1987

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1987. *Transactions of the Nebraska Academy of Sciences*, XV: 15-21.

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Between September and November 1986, collections of fishes were made in Weeping Water Creek in Cass and Otoe counties of southeastern Nebraska. Eighteen sampling stations yielded a total of 2,960 specimens of 19 species and five families. The most common species, in terms of numbers of individuals, were the cyprinid minnows *Notropis dorsalis, N. lutrensis, N. stramineus, Pimephales promelas, Semotilus atromaculatus,* and the sunfish, *Lepomis cyanellus*. The number of species per station varied from three to eleven. No obvious changes are evident from a survey in 1973.

† † †

INTRODUCTION

In 1973 the Nebraska Game and Parks Commission was concerned that "water resource and land development projects" in the Nemaha Basin were interrupting or modifying natural aquatic environments (Bliss and Schainost, 1973). Fish stocks in the Nemaha Basin are important for environmental reasons and for sport fishing. The concern of the Game and Parks Commission was that these development projects would be responsible for reductions in distribution of many of the fish species. Because there is no information on the distribution of fishes in Weeping Water Creek prior to 1973, the primary objective of the survey was to gather data on the relative abundance and distribution of fishes within the Nemaha Basin.

The Nemaha Basin is located in the southeastern corner of Nebraska. It is drained by three major streams: Weeping Water Creek on the north, and the Little and Big Nemaha rivers on the south. All three have similar habitat structure and empty into the Missouri River.

In the Fall of 1986 I chose Weeping Water Creek as the site for a fish survey. This creek is part of the Nemaha Basin which was sampled in 1973 by Bliss and Schainost, so for this study sites were selected and sampled as close as possible to the original 1973 locations. This allows for comparison of data between the two surveys, and can help to establish any changes that may have occurred in the native fish population over the last 13 years. Results from this survey will be useful in future studies in the Weeping Water Creek drainage system.

PHYSICAL DESCRIPTION OF STUDY AREA

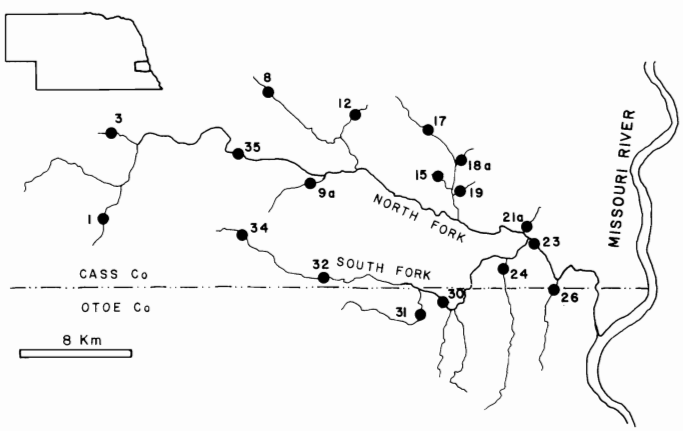

FIGURE 1. Weeping Water Creek showing distribution of collecting stations for 1986.

Weeping Water Creek drains approximately 62,420 hectares in southeastern Nebraska (Bliss and Schainost, 1973). Its length is listed as 77.9 km for the main branch and 41.1 km for the south branch of the stream. The creek spans Cass and Otoe counties, and flows eastward into the Missouri River just north of Nebraska City (Fig. 1). It has been channelized in several areas to reduce the chances of severe flooding. The altered stream mileage lost is recorded to be 2.7 km in the main branch and 0.96 km in the smaller southern branch (Bliss and Schainost, 1973). Evidence of these alterations is still apparent in some areas of the stream system.

The surrounding lands are mostly rolling hills. The uppermost bedrock is composed of limestone and some shale. Rock outcrops were noticed at station 15 just outside of Nehawka. Weeping Water Creek flows primarily through agricultural land; the cultivated crops are grain, sorghum, corn, wheat, and soybeans (Maret and Peters, 1980). Uncultivated grasslands are usually grazed.

The creek is very typical of eastern Nebraska streams. Severe fluctuations in flow from season to season create several

distinct habitats capable of supporting a limited fish diversity. The banks are composed primarily of mud and clay, and the bottom varies considerably, with mud and gravel being the principal substrates (Table I). The banks are often heavily wooded. Siltation in the stream is usually very heavy except at the headwaters.

It should be noted that Weeping Water Creek and surrounding rivers and streams were near flood stage during the months of October and November, 1986, and the creek left its banks about 3 mi east of the town of Weeping Water.

MATERIALS AND METHODS

Field work extended from September to November of 1986. Eighteen stations were selected throughout the stream system, based on accessible sites represented in both 1973 and 1986 (Table I). Station numbers used here are the same as were used by Bliss and Schainost (1973). In three cases (9a, 18a, and 21a) I was unable to collect in the 1973 locations, but I collected near them (within 1 mi). Station 35 was not sampled by Bliss and Schainost (1973), but was selected because of access and because John Lynch had sampled it in years past.

Sampling Techniques

Seines were the only devices employed for the capture of fish. The lengths of the seines ranged from 1.8 to 6 meters, their depths were either 1.2 or 1.8 meters, and they were of 0.63 cm mesh size. Every attempt was made to seine all the habitats within a particular site, especially pools, riffles, and along banks. If there were fallen trees or other types of shaded areas, then every attempt was made to seine under them. Generally, procedures for seining called for at least 6 or 7 sweeps through each station. If an additional species was caught in the fifth or sixth sweep, then more sweeps were made.

Preservation and Identification

All specimens captured were fixed in 10% formalin and transported to the laboratory, where they were transferred to 70% ethanol. Identificatons were made and all physical data recorded in the laboratory. Specimens were deposited in the University of Nebraska State Museum (Museum numbers: ZM-01836–01842, 01871–01890, 01938–01949, 01950–01955, 02037–02060, 02065–02075, 02429–02439, 02620–02625, 02662–02670).

TABLE I. Description of collecting stations, 1986.

Station Name and Number[1]	Date	Legal Description				Average width (m)	Average depth (m)	Average velocity (cm/sec)	Substrate[2]
		T	R	Sec	¼				
Stove Creek 1	10/9	10N	10E	15	NW	2.1	0.4	46	silt, rock
Branch, Weeping Water Creek 3	10/12	11N	10E	34	NW	2.1	0.4	30	silt, gravel
South Cedar Creek 8	10/16	11N	11E	23	SW	2.1	0.4	NA	clay, silt
Cascade Creek 9a	10/19	10N	11E	12	NE	4.6	0.6	30	rock, silt, clay
Branch, S. Cedar Creek 12	10/12	11N	12E	28	SW	2.7	0.8	30	silt, rock, gravel
Branch, Weeping Water Creek 15	10/16	10N	12E	12	N½	7.6	0.6	2	silt, limestone
Branch, Weeping Water Creek 17	10/16	11N	13E	36	NW	0.7	0.6	9	silt, rock
Branch, Weeping Water Creek 18a	10/16	10N	13E	6	S½	6.1	0.3	30	gravel, silt, limestone
Branch, Weeping Water Creek 19	10/16	10N	13E	7	S½	7.6	0.6	15	silt, rock, gravel
Branch, Weeping Water Creek 21a	10/19	10N	13E	21	NW	1.2	0.3	NA	clay, gravel
N. Branch, Weeping Water Creek 23	10/5	10N	13E	22	SE	4.6	0.6	31	silt, sand, gravel
Big Slough Creek 24	10/5	10N	13E	33	NW	2.7	0.5	15	clay, silt
Wolf Creek 26	10/19	10N	13E	35	SE	2.0	0.3	NA	clay, gravel
S. Branch, Weeping Water Creek 30	9/25	9N	12E	1	SE	6.1	0.8	31	gravel, silt
Flood Creek 31	9/25	9N	12E	11	NE	4.6	0.9	46	silt, rock
S. Branch, Weeping Water Creek 32	9/25	10N	12E	31	SE	2.4	0.5	15	silt
S. Branch, Weeping Water Creek 34	10/9	10N	11E	22	SW	2.7	0.3	5	silt
N. Branch, Weeping Water Creek 35	9/28	11N	11E	4	NW	9.1	0.7	15	sand, silt, gravel

[1]Station number follows the name.
[2]Substrate types in order of importance.
NA = Not Available.

Physical Data

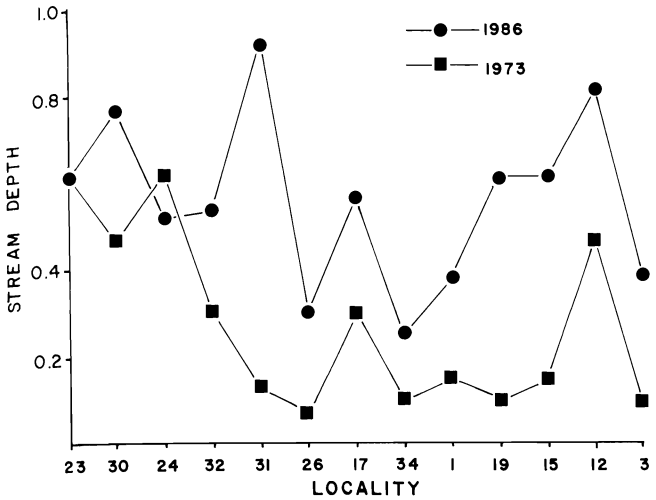

FIGURE 2. Comparison of stream depths at times of collections for 1973 and 1986 in Weeping Water Creek.

A complete description of physical characteristics of the creek was recorded for each site (Table I). Any physical or biological alteration from the undisturbed condition was also noted. Physical data taken included average depth (Fig. 2), average width, average current velocity, and substrate composition.

ANNOTATED LIST OF SPECIES

A total of 2,960 specimens representing 5 families and 19 species was taken from the 18 stations. In this list, scientific and common names used are those adopted by the American Fisheries Society.

CATOSTOMIDAE

***Carpoides carpio* (Rafinesque),** river carpsucker. Stations 23 and 35. Two specimens were caught in 1986, both juveniles about 7.6 cm in length. Bliss and Schainost (1973) did not catch any carpsuckers in their survey. From the data collected it seems these fish prefer calm, deep pools in the main channel of the stream.

***Catostomus commersoni* (Lacepede),** white sucker. Stations: 19, 30, and 35. Three specimens 30.5 cm long were captured in 1986. Bliss and Schainost (1973) reported no white suckers in their survey. I discovered them in deep pools with a gravel substrate.

CENTRARCHIDAE

***Lepomis cyanellus* (Rafinesque),** green sunfish. Stations: 1, 3, 9a, 12, 15, 17, 24, 26, 30, 31, 32, 34, and 35. This was the only centrarchid caught by Bliss and Schainost (1973). Adults and juveniles were collected in 1973 and 1986. The species has such a wide distribution that it was not surprising to find it was the second most widely distributed fish in the creek. The green sunfish is native to Nebraska waters and seems to thrive in the still, muddy pools of Weeping Water Creek.

***Lepomis macrochirus* (Rafinesque),** bluegill. Station 35. Bliss and Schainost collected no bluegills in their survey of Weeping Water Creek, but one specimen was caught in 1986, a mature male 12.7 cm long. The specimen is more than likely a stray from an area pond, and may have come through one of the spillways that drain the local farm ponds, where bluegills are commonly stocked. These fish seem to do the best in small ponds or pools with very little current.

***Micropterus salmoides* (Lacepede),** largemouth bass. Station 30. The largemouth bass is not native to Weeping Water Creek, but it is stocked in the local lakes and ponds for sport fishing. The only specimen captured in 1986 was a juvenile 12 cm long. The habitat structure of Weeping Water Creek is unsuitable for this fish, which prefers deep pools, moderate flow, and low turbidity (Witt, 1970). Again, the individual that I caught probably came through the spillway of a local pond.

CLUPEIDAE

***Dorosoma cepedianum* (Lesueur),** gizzard shad. Station 30. One specimen 11.0 cm long was captured in 1986. The gizzard shad is not a fish of small creeks, and the juvenile specimen captured was probably a stray from the Missouri River. According to Witt (1970), the gizzard shad is usually found in quiet waters just outside the main channel of that river. Bliss and Schainost (1973) did not catch this species in their survey of the creek.

CYPRINIDAE

***Cyrinus carpio* (Linnaeus),** carp. Station 35. Carp can be found quite frequently in Nebraska lakes and backwater areas. The four specimens collected in 1986 ranged from 7.6 cm to 25.4 cm in length. Weeping Water Creek does not exhibit the type of habitat that these fish prefer. Carp move up into smaller streams to breed and these four specimens are probably strays from the Missouri River. Bliss and Schainost (1973) did not collect them in their survey.

***Hybognathus argyritis* (Girard),** western silvery minnow. Station 23. Only 4 specimens were caught in 1986, each about 5.0 cm long. The four specimens were collected in deeper water with little or no current and a sandy substrate. They were probably strays from the Missouri River. Bliss and Schainost (1973) did not catch this species in their survey of Weeping Water Creek.

***Hybopsis gracilis* (Richardson),** flathead chub. This species was not collected in the 1986 survey, but Bliss and Schainost (1973) caught two individuals just southeast of the city of Weeping Water. Baily and Allum (1962) considered these fish to be inhabitants of the Missouri River and the larger streams in the area.

***Notropis atherinoides* (Rafinesque),** emerald shiner. Station 23. Eight adults and juveniles were captured in 1986. The specimens were 2.5–8.9 cm long. Bliss and Schainost (1973) did not collect the species which is, by most accounts, restricted to major rivers (Maret and Peters, 1980).

***Notropis dorsalis* (Agassiz),** bigmouth shiner. Stations: 3, 15, 17, 18a, 19, 21a, 24, 26, and 32. Bigmouth shiners were caught both in 1973 and 1986. Adults and juveniles were captured in both years. This species can be found in a variety of habitats, but it seems to prefer small streams with a moderate current and a smooth (mud, gravel, sand) bottom. I observed that wherever *N. dorsalis* was, *N. lutrensis* was either absent or present in reduced numbers, and vice-versa (Table II). This suggests that the two species have very different habitat and food requirements.

***Notropis lutrensis* (Baird and Girard),** red shiner. Stations: 1, 18a, 19, 21a, 23, 24, 26, 30, 31, and 35. The fact that this species was caught at the deepest sites (23, 30, and 35) suggests to me that it prefers deeper and slower waters. It also seems to have different requirements than *Semotilus atromaculatus* (Table II). Gross (1967) says that "red shiners are most numerous where few other kinds of fish occur". The findings of both the 1973 and 1986 surveys suggest that the population of red shiners has remained relatively constant over the last 13 years. Adults and juveniles were captured in both surveys.

***Notropis stramineus* (Cope),** sand shiner. Stations: 1, 3, 9a, 15, 17, 18a, 19, 23, 24, 26, 30, 31, 32, and 35. The sand shiner was the second most abundant species caught in the 1986 survey. Bliss and Schainost (1973) found it to be the most abundant species in their survey. Yet the only difference between the first *(N. stramineus)* and second *(Pimephales promelas)* places in the 1973 survey is one fish. Since this small difference is not significant, the two species are essentially equal in the 1973 survey. Adults and juveniles were collected in 1973 and 1986. The sand shiner is widely distributed throughout the waters of Nebraska, and placing it in a particular habitat would be very difficult to do.

***Phenacobius mirabilis* (Girard),** suckermouth minnow. Stations: 9a, 18a, 23, 24, 30, and 35. Maret and Peters (1980) described the suckermouth minnow as having a limited ecological distribution, and my findings tend to support this claim. These fish were only caught at sites that had an abundance of water flowing through them. Adults and juveniles were captured in the 1986 survey. Bliss and Schainost (1973) caught this species at only one site (31) during their survey. These fish prefer swift water over gravel or hard mud bottoms.

***Pimephales promelas* (Rafinesque),** fathead minnow. Stations: 3, 9a, 12, 15, 17, 18a, 19, 21a, 24, 26, 31, 32, and 34. Due to a very large sample taken at station 15, the fathead minnow was the most abundant fish caught in 1986. Bliss and Schainost (1973) found this species equally abundant with *Notropis stramineus* (see above). These fish are considered to be pioneers as they are usually the first to enter a new stream (Cross, 1967; Pflieger, 1975). They prefer very turbid waters and are found quite frequently in headwater areas. Adults and juveniles were captured in both 1973 and 1986.

***Semotilus atromaculatus* (Mitchell),** creek chub. Stations: 1, 3, 9a, 12, 15, 17, 19, 21a, 24, 26, 32, and 34. As this name implies, creek chubs are found almost exclusively in small creeks. The greatest number of these fish was caught in shallow, swiftly moving water. Both surveys show similar frequencies of creek chubs. This is an indication that the population has remained relatively constant over the last 13 years.

TABLE II. Comparison of localities where three species of Cyprinids were captured.

SPECIES	SITES										
	1	18a	19	21a	23	24	26	30	31	32	35
Notropis dorsalis	0*	28	60	1	0	3	132	1	0	0	0
Notropis lutrensis	28	20	6	22	18	2	13	99	6	40	78
Semotilus atromaculatus	2	0	179	2	0	13	49	0	0	18	0

*Actual numbers of specimens caught at the different localities.

ICTALURIDAE

***Ictalurus melas* (Rafinesque),** black bullhead. Stations: 1, 9a, 31, 32, and 35. This was the only ictalurid caught by Bliss and Schainost (1973). The number of black bullheads I caught at any one site was relatively low, 17 fish at station 9a being the largest number taken. These fish prefer waters with no current and a muddy bottom. The smooth deep waters after a long riffle provide the best habitat for them. Adults and young–of–the–year were collected in both surveys.

***Ictalurus natalis* (Lesueur),** yellow bullhead. Stations: 1, 17, 24, and 35. All specimens collected in 1986 were juveniles. They ranged in size from 5.0 cm to 16.2 cm. Bliss and Schainost did not collect any yellow bullheads in their survey. These fish appear to prefer mud bottoms and areas with little current. In this survey, the fish were taken exclusively in pools in the main channel of the stream. Two was the maximum captured at any one site.

***Ictalurus punctatus* (Rafinesque),** channel catfish. Stations: 23, 30, 32, and 35. This is perhaps the most surprising catch made in the entire survey. One hundred and four specimens were collected: 99 juveniles (5–6 cm) and 5 small adults (23.0 cm). Bliss and Schainost (1973) did not collect any channel catfish. These fish seem to prefer deeper water, but specimens were obtained in some of the riffle areas of the stream. The fact that most of the specimens collected were juveniles suggest that these fish may have been using Weeping Water Creek as a spawning ground in 1986.

***Noturus flavus* (Rafinesque),** stonecat. Stations 24 and 30. This species was represented by 2 specimens. The specimen at station 24 was 13 cm long and the specimen from station 30 was only 5.2 cm long. Bliss and Schainost (1973) did not collect any stonecats in their survey. This is a retiring species, often collected only after the immediate area has been disturbed by seining or from holes under the bank.

DISCUSSION

The relatively low diversity of species found in Weeping Water Creek is a characteristic of all eastern Nebraska streams and rivers. In this survey, the cyprinids were 52.6% of the species; ictalurids and centrarchids were 21.1% and 15.8% of the total, respectively. The two remaining families were represented by one or two species each (and only six individuals), and are not considered to be a significant part of the stream fauna.

Stations 30 and 35 each had eleven species of fish. The higher diversity observed at these stations can be attributed to the large amounts of water. Station 30 is located near the confluence of two smaller creeks with Weeping Water Creek. The volume at this site is considerably more than at most of the other stations. Station 35 is located just outside the city of Weeping Water. The large quarry just west of town has created a series of connected pools that extend for nearly 0.4 km down the main channel of Weeping Water Creek. These pools are capable of supporting a much greater diversity than is characteristically seen in Weeping Water Creek.

The most fish collected at any one site was 868. This occurred at station 15, where five species were caught, representing two families. *Pimephales promelas* was the most abundant with 368 individuals caught.

Fourteen of the eighteen stations sampled in 1986 were the same ones that Bliss and Schainost sampled. The 1986 total for these fourteen stations was 2,485 fish; Bliss and Schainost caught 773 fish from them.

In Maret and Peters' (1980) survey of the Salt Creek Basin, fluctuations in water levels were of "primary importance in limiting survival and distribution of the fish fauna." The importance of this statement, for my survey, lies in the fact that in 1986 the water levels in Weeping Water Creek were considerably higher than in 1973 (Fig. 2). Thus, an increase in the number of species from 10 in 1973 to 19 in 1986 might be explained by the higher water levels in 1986.

Weeping Water Creek has few habitats. This can be seen most easily in the widespread distribution and relative abundance of *Pimephales promelas*. The fathead minnow dominates this creek system because of its ability to withstand "high temperature(s), extreme turbidity, and low oxygen" levels (Pflieger, 1975). The other five most abundant species also show a great deal of tolerance to these conditions.

The small discrepancies observed in the relative abundances of the six most common species of fish in the 1973 and 1986 surveys can be attributed to the normal fluctuations in population levels. Those species that were rarely collected may normally reside in the Missouri River or a local pond, and their occasional appearance in Weeping Water Creek is considered insignificant. However, *Ictalurus punctatus* is the exception; its occurrence in Weeping Water Creek is not so easy to explain. The facts that Bliss and Schainost did not collect any channel catfish, but I caught 104, suggest that their efforts to sample the entire Nemaha Basin may have prohibited them from accurately sampling Weeping Water Creek. Although Bliss and Schainost (1973) added considerbly to our understanding of

the fishes in this creek, the lack of intensity in their sampling techniques somewhat limits the usefulness of their results. Therefore, I decided to use an alternative survey to help distinguish the native population from the total population. This alternative survey was done on the Big and Little Nemaha rivers by Witt in 1970. The water quality and habitat structure of these rivers is very similar to that of Weeping Water Creek. When comparing my results with that of Witt (Table III), we see that the most abundant species in both surveys are very similar. In Witt's (1970) survey of the Big Nemaha River, the top four species were *Notropis lutrensis, N. stramineus, Pimephales promelas,* and *Semotilus atromaculatus*. Similarly, his survey of the Little Nemaha River has *Notropis stramineus, N. lutrensis,* and *N. dorsalis* as its top species. Another interesting comparison can be made regarding the less abundant species. Fish such as *Phenacobius mirabilis, Ictalurus melas, I. natalis,* and *Lepomis cyanellus* show frequencies similar to mine. Discrepancies between species like *Notropis atherinoides* and *Hybognathus argyritis* can be explained by the fact that the Nemaha rivers are considerably larger than Weeping Water Creek.

In Table III I have labeled species represented by juveniles (juv) or young–of–the–year (yng) only. This helps to establish which species are native to Weeping Water Creek. Those species represented by juveniles or young–of–the–year cannot be considered part of the natural ichthyofauna because as adults these fish can only be found in larger rivers and streams. If we now eliminate all species represented by juveniles, young–of–the–year, and strays (also labeled in Table III), we are left with the resident species of this creek. Interestingly enough, this list of residents is almost identical to that of the 1973 survey. Since the 1973 and 1986 surveys are very similar once we eliminate all the extraneous fishes, it is appropriate to conclude that the native fish population in Weeping Water Creek has not changed significantly over the last 13 years. The differences between the 1973 and 1986 surveys can be attributed to the environmental conditions (high water) and the time spent sampling the various locations (Bliss and Schainost sampled 34 stations along Weeping Water Creek in three days). Also, one additional limitation in their collections may have contributed to the differences between the surveys: no reference specimens were retained in a museum, and thus I was unable to verify their findings.

TABLE III. Numbers of individuals collected and the relative abundances (percent) of each species for Weeping Water Creek.

SPECIES	WEEPING WATER 1986	WEEPING WATER 1973*	BIG NEMAHA 1970**	LITTLE NEMAHA 1970**
Pimephales promelas	694–23.4%	337–23.3%	1272–10.3%	237–2.9%
Notropis stramineus	646–21.8%	338–23.4%	3577–28.8%	2381–29.6%
N. dorsalis	592–20.0%	312–21.6%	—	859–10.7%
Semotilus atromaculatus	362–12.2%	162–11.2%	552–4.4%	268–3.3%
N. lutrenis	332–11.2%	270–18.7%	4408–35.5%	2355–29.3%
Lepomis cyanellus	154–5.2%	13–0.9%	168–1.4%	138–1.7%
Ictalurus punctatus (95% yng)	104–3.5%	—	105–0.9%	305–3.8%
Phenacobius mirabilis	17–0.6%	2-0.1%	210–1.7%	151–1.9%
Ictalurus melas	15–0.5%	8–0.6%	103–0.8%	64–0.8%
Ictalurus natalis (juv)	10–0.3%	—	14–0.1%	5–0.1%
N. atherinoides (stray)	8–0.3%	—	342–2.8%	147–1.8%
Hybognathus argyritis (stray)	4–0.1%	—	268–2.2%	425–5.3%
Cyprinus carpio (stray)	4–0.1%	—	29–0.2%	37–0.5%
Catostomus commersoni	3–0.1%	—	—	—
Carpoides carpio (juv)	2–T	—	368–3.0%	217–2.7%
Noturus flavus	2–T	—	31–0.2%	—
Lepomis macrochirus (stray)	2–T	1–T	18–0.1%	2–T
Dorosoma cepedianum (stray)	1–T	—	52–0.4%	39–0.5%
Micropterus salmoides (stray)	1–T	—	45–0.4%	17–0.2%
Hybopsis gracilis	—	2–0.1%	88–0.7%	77–1.0%
TOTALS	2960 (100%)	1446 (100%)	12405 (92.7%)	8042 (96.1%)

T–Trace
*–Bliss and Schainost, 1973.
**–Witt, 1970.

ACKNOWLEDGMENTS

For assistance in collecting I would like to thank Jeff Livingston, John Lynch, Randall Morrison, and David Woodman. Access to the stream survey cards containing data for the 1973 survey was granted by Steve Schainost of the Nebraska Game and Parks Commission. A special thanks goes to John D. Lynch and David A. Woodman for advice, encouragement, and criticisms during the preparation of this report.

REFERENCES

Bailey, R. M., and M. O. Allum. 1962. Fishes of South Dakota, *Miscellaneous Publications of the Museum of Zoology at the University of Michigan,* 119: 1–131, 1p1.

Bliss, Q. P., and S. Schainost. 1973. Nemaha Basin stream inventory report. *Nebraska Game and Parks Commission, Wildlife Services, Aquatic Wildlife Division,* Lincoln, Nebraska.

Cross, F. B. 1964. Handbook of fishes of Kansas. *Miscellaneous Publications of the University of Kansas Museum of Natural History,* 45: 1–357.

Maret, T. R., and E. J. Peters. 1980. The fishes of Salt Creek Basin, Nebraska. *Transactions of the Nebraska Academy of Sciences,* 8: 35–54.

Pflieger, W. L. 1975. The fishes of Missouri. *Miscellaneous Publications of the Missouri Department of Conservation.* 343p.

Witt, L. A. 1970. The fishes of the Nemaha Basin, Nebraska. *Transactions of the Kansas Academy of Sciences,* 73: 70–88.