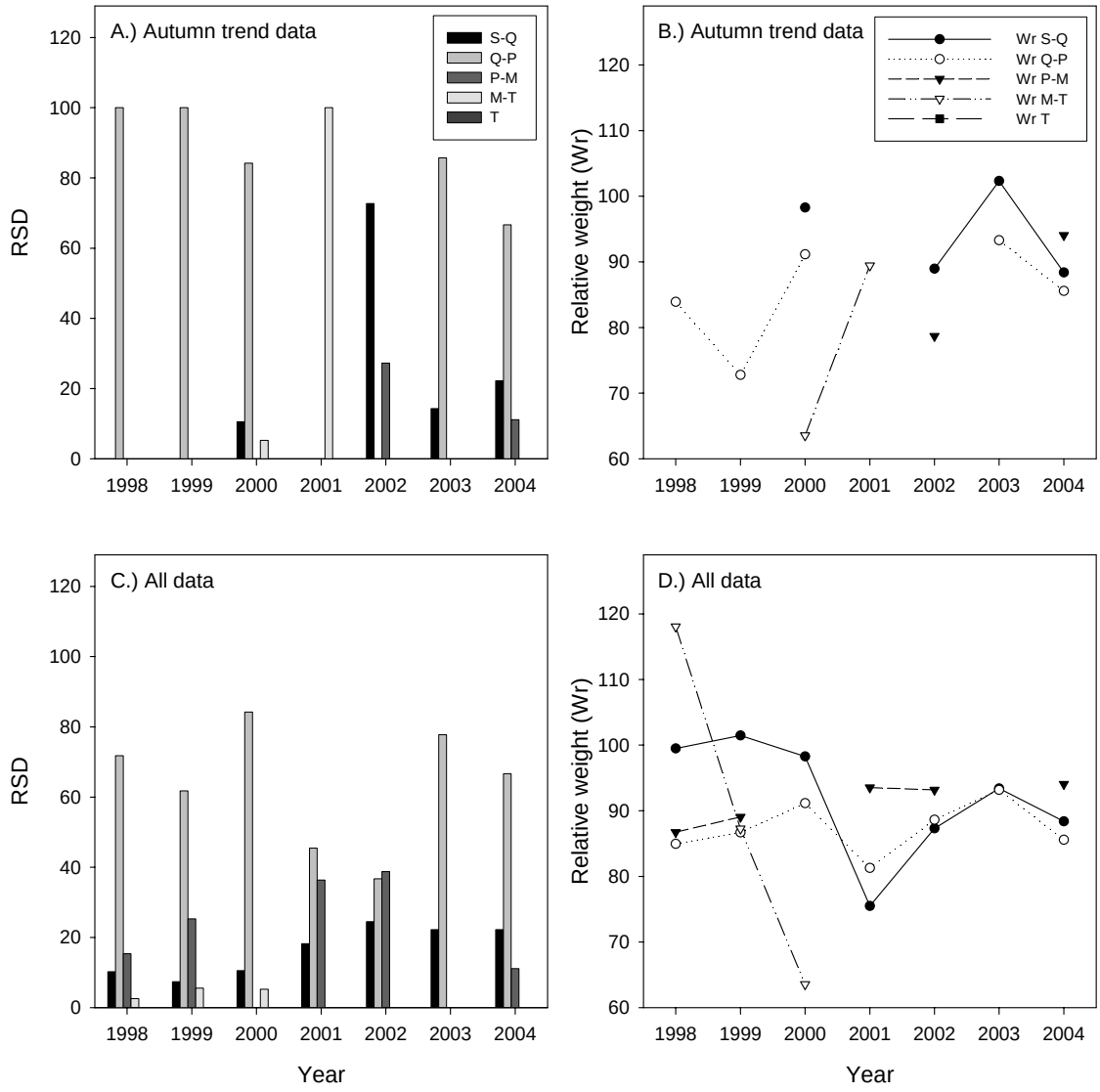

Figure 18. Incremental relative stock density (RSD) and relative weight (Wr) by length category of walleye captured in the Yellowstone River, 1998 to 2004.

Rare game fishes

Abundances of most rarely encountered game fish have decreased during the study period (Figure 19). Higher abundances may have resulted from uncommonly high flows during the 1990s and declines may be attributed to recent drought conditions. All of these fishes are nonnative and more commonly associated with lentic habitats

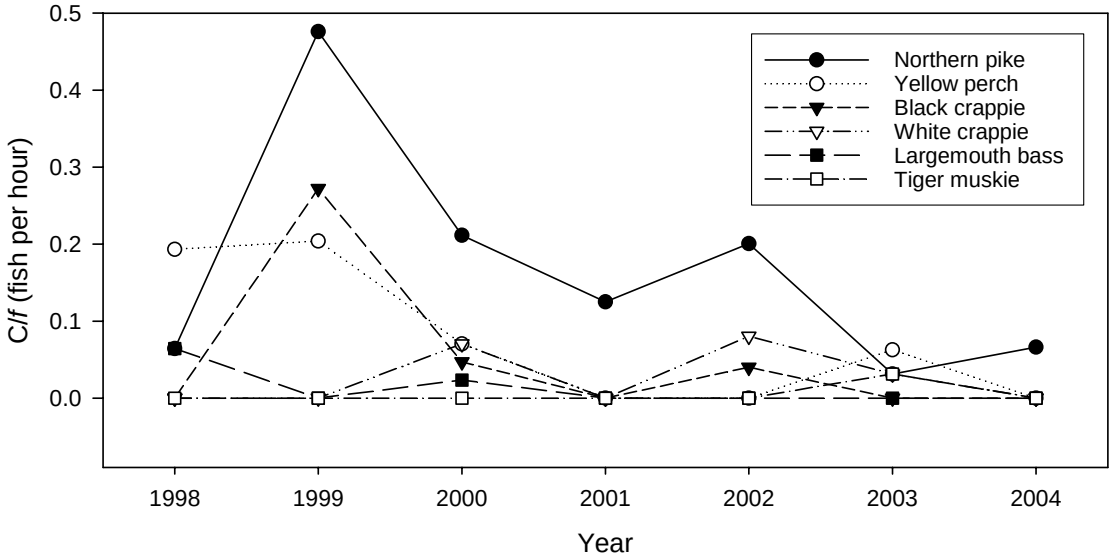

Figure 17. Catch per effort of rare game fishes in the Yellowstone River, 1998 to 2004.

Common non-game fishes

Abundances of common non-game fishes were consistent or increasing during the study period, although declines during the onset of drought conditions in 2000 were common (Figure 18). Shorthead redhorse sucker, goldeye, and river carpsucker experienced the largest declines and subsequent increases. Dissimilar food habits and niches for these species (Brown 1971; Welker 2000) suggest large-scale and pervasive unfavorable conditions coinciding with the onset of drought.

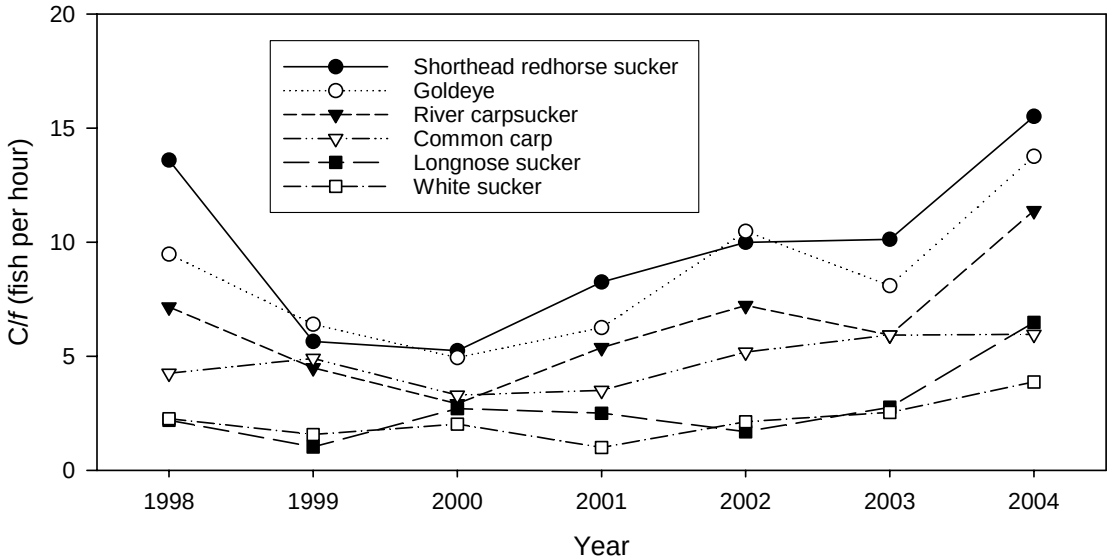

Figure 18. Catch per effort of common non-game fishes in the Yellowstone River, 1998 to 2004.

Rare non-game fishes

Abundances of rare non-game fishes were consistent or increasing during the study period (Figure 19). Abundances of blue sucker, a Species of Special Concern, exhibited proportionally large fluctuations from 1998 to 2000 but were stable overall. Smallmouth buffalo experienced a six-fold increase in abundance. Abundances of other catastomid planktivores remained constant (bigmouth buffalo) or increased (river carpsucker; Figure 18).

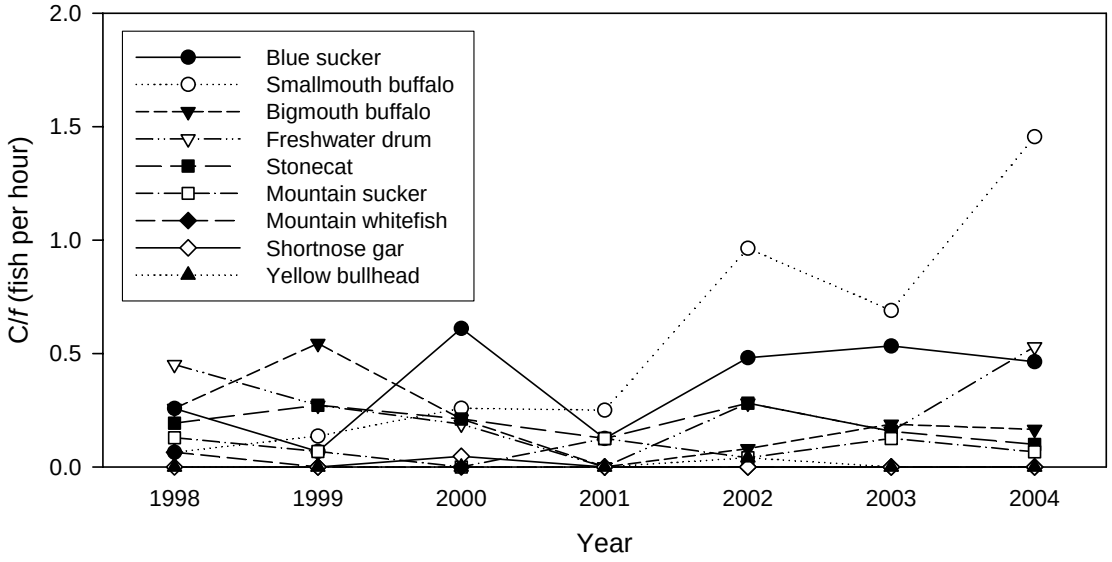

Figure 19. Catch per effort of rare non-game fishes in the Yellowstone River, 1998 to 2004.

Cyprinids

Only three cyprinids (flathead chub, Hybognathus spp., emerald shiner) were commonly encountered and catch rates of these species were consistent among years (Figure 20). Although electrofishing is likely an inefficient sampling method for most cyprinids, seine surveys found similar relative abundances among species in the Yellowstone River (Stewart 1997). Sturgeon chub, a Species of Special Concern, were rarely captured although electrofishing is an inefficient sampling method for this species (Stewart 1996). Sturgeon chub were commonly captured with benthic trawls throughout the Yellowstone River downstream of Cartersville Diversion (Bill Gardner, Montana Fish, Wildlife, and Parks, Lewistown, Montana, personal communication).

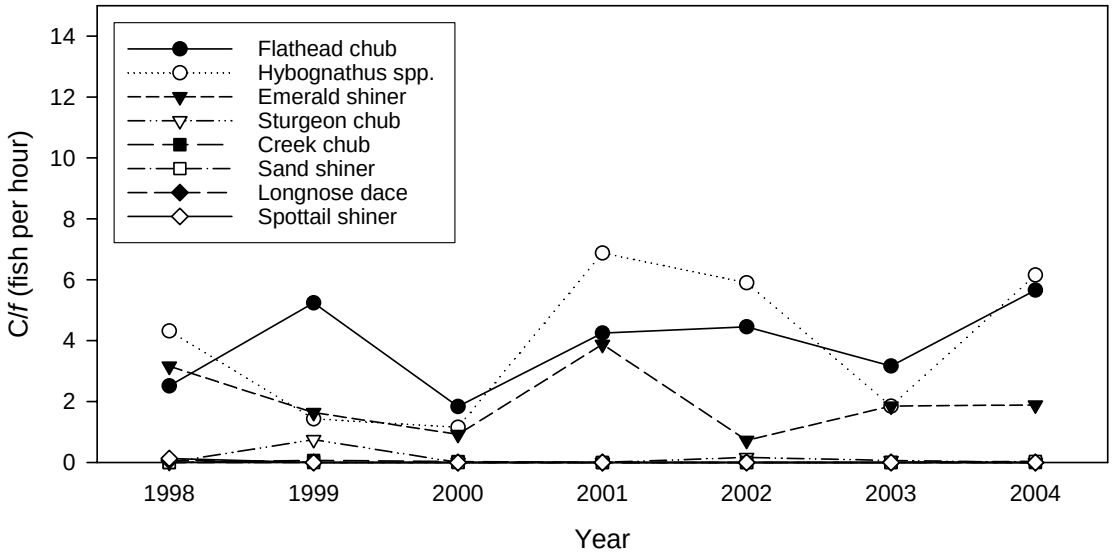

Figure 20. Catch per effort of cyprinids in the Yellowstone River, 1998 to 2004.

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Key words:

Population abundance, structure, and condition.

Sauger, channel catfish, smallmouth bass, shovelnose sturgeon, burbot, walleye, game fish, non-game fish, cyprinids.

Prepared by: Matthew Jaeger

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APPENDIX 1

SUMMARY OF ANNUAL CATCH BY TREND SECTION

Table 1. Results of trend sampling in the Yellowstone River, 2001.

Species	N	C/*f* (fish/hour)	Mean Length (mm)	Length Range (mm)	Mean Weight (gm)	Weight Range (gm)
	Forsyth - 120 minutes					
Channel catfish	4	2.00	552	422-733	1798	620-4050
Emerald shiner	10	5.00	65	37-98	--------	--------
Goldeye	5	2.50	336	320-360	302	280-330
Hybognathus spp	20	10.00	106	89-125	--------	--------
Longnose sucker	3	1.50	193	140-223	90	30-120
River carpsucker	8	4.00	405	390-438	913	760-1100
Sauger	1	0.50	465	--------	830	-------
Shorthead redhorse	17	8.50	346	136-497	553	30-1250
Smallmouth buffalo	21	10.50	323	190-433	643	110-1550
Walleye	1	0.50	512	--------	1300	--------
White sucker	7	3.50	355	197-438	586	130-870
	Miles City – 120 minutes					
Blue sucker	1	0.50	753	--------	4000	--------
Carp	24	12.00	493	125-616	1673	25-3080
Flathead chub	4	2.00	150	124-163	30	--------
Goldeye	5	2.50	280	116-362	206	10-360
Hybognathus spp	20	10.00	105	82-127	--------	-------
Longnose sucker	14	7.00	242	180-407	190	50-800
Mountain sucker	1	0.50	148	--------	20	--------
Northern pike	1	0.50	457	--------	630	-------
River carpsucker	9	4.50	406	353-455	952	570-1440
Sauger	2	1.00	354	309-398	370	240-500
Shorthead redhorse	20	10.00	247	163-417	207	50-810
Smallmouth bass	4	2.00	225	125-300	228	10-500
White sucker	1	0.50	222	--------	110	--------
	Fallon - 120 minutes					
Burbot	1	0.50	337	--------	190	--------
Carp	3	1.50	440	277-565	1243	310-2100
Channel catfish	4	2.00	460	204-635	1318	70-3100

Emerald shiner	14	7.00	78	70-93	--------	--------
Flathead chub	10	5.00	137	110-183	19	5-50
Goldeye	20	10.00	200	98-335	94	5-270
Hybognathus spp	8	4.00	102	82-142	20	-------
Longnose sucker	2	1.00	210	200-219	100	80-120

Table 1 (*cont.*)

River carpsucker	6	3.00	418	352-467	1057	560-1480
Sauger	9	4.50	370	280-470	431	150-900
Shorthead redhorse	20	10.00	279	174-468	279	50-1050
Smallmouth buffalo	1	0.50	522	-------	2010	-------
	Intake - 120 minutes					
Carp	1	0.50	617	--------	2200	-------
Emerald shiner	7	3.50	81	64-91	-------	-------
Flathead chub	20	10.00	139	112-187	26	10-60
Goldeye	20	10.00	218	111-395	114	10-610
Hybognathus spp	7	3.50	100	86-117	10	-------
Longnose sucker	1	0.50	176	--------	70	--------
River carpsucker	20	10.00	388	201-468	958	100-1500
Sauger	44	22.00	195	135-404	67	15-440
Shorthead redhorse	9	4.50	192	135-235	77	30-150
Shovelnose sturgeon	1	0.50	563	--------	570	--------
Smallmouth Buffalo	1	0.50	702	--------	5000	--------
Stonecat	1	0.50	96	--------	5	--------

Table 2. Results of trend sampling in the Yellowstone River, 2002.

Species	N	C/*f* (fish/hour)	Mean Length (mm)	Length Range (mm)	Mean Weight (g)	Weight Range (g)
	Forsyth - 365 minutes					
Blue sucker	3	0.49	775	745-800	4085	3575-4500
Burbot	1	0.16	285	--------	100	--------
Carp	57	9.38	534	405-678	2082	910-4550
Channel catfish	28	4.61	529	302-726	1638	220-4160
Emerald shiner	6	0.99	74	64-86	5	--------
Flathead chub	6	0.99	125	104-165	14	5-30
Freshwater drum	1	0.16	360	--------	530	-------
Goldeye	70	11.51	317	193-363	270	70-400
Hybognathus spp	17	2.80	94	78-117	7	5-20
Longnose sucker	13	2.14	358	203-668	425	50-800
Mountain sucker	1	0.16	147	-------	60	-------
Northern pike	1	0.16	620	--------	1610	--------
River carpsucker	56	9.21	388	126-445	781	20-1140
Sauger	26	4.28	388	287-614	535	160-1960
Shorthead redhorse	92	15.13	298	143-498	339	40-1200
Shovelnose sturgeon	7	1.15	828	751-920	3280	2300-5550

Smallmouth bass	44	7.24	264	76-467	463	10-1640
Smallmouth buffalo	7	1.15	471	408-535	1570	990-2240
Sturgeon chub	1	0.16	80	--------	5	--------
Walleye	4	0.66	441	332-583	853	320-1820
White sucker	43	7.07	321	130-428	435	20-860
Yellow bullhead	1	0.16	230	--------	160	--------

Table 2 (*cont.*)

	Miles City - 364 minutes					
Bigmouth buffalo	2	0.33	566	557-574	2925	2680-3170
Black crappie	1	0.16	208	--------	150	--------
Blue sucker	5	0.82	717	663-795	3172	2530-4300
Burbot	1	0.16	400	--------	250	--------
Carp	50	8.24	476	324-576	1488	310-2940
Channel catfish	9	1.48	534	344-690	1673	310-2930
Emerald shiner	8	1.32	77	72-86	--------	--------
Flathead chub	67	11.04	130	95-190	23	5-80
Freshwater drum	3	0.49	427	367-494	1083	640-1550
Goldeye	58	9.56	304	106-374	255	5-410
Hybognathus spp	81	13.34	111	87-150	13	5-30
Longnose sucker	25	4.12	333	205-425	431	80-830
River carpsucker	67	11.04	376	74-498	750	5-1320
Sauger	47	7.74	367	237-528	437	110-1150
Shorthead redhorse	50	8.24	304	175-440	337	70-850
Smallmouth bass	15	2.47	247	56-348	286	5-650
Smallmouth buffalo	16	2.64	512	303-721	2016	300-5000
Sturgeon chub	1	0.16	89	--------	5	--------
Walleye	5	0.82	328	307-341	324	280-380
White crappie	2	0.33	268	194-342	395	100-690
White sucker	6	0.99	287	230-385	290	170-580
	Fallon - 396 minutes					
Blue sucker	2	0.30	732	721-742	3310	3300-3320
Carp	12	1.82	485	200-615	1590	120-2850
Channel catfish	5	0.76	324	145-654	672	30-2800
Emerald shiner	1	0.15	73	--------	--------	-------
Flathead chub	8	1.21	146	121-171	30	20-50
Freshwater drum	1	0.15	447	--------	1240	-------
Goldeye	65	9.85	272	108-358	185	15-410
Hybognathus spp	10	1.52	104	77-140	10	5-20
Longnose sucker	3	0.45	342	304-366	433	310-510
Northern pike	1	0.15	536	--------	990	--------
River carpsucker	17	2.58	366	178-459	724	70-1220
Sauger	21	3.18	372	169-565	453	30-1440
Shorthead redhorse	65	9.85	304	163-485	317	40-1040
Shovelnose sturgeon	4	0.61	602	457-690	978	320-1450
Smallmouth buffalo	1	0.15	494	--------	1650	--------
Stonecat	7	1.06	116	92-144	11	5-20
Sturgeon chub	2	0.30	73	69-77	5	--------
White sucker	2	0.30	300	251-349	270	110-430

	Intake - 370 minutes					
Carp	10	1.61	442	186-710	1728	100-4540
Channel catfish	4	0.65	474	235-580	1218	120-1800
Emerald shiner	3	0.48	82	77-87	5	--------
Flathead chub	30	4.84	167	124-210	44	10-80

Table 2 (*cont.*)

Freshwater drum	1	0.16	295	--------	300	--------
Goldeye	61	9.84	243	104-362	145	10-400
Hybognathus spp	39	6.29	106	91-128	9	5-20
Longnose sucker	1	0.16	267	--------	200	--------
Northern pike	3	0.48	679	568-889	1833	920-3530
River carpsucker	40	6.45	408	168-520	1130	90-2320
Sauger	122	19.68	286	190-475	198	60-830
Shorthead redhorse	42	6.77	253	180-378	195	70-600
Shovelnose sturgeon	21	3.39	499	331-738	512	120-1700
Walleye	2	0.32	402	293-510	730	210-1250
White sucker	2	0.32	281	264-298	210	120-300

Table 3. Results of trend sampling in the Yellowstone River, 2003.

Species	N	C/*f* (fish/hour)	Mean Length (mm)	Length Range (mm)	Mean Weight (gm)	Weight Range (gm)
	Downstream of Rancher Diversion Dam - 110 minutes					
Carp	42	22.91	551.8	355-660	2355.5	640-3920
Channel catfish	28	15.28	561.9	423-710	2108.9	620-5300
Flathead chub	20	10.91	124.5	93-174	18	10-50
Freshwater drum	2	1.09	453.5	390-517	1440	710-2170
Goldeye	23	12.55	327	284-378	310.9	200-470
Longnose sucker	17	9.27	281.1	196-407	248.8	60-600
River carpsucker	15	8.18	396.8	282-450	793.3	290-1050
Shorthead redhorse	93	50.74	342.1	153-507	495	40-1240
Smallmouth bass	8	4.36	260.1	112-380	431.3	20-1060
Smallmouth buffalo	2	1.09	698.5	645-752	5650	4300-7000
Western silvery minnow	2	1.09	111	110-112	10	---
White sucker	10	5.46	345.5	235-432	476	120-920
	Forsyth - 413 minutes					
Bigmouth buffalo	4	0.58	611.5	481-806	3445	210-7090
Blue sucker	2	0.29	735.5	715-756	3875	3000-4750
Burbot	1	0.15	430	---	410	---
Carp	83	12.06	515.2	316-702	1853.7	300-5000
Channel catfish	67	9.74	508.9	295-741	1587.8	240-5020
Emerald shiner	8	1.16	78.3	68-94	10	---
Flathead chub	9	1.31	120.2	95-176	29.4	10-50
Freshwater drum	1	0.15	430	---	1130	---
Goldeye	115	16.72	314.4	272-355	287.3	200-370
Longnose sucker	22	3.20	250.2	88-450	299.5	20-950

Mountain sucker	4	0.58	131.5	112-163	31.3	20-50
River carpsucker	68	9.88	382	225-520	760.2	120-2580
Sauger	45	6.54	361	164-552	456	20-1620
Shorthead redhorse	202	29.36	337.4	142-453	439.3	30-950
Shovelnose sturgeon	14	2.03	810.4	573-915	2700.7	680-4900
Smallmouth bass	39	5.67	223.2	68-403	417.7	10-1280

Table 3 (*cont.*)

Smallmouth buffalo	11	1.60	531.5	389-722	2588.2	900-6200
Walleye	4	0.58	379	223-446	612.5	110-890
Western silvery minnow	4	0.58	105.5	90-112	12.5	10-20
White crappie	1	0.15	172	---	80	---
White sucker	37	5.38	349.3	171-450	534.6	70-900
	Miles City - 400 minutes					
Blue sucker	7	1.05	695.3	610-738	3162.9	2020-3840
Carp	39	5.85	515.7	309-670	2021.7	380-5000
Channel catfish	19	2.85	505.2	69-688	1737.8	380-4800
Emerald shiner	79	11.84	86.4	75-105	5	---
Flathead chub	24	3.60	143.8	110-170	35.7	10-60
Goldeye	55	8.25	307.8	140-307.8	290.2	20-460
Longnose sucker	24	3.60	310.8	125-445	360.8	20-780
River carpsucker	32	4.80	39706	227-458	827.5	150-1200
Sauger	20	3.00	381.4	265-507	508.5	170-1150
Shorthead redhorse	159	23.84	304.9	92-465	368.5	60-1130
Shovelnose sturgeon	3	0.45	796.3	684-868	2853.3	1510-3870
Smallmouth bass	49	7.35	130.5	80-384	87.5	5-1100
Smallmouth buffalo	3	0.45	583.7	480-636	3603.3	1720-5000
Stonecat	2	0.30	134.5	129-140	10	---
Tiger muskey	1	0.15	864	---	5100	---
Walleye	1	0.15	208	---	110	---
Western silvery minnow	21	3.15	104.9	83-139	18.6	10-40
White sucker	4	0.60	353	328-399	530	450-700
	Fallon - 417 minutes					
Blue sucker	5	0.72	660	466-757	3052	750-4550
Burbot	1	0.14	370	---	190	---
Carp	30	4.32	444.3	88-710	1566.9	10-4600
Channel catfish	23	3.31	393.4	70-601	1267.8	20-2270
Flathead chub	28	4.03	139.6	98-207	30	10-80
Freshwater drum	2	0.29	467	394-540	1475	820-2130
Goldeye	37	5.32	197.5	84-327	222.4	10-360
Longnose sucker	4	0.58	264.3	116-371	376.7	270-560
River carpsucker	13	1.87	351.4	72-475	872.7	280-1700
Sauger	71	10.22	380.1	174-549	502.8	40-1460
Shorthead redhorse	66	9.50	335.7	68-480	576.2	20-1350
Shovelnose sturgeon	18	2.59	743.8	584-867	2188.3	770-3930
Smallmouth bass	1	0.14	126	---	30	---
Smallmouth buffalo	2	0.29	300	110-490	1760	---
Stonecat	3	0.43	114.7	106-128	---	---

Walleye	1	0.14	200	---	50	---
Western silvery minnow	4	0.58	102.8	96-117	---	---
	Intake - 444 minutes					
Blue sucker	3	0.41	730	711-750	3690	3380-4010
Carp	7	0.95	42634	187-521	1234.3	100-2000

Table 3 (*cont.*)

Channel catfish	20	2.70	544	132-704	1823.5	100-4500
Emerald shiner	19	2.57	84.7	72-101	---	---
Flathead chub	20	2.70	147	84-217	36.3	10-110
Goldeye	69	9.32	266.9	100-393	192.3	10-400
Longnose sucker	5	0.68	214.6	110-265	124	10-230
River carpsucker	68	9.19	434	213-624	1340.9	100-3050
Sauger	154	20.81	265.7	161-512	172.2	20-1040
Shorthead redhorse	34	4.59	260.9	160-360	220.6	40-500
Shovelnose sturgeon	10	1.35	587.3	315-830	1154	100-2820
Smallmouth buffalo	4	0.54	516	468-575	1892.5	1250-2420
Sturgeon chub	2	0.27	98.5	82-97	---	---
Walleye	5	0.68	217.2	210-228	86	70-110
Western silvery minnow	24	3.24	102.8	57-135	11.5	5-20
White sucker	1	0.14	322	---	380	---

Table 4. Results of trend sampling in the Yellowstone River, 2004.

Species	N	C/*f* (fish/hour)	Mean Length (mm)	Length Range (mm)	Mean Weight (gm)	Weight Range (gm)
	Downstream of Rancher Diversion Dam - 325 minutes					
Blue sucker	1	0.18	683	---	2490	---
Burbot	1	0.18	330	---	220	---
Carp	78	14.39	595.9	379-706	2958.8	680-4200
Channel catfish	33	6.09	576.1	323-752	2336.1	270-5900
Flathead chub	4	0.74	121.8	106-147	30	---
Freshwater drum	1	0.18	378	---	740	---
Goldeye	29	5.35	327.2	297-344	305.2	210-360
Longnose sucker	143	26.38	243.5	70-482	193.6	10-1180
Mountain sucker	1	0.18	118	---	---	---
River carpsucker	86	15.87	403.5	343-457	881.1	530-1420
Sauger	5	0.92	387	336-454	498	250-860
Shorthead redhorse	356	65.68	339.8	149-508	489.8	40-1520
Smallmouth bass	47	8.67	208.8	141-345	176.1	40-770
Smallmouth buffalo	6	1.11	616	483-750	4151.7	1720-8040
Stonecat	1	0.18	104	---	---	---
Western silvery minnow	124	22.88	99.6	79-145	15	10-20
White sucker	53	9.78	343.5	104-451	520.9	170-1070

	Forsyth - 380 minutes					
Bigmouth buffalo	2	0.32	572	528-616	3510	2320-4700
Blue sucker	2	0.32	729	706-752	3715	3250-4180
Burbot	1	0.16	435	---	270	---
Carp	65	10.27	543.7	245-684	2207.5	250-3810

Table 4 (*cont.*)

Channel catfish	25	3.95	537.3	266-711	1994.4	190-3720
Emerald shiner	43	6.79	73.1	56-98	---	---
Flathead chub	6	0.95	141.2	132-159	22	10-40
Freshwater drum	5	0.79	417.4	378-472	924	760-1210
Goldeye	125	19.75	316.1	195-379	275.6	60-450
Longnose sucker	44	6.95	277.8	115-452	322.1	30-920
Mountain sucker	1	0.16	130	---	60	---
River carpsucker	84	13.27	395	268-460	803.9	250-1200
Sand shiner	1	0.16	68	---	---	---
Sauger	21	3.32	372.9	158-489	482.4	20-1100
Shorthead redhorse	269	42.50	349.9	150-505	514.3	50-1180
Shovelnose sturgeon	3	0.47	772	750-803	2430	1780-3310
Smallmouth bass	28	4.42	240.4	129-394	302.9	30-1120
Smallmouth buffalo	16	2.53	549.3	335-665	2682.5	640-5000
Walleye	2	0.32	425.5	387-464	765	530-1000
Western silvery minnow	8	1.26	79.4	74-85	---	---
White sucker	48	7.58	323.9	98-423	468.5	10-850
	Miles City - 360 minutes					
Blue sucker	10	1.67	713.2	678-770	3069	2350-3990
Carp	53	8.83	529.9	260-1495	1906	300-3600
Channel catfish	13	2.17	416.4	256-625	810.8	140-2380
Emerald shiner	5	0.83	76.2	55-93	---	---
Flathead chub	52	8.67	146	106-196	33.3	10-80
Freshwater drum	4	0.67	404.8	372-463	972.5	780-1370
Goldeye	67	11.17	296.2	103-346	265.8	10-360
Longnose sucker	26	4.33	307	209-452	373.5	80-960
Northern pike	1	0.17	617	---	1520	---
River carpsucker	64	10.67	390.6	251-513	831.4	100-1930
Sauger	24	4.00	395	290-485	539.6	130-1070
Shorthead redhorse	260	43.33	332.1	135-494	484.9	20-1310
Shovelnose sturgeon	1	0.17	913	---	4400	---
Smallmouth bass	27	4.50	221.6	92-410	277	10-1140
Smallmouth buffalo	8	1.33	518.8	324-720	2405	250-6100
Walleye	3	0.50	468	393-526	993.3	490-1490
Western silvery minnow	26	4.33	121.3	98-146	21.3	10-60
White sucker	12	2.00	333.8	240-400	495	120-780

	Fallon - 386 minutes					
Carp	22	3.42	536.9	383-652	2133.6	770-3880
Channel catfish	14	2.18	478.8	315-662	1153.6	260-3090
Flathead chub	77	11.98	132.1	92-233	33.3	5-120
Freshwater drum	3	0.47	333.7	287-392	490	320-740

Table 4 (*cont*.)

Goldeye	143	22.24	273.7	86-347	238.9	60-350
Longnose sucker	6	0.93	269.7	202-350	250	80-520
Northern pike	1	0.16	827	---	4150	---
River carpsucker	51	7.93	391.1	133-530	891	20-2330
Sauger	66	10.26	405.9	239-560	568.3	120-1320
Shorthead redhorse	146	22.71	261.2	148-487	293.6	30-1280
Smallmouth bass	4	0.62	167.3	65-207	133.3	120-150
Smallmouth buffalo	8	1.24	429.8	198-582	1530	130-3120
Stonecat	2	0.31	114	86-142	30	---
Walleye	1	0.16	384	---	520	---
Western silvery minnow	85	13.22	103	86-140	---	---
White sucker	3	0.47	336.3	270-428	486.7	220-900
	Intake - 363 minutes					
Bigmouth buffalo	3	0.50	646	591-700	4150	3340-5080
Blue sucker	1	0.17	733	---	3280	---
Burbot	3	0.50	375.7	167-527	361.7	15-680
Carp	15	2.48	460.4	324-603	1424.7	490-2780
Channel catfish	9	1.49	479.9	225-668	1641.1	160-3170
Emerald shiner	9	1.49	77.9	69-86	---	---
Flathead chub	32	5.29	149.9	93-198	37.3	10-70
Freshwater drum	3	0.50	308.3	290-320	390	350-460
Goldeye	200	33.06	273.3	110-372	195.7	10-370
Longnose sucker	2	0.33	273.5	237-310	215	80-350
River carpsucker	118	19.50	415	149-560	1187.2	50-3250
Sauger	187	30.91	313.5	197-500	253.5	50-1000
Shorthead redhorse	54	8.93	271.8	130-392	280.4	30-700
Shovelnose sturgeon	31	5.12	569.8	405-861	952.6	170-3280
Smallmouth bass	1	0.17	214	---	180	---
Smallmouth buffalo	6	0.99	416.3	189-528	1201.7	100-2160
Walleye	3	0.50	363.3	298-473	480	210-920
Western silvery minnow	35	5.79	100	84-128	10	---
White sucker	2	0.33	286	260-312	295	210-380