Pallid sturgeon and sturgeon chub in the lower Platte River 2000 to 2004: final report to the Pallid Sturgeon / Sturgeon Chub Task Force

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INTRODUCTION

In 1999, the Nebraska Game and Parks Commission (NGPC) along with a consortium of Natural Resources Districts and Public Power and Irrigation districts developed a committee to investigate the possibilities of funding research on the Platte River dealing with pallid sturgeon (*Scaphirhynchus albus*). This developed into an organization known as the Pallid Sturgeon / Sturgeon Chub Task Force (Task Force) and on May 18, 2000, they approved the funding of a five-year study of pallid sturgeon, sturgeon chub (*Macrhybopsis gelida*), and associated species in the lower Platte River. The funding provided by the Task Force, which included grants from the Nebraska Environmental Trust and from the State Wildlife Fund, was coordinated with funding from NGPC and the University of Nebraska (UNL). The Task Force funding was focused on research to address Task Force goals for pallid sturgeon and sturgeon chub.

GOALS AND OBJECTIVES:

The goal of the Task Force study was to quantitatively describe habitat use by pallid sturgeon and sturgeon chub in the lower Platte River. The study also included an analysis of the ecological relationships among pallid sturgeon and sturgeon chub, and other fish species typical of shifting sand-bed rivers, exemplified by the Platte River.

To accomplish these goals, the study delineated five objectives.

- Objective 1 was to document habitat use, relative habitat preference, and species assemblages associated with adult and juvenile pallid sturgeon and sturgeon chub in the lower Platte River.
- Objective 2 was to document the phenology and relative abundance of larvae for pallid sturgeon, sturgeon chub and associated species in the lower Platte River.
- Objective 3 was to determine if changes in ambient river habitat conditions influence habitat use by pallid sturgeon and sturgeon chub life stages in the lower Platte River.
- Objective 4 was to document the catch of sturgeon by anglers in the lower Platte River.
- Objective 5 was to develop management recommendations and educational materials to facilitate appropriate recovery efforts for pallid sturgeon and sturgeon chub in the lower Platte River.

STUDY AREA:

The Platte River has been a significant feature in the central Great Plains of North America since before the end of the last glacial advance. It drains over 230,000 km^2

starting at the east slope of the Rocky Mountains in Colorado and extending east across Nebraska (Galat et al. 2005a, NRC 2005). Flows in the Platte River system have been modified greatly by municipal and irrigation diversions, which are facilitated by dams on the main stem as well as on major tributaries. Even with the alterations in discharge that have accompanied the diversions from upstream sources, the lower Platte River has retained many of the braided channel characteristics of the historic river. In particular, the active channel of the lower Platte near Ashland, Nebraska was nearly as wide with shallow, shifting sand bars in 1980 (90%) as it was in 1860 (Eschner et al.1983). This is in contrast to the narrowing of the active channel that has occurred at upstream sites. Eschner et al. (1983) found that in 1980 the active river channel near Duncan, NE site was 50% of its 1860 width and near Cozad, NE the active channel was less than 10% of its 1860 width.

The lower Platte River is nearly unique among the tributaries of the middle Missouri River in that it has retained much of its braided channel morphology including wide, shallow expanses of shifting sand bar habitats even though its annual mean flow and annual flood peaks have been reduced by upstream damming and diversions (Eschner et al.1983, Randle and Samad 2003). This kind of habitat, now found in only a small proportion of the middle Missouri River and its tributaries, may have been preferred by pallid sturgeon and sturgeon chub before channel stabilization activities of the Reclamation Act of 1904 and dam construction by the Pick-Sloan Plan of 1944 changed the middle Missouri River from a braided river with shifting sand bars to its present channelized form (Galat et al 2005a). Other laws that contributed to the channelization and bank stabilization of the lower Missouri River included, in 1912 Public Law 62-241, in 1925 Public Law 68-585, in 1927 Public Law 70-560, and in 1945 Public Law 79-14.

The lower Platte River begins at the confluence of the Platte and Loup Rivers near the city of Columbus, Nebraska and extends downstream approximately 162 km to the Missouri River near Plattsmouth, Nebraska (Figure 1). In this reach, the Platte River is characterized by a wide, gently sloping channel of shifting sandbars. Riparian vegetation and stabilized sand bars are generally covered by a combination of cottonwood and eastern red cedar interspersed with areas of grasses and croplands (NDEQ 1990, Peters et al. 1989). Table 1 lists the major study locations and their river mile (RM) designations along the lower Platte River. These RM values are taken from a set of U.S. Army Corps of Engineers aerial photos (April 21, 1979).

In the lower Platte River, water temperatures of over 40 °C have been recorded in June, July, and August, but average monthly temperatures range from near 0 °C in January to about 25 °C in July (Peters et al. 1989). United States Geological Survey (USGS) records document typical pH values of 8.0, alkalinity of 153.5 mg $CaCO_3$/L, nitrate nitrogen of 1.35 mg/L and phosphate phosphorous of 0.73 mg/L (Galat et al. 2005a). The basin, which originally was dominated by grasslands (NRC 2005, Galat et al. 2005a), has been highly modified for agriculture which occupies approximately 90% of the land area. Irrigated agriculture in the central and lower sub-basins of the Platte River in Nebraska consumes 1,366,400 acre-feet of surface water each year (NRC 2005). The majority of this water is used to grow corn.

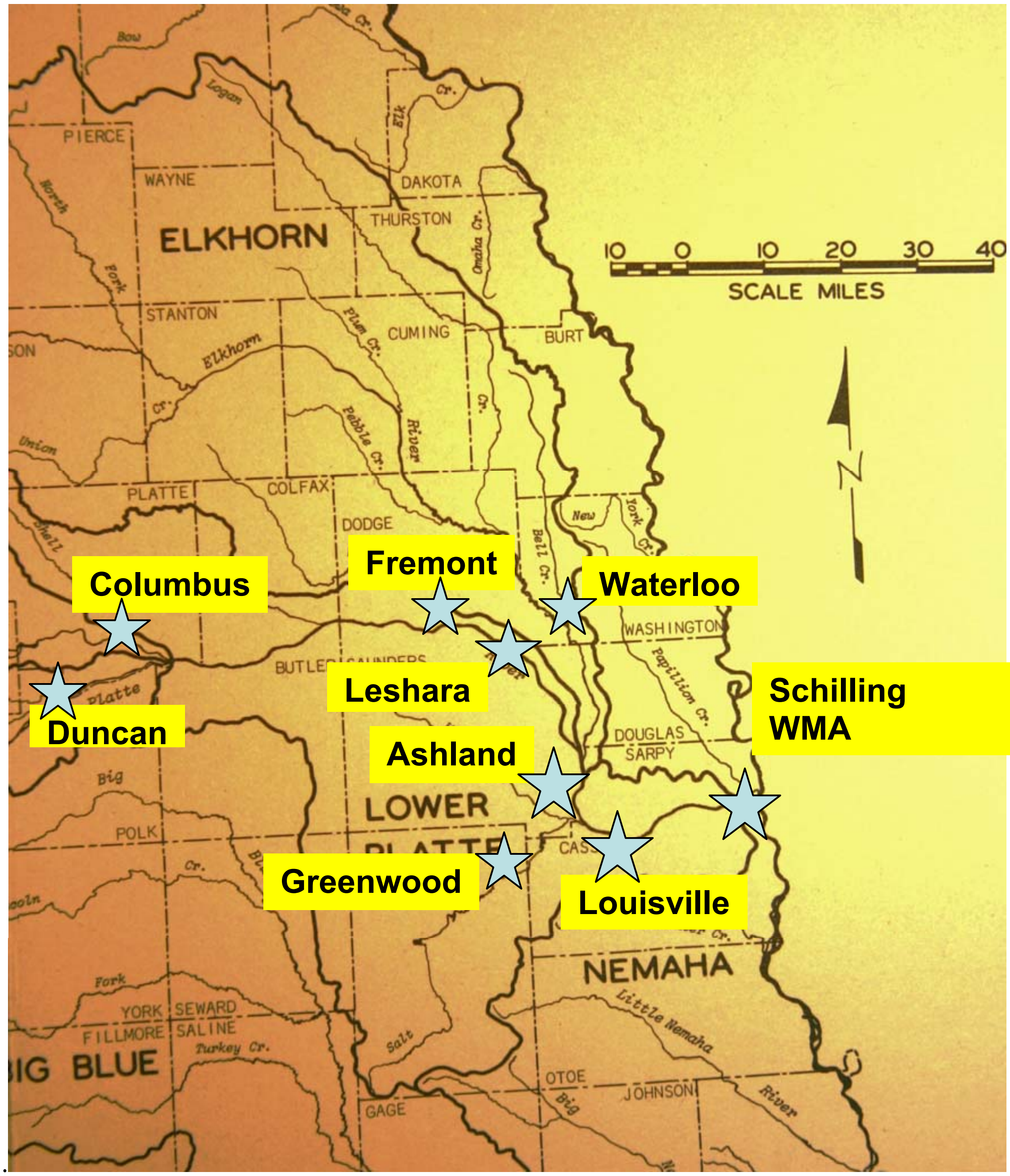


Figure 1. Map of the lower Platte River showing major tributaries and important landmarks used to reference study sites.

Table 1. Location of study sites and points of reference along the lower Platte River, Nebraska indicating river miles (RM) from the confluence of the Platte and Missouri Rivers (US Army Corps of Engineers aerial photography, April 21, 1979).

LOCATION	RM	TYPE OF SAMPLING or POINT OF REFERENCE
US Highway 81 bridge	106.1	Larval fish sampling
Confluence of Loup River with the Platte River	103	POINT OF REFERENCE
Confluence of the Loup Power Canal with the Platte River	101.5	POINT OF REFERENCE
Nebraska Highway 15 bridge	88.5	POINT OF REFERENCE
Nebraska Highway 79 bridge	72.4	Larval fish sampling Substrate sampling
US Highway 77 bridge	56. 8	POINT OF REFERENCE
Nebraska Highway 64 bridge	48.8	Substrate sampling Water chemistry sampling Access point for trawling
Nebraska Highway 92 bridge	41.5	POINT OF REFERENCE
Two Rivers State Recreation area	40.8	Larval fish sampling
Confluence of Elkhorn River with the Platte River	32.8	POINT OF REFERENCE
US Highway 6 bridge	27.8	Larval fish sampling site Substrate and water chemistry sampling site
Confluence of Salt Creek with the Platte River	25.9	POINT OF REFERENCE
Interstate Highway 80 bridge	25	POINT OF REFERENCE
Schramm Park	22	Upstream access point for creel survey
Louisville Lakes State Recreation Area	17-18	Access point for creel survey
Nebraska Highway 50 bridge	16.3	Access point for creel survey Substrate and water chemistry sampling site
Sand bar and deep run downstream from Louisville	15.5	Larval fish sampling site
Omaha Metropolitan Utilities District Cedar Island Well Field	5-7	POINT OF REFERENCE
US Highway 73,75 bridge	2.6	POINT OF REFERENCE
Schilling Wildlife Management Area	0 – 0.5	Downstream access point for creel survey Larval fish sampling site

River Discharge (contributions of tributaries to the Platte River)

At its upstream end the lower Platte River receives water from the Platte River and the Loup River. An examination of the mean monthly discharge records for the common time period of 1954 to 2004 for all gages except the Platte River at Ashland, NE (USGS Gage: 6801000, 1954 – 1960 and 1989 – 1999) as displayed in Table 2 (Mean monthly discharges) and Table 3 (Percentages of Louisville discharge) shows that mean monthly discharge records from the Platte River near Duncan, NE (USGS Gage: 677400) average about 27% of the mean monthly discharge at the Louisville, NE gage (USGS Gage: 6805500). The highest monthly percentage of discharge, between Duncan and Louisville, occurs during January (34%), December (33%) and February (31%). The lowest percentage monthly discharge at Duncan occurs during August and is 18% of discharge at the Louisville gage.

During dry periods, especially during the summer, most or all of the flow in the Platte River comes from the Loup River system. The Loup River system drains approximately 15,230 square miles of sandy and loess soils in central Nebraska. Most of the sandy soils support rangeland agriculture, while most of the loess soils are devoted to cultivated cropland agriculture (NDEQ 1990). Mean monthly discharge records from the Loup River near Genoa, NE (USGS Gage: 679300) averages about 10% of the Louisville gage and the Loup River Power Canal near Genoa, NE (USGS Gage: 6792500) over its period of record from1937 to present averages 24% of the Louisville Gage. The sum of these two gages, which would represent the total flow of the Loup River at the mouth of the Loup River, therefore averages, about 34% of the discharge at the Louisville gage. The percentage that the Loup River contributes to the Platte River discharge at Louisville ranges from 25% during June to 46% during January.

Between the Loup River and the Elkhorn River the lower Platte receives small additions to its flow from the Shell Creek and Lost Creek drainages. However, on some occasions heavy rains in the Shell Creek Drainage can contribute large volumes of runoff to the lower Platte River. This runoff is typically silt-laden and has been noted to carry pesticides and nutrients at concentrations that are ranked “among the highest in the Nation” (Frenzel et al. 1998). This section of the lower Platte River also receives inflow from several drainage ditches that were dug to lower water tables on the north side of the river.

The Elkhorn River drains about 7,000 square miles from the eastern Sandhills, which produces considerable amounts of hay from grasses and alfalfa (NDEQ 1990). The eastern portion of the basin produces large quantities of corn and soybeans on loess soils in northeast Nebraska. Irrigation in most of the Elkhorn River drainage depends heavily on ground water withdrawals. Discharge from the Elkhorn River at Waterloo, NE (USGS Gage: 6800500) averages 21% of the discharge for the Platte River at Louisville and ranges from 15% during January to 27% during June. This means that the Elkhorn River is an important contributor to summer flows in the lower Platte River.

Downstream from the Elkhorn River, Salt Creek, which includes the flows from the Wahoo Creek Drainage enters the lower Platte River from the south side. Discharge from Salt Creek at Greenwood, NE (USGS Gage: 6803555) averages 5% of the Platte River discharge at Louisville and ranges from 3% during November through January to 8% during July and August. This is the only major tributary that drains land on the south side of the Platte River in Nebraska. Salt Creek receives flows from sewage treatment facilities in Lincoln, Nebraska and saline water from salt marshes in Lancaster County and therefore has water chemistry characteristics that are quite different from the other tributaries to the lower Platte River.

Overall, the inputs from these gaged sources account for an annual average of 88% of the discharge at Louisville and ranges from a low of 83% during May to July to a high of 99% during January. In contrast to these sources of water for the lower Platte River the well fields for the cities of Lincoln and Omaha withdraw water from aquifers along and under the Platte River. The Lincoln well fields extend from just downstream of the confluence of the Platte River and the Elkhorn River (RM 32.8) to just upstream from the confluence of the Platte River and Salt Creek (RM 25.9). The operating Omaha well field is located in the area downstream from the Nebraska highway 50 bridge approximately from RM 7 downstream to RM 5. A new well field for the Omaha metropolitan area is being developed in the area upstream from the confluence of the Platte River and Elkhorn River between RM 33 and 38. Specific depletions of flows in the Platte River have not, to our knowledge, been measured, but water system officials from both Lincoln and Omaha have expressed concern when flows in the Platte River are low, especially during the summer.

Table 2. Mean Monthly Discharge from 1954 to 2004 for Selected Gage Stations Associated with the lower Platte River, Nebraska. All gages have complete record except the Platte River at Ashland, NE where the period of record is 1954-1960 & 1989-1999.

				Discharge (cfs)				
Gage Location	USGS Gage Number	JAN	FEB	MAR	APR	MAY	JUN	JUL
Platte River near Duncan, NE	6774000	1633	2328	2923	2552	2601	2891	1432
Loup River near Genoa, NE	6793000	1043	1360	1661	732	612	727	293
Loup River Power Canal near Genoa, NE	6792500	1155	1604	1939	2191	2035	1960	1371
Platte River near North Bend, NE	6796000	3409	5164	7285	5992	5858	6562	3573
Elkhorn River near Waterloo, NE	6800500	713	1396	2421	2381	2321	2998	1616
Platte River near Ashland, NE	6801000	4047	6012	8610	8299	8298	9523	6186
Salt Creek near Greenwood, NE	6803555	159	262	496	393	608	716	508
Platte River near Louisville, NE	6805500	4742	7455	11013	9819	9823	11166	6278

				Discharge (cfs)			
Gage Location	USGS Gage Number	AUG	SEP	OCT	NOV	DEC	Yearly Mean
Platte River near Duncan, NE	6774000	729	1025	1487	1602	1596	1900
Loup River near Genoa, NE	6793000	241	258	148	470	1165	726
Loup River Power Canal near Genoa, NE	6792500	1262	1587	2024	1926	986	1670
Platte River near North Bend, NE	6796000	2452	3049	3837	4169	3606	4580
Elkhorn River near Waterloo, NE	6800500	989	789	827	871	770	1508
Platte River near Ashland, NE	6801000	3963	3652	4421	5076	4599	6057
Salt Creek near Greenwood, NE	6803555	314	261	258	180	149	359
Platte River near Louisville, NE	6805500	4105	4285	5164	5500	4894	7020

Table 3. Percentage of Discharge Compared with Louisville Discharge from 1954 to 2004 for Selected Gage Stations Associated with the lower Platte River, Nebraska. All gages have complete record except the Platte River at Ashland, NE where the period of record is 1954-1960 & 1989-1999.

				Discharge (%)				
Gage Location	USGS Gage Number	JAN	FEB	MAR	APR	MAY	JUN	JUL
Platte River near Duncan, NE	6774000	34%	31%	27%	26%	26%	26%	23%
Loup River near Genoa, NE	6793000	22%	18%	15%	7%	6%	7%	5%
Loup River Power Canal near Genoa, NE	6792500	24%	22%	18%	22%	21%	18%	22%
Platte River near North Bend, NE	6796000	72%	69%	66%	61%	60%	59%	57%
Elkhorn River near Waterloo, NE	6800500	15%	19%	22%	24%	24%	27%	26%
Platte River near Ashland, NE	6801000	85%	81%	78%	85%	84%	85%	99%
Salt Creek near Greenwood, NE	6803555	3%	4%	5%	4%	6%	6%	8%
Platte River near Louisville, NE	6805500	100%	100%	100%	100%	100%	100%	100%

				Discharge (%)			
Gage Location	USGS Gage Number	AUG	SEP	OCT	NOV	DEC	Yearly Mean
Platte River near Duncan, NE	6774000	18%	24%	29%	29%	33%	27%
Loup River near Genoa, NE	6793000	6%	6%	3%	9%	24%	10%
Loup River Power Canal near Genoa, NE	6792500	31%	37%	39%	35%	20%	24%
Platte River near North Bend, NE	6796000	60%	71%	74%	76%	74%	65%
Elkhorn River near Waterloo, NE	6800500	24%	18%	16%	16%	16%	21%
Platte River near Ashland, NE	6801000	97%	85%	86%	92%	94%	86%
Salt Creek near Greenwood, NE	6803555	8%	6%	5%	3%	3%	5%
Platte River near Louisville, NE	6805500	100%	100%	100%	100%	100%	100%

Comparison of Historic Discharge Records to the 2000 to 2004 study period:

The period of 2000 to 2004 was one of very low precipitation in the Platte River drainage (US Drought Monitor: http://drought.unl.edu/dm). This resulted in depletions in the amount of water stored and released from reservoirs of the North and South Platte River system and resulted in periods of zero discharge in the Platte River upstream from Columbus. An examination of the mean monthly discharge records at the Louisville gage as displayed in Table 4 (Comparison of mean monthly discharges) and Table 5 (Percentages) shows that discharge during the 2000 to 2004 period of study averaged 74% of pre-2000 flows and ranged from 53% of pre-2000 flows during June to 98% of pre-2000 flows during January. Discharge during the period of the study at the Duncan gage on the Platte River was proportionally the lowest, averaging 55% of pre-2000 flows while discharge during the period of the study at the Elkhorn River at Waterloo gage was proportionally the highest, averaging 102% of pre-2000 flows.

Mean daily discharge values from USGS gaging stations for the Platte River at Leshara, the Elkhorn River at Waterloo, Salt Creek at Greenwood, and the Platte River at Louisville for July 2001 through June 2004 on the dates those sites were sampled for water quality parameters are displayed on Figures 2, 3, 4 and 5, respectively (note that the scales on the Y-axes vary at each site).

Table 4. Mean Monthly Discharge Prior to and during Study Period for Selected Gage Stations Associated with the lower Platte River, Nebraska

				Discharge (cfs)					
Gage Location	USGS Gage Number	Time Period	January	February	March	April	May	June	July
Platte River near Duncan, NE	6774000	1929-1999	1506	2310	3019	2429	2560	2872	1259
		2000-2004	1587	1719	1918	1495	1324	592	337
Loup River near Genoa, NE	6793000	1944-1999	957	1377	1667	680	638	928	376
		2000-2004	1254	976	1634	887	501	129	139
Loup River Power Canal near Genoa, NE	6792500	1937-1999	1158	1513	1810	2107	1969	1921	1367
		2000-2004	835	1331	1621	2028	1898	1674	1266
Platte River near North Bend, NE	6796000	1950-1999	3466	5411	7510	6113	6020	6778	3778
		2000-2004	2828	3466	4912	4732	4462	3037	2075
Elkhorn River near Waterloo, NE	6800500	1929-1999	608	1198	2281	2061	2040	2857	1421
		2000-2004	922	1231	1838	1949	2847	2115	1841
Platte River near Ashland, NE	6801000	1928-1960 & 1989-1999	3732	5837	9007	7514	7675	9905	5385
		2000-2004	3255	5022	7354	6573	7997	5539	3743
Salt Creek near Greenwood, NE	6803555	1952-1999	159	269	518	423	595	725	537
		2000-2004	141	171	276	178	619	542	211
Platte River near Louisville, NE	6805500	1954-1999	4751	7610	11270	10071	9949	11706	6513
		2000-2004	4654	6030	8648	7498	8661	6193	4115

Table 4 (continued). Mean Monthly Discharge Prior to and during Study Period for Selected Gage Stations Associated with the lower Platte River, Nebraska

				Discharge (cfs)				
Gage Location	USGS Gage Number	Time Period	August	September	October	November	December	Yearly Mean
Platte River near Duncan, NE	6774000	1929-1999	563	903	1314	1479	1441	1140
		2000-2004	248	271	570	764	1022	575
Loup River near Genoa, NE	6793000	1944-1999	260	237	151	436	1072	431
		2000-2004	82	223	167	688	1342	500
Loup River Power Canal near Genoa, NE	6792500	1937-1999	1239	1546	1942	1853	992	1514
		2000-2004	1126	1530	1852	1713	970	1438
Platte River near North Bend, NE	6796000	1950-1999	2588	3129	3873	4219	3666	3495
		2000-2004	1464	2137	2897	3338	2664	2500
Elkhorn River near Waterloo, NE	6800500	1929-1999	964	735	730	752	655	767
		2000-2004	704	645	701	909	876	767
Platte River near Ashland, NE	6801000	1928-1960 & 1989-1999	3557	3428	3971	4529	3980	3893
		2000-2004	1908	2565	3406	4212	3851	3188
Salt Creek near Greenwood, NE	6803555	1952-1999	321	263	255	178	148	233
		2000-2004	203	171	191	163	124	170
Platte River near Louisville, NE	6805500	1954-1999	4298	4437	5287	5586	4947	4911
		2000-2004	2327	2887	3740	4507	4288	3550

Table 5. Percentage of Discharge for Study Period (2000-2004) Compared with Discharge Prior to Study Period for Selected Gage Stations Associated with the lower Platte River, Nebraska

				% of prestudy flows				
Gage Location	USGS Gage Number	JAN	FEB	MAR	APR	MAY	JUN	
Platte River near Duncan, NE	6774000	105	74	64	62	52	21	
Loup River near Genoa, NE	6793000	131	71	98	131	79	14	
Loup River Power Canal near Genoa, NE	6792500	72	88	90	96	96	87	
Platte River near North Bend, NE	6796000	82	64	65	77	74	45	
Elkhorn River near Waterloo, NE	6800500	152	103	81	95	140	74	
Platte River near Ashland, NE	6801000	87	86	82	87	104	56	
Salt Creek near Greenwood, NE	6803555	89	63	53	42	104	75	
Platte River near Louisville, NE	6805500	98	79	77	74	87	53	

				% of prestudy flows				
Gage Location	USGS Gage Number	JUL	AUG	SEP	OCT	NOV	DEC	Yearly Mean
Platte River near Duncan, NE	6774000	27	44	30	43	52	71	55
Loup River near Genoa, NE	6793000	37	32	94	111	158	125	91
Loup River Power Canal near Genoa, NE	6792500	93	91	99	95	92	98	92
Platte River near North Bend, NE	6796000	55	57	68	75	79	73	67
Elkhorn River near Waterloo, NE	6800500	130	73	88	96	121	134	102
Platte River near Ashland, NE	6801000	70	54	75	86	93	97	81
Salt Creek near Greenwood, NE	6803555	39	63	65	75	91	84	68
Platte River near Louisville, NE	6805500	63	54	65	71	81	87	74

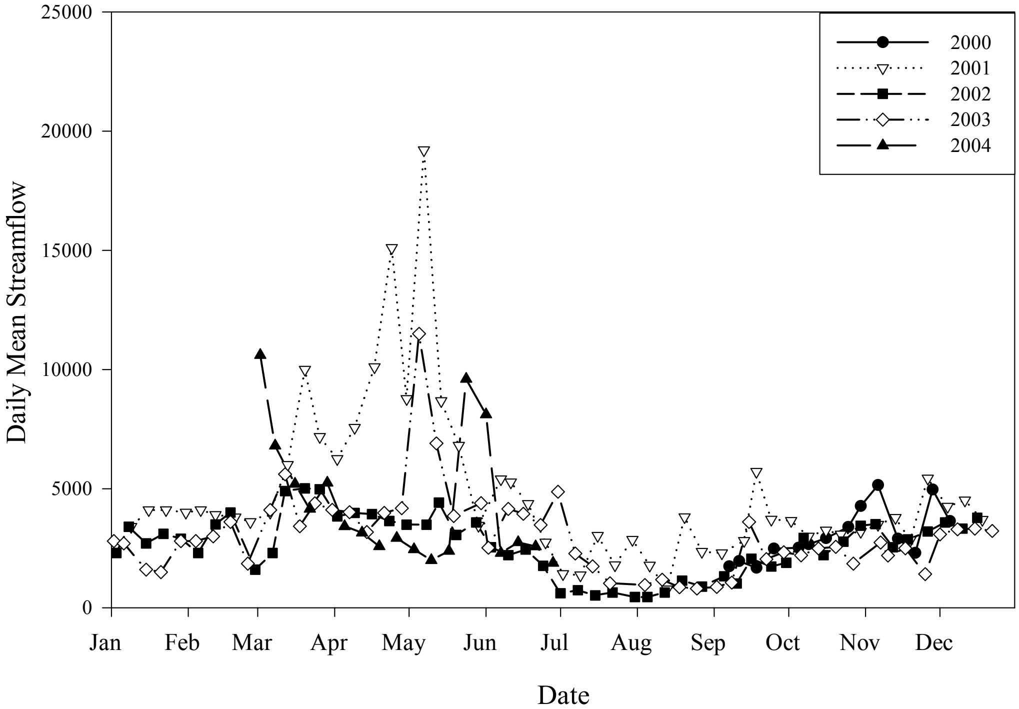


Figure 2. Platte River at Leshara daily mean streamflow (cfs), September 2000 to June 2004 (USGS data).

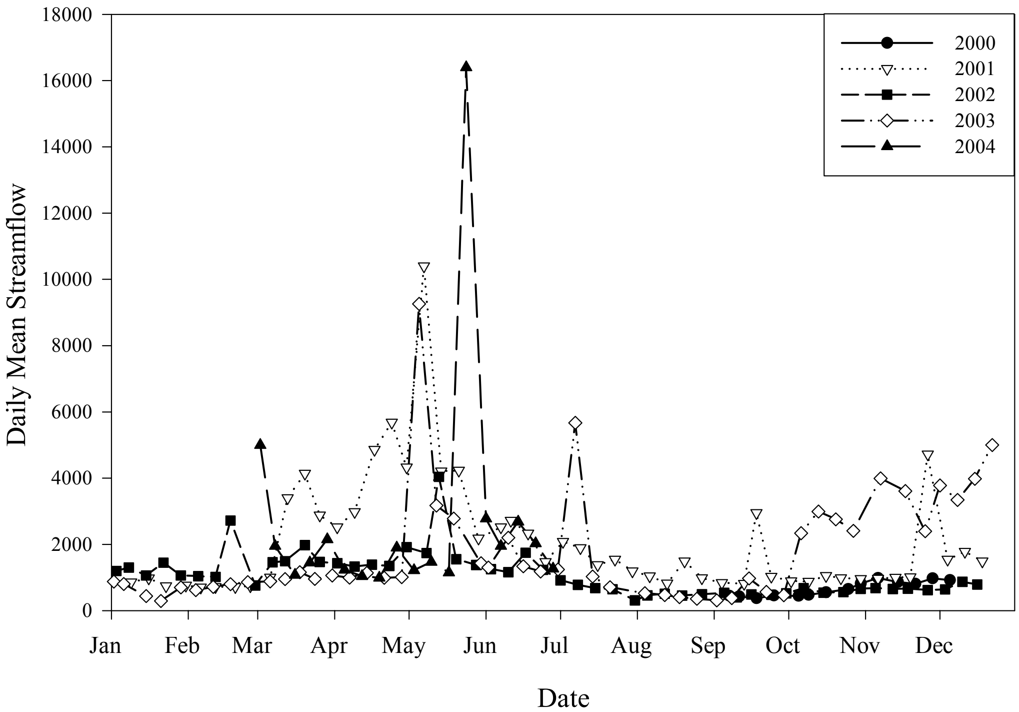


Figure 3. Elkhorn River at Waterloo daily mean streamflow (cfs), September 2000 to June 2004 (USGS data).

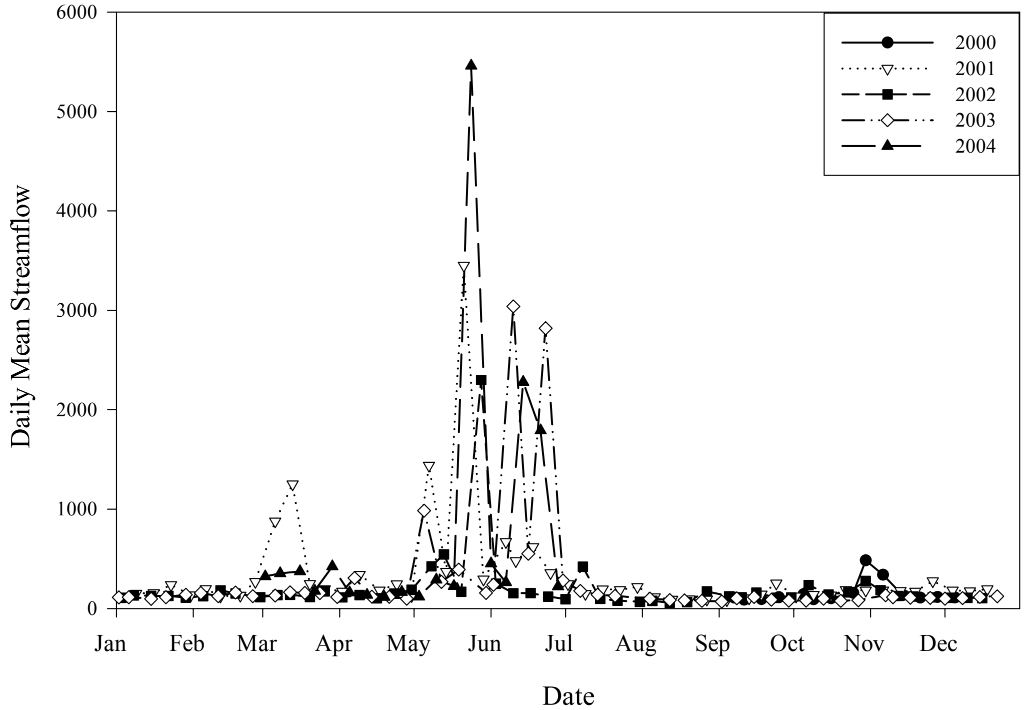


Figure 4. Salt Creek at Greenwood daily mean streamflow (cfs), September 2000 to June 2004 (USGS data).

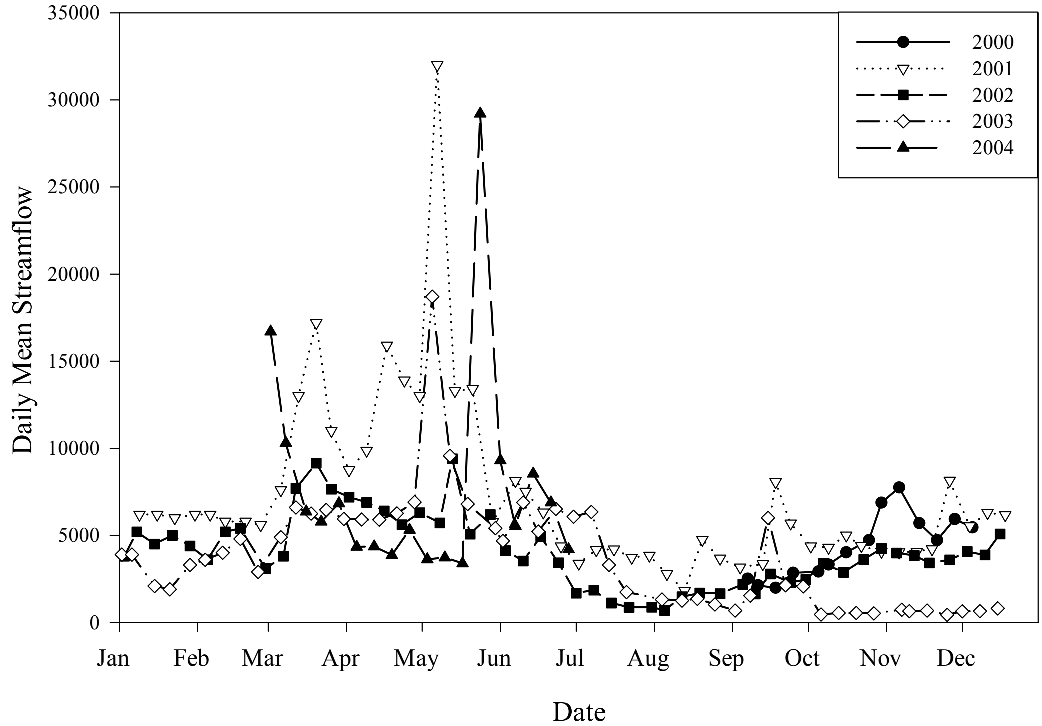


Figure 5. Platte River at Louisville daily mean streamflow (cfs), September 2000 to June 2004 (USGS data).

HISTORICAL CONTEXT:

Over the years since the first European settlement of the Platte River basin, many conflicts have arisen over the use and allocation of its water resources. These conflicts have included the need for water to support the habitat of endangered and threatened species under the US Endangered Species Act. The US Fish and Wildlife Service has issued jeopardy opinions for activities that would affect the central Platte River, including one for the Narrows Project on the South Platte River in 1983, for water diversions on the Front Range in Colorado in 1994, and for relicensing the Kingsley hydroelectric project in 1997 (NRC 2005). In 1997, the states of Colorado, Wyoming, and Nebraska and the Department of the Interior entered into a Cooperative Agreement. As part of this agreement the parties have attempted to develop a program, which if signed, would aim to reduce shortages to U.S. Fish and Wildlife Services target flows at Grand Island by 130,000 to 150,000 acre-feet per year and to protect or restore 10,000 acres of habitat in the central Platte region.

FISH SPECIES:

One hundred species of fish (76 native, 24 exotic) have been recorded from the Platte (Schainost and Koneya 1999, Peters and Schainost 2005). Of particular interest to this study are the pallid sturgeon and sturgeon chub. In recent years, the Nebraska distribution of these species has been confined to the Missouri River and the lower reaches of the Platte River.

Pallid sturgeon:

Extensive sampling in the tributaries of the Missouri River basin has found populations of pallid sturgeon only in the Yellowstone, Kansas and Platte Rivers (USFWS 1993) and Cross and Collins (1995) state that it only enters the Kansas River during floods. However, tributary mouths have been characterized as an important habitat feature by several studies (Hurley1998, Sheehan et al. 1998) The earliest records of pallid sturgeon in Nebraska were from the Missouri River during the 1950's and the earliest record from the Platte River was from Sarpy County in 1979 (Darrell Feit; personal communication) . However, as Keenlyne (1989) pointed out, many fishery reports failed to distinguish between pallid and shovelnose sturgeon until the 1970's. Starting in January 2000, the NGPC began compiling pallid sturgeon catches in Nebraska (Darrell Feit; personal communication) and this includes records from 1979, 1990, 1993, 1995, and 1997. This listing includes documented Heritage Data base reports from anglers and each report was subjectively evaluated for accuracy. Figures 6 and 7 indicate the locations of pallid sturgeon captured by anglers that were confirmed by Darrell Feit from the NGPC from the Platte River and the Elkhorn River prior to and during this study.

Historically, pallid sturgeon were more abundant in the main stem and major tributaries of the Missouri and Mississippi Rivers than they are currently. Keenelyne (1989) reported that "correspondence and notes of researchers suggest that pallid sturgeon were still fairly common in many parts of the Mississippi and Missouri river systems as late as 1967. Forbes and Richardson (1905) estimated that pallid sturgeon comprised 1 in 5 river sturgeon collected in the lower Missouri River. The pallid sturgeon was listed as an endangered species by the US Fish and Wildlife Service in 1990 (Federal Register 55 [September 6, 1990]: 36641-36647). Overfishing and modification of rivers for navigation, power production, and agricultural water use are hypothesized to be responsible for the decline of pallid sturgeon (Kallemeyn 1983, USFWS 1993).

Since 1997 pallid sturgeon have been stocked in the Missouri River and Platte River to attempt to augment their recovery from endangered status (Krentz et al. 2005). In 1997, 401 pallid sturgeon were stocked into the Platte River at the Nebraska highway 50 bridge. These fish were hatched in 1997 at the Blind Pony Fish Hatchery in Missouri and were tagged with external Floy tags at the base of their pectoral fins. In 1998, 84 age 6 pallid sturgeon, spawned at the Blind Pony Fish Hatchery in Missouri in 1992 were tagged with passive integrated transponder (PIT) tags and coded wire tags and released into the Platte River at Two Rivers State Recreation Area (RM 40). Ten of these fish were also implanted with radio transmitters. In 1999, 15 age 7 pallid sturgeon were PIT tagged, coded wire tagged and implanted with radio transmitters and released into the Platte River at Two Rivers State Recreation Area. These fish were monitored for movement and habitat use from April 1998 to May 2000 (Snook 2001), but none of these fish were collected during this study. From 1994 through 2004, 68,815 Pallid sturgeon have been stocked into the section of the Missouri River which comprises Recovery Priority Management Area 4 that extends from Gavins Point Dam downstream to the mouth of the Missouri River. Of these, 20,622 were stocked in the Missouri River between Bellevue, NE (RM 601.4) and St. Helena, NE (RM 799) during the years 2002-2004 Krentz et al (2005).

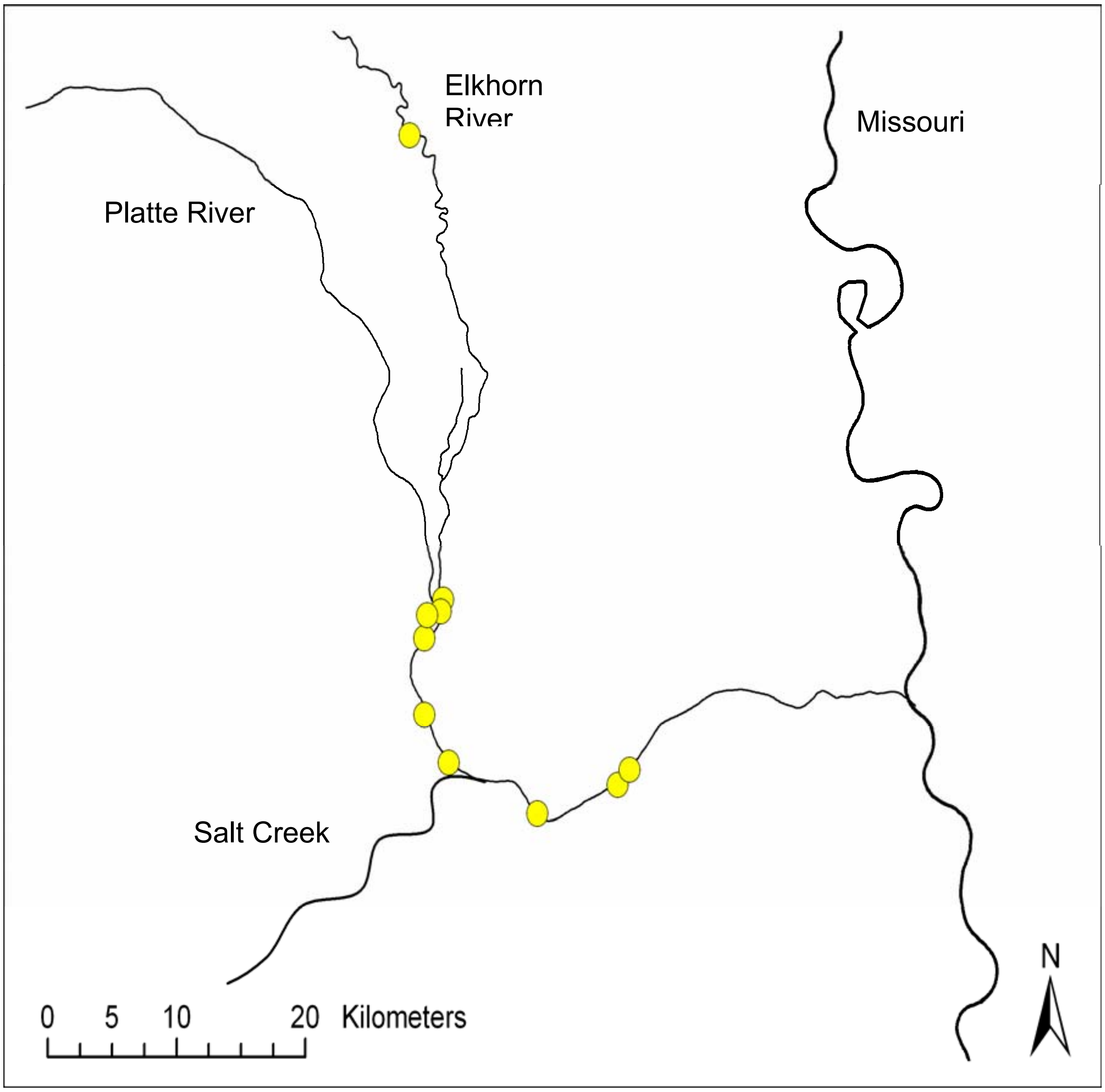


Figure 6. Locations of confirmed pallid sturgeon captures by anglers (1979 – 2000) prior to this study.

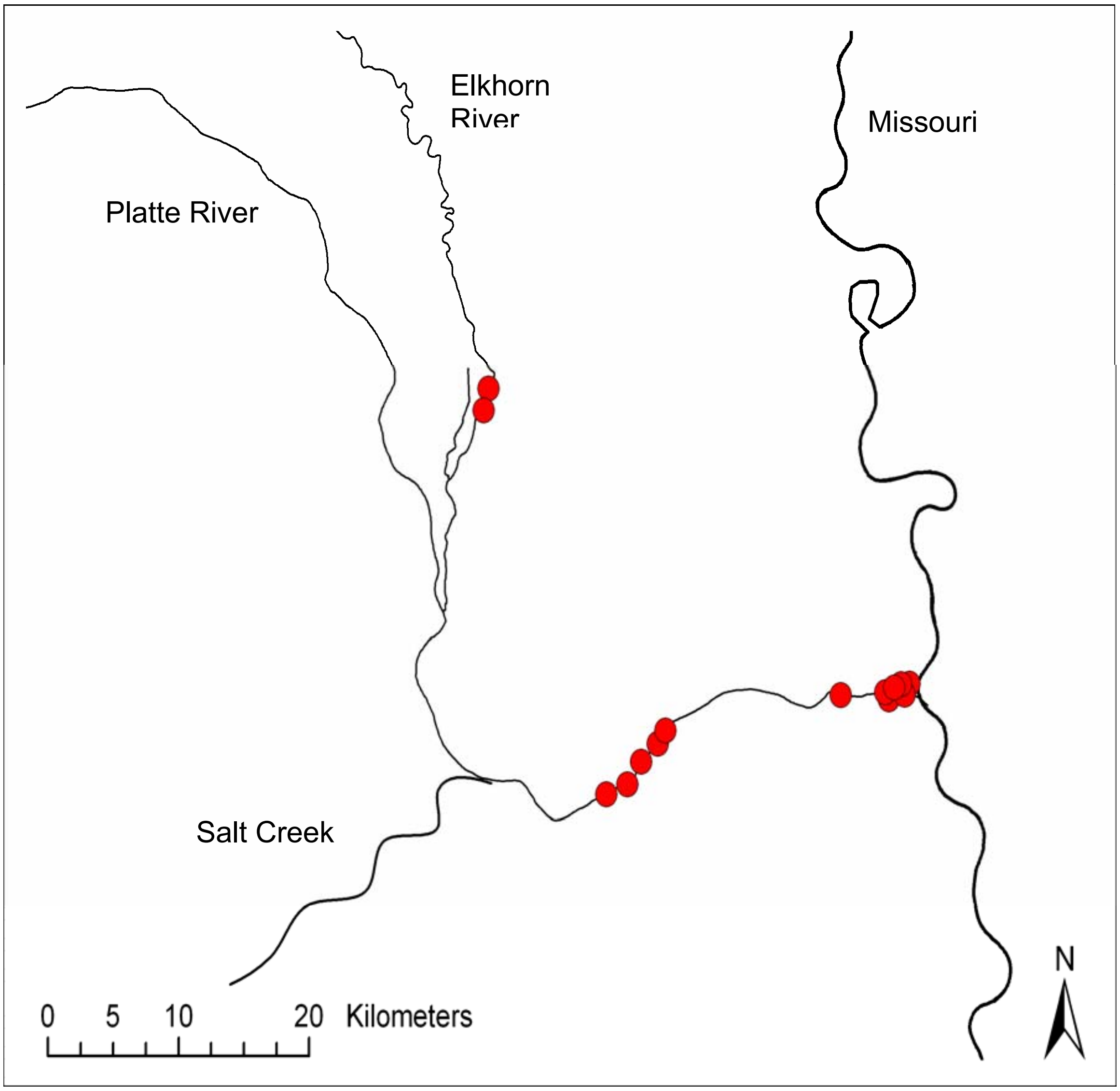


Figure 7. Locations of confirmed pallid sturgeon captures (2001 – 2004) during this study.

Movement of pallid sturgeon: To aid in the conservation and recovery of the sturgeon species, information regarding the movement of these fish is needed (Quist et al. 2004). Movement patterns by pallid sturgeon have been described by several authors (Erickson 1992, Tews 1994, Bramblett 1996, Constant et al. 1997, Hurley 1998, Snook 2001, Swigle 2003). Within our objectives we studied the movement of pallid sturgeon into, out of, and within the lower Platte River.

Sturgeon Food Habits: One of the most direct links between a species and its association with other species is via the food resources that it consumes. During the period 2001 to 2002, we sampled shovelnose sturgeon (*Scaphirhynchus platorynchus*) stomachs to find the composition of their diet (Shuman 2003). This was done to perfect our techniques so that when gastric lavage was approved for use on pallid sturgeon we would be able to use this method. Shovelnose sturgeon were used because of their similar body structure and because they are a closely related species. Associated with this study, we also investigated the potential hazards and the efficacy of using pulsed gastric lavage as a tool for sampling the diets of pallid sturgeon.

A limitation of diet analysis is that in many cases the study animals must be sacrificed to obtain reliable information. Gastric lavage was developed by Foster (1977) and has been used successfully on many species. Hofpar (1997) used gastric lavage on shovelnose sturgeon in the Platte River and Brosse et al. (2002) used it on Siberian sturgeon (*Acipenser baeri*). Both of these studies found no problems with the use of gastric lavage. However, there have been several reports of water being forced into the air bladder of sturgeon during the lavage process (Sprague et al. 1993). This potentially serious problem resulted in a restriction being placed on the use of this technique on endangered species like pallid sturgeon. Within our objectives we tested the safety of gastric lavage for use on pallid sturgeon by running a series of controlled tests on wild caught shovelnose sturgeon.

Habitat use: Pallid sturgeon are fish of large turbid rivers (Cross and Collins 1995, Bailey and Allum 1962, Lee 1980). Bramblett and White (2001) found them most regularly in river reaches with frequent islands and sand bars. Hurley (1998) found them at the mouths of tributaries and Snook et al (2002) found them at the downstream end of sand bars where currents converge. Depth of water used by telemetry located pallid sturgeon range from less than 1meter (Bramblett and White 2001 and Snook et al. 2002) to 12 meters (Hurley 1998). Bottom velocity use ranged from 0 to 0.97m/s (Bramblett and White 2001 and Snook et al. 2002). Pallid sturgeon tolerate temperatures from 0 to 33^0C, but no specific thermal tolerances have been published. Bailey and Cross (1954) and Erickson (1992) state that pallid sturgeon avoid areas that are not turbid. Very little is known about pallid sturgeon tolerances for most water chemistry parameters, but the Missouri River and its western tributaries are generally high in dissolved solids (Galat et al. 2005a).

Age and growth: Pallid sturgeon are long lived fishes. As a result of this and the fact that most of their skeletons are cartilaginous, determination of growth rates has been challenging (Morrow et al. 1998). Helms (1973), working in the Mississippi River and Fogle (1963) working in the Missouri River, found large variations in length at age for shovelnose sturgeon. Determining the age of pallid sturgeon has been limited by endangered species regulations designed to protect the species from undue stress. Hurley (1998) used hatchery reared pallid sturgeon to document the age determination by use of pectoral fin rays and found that most readings were 3 years off. Fogle (1963) found that pallid sturgeon growth was rapid at first, but slowed to about 70 mm per year by age 5.

Length / Weight: Indexes of condition for fish fall into two main types, the Fulton condition factors (K) and relative weight (Wr) (Anderson and Neumann 1996). The value of K is computed by multiplying the weight of a fish in grams (W) by 100,000 and dividing this product by the length of the fish in millimeters cubed (L^3). Relative weight values compare the weight of an individual fish of a given length to a standard weight for fish of that same length as calculated from a regression equation developed for that species. Carlander (1969) summarized K values for many species including pallid sturgeon. However, the values he listed were calculated using total lengths (K(TL)) rather than the fork length measurements we typically use to measure pallid sturgeon today. More recently, Quist et al. (1999) developed standard weight equations for shovelnose sturgeon that has allowed use of this method of assessing condition to be used for the management and evaluation of shovelnose sturgeon population health. However, at this time, there are no published standard weight equations for evaluation of pallid sturgeon condition.

Morphometrics: Difficulties in distinguishing between pallid sturgeon and shovelnose sturgeon have led several studies to propose morphological and meristic tools as field aids. Compounding the difficulties in accurate species identification is the suspicion that the two species are hybridizing. Hybridization has led to a number of intergrades with individuals lacking definite characteristics of one species or the other. Carlson et al. (1985) and Sheehan et al. (1999), have proposed indexes that have been the basis for many field identifications. Unfortunately, several studies, including Kuhajda et al. (2005) have found inconsistencies in identification of specimens because of the difficulties in consistently performing certain field measurements such as barbel lengths. On the other hand, Murphy et al. (2005) found that in the lower Mississippi River basin, using morphometric ratios may be useful in areas where hybridization rates are low.

Sturgeon chub:

During recent years, sturgeon chubs have been collected widely during surveys in the Missouri River main stem (Galat et al. 2005b) and several of its tributaries (Werdon 1992). Because of their apparently greater abundance than previously thought, the sturgeon chub did not receive Federal endangered species or threatened species status, even though their overall distribution has been constricted (Werdon 1993). However, sturgeon chub are considered a threatened species in Nebraska. The first documented collection of sturgeon chubs in Nebraska is from Bazile Creek and the Platte River near Grand Island (Evermann and Cox 1896). Johnson (1942) considered sturgeon chub to be abundant in the Republican River and he indicated that they were found in the Platte River downstream from Gothenburg and in the Elkhorn River downstream from Winslow. Collections, since 1980, have only found them in the lower Platte River and the Missouri River (Schainost and Koneya 1999), and there are no recent records from the Republican River.

Habitat use: Sturgeon chub are endemic to the Missouri River and its tributaries on the west along with the Mississippi River downstream from the Missouri River (Bailey and Allum 1962 and Pflieger 1997, Etnier and Starnes 1993). It is commonly found in turbid conditions over sand and gravel substrates and avoided clear water conditions (Werdon 1992)

Age and growth: Sturgeon chub live for up to four years and attained lengths up to 96mm in Wyoming (Stewart 1981) but seldom attain lengths of over 75mm in Missouri where they seldom live past age 2 (Pfleiger 1997).

Length Weight: Stewart (1981) measured and weighed 28 specimens of sturgeon chub from the Powder River in Wyoming and we calculated condition factors for these fish. The average condition factor was 0.59 with a range of 0.29 to 0.87.

LARVAL FISHES:

Until recently, most studies of river fishes have largely ignored their eggs, larvae, and other early life stages (Brown and Coon 1994, Scheidegger and Bain 1995, Wolf et al. 1996). However, the presence of the larval stage of a species can give an indication of the spawning success for that year and provide an early indication of the year-class-strength later in the life of that cohort (Hergenrader et al. 1982, Franzin and Harbicht 1992). Prior to the studies of Hofpar (1997) and Reade (2000) there was virtually no information on larval fish in the Platte River. Both studies collected larval sturgeon and Reade (2000) collected chub larvae. Based on the information from these studies, one of our objectives in this study was to document the phenology and relative abundance of larval recruitment for pallid sturgeon, sturgeon chub, and associated species in the lower Platte River.

AMBIENT HABITAT CONDITIONS:

Habitat conditions are important to the existence and viability of fish populations. In association with a study of pallid sturgeon and sturgeon chub populations in the Platte River, we initiated a monitoring program to document changes in several water quality parameters in September 2000. The objective of this potion of the study was to sample the water quality parameters of temperature, dissolved oxygen, water conductivity (including specific conductivity and salinity), and suspended solids at four locations in the lower Platte River basin. Two sampling sites, near Leshara, NE (Nebraska Highway 64 bridge) and Louisville, NE (Nebraska Highway 50 bridge), were on the Platte River, while two other sites, near Greenwood, NE and Waterloo, NE were located on Salt Creek and the Elkhorn River, respectively. Salt Creek and the Elkhorn River are the two main tributaries of the lower Platte River and examination of past water quality records indicated that their inflows have important impacts on the chemistry of the Platte River (Hitch et al. 2003). An additional important component of the ambient river habitat conditions is to evaluate the composition of the substrate within our study area on the Platte River. In 2003, we initiated a substrate sampling effort that included the four water quality sites and additional sites at North Bend (Nebraska Highway 79 bridge) and Ashland (US Highway 6 bridge) on the Platte River.

The parameters measured correspond directly to the water quality measurements made in association with radio-telemetry locations of tagged pallid sturgeon and with collections of fish during the sturgeon and sturgeon chub studies. Locations of pallid sturgeon, sturgeon chub and associated species and the habitats they use will be related to ambient conditions in the Platte River.

ANGLER SURVEY OF THE LOWER PLATTE RIVER:

Recreational angling for sturgeon is a small but important spring activity in the lower Platte River according to 1992 and 1993 angler creel surveys (Holland and Peters 1994). These surveys found that most anglers fished primarily for channel catfish, but in the lower 25 miles of the river and especially near the Schilling Wildlife Management Area (WMA), shovelnose sturgeon fishing was popular in the early spring, where they comprised 4.0 and 5.3% of the catch in 1992 and 1993, respectively. Harvest of shovelnose sturgeon was over 73% of the total sturgeon caught during 1992 and 1993.

Unintentional harvest of pallid sturgeon by shovelnose sturgeon anglers is a concern for conservation and recovery efforts for the pallid (USFWS 1993). Therefore many states along the upper and middle reaches of the Missouri River have banned fishing for sturgeon. However, Nebraska has maintained this recreational fishery for shovelnose sturgeon on the Platte River and on the Missouri River below the confluence with the Big Sioux River. Commercial fishing operations in the Missouri River are not allowed to harvest any sturgeon species and are allowed to harvest rough fish only. Under Nebraska commercial fishing law the following species may be harvested: black bullhead, yellow bullhead, freshwater drum, yellow perch in addition to common carp, grass carp, silver carp, bighead carp, bigmouth buffalo, smallmouth buffalo, river carpsucker, quillback, white sucker, longnose gar, shortnose gar, and gizzard shad.

As part of our study, we wanted to evaluate the impact of angling on sturgeon and therefore our objective was to document the catch of sturgeon by anglers in the lower Platte River. We also wanted to evaluate the ability of anglers to distinguish pallid from shovelnose sturgeon.

METHODS

OVERVIEW OF FIELD METHODS:

To determine habitat use for pallid sturgeon, sturgeon chubs, and associated species in the lower Platte River, we sampled for fish using a range of gear types. The gear types included drifted gill nets, drifted trammel nets, stationary gill nets, trotlines, trawls, seines, and minnow traps. Since pallid sturgeon and sturgeon chub life stages are typically captured in different habitats and by different types of sampling gear, we used the gear to sample as many different Platte River habitats as practical, but our efforts centered on those areas where previous research and literature suggested that pallid sturgeon and sturgeon chub would most likely be found. Previous studies (Peters et al. 1989, Peters and Holland 1994 and Yu 1996) intensively sampled shallow water habitats and shoreline habitats in the lower Platte River between 1986 and 1995 and the results suggest that neither pallid sturgeon nor sturgeon chub use shallow water or shoreline habitats extensively, therefore, much of our sampling effort was focused in the deepest and swiftest sections of the river.

Pallid sturgeon that weighed at least 300 grams were deemed sufficiently large enough to hold a transmitter and were captured at times during the year when water temperatures were 16^{o}C or less were implanted with radio-telemetry transmitters and were tracked during the time they remained in the Platte River. In general, all fish captured in any effort using the different gear types were identified, weighed, and measured (fork length for sturgeon and total length for other species), and the habitat was characterized by recording information on habitat variables at several locations. All sturgeon captured were also measured for morphometric analysis using the morphometric character index (mCI) (Sheehan et al. 1999). A PIT tag was inserted lateral to the dorsal fin and pictures were taken to enable verification of our field identification. Sturgeon chub and other similar species were fixed in formalin for identification in the laboratory.

FISH SAMPLING METHODS:

Drifted Gill Nets and Trammel Nets:

Gill nets were constructed of monofilament nylon, 1.8 m (6 ft) deep by 30.5 m (100 ft) long, with four 7.6 m (25 ft) long alternating panels of 2.5 cm (1 in) and 5.1 cm (2 in) bar mesh. A pallid sturgeon or any other fish may be entangled in a gill net by wedging, caught by the gills or caught by their bony scutes (sharp bony scales) or other body projections. Trammel nets used in the Platte River measured 38.1 m (125 ft) long by 1.8 m (6 ft) deep. Trammel nets consist of three panels of netting suspended from a float line and a single or double lead line. The two outer panels are a larger mesh (15.2cm) than the inner panel (2.5cm). Fish are either gilled in the mesh or become bagged within the smaller mesh. Generally, trammel nets are less injurious to fish than gill nets and are also less size-selective (Hubert 1996). In addition, although they are more cumbersome to operate because of multiple, heavier mesh, they tend to be more efficient at catching and retaining fish located on or near the river bottom. The conversion of gear from drifted gill nets to drifted trammel nets was dictated by the desire to comply with the standards set forth and that are currently being used by other researchers on the Missouri River Pallid Sturgeon Recovery Team.

Both gill and trammel nets were drifted with the current, perpendicular to the flow of the current for distances up to about 200-400 m, depending on where landing sites were available. Locations for drifting a net were determined on site to best sample the available habitat. Areas that contained high concentrations of sunken snags were typically avoided when using entanglement gear. A crew of three or more workers deployed the net at the upstream end of the area to be sampled and walked or floated with the net to keep it spread and to release it if it became snagged on underwater obstructions. Sampling locations were selected at areas along and downstream from sandbars where water currents converge, or areas of sunken sandbars (underwater areas of shifting sand dunes typically 30-200 cm under the water surface) that were identified by Snook (2001) to be important habitats for pallid sturgeon. These areas typically had a 0.5-2 m deep shelf located on the downstream end. The average width of the net fished throughout the run and total length of the run was measured with a laser range finder. The length and width measurement was then multiplied to estimate the area sampled. The location of each run was determined at the start and the end of each run using a handheld global positioning system (GPS) unit.

Measurements used to describe the habitat sampled by the drifted nets were as follows. Water depth, mean column velocity, bottom velocity, and substrate were recorded at the estimated center of the net width at the start, mid point and end of the drift. Additionally, a single measurement of water temperature, dissolved oxygen, and specific conductivity was recorded for each run. A water sample was collected to determine total suspended solids and water turbidity in the laboratory, and pictures of the area sampled were taken. The distance to the shore in each direction was measured with a laser rangefinder to provide a method to approximate channel position of the run.

Stationary Gill Nets:

Stationary gill nets sets were used to attempt to capture sturgeon in the Platte River after they were recommended by researchers working in the Missouri and Mississippi Rivers. The nets were set parallel with the current in deep, slack water areas. The gill nets used were the same as the drifted gill nets, measuring 1.8 m (6 ft) deep by 30.5 m (100 ft) long, with four 7.6 m (25 ft) long alternating panels of 2.5 cm (1 in) and 5.1 cm (2 in) bar mesh and constructed of monofilament nylon. Nets were set overnight and fish were removed, identified and counted the following morning.

Trotlines:

Trotlines were used to sample for sturgeon in the cold water times of the year. They were recommended by researchers working in the lower Mississippi River (Killgore; personal communication). Our trotlines were 30 m long with 24 circle hooks alternating in size (10/0 and 12/0) attached to the main line by 0.5m drop lines at 1.0m intervals. Hooks were baited with night crawlers. Trotlines were set in the late afternoon, allowed to fish all night and the trotlines were retrieved in the morning. The trotlines were fished for approximately 18 hours and any fish caught were removed, identified, measured and released. Trotlines were typically set in deep pools and runs, and near sunken sandbars. Habitat variables were recorded at the upstream and downstream ends of the trotline after the line was set and then the next day prior to removing the trotline from the water. The location of each trotline set was determined by a GPS unit.

Trawls:

Benthic fish trawls were used to sample deeper run and pool habitats for pallid sturgeon, sturgeon chub and associated species. The trawl design was a modified otter trawl and it was used primarily in water over 1.0 m deep. The majority of samples were taken from channel habitat and areas of swift velocity where chubs have been found in previous research (Peters et al. 1989, Schainost and Koneya 1999). Sampling started in May and concluded in September. Sampling was timed to include the time chub spawning takes place to allow various age classes to be collected.

Habitat measurements recorded for each sample included: depth, mean column velocity, bottom velocity, dissolved oxygen, temperature, specific conductivity, total suspended solids, and GPS coordinates. Sand/gravel substrate combinations were recorded by percent of composition. Large fish were counted, measured and released in the field and small fish were preserved in 10% formalin and brought back to the lab for further analysis.

Seines and minnow traps:

Smaller fishes were also sampled using several other gears. Seines were used to sample shallow water habitats near sandbars. The seines used in this study included 1/16th in, 1/8th in, and 3/8th in mesh seines from 15 to 25 ft long. Some seines were modified by attaching a chain to the lead line to attempt to capture fish near the bottom of the river.

In addition to general seine hauls during 2002 and 2003, we collected small-fish at the US Highway 6 Bridge using minnow traps. Rectangular minnow traps made of 6.35 mm (1/4 in) wire mesh were deployed at dusk, left undisturbed over night, and retrieved at dawn. Traps were placed in "clusters" of three traps each in three different macro habitats. Typical habitats sampled included: deeper swift channels, shallow riffle areas, snag eddies (pools), and stabilized bank runs. Each trap was held in place with a 1.8 m (6 ft) length of rebar rod. Minnow traps were typically set in a side by side by side configuration in broader habitat types (such as deep or shallow runs) or in line with one another in narrower habitats (such as along a bank or behind a snag). At sunrise, traps were removed and the fish were either identified and measured in the field or preserved in 10% formalin and processed in the laboratory.

Telemetry:

Pallid sturgeon captured using drifted gill or trammel nets and trotlines were evaluated to determine whether they could receive a radio transmitter. These fish were identified using Sheehan et al. (1999) , and measured for fork length and weight. Only those pallid sturgeons whose body weight exceeded 300 g were considered to be large enough to receive a transmitter. This corresponds to the recommendation that all transmitters weigh less than 2.0% of each individual's body weight (Winter 1996). Small transmitters weighed 15 g, measured 42 x 15 mm, and had a life expectancy of approximately 400 days. Large transmitters weighed 20 g, measured 51 x 15 mm, and had a battery life of approximately 625 days.

To insert a radio tag into a pallid sturgeon, the fish was held belly side up over a plastic tub (65 x 42 x 25 cm) while the gills were irrigated with river water. A small mid-ventral incision was made in the peritoneal cavity to allow for insertion of the transmitter. The radio transmitter was inserted and a 30 cm radio antenna protruded from the fish's belly through a separate incision made with a large gauge hypodermic needle. Finally, the incision was closed with three or four individually tied sutures. Radio tagged fish were searched for or monitored throughout the year, from shore, boat, and aircraft to determine their locations in the Platte River. A permanent telemetry station was set up at the Schilling WMA located at the confluence with the Missouri River to monitor when radio tagged fish entered or left the Platte River.

Radio telemetry information used to evaluate habitat use was obtained exclusively from airboat surveys, while movement data came from all three contact methods (shore, boat and aircraft). Pallid sturgeons were located by triangulating the radio signal using a directional loop antenna. Final locations were typically accomplished by removing the antenna from the receiver to find the strongest signal.

To describe the area used by a telemetry tagged sturgeon, measurements of the habitat, including water depth, mean column velocity, bottom velocity, substrate, and cover, were made at the focal point of the radio signal location and then, 2 m upstream, 2 m downstream, 2 m to the left and 2 m to the right of the focal location (Hofpar 1997, and Snook 2001). This combination of measurements was used to provide a more detailed description of the habitat conditions in the immediate vicinity of sturgeon. This set of measurement locations also encompassed the estimated range of error associated with location of radio signals determined from previous studies of sturgeon and catfish (Bunnell 1988, Chapman 1995, Hofpar 1997, Snook 2001). In addition, single measurements of dissolved oxygen, water temperature, conductivity, and suspended solids were made at each location. This protocol was consistent with those used by similar studies in Montana (Bramblett 1996) and Illinois (Hurley 1998). The presence of underwater sand dunes and the proximity of radio-tagged fish to shallow sunken sandbar ledges were also recorded. Underwater sand dunes are waves in the sandy riverbed and sandbar ledges are areas with a rapid increase in water depth downstream from or lateral to shallowly submerged sandbars.

ANALYTICAL METHODS:

HABITAT USE

Habitat use:

The sampling strategy on the lower Platte River was not designed to be a random sample. Specific habitats that previous and concurrent studies have shown to harbor pallid sturgeon (Bramblett 1996, Bramblett and White 2001, Snook 2001, Snook et al. 2002, Swigle 2003) and sturgeon chub (Peters et al. 1989, Herzog and Ostendorf 2002, Elser et al. 1980) were preferentially sampled to attempt to capture these species of specific interest. Most of the efforts focused on the deepest and swiftest waters in the Platte River, which had been minimally sampled in previous studies due to this habitat type's rarity and difficulty to sample. A description of the habitat characteristics of the area sampled by the gear provided a general picture of the habitat in which the gear was set. Discharge measurements from the nearest USGS gage locations were used and recorded for the date of the sample. Due to the low number of pallid sturgeon and sturgeon chub captured during this study, we descriptively compared the habitats used by the fishes to the habitats sampled.

Movement:

All pallid sturgeon captured during this study were either tagged with a radio transmitter and/or a PIT tag if they did not already have a PIT tag. We obtained stocking location information for PIT tagged individuals from the U. S. Fish and Wildlife Service database (Bismarck, North Dakota). From this we estimated travel distances from point of stocking to point of capture in the Platte River by using Missouri River, river mile (RM) designations for the point of release for each fish.

Radio telemetry tracking was accomplished by listening for and triangulating the unique frequencies for each implanted fish during aerial and airboat surveys. Each fish was given a unique identification number which was associated with its transmitter frequency. Aerial surveys provided location data twice per month and airboat surveys also located sturgeon once per week, during ice free periods on the Platte River. Aerial and airboat surveys provided location data via geographic coordinates recorded from a handheld GPS unit. Coordinates were uploaded into a geographical information system (GIS) database and plotted with ArcGIS 9.0 (ESRI, Inc., *2004*) on 1993 digital orthophotographic quarter quadrant images of the lower Platte River (USGS, unpublished data). The resulting plots of fish locations were used to determine movement by radio-tagged sturgeon. Distance between successive fish locations was defined as the shortest lineal distance through water. Due to the shifting nature of sandbars in the Platte River, exposed sandbars on aerial images were treated as open water when determining distance moved. However, movement routes were plotted around large vegetated islands. Although movement near vegetated islands included distances needed to avoid such obstacles, calculating the shortest linear distance likely underestimated actual movements.

Food habits:

Shovelnose sturgeon used to evaluate food habits were sampled from the Platte River using drifted gill nets. Sturgeon captured were first measured for fork length and morphological index characters, weighed, and tagged with a PIT tag, prior to gastric lavage.

Pulsed gastric lavage (PGL) was accomplished by inserting a flexible, 6mm diameter plastic tube through the sturgeon's mouth, into the anterior portion of the digestive tract and pulsing water from a pressurized sprayer tank into the stomach. During this procedure, the abdomen of the fish was gently massaged. Materials washed from the stomach were caught in a 595 µm mesh sieve and transferred to labeled jars, fixed with 10% formalin, and transported to the lab for identification, and enumeration.

To study the effects of PGL on shovelnose sturgeon, nine batches consisting of eight fish each were captured and handled in the field just as those used for food habits studies. The only exception was that they were not subjected to PGL in the field. Each batch of eight fish was transported to UNL where they were randomly assigned to two holding tanks (four fish per tank) for a 4-6 day acclimation period. After acclimation, PGL was performed on six of the eight fish per batch as it would have been done in the field. The two control fish were handled in the same way and for the same duration as the PGL fish but their stomach's were not lavaged. All fish were returned to their tank, where they were held for a 15-day observation period.

During the acclimation and observation period temperature, dissolved oxygen, conductivity, and salinity were monitored daily with a hand held meter, and nitrite and ammonia concentrations were monitored using specific test kits. Fish were not fed during the acclimation or observation periods. Sodium chloride was added to the tanks to a concentration of 1mg/l for batches 7, 8 and 9 to reduce handling stress on these fish. In addition, fish in batch 7 were treated with 55mg/Kg oxytetracycline hydrochloride because of a *Columnaris* infection.

Logistic regression was used to test whether survival of control fish was greater than survival of experimental fish. Analysis of variance was used to test for differences in temperature, dissolved oxygen, nitrite, ammonia, conductivity and salinity among batches. If significance was detected, Tukey's multiple comparison test was performed to identify specific differences. All tests were performed using SAS software.

Length / weight:

All sturgeon were measured (fork length) and weighed. For shovelnose sturgeon, their relative weight (Wr) was calculated using the standard weight equation developed by Quist et al. (1999). For pallid sturgeon we calculated a Fulton Condition Factor (K (FL)) for each individual. These values were compared to a set of condition factors from 74 hatchery reared pallid sturgeon that were stocked in the Platte River in April 1998. We also used the shovelnose sturgeon standard weight equation, but only as a point of reference.

Morphometrics:

Starting in 2000, all sturgeon were measured following Sheehan et al.(1999) to calculate the mCI. In addition, a set of two digital photos was taken of each fish as a visual record for future analysis. These photos included a ruler for reference. Each fish was also PIT tagged and this number or alpha-numeric code was used to reference each individual. Starting in 2003 we added the measurements, new head length 1 and new head length 2 along with point to point in an attempt to improve our ability to distinguish pallid from shovelnose sturgeon (Figure 8).

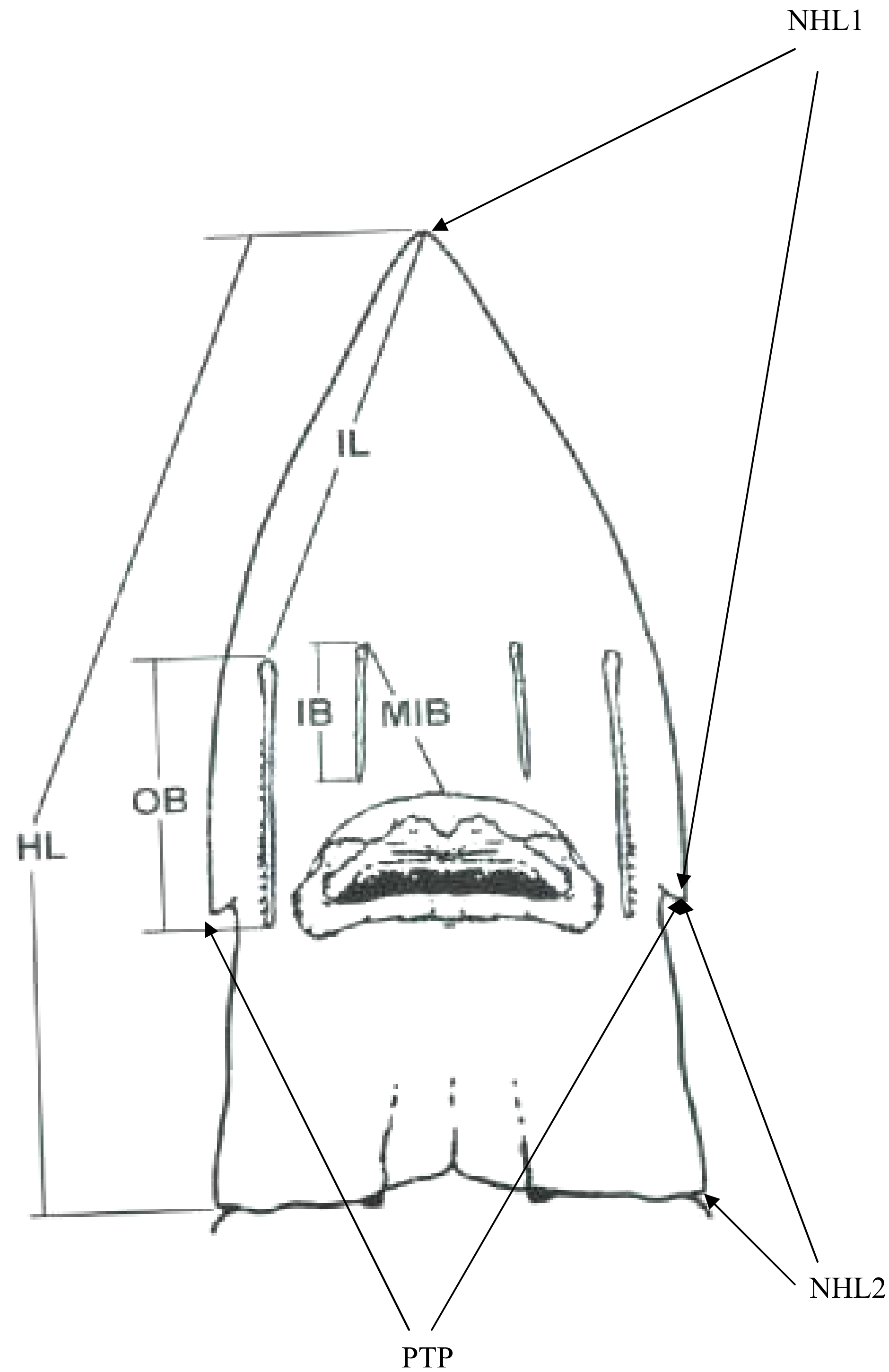


Figure 8. Diagram of the underside of a pallid sturgeon head showing measurements used calculate the morphometric character index (Sheehan et al. 1999). OB = outer barbel length, IB = inner barbel length, MIB = mouth to inner barbel length, IL = interrostrum length, HL = head length, PTP = point to point length, NHL1 = new head length 1, NHL2 = new head length 2 (Total head length = NHL1+NHL2).

STURGEON CHUB:

Sturgeon chubs were captured primarily by the use of trawls and seines. All specimens were fixed in formalin and returned to the laboratory for further study. In the laboratory, specimens were identified, measured, weighed, and examined to determine their sex and spawning condition. Additional measurement of individual and population conditions were planned if a sufficient number of sturgeon chub were captured.

Age and Growth:

Length-frequency distributions were developed using total length measurements. When the total number of specimens captured allowed, length frequency histograms were used to identify cohorts (year classes) of individuals. These were then used to assign ages and to track growth of the species through the growing/sampling season.

Length-Weight:

Length-weight relationships were developed by plotting the $\log_{10}$ length against $\log_{10}$ weight for all specimens. Linear regression was used to calculate the intercepts and slopes of the relationships.

Population Density:

Population density was estimated using information measured at the time that trawl samples were collected. The distance of a trawl run was multiplied by the width of the trawl mouth to estimate the area sampled. This value was then divided into the number of fish of each species caught to obtain an estimate of catch per unit area.

Reproductive Status:

Individuals large enough to be considered adults were dissected to examine their gonads and determine their gender and reproductive status. Gonads were then weighed and the gonadosomatic index (GSI) was calculated. GSI equals the gonad weight (X100) divided by the total weight. Plots of GSI values by sampling date were then used to identify spawning times for each species. These data along with larval fish sampling provided insight about chub spawning times.

LARVAL FISH SAMPLING:

Larval fish were sampled at 4 sites in the lower Platte River to describe the chronology of reproduction and hatching of all species in the lower Platte River. These sites were located near Two Rivers SRA (RM 41), US Highway 6 Bridge (RM 28), Nebraska Highway 50 Bridge (RM 16), and Schilling WMA (RM 0). Sampling commenced in May and continued through July of 2000 and 2001, but generally terminated by the end of June during 2002, 2003 and 2004.

Nets used for larval fish sampling were rectangular, 0.5 m high by 1.0 m wide by 5 m long made from 0.6 mm mesh Nytex. Each net was equipped with a current meter to measure average water velocity through the net during the time it was deployed, which in turn allowed us to determine the water volume sampled. Nets were typically set in pairs for up to 15 minutes as determined by visual inspection of net clogging. A sample at a site consisted of 4 net sets. Time of sampling began at either midnight (0000 hours); 0300 hours; 0600 hours; 0900 hours; noon (1200 hours); 1500 hours; 1800 hours; or 2100 hours. Samples were preserved in 10% formalin in the field and transported to the lab for analysis.

In the laboratory, specimens were sorted from extraneous material, identified to the lowest taxonomic category practicable, categorized by developmental stage, and enumerated. The number of each taxon and developmental stage were expressed per unit of water volume and number per net. All specimens were retained as vouchers and are either in the collections of the Nebraska State Museum or at the larval fish laboratory at Colorado State University in Fort Collins, Colorado.

During 2000, 2001, and 2002 time for regular sampling was chosen at random and each site was sampled once per month starting the first week in May and continuing until August. In addition, the site near Ashland was sampled every 3 hours for a 24-hour period on weeks alternating with the regular sampling to determine diel periodicity of larval drift. In 2003, the sampling protocol was modified to try to identify more specifically the timing and location of sturgeon spawning in the areas downstream from the mouth of the Elkhorn River. A site at Louisville and the site at the Highway 6 Bridge were sampled simultaneously every other week at three-hour intervals commencing at 1800 hr and concluding at 0600 hr. In 2004, the downstream site was moved to the vicinity of the Schilling WMA. The final sampling was completed June 10, 2004. Because this timeframe was within the window of time sturgeon and other large river species have historically spawned, we attempted to sample sturgeon eggs and larvae just below a known radio-tagged shovelnose sturgeon, which had remained stationary over the previous week. Since this fish had remained stationary, we thought that this may have indicated spawning activity.

AMBIENT RIVER HABITAT CONDITIONS:

Starting in September 2000, we measured water temperature (^{o}C), dissolved oxygen (mg/L), specific conductivity (µS/cm), salinity (ppt), and total suspended solids (mg/L) at four sites in the lower Platte River basin. Starting in July 2001, turbidity was added to the list of parameters measured. Temperature, dissolved oxygen, specific conductivity and salinity were measured using a YSI model 85 meter. Suspended solids were determined by filtering a measured portion of a water sample following the APHA (1987) standard method. Turbidity was measured from a water sample using a Hach model 2100P turbidimeter.

All sites were sampled weekly through the year, except when ice conditions made water sampling dangerous. A sample at a location consisted of two readings at the Elkhorn River and Salt Creek sites, four readings at the Leshara site and five readings at the Louisville site. The number of samples varied with respect to the width of the river at the sampling location. Five temperature-recording units were placed at the Louisville site to monitor temperature on a continuous basis.

In the summer of 2003 (July/August), we collected substrate samples at all four water quality study sites and from sites at the US Highway 6 bridge near Ashland, NE and the Nebraska State Highway 79 bridge near North Bend, NE. Subsequent samples were collected during October 2003 and March 2004. Samples were collected along transects across the channel using a hand-held corer that penetrated the substrate to a depth of approximately 30 cm. A random number determined the distance of each initial core location from the shore. Ten core samples were collected at an even distance for narrow sites (Salt Creek and the Elkhorn River) and 20 for Platte River sites. Water depth and mean column velocity were also measured at each core location. Cores were placed in individually labeled gallon plastic jars with any accompanying water in the corer. In the lab, samples were allowed to evaporate and then placed in pans for drying in an oven at 105 °C. Samples were then dry sieved through nested screens to separate, silt (passed through 230 sieve), fine sand (retained by 230 sieve), sand (retained by 60 sieve), coarse sand (retained by 18 sieve), and gravel (retained by 10 sieve). Each textural component was then weighed and expressed as a percentage of the total weight of the core sample.

CREEL SURVEY OF THE LOWER PLATTE RIVER:

This objective was accomplished by conducting a focused creel survey in the Platte River approximately from the Ak-Sar-Ben aquarium at Schramm Park SRA (RM 25) downstream to the mouth of the Platte at the Schilling WMA (RM 0). The survey was an access point creel with standard stops along the road at Schramm Park SRA, Louisville SRA, and Schilling WMA.

The creel survey followed a stratified multi-stage probability sampling regime designed using the WinFin computer program produced by the NGPC. A total goal of 10 survey days was performed each month, from April 1 through May 31, with the number of creel days per month stratified between weekdays and weekends/holidays. Each creel day was further stratified into 4 time periods and count times were randomized within these time periods. During each count the creel clerk recorded the number of anglers present. Clerks interviewed anglers to collect information on what they were fishing for, duration of their trip and number and species of fish captured and harvested. All sturgeons in the creel were measured and barbel clips collected for DNA analysis. To estimate overall catch, the number of anglers was divided by the number of time periods sampled within the month, then multiplied by the total number of time periods within the month. This resulted in an estimated angler effort for the month. An estimate of average angler catch was calculated by dividing the total number of fish reported by the total number of anglers surveyed. The estimate of total monthly catch by anglers was calculated by multiplying the average angler catch by the estimated angler effort for the month.

To evaluate the ability of anglers to discern the differences between pallid and shovelnose sturgeon, each angler was asked to identify pallid and shovelnose sturgeon from photos (Figure 9). The creel survey clerks also passed out flyers to increase the awareness of local anglers about pallid sturgeon conservation efforts.

Figure 9. Photographs of shovelnose sturgeon (left) and pallid sturgeon (right) used to test anglers on their ability to identify species.

RESULTS AND DISCUSSION

SAMPLING EFFORT

As noted in the methods section, the sampling effort on the lower Platte River was designed to attempt to capture the rare pallid sturgeon. As a result, the sampling effort was not evenly distributed throughout the lower Platte River. Most of the effort was focused on the reach of river below the confluence with the Elkhorn River. In this area, two smaller areas, one around Louisville, NE and the other near the mouth of the Platte River received extra effort as we captured pallid sturgeon in these areas. Figures 10 a, b, and c through 14 a, b, and c show the distribution of the major gear types used to sample the river. Stationary gill nets and minnow traps are not shown or further discussed as neither method was effective at catching pallid sturgeon or sturgeon chubs and their use was discontinued after a preliminary testing period.

The types of sampling gear used also changed throughout the year. Trotlines were used during the cold water periods and then the actively deployed nets and trawls were used primarily in the warmer water periods of the year. In addition to being used in cold water, trotlines were most effective at sampling the deepest and swiftest waters in the river and captured mostly shovelnose and pallid sturgeon. As the water warmed and discharge decreased as the year progressed, trammel nets proved effective at catching a wide range of species, including many shovelnose sturgeon and a few pallid sturgeon. Tables 6 to 15 show the average monthly habitat conditions and average monthly water quality conditions associated with the different gear types. Trawls proved most effective for capturing sturgeon chub, although neither seines nor trawls caught many.

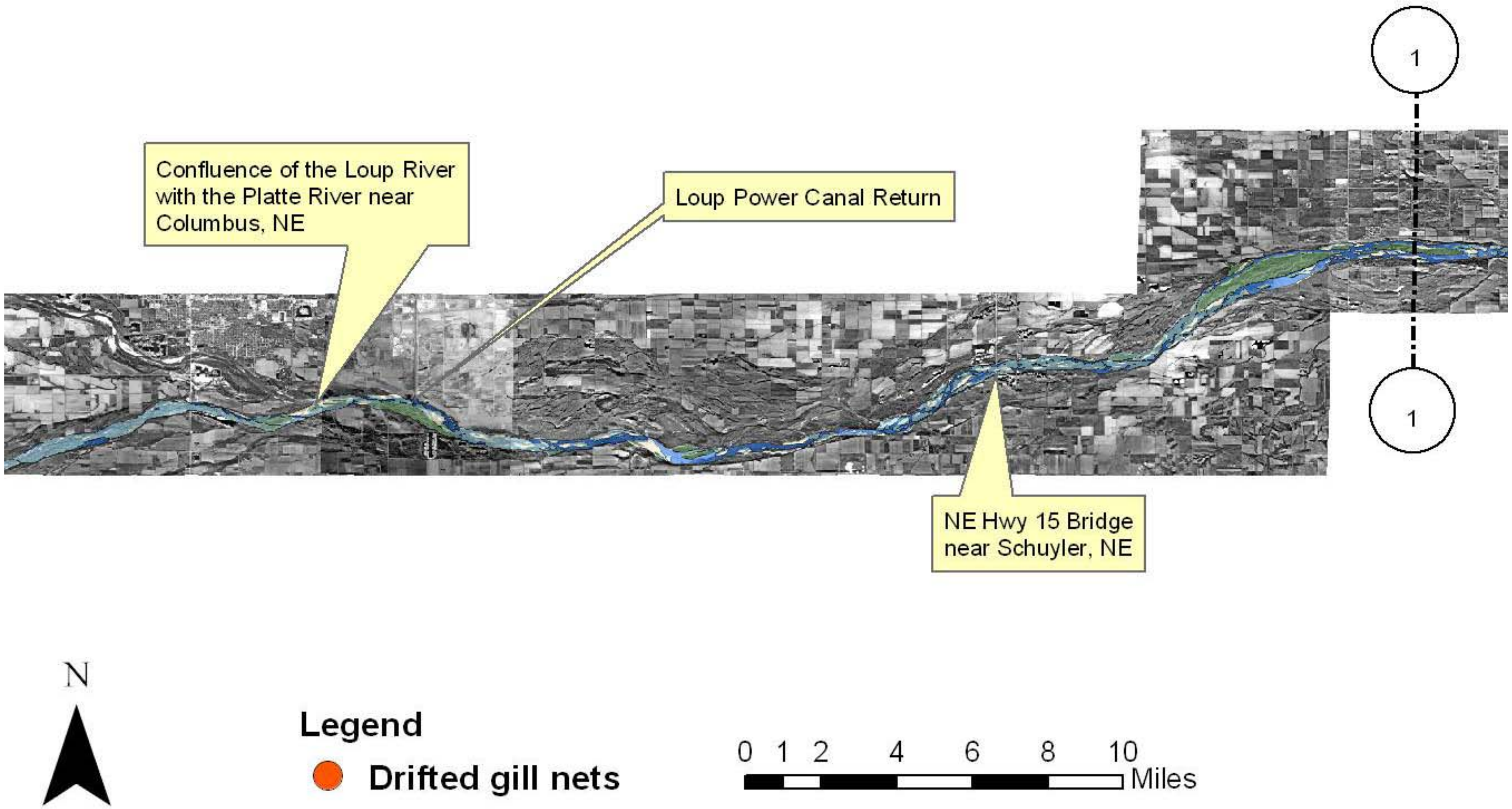


Figure 10a. Map of the locations of drifted gill net runs attempting to capture pallid sturgeon in the lower Platte River. Match lines with other map sections of the lower Platte River are denoted by number and dashed lines.

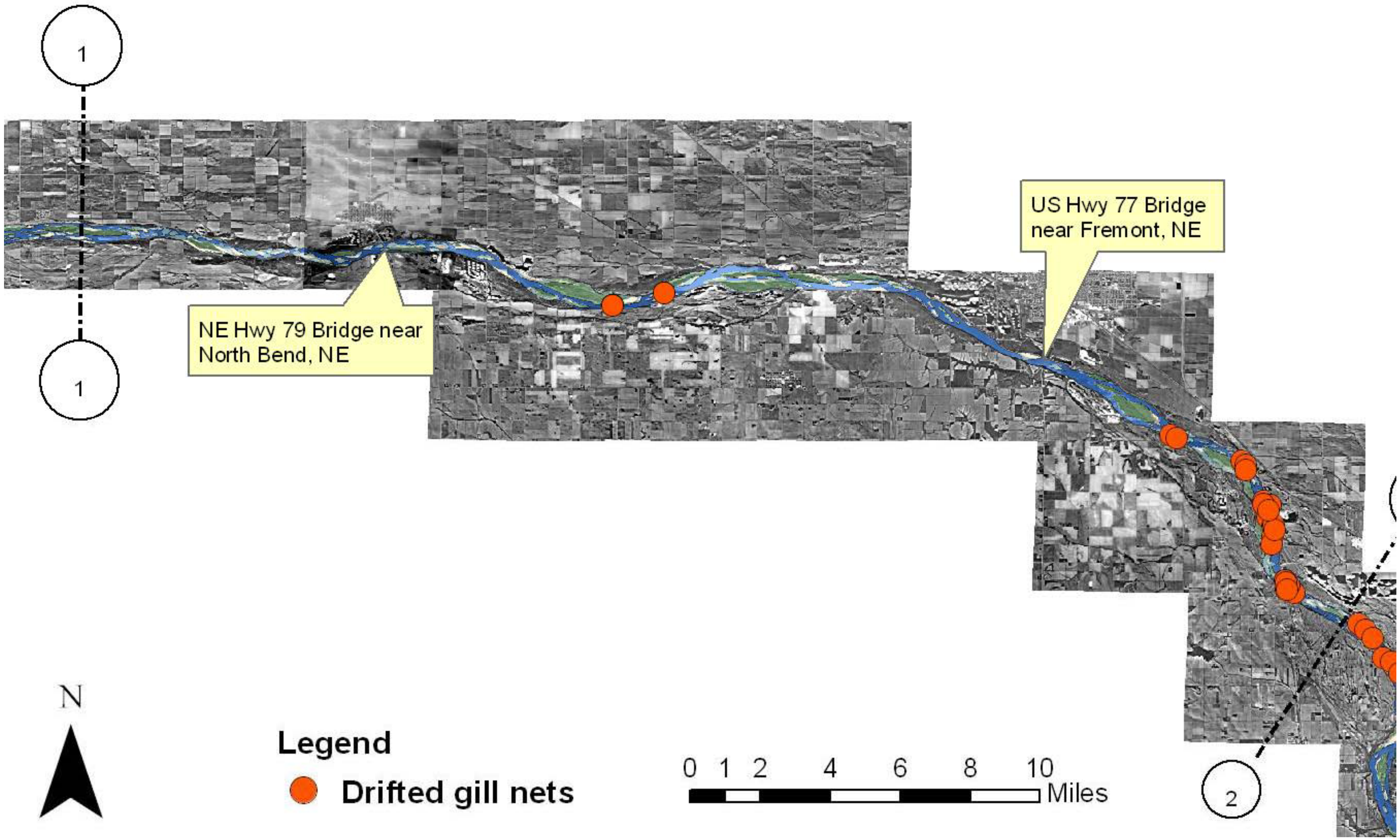


Figure 10b. Map of the locations of drifted gill net runs attempting to capture pallid sturgeon in the lower Platte River. Match lines with other map sections of the lower Platte River are denoted by number and dashed lines.

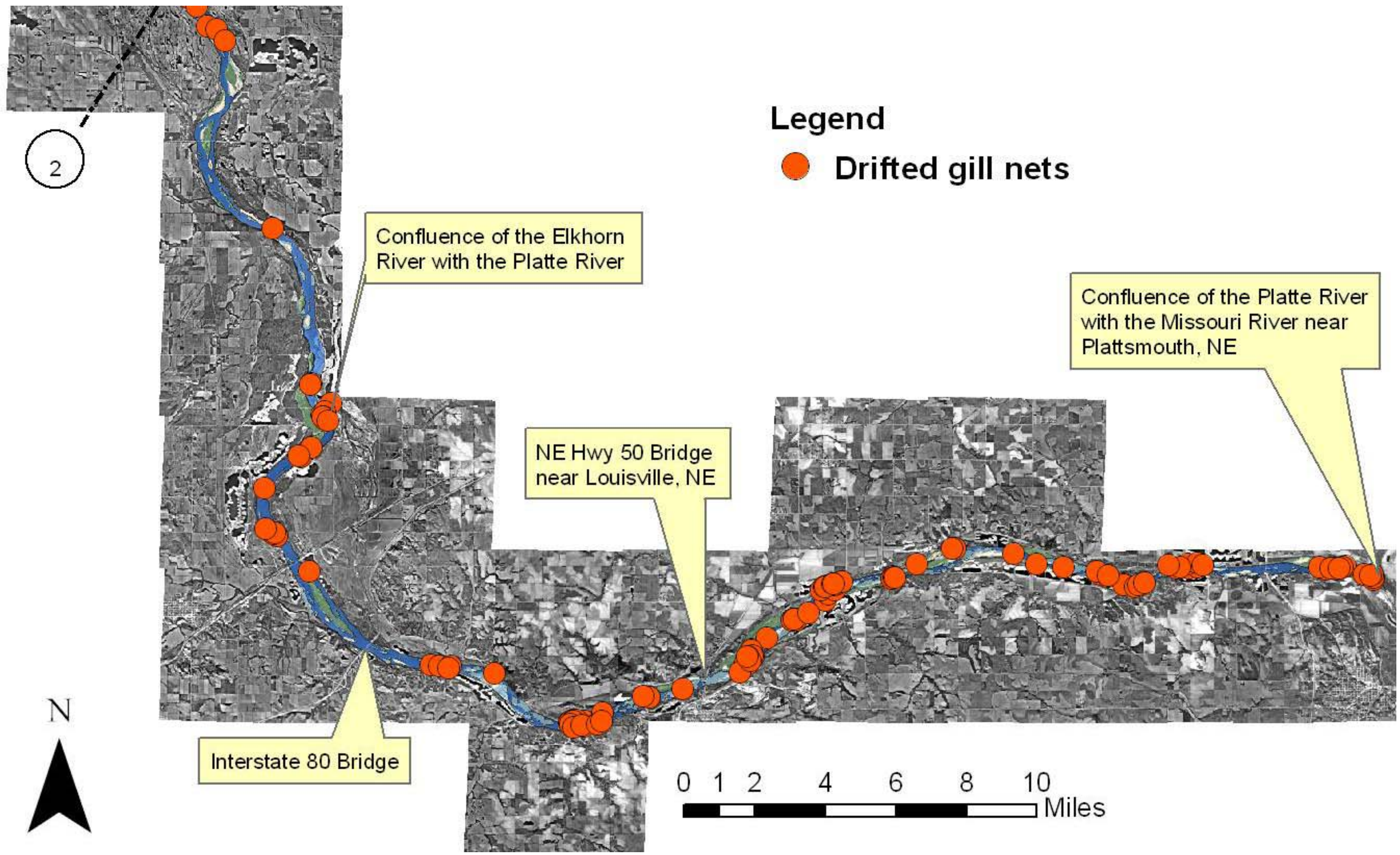


Figure 10c. Map of the locations of drifted gill net runs attempting to capture pallid sturgeon in the lower Platte River. Match lines with other map sections of the lower Platte River are denoted by number and dashed lines.

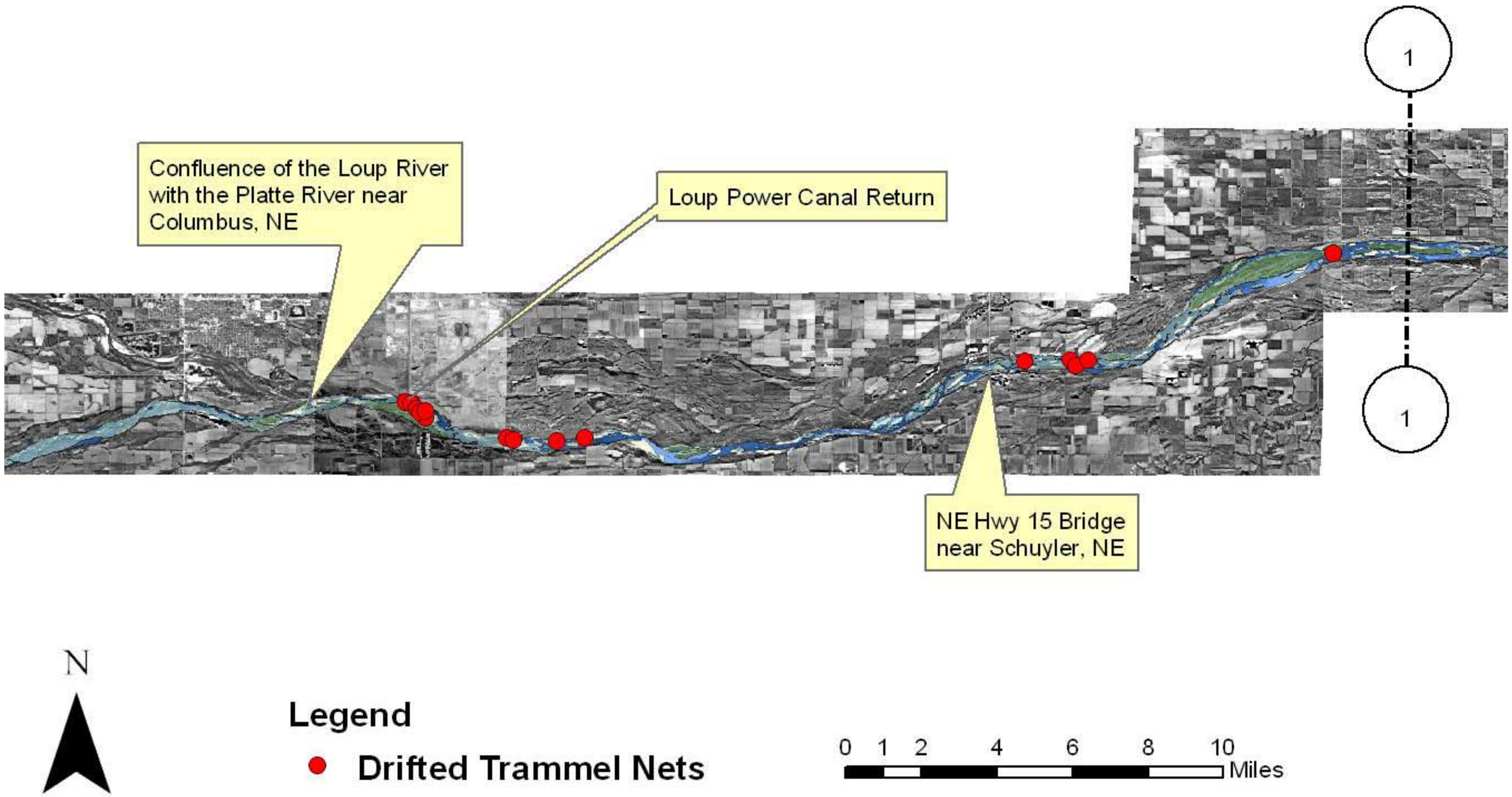


Figure 11a. Map of the locations of drifted trammel net runs attempting to capture pallid sturgeon in the lower Platte River. Match lines with other map sections of the lower Platte River are denoted by number and dashed lines.

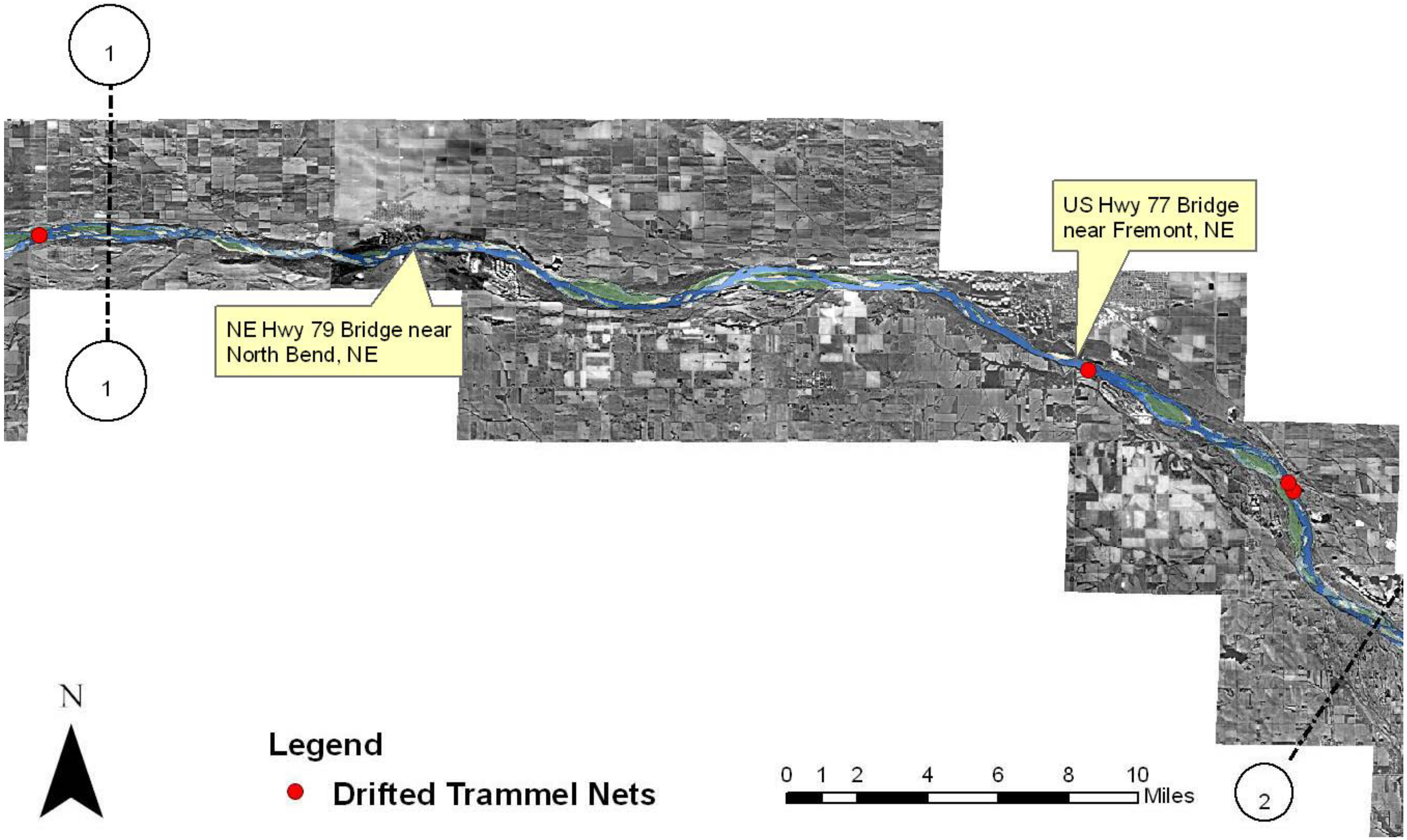
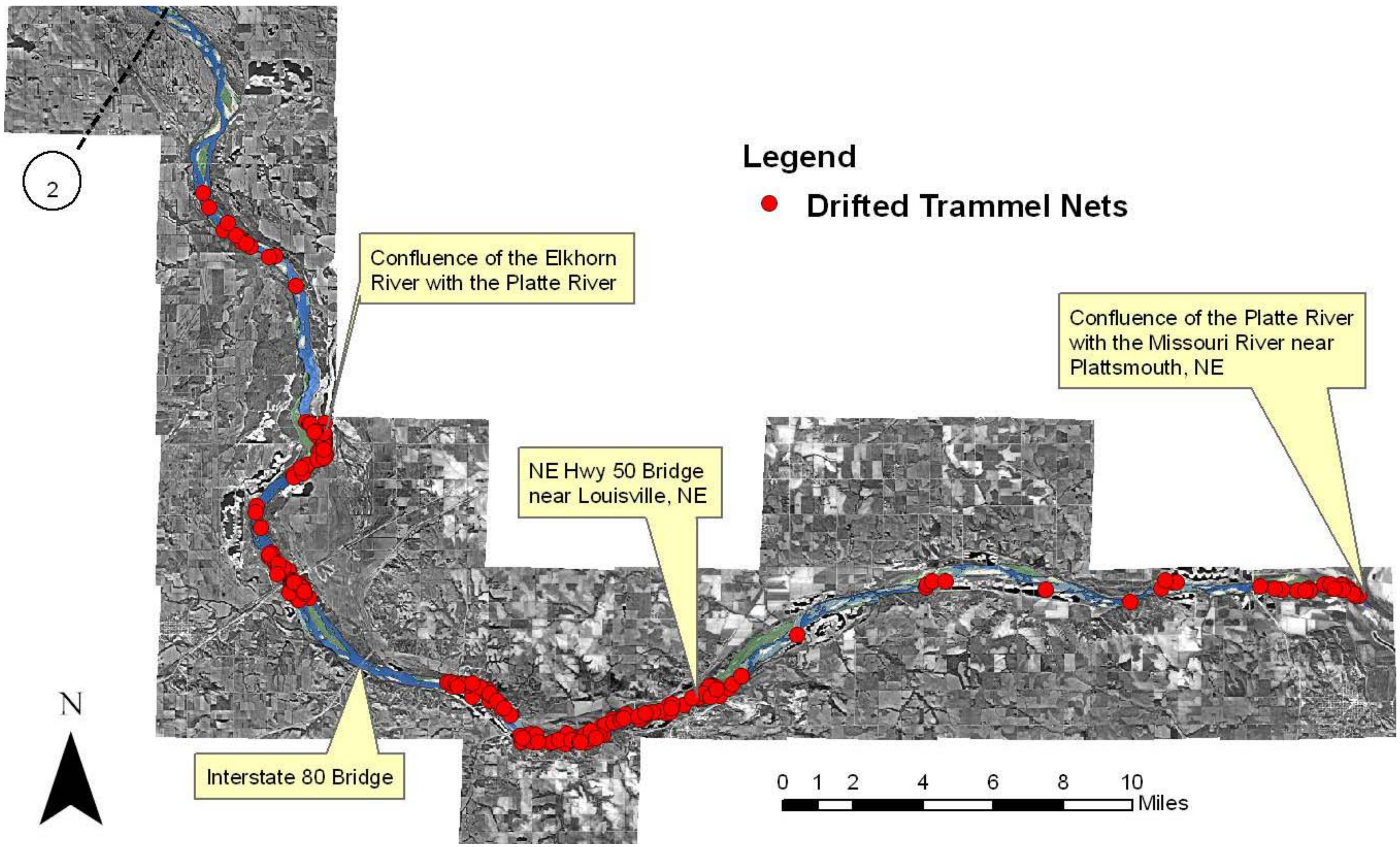


Figure 11b. Map of the locations of drifted trammel net runs attempting to capture pallid sturgeon in the lower Platte River. Match lines with other map sections of the lower Platte River are denoted by number and dashed lines.



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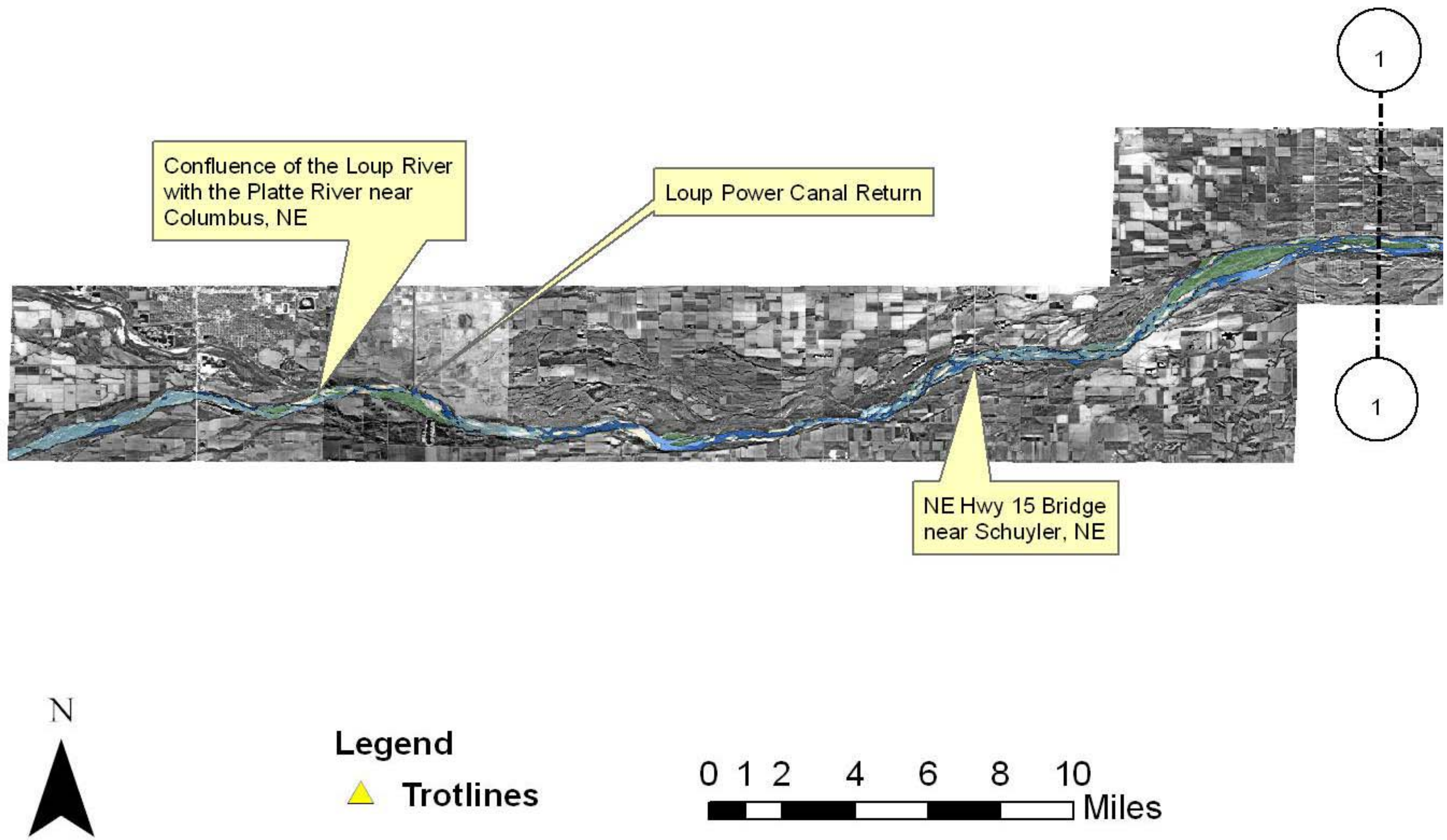

Figure 12a. Map of the locations of trotline sets attempting to capture pallid sturgeon in the lower Platte River. Match lines with other map sections of the lower Platte River are denoted by number and dashed lines.

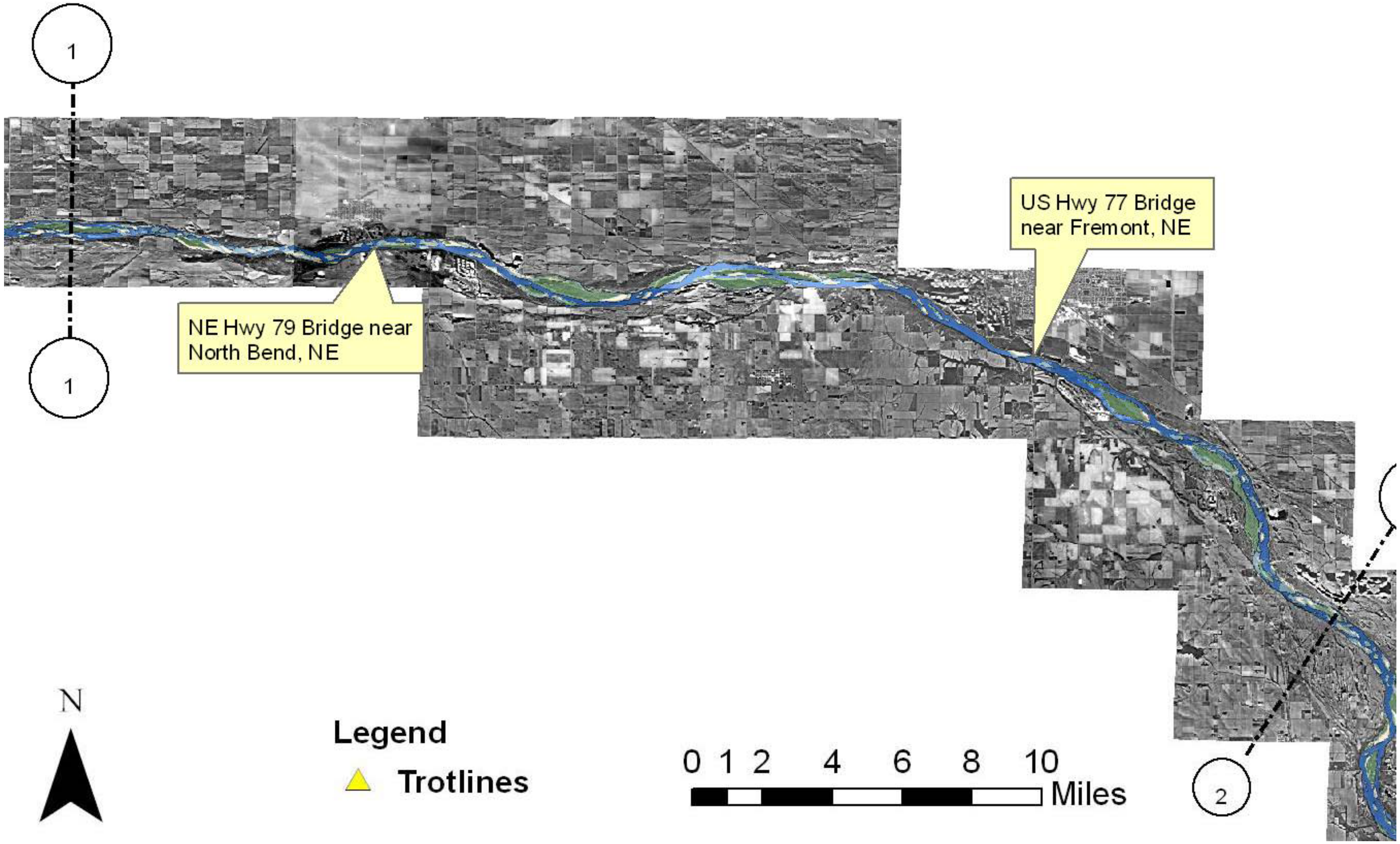

Figure 12b. Map of the locations of trotline sets attempting to capture pallid sturgeon in the lower Platte River. Match lines with other map sections of the lower Platte River are denoted by number and dashed lines.

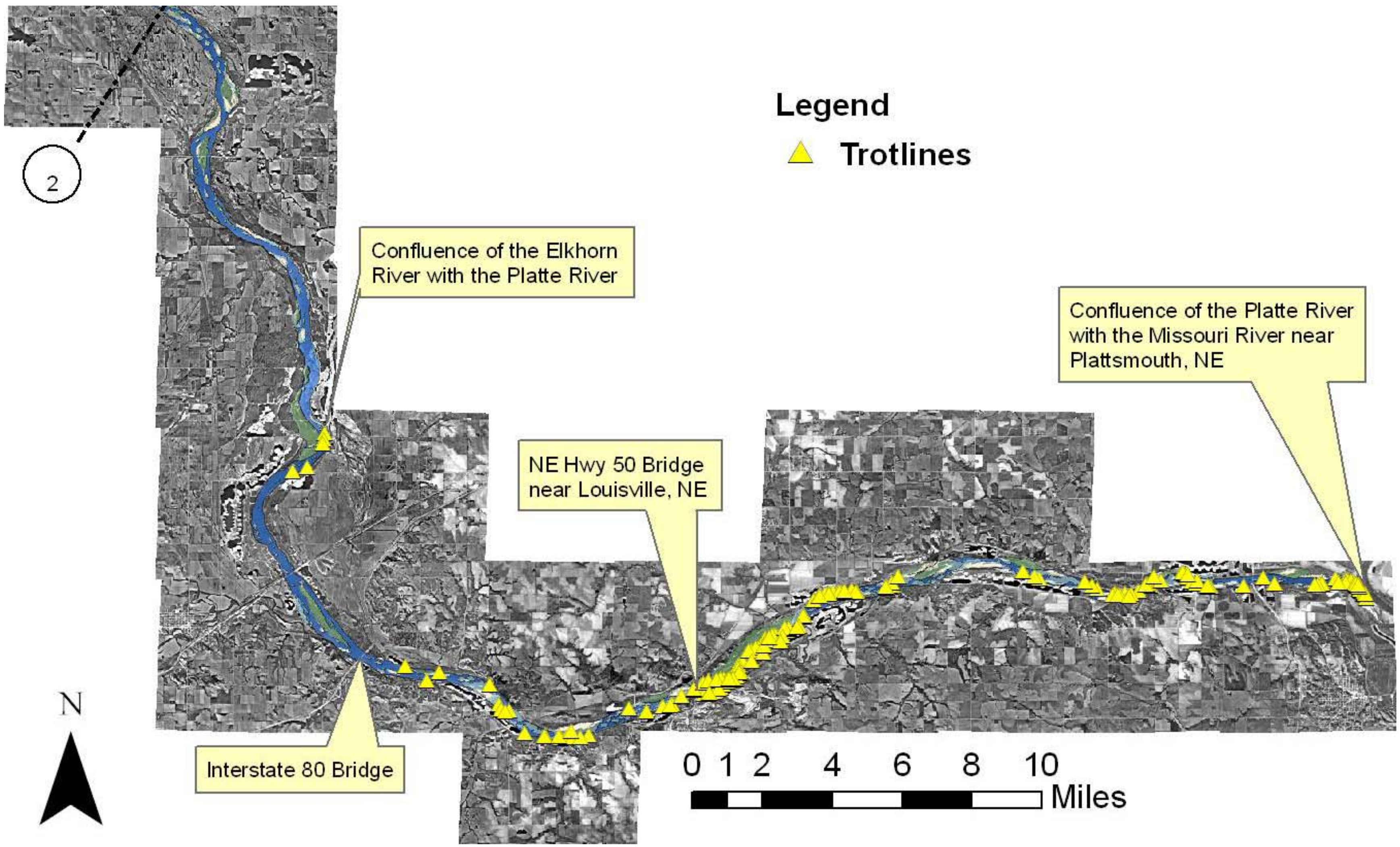

Figure 12c. Map of the locations of trotline sets attempting to capture pallid sturgeon in the lower Platte River. Match lines with other map sections of the lower Platte River are denoted by number and dashed lines.

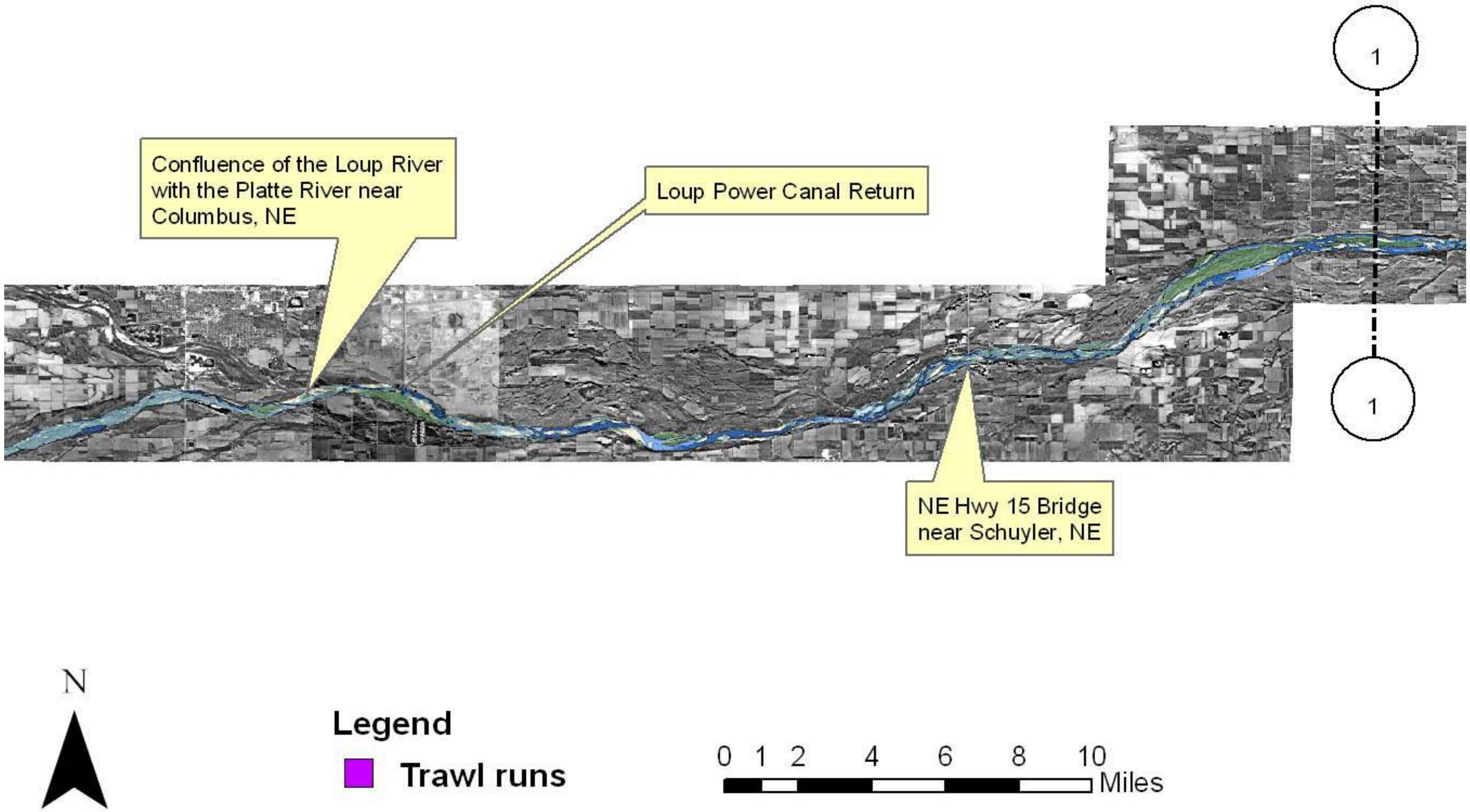

Figure 13a. Map of the locations of trawl runs attempting to capture pallid sturgeon and sturgeon chub in the lower Platte River. Match lines with other map sections of the lower Platte River are denoted by number and dashed lines.

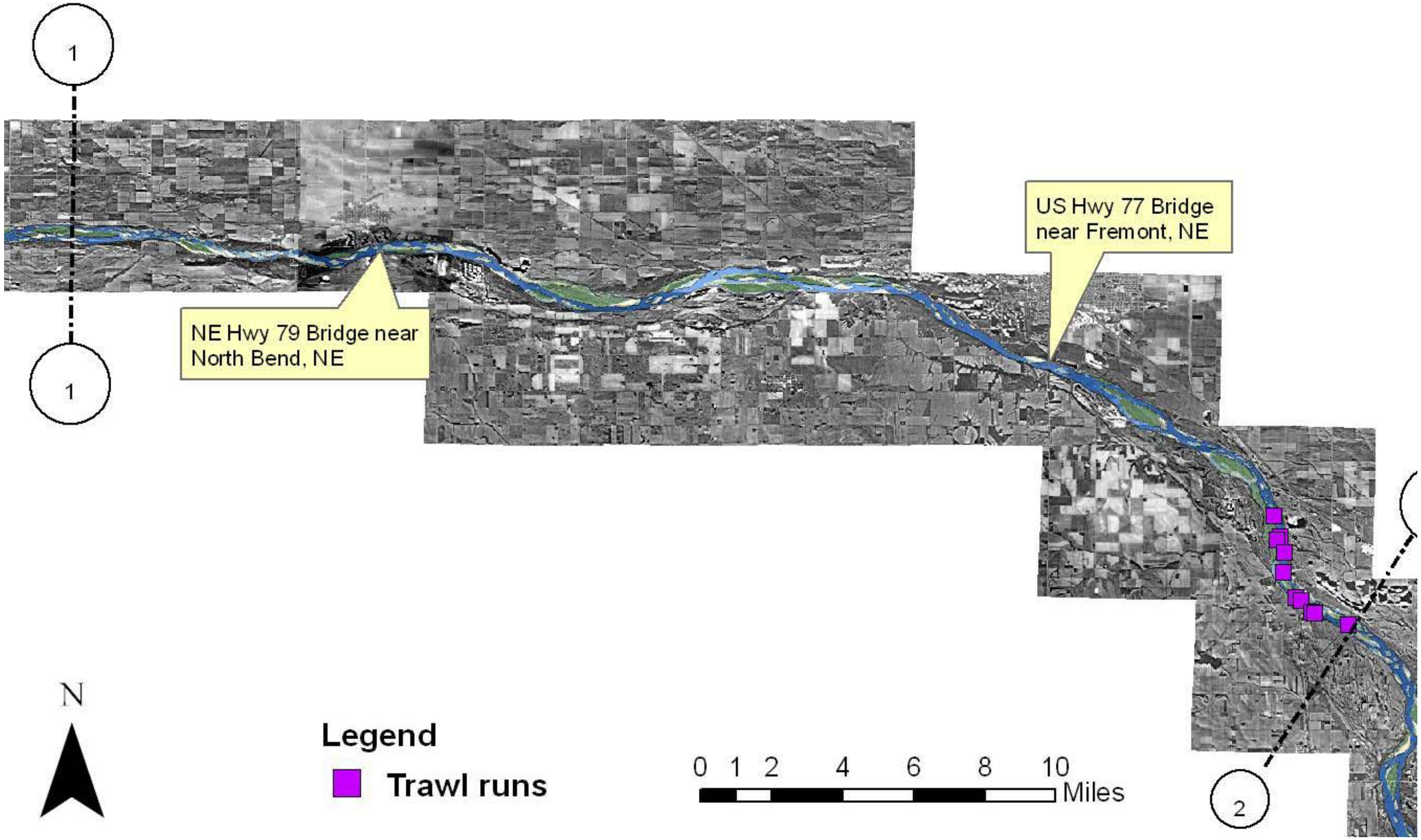

Figure 13b. Map of the locations of trawl runs attempting to capture pallid sturgeon and sturgeon chub in the lower Platte River. Match lines with other map sections of the lower Platte River are denoted by number and dashed lines.

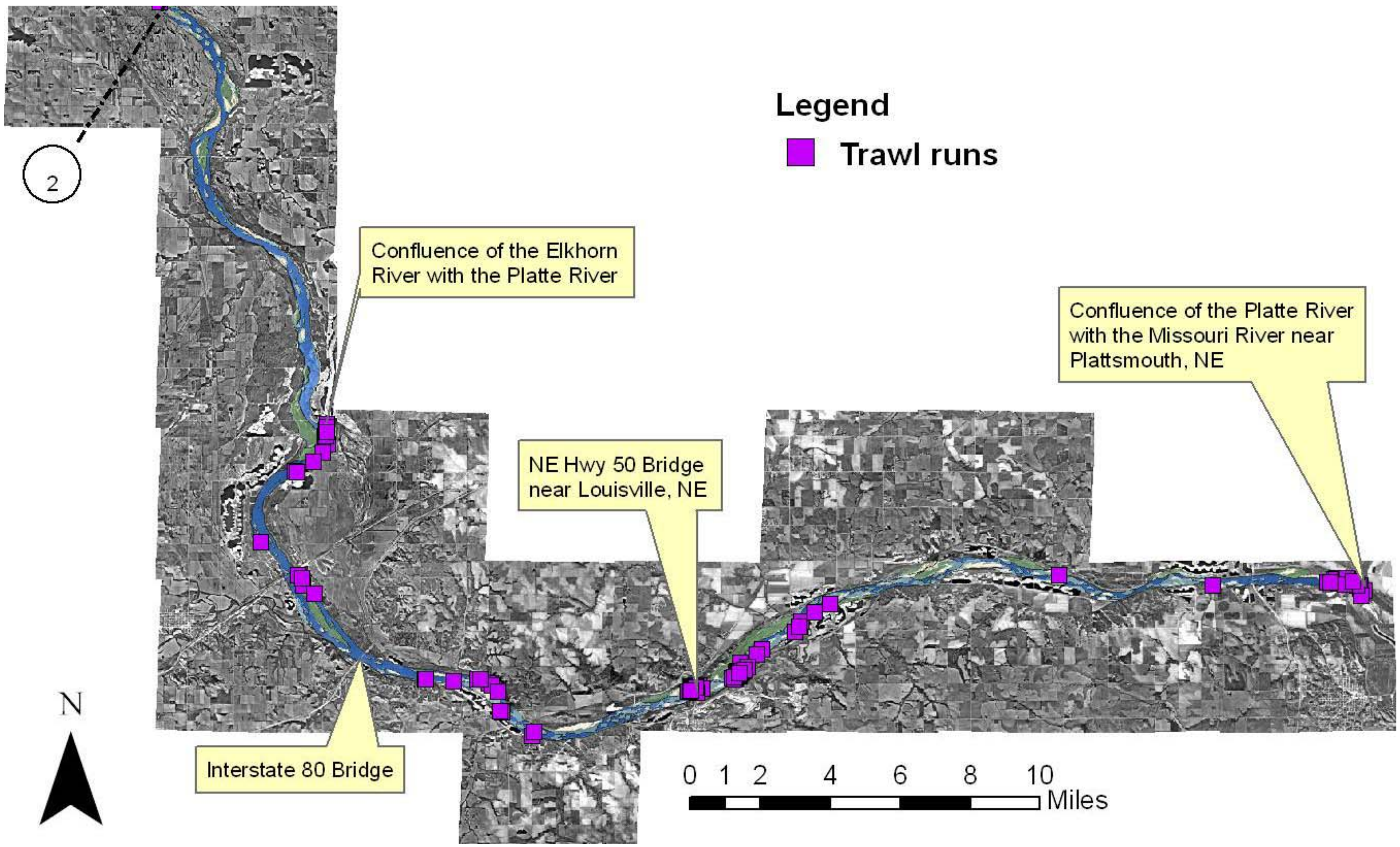

Figure 13c. Map of the locations of trawl runs attempting to capture pallid sturgeon and sturgeon chub in the lower Platte River. Match lines with other map sections of the lower Platte River are denoted by number and dashed lines.

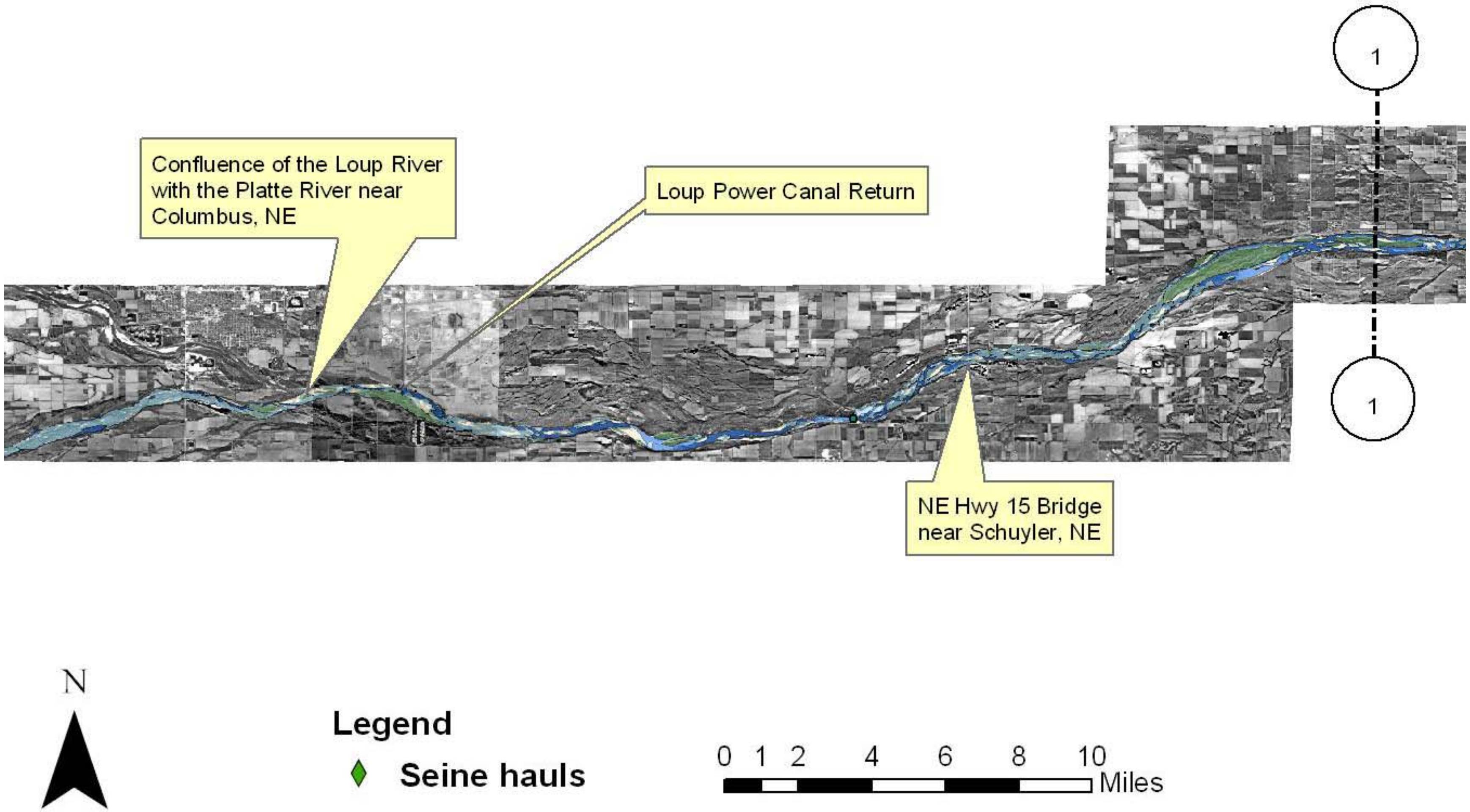

Figure 14a. Map of the locations of seine hauls attempting to capture pallid sturgeon and sturgeon chub in the lower Platte River. Match lines with other map sections of the lower Platte River are denoted by number and dashed lines.

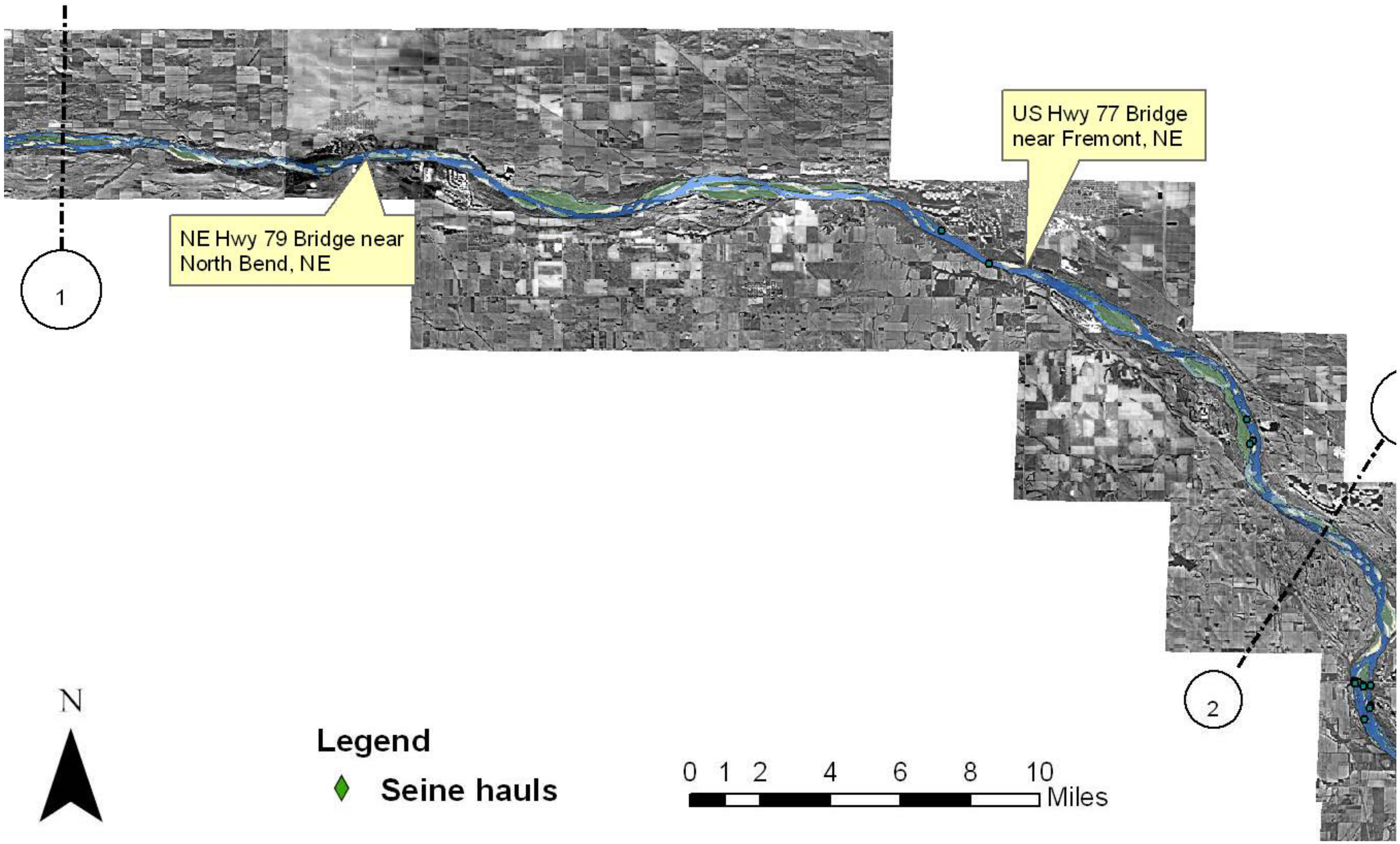

Figure 14b. Map of the locations of seine hauls attempting to capture pallid sturgeon and sturgeon chub in the lower Platte River. Match lines with other map sections of the lower Platte River are denoted by number and dashed lines.

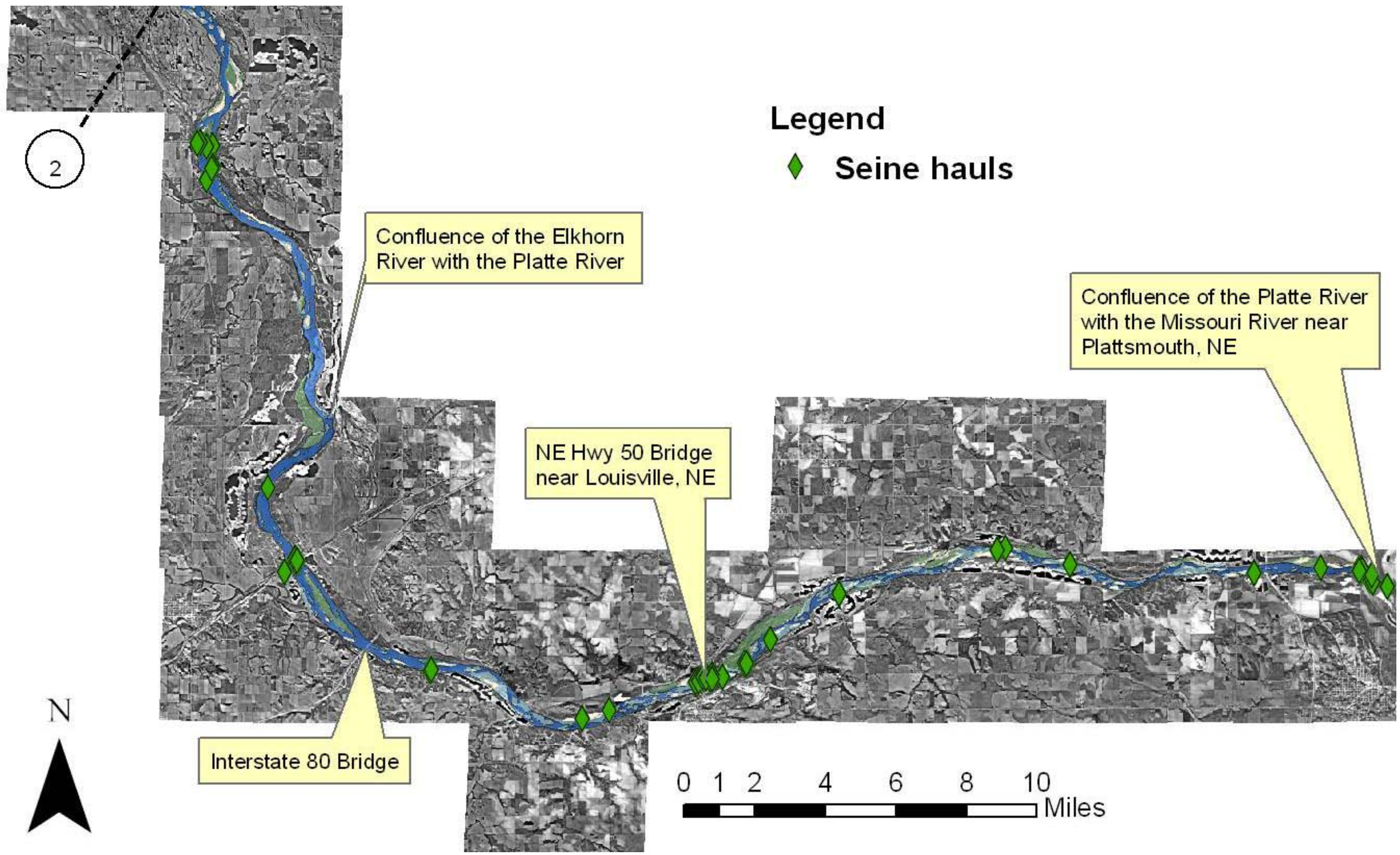

Figure 14c. Map of the locations of seine hauls attempting to capture pallid sturgeon and sturgeon chub in the lower Platte River. Match lines with other map sections of the lower Platte River are denoted by number and dashed lines.

Table 6. Average monthly habitat variables associated with drifted gill nets.

Method	Date By Month	Average Depth (m)	Average Mean Velocity (m/s)	Average Bottom Velocity (m/s)	Number of Runs
Gill Net	04/2004	1.13	0.77	0.40	2
Gill Net	05/2000	0.70	0.64	0.29	8
Gill Net	05/2001	0.85	0.68	0.40	6
Gill Net	05/2002	0.56	0.52	0.32	63
Gill Net	06/2000	0.81	0.65	0.37	17
Gill Net	06/2001	0.86	0.61	0.38	35
Gill Net	06/2002	0.56	0.50	0.31	54
Gill Net	07/2000	0.52	0.52	0.34	26
Gill Net	07/2001	0.70	0.59	0.37	28
Gill Net	07/2002	0.54	0.47	0.34	14
Gill Net	08/2000	0.70	0.60	0.39	12
Gill Net	08/2001	0.66	0.54	0.35	22
Gill Net	08/2002	0.51	0.49	0.34	16
Gill Net	09/2001	0.67	0.54	0.35	9
Gill Net	09/2002	0.59	0.59	0.40	7
Gill Net	10/2001	0.70	0.50	0.32	2

Table 7. Average monthly water quality measurements associated with drifted gill nets

Method	Date By Month	Average Water Temp (°C)	Average Dissolved Oxygen (mg/L)	Average Specific Conductivity (µS/cm)	Average Total Suspended Solids (mg/L)	Average Turbidity (NTU)	Number of net runs
Gill Net	04/ 2004	17.0	11.2	619.5	91.5	41.8	2
Gill Net	05/ 2000	21.1	9.3	548.9	521.3		8
Gill Net	05/ 2001	20.9	8.9	595.0	400.6		6
Gill Net	05/ 2002	22.2	10.0	547.4			63
Gill Net	06/ 2000	24.5	8.3	658.4	448.8		17
Gill Net	06/ 2001	24.3	10.6	582.3	211.3		35
Gill Net	06/ 2002	25.6	8.6	440.3			54
Gill Net	07/ 2000	28.0	9.5	606.3	375.8		26
Gill Net	07/ 2001	26.4	8.9	626.7	337.3		28
Gill Net	07/ 2002	27.0	10.6	428.5			14
Gill Net	08/ 2000	26.1	9.0	669.0	154.9		12
Gill Net	08/ 2001	26.3	10.0	641.7			22
Gill Net	08/ 2002	24.1	9.8	536.7			16
Gill Net	09/ 2001	20.5	10.7	724.4			9
Gill Net	09/ 2002	17.7	9.9	513.0			7
Gill Net	10/ 2001	14.9	10.3	672.5			2

Table 8. Average monthly habitat variables associated with drifted trammel nets.

Method	Date By Month	Average Depth (m)	Average Mean Velocity (m/s)	Average Bottom Velocity (m/s)	Number of Runs
Trammel Net	03/2004	0.90	0.45	0.21	4
Trammel Net	04/2004	1.19	0.65	0.27	23
Trammel Net	05/2003	0.58	0.60	0.40	25
Trammel Net	05/2004	1.21	0.66	0.34	19
Trammel Net	06/2003	0.57	0.50	0.31	53
Trammel Net	06/2004	0.61	0.49	0.31	15
Trammel Net	07/2003	0.63	0.47	0.25	38
Trammel Net	07/2004	0.84	0.66	0.50	12
Trammel Net	09/2003	0.45	0.51	0.26	3
Trammel Net	09/2004	0.36	0.52	0.40	2
Trammel Net	10/2003	0.52	0.50	0.44	3

Table 9. Average monthly water quality measurements associated with drifted trammel nets.

Method	Date By Month	Average Water Temp (°C)	Average Dissolved Oxygen (mg/L)	Average Specific Conductivity (µS/cm)	Average Total Suspended Solids (mg/L)	Average Turbidity (NTU)	Number of net runs
Trammel Net	03/ 2004	17.2	10.7	698.3	126.0	63.5	4
Trammel Net	04/ 2004	16.2	12.4	630.8	124.7	58.1	23
Trammel Net	05/ 2003	20.8	10.5	533.1	389.5	391.7	25
Trammel Net	05/ 2004	16.5	13.7	671.9	166.7	117.5	19
Trammel Net	06/ 2003	24.0	10.1	463.5	468.4	412.2	53
Trammel Net	06/ 2004	22.3	9.4	399.5	1251.3	1767.0	15
Trammel Net	07/ 2003	29.1	8.5	476.9	532.5	568.8	38
Trammel Net	07/ 2004	27.6	12.0	417.1			12
Trammel Net	09/ 2002	19.3	9.1	430.4			4
Trammel Net	09/ 2003	17.7	12.4	445.7	102.3	91.4	3
Trammel Net	09/ 2004	20.8	10.1	678.0		1040.0	2
Trammel Net	10/ 2003	16.6	12.7	754.0			3

Table 10. Average monthly habitat variables associated with trotline sets.

Method	Date By Month	Average Depth (m)	Average Mean Velocity (m/s)	Average Bottom Velocity (m/s)	Number of Runs
Trotline	03/2001	1.16	0.51	0.30	5
Trotline	03/2002	1.03	0.56	0.31	3
Trotline	03/2003	1.12	0.74	0.39	15
Trotline	03/2004	1.70	0.83	0.37	28
Trotline	04/2001	0.89	0.58	0.37	7
Trotline	04/2002	1.11	0.66	0.37	11
Trotline	04/2003	1.36	0.69	0.35	57
Trotline	04/2004	1.86	0.88	0.31	43
Trotline	05/2001	1.23	0.74	0.37	13
Trotline	05/2002	1.45	0.60	0.38	7
Trotline	06/2001	1.15	0.65	0.56	5
Trotline	09/2001	0.97	0.70	0.46	4
Trotline	10/2001	0.89	0.47	0.31	3
Trotline	10/2002	1.28	0.65	0.37	8
Trotline	11/2001	1.30	0.71	0.40	10
Trotline	11/2002	0.66	0.44	0.28	5

Table 11. Average monthly water quality measurements associated with trotline sets.

Method	Date By Month	Average Water Temp (°C)	Average Dissolved Oxygen (mg/L)	Average Specific Conductivity (µS/cm)	Average Total Suspended Solids (mg/L)	Average Turbidity (NTU)	Number of net runs
Trotline	03/2001	7.7	11.0	616.2		176.0	5
Trotline	03/2002	6.7	12.3	845.0	55.7	117.8	3
Trotline	03/2003	10.9	10.6	619.9	87.6	170.9	15
Trotline	03/2004	10.0	10.9	601.1	143.3	191.6	28
Trotline	04/2001	12.5	10.0	618.1		465.8	7
Trotline	04/2002	14.4	12.1	725.4	63.5	125.5	11
Trotline	04/2003	15.6	11.3	592.2	83.3	188.4	57
Trotline	04/2004	13.7	12.1	620.6	70.6	115.7	43
Trotline	05/2001	19.8	8.8	703.5		286.7	13
Trotline	05/2002	16.0	9.6	654.2	426.7	533.6	7
Trotline	06/2001	18.2	10.4	530.4		180.5	5
Trotline	09/2001	18.6	10.3	493.5			4
Trotline	10/2001	12.8	10.1	741.2	40.6	86.3	3
Trotline	10/2002	10.6	11.5	602.1			8
Trotline	11/2001	12.9	11.4	678.0	40.9	79.9	10
Trotline	11/2002	5.9	13.9	588.7			5

Table 12. Average monthly habitat variables associated with trawl runs.

Method	Date By Month	Average Depth (m)	Average Mean Velocity (m/s)	Average Bottom Velocity (m/s)	Number of Runs
Trawl	04/2004	1.1	0.5	0.2	3
Trawl	05/2002	1.4	0.7	0.3	40
Trawl	05/2003	1.4	0.5	0.4	4
Trawl	05/2004	1.6	0.7	0.3	7
Trawl	06/2001	1.9	0.7	0.0	6
Trawl	06/2002	1.3	0.7	0.4	61
Trawl	06/2004	1.7	0.8	0.5	110
Trawl	07/2001	0.9	0.7	0.4	8
Trawl	07/2002	0.8	0.6	0.3	34
Trawl	07/2004	1.1	1.0	0.6	12
Trawl	08/2002	0.7	0.5	0.2	20
Trawl	09/2001	0.2	0.4	0.2	4
Trawl	09/2002	0.8	0.6	0.3	30

Table 13. Average monthly water quality measurements associated with trawl runs.

Method	Date By Month	Average Water Temp (°C)	Average Dissolved Oxygen (mg/L)	Average Specific Conductivity (µS/cm)	Average Total Suspended Solids (mg/L)	Average Turbidity (NTU)	Number of net runs
Trawl	04/2004	13.6	11.6	696.0			3
Trawl	05/2002	22.4	9.0	621.4	660.9	741.3	40
Trawl	05/2003	17.5	9.0	392.9			4
Trawl	05/2004	25.7	9.4	526.3			7
Trawl	06/2001	27.6	8.2	647.3			6
Trawl	06/2002	23.4	8.5	619.5	604.0	657.7	61
Trawl	06/2004	23.1	9.4	547.5	1558.3	1973.6	110
Trawl	07/2001	29.0	8.5	725.0			8
Trawl	07/2002	26.0	10.5	1124.6	95.8	53.1	34
Trawl	07/2004	27.6	12.0	417.1			12
Trawl	08/2002	26.3	8.8	1343.7	80.7	44.1	20
Trawl	09/2001	17.7	11.6	427.3			4
Trawl	09/2002	23.0	10.2	1006.2	117.2	56.9	30

Table 14. Average monthly habitat variables associated with seine hauls.

Method	Date By Month	Average Depth (m)	Average Mean Velocity (m/s)	Average Bottom Velocity (m/s)	Number of Runs
1/8" seine	04/2003	0.8	0.2	0.1	12
1/8" seine	05/2002	0.4	0.2	0.1	18
1/8" seine	05/2003	0.7	0.3	0.2	10
1/8" seine	06/2002	0.6	0.1	0.0	20
1/8" seine	06/2003	0.6			4
1/8" seine	07/2002	0.5	0.2	0.1	58
1/8" seine	07/2003	0.6	0.1	0.1	25
1/8" seine	08/2002	0.7	0.5	0.2	6
1/8" seine	08/2003	0.7	0.1	0.1	14
1/8" seine	09/2002	0.4	0.3	0.2	18
1/8" seine	09/2003	0.6	0.2	0.1	10
1/8" seine	10/2002	0.7	0.5	0.1	3
1/8" seine	10/2003	0.4	0.2	0.1	13
1/8" seine	11/2002	0.5	0.3	0.2	8
1/8" seine	12/2002	0.6	0.2	0.1	7
1/16" seine	05/1998	0.4	0.2		32
1/16" seine	05/2000	0.2	0.3		26
1/16" seine	05/2001	0.6			7
1/16" seine	05/2002	0.2	0.2		8
1/16" seine	05/2003	0.3	0.1		6
1/16" seine	06/1998	0.3	0.2		36
1/16" seine	06/1999	0.4	0.2		13
1/16" seine	06/2000	0.3	0.3		30
1/16" seine	06/2001	0.6	0.0		22
1/16" seine	06/2002	0.4			10
1/16" seine	07/1998	0.5	0.2		19
1/16" seine	07/1999	0.4	0.0		8
1/16" seine	07/2000	0.6	0.3		15
1/16" seine	07/2001	0.2	0.1		85
1/16" seine	07/2002	0.4	0.1		89
1/16" seine	08/1999	0.1	0.2		8
1/16" seine	08/2000	0.3	0.2		22
1/16" seine	08/2001	0.4			176
1/16" seine	08/2002	0.5	0.1		51
3/8" seine	04/2002	0.6	0.6	0.5	2
3/8" seine	05/2002	0.5	0.4	0.3	28
3/8" seine	05/2003	0.6	0.9		11
3/8" seine	06/2001	0.6	0.2	0.2	35
3/8" seine	07/2001	0.4	0.3	0.2	41
3/8" seine	07/2002	0.4	0.3	0.2	50
3/8" seine	07/2003	0.5	0.4		31
3/8" seine	08/2002	0.3	0.3	0.2	23
3/8" seine	08/2003	0.7	0.6		9
3/8" seine	09/2001	0.3	0.4	0.4	14

Table 15. Average monthly water quality measurements associated with seine hauls.

Method	Date By Month	Water Temp (°C)	Dissolved Oxygen (mg/L)	Specific Conductivity (µS/cm)	Total Suspended Solids (mg/L)	Average Turbidity (NTU)	Number of net runs
1/8" seine	04/2003	14.6	10.1	462.5	335.5		6
1/8" seine	05/2002	18.9	9.4	637.0	179.0		7
1/8" seine	05/2003	18.4	9.7	518.8	338.3		9
1/8" seine	06/2002	23.6	7.1	554.6	190.2		13
1/8" seine	06/2003	23.3	6.2	512.0			3
1/8" seine	07/2002	27.3	9.4	428.0	100.5		15
1/8" seine	07/2003	26.0	5.9	513.8	166.0		9
1/8" seine	08/2002	21.7	6.6	451.3			3
1/8" seine	08/2003	24.1	7.7	448.6	123.0		6
1/8" seine	09/2002	21.1	6.6	388.1			6
1/8" seine	09/2003	13.4	8.7	493.6	98.0		6
1/8" seine	10/2002	14.8	8.3	505.0			3
1/8" seine	10/2003	15.8	8.9	491.6	53.0		6
1/8" seine	11/2002	4.8	12.3	344.8			6
1/8" seine	12/2002	0.0	13.5				3
1/16" seine	05/1998	21.7	10.4	681.6	257.6		9
1/16" seine	05/2000	24.1	9.2	572.6	504.7		7
1/16" seine	05/2001	14.9	3.9		237.0		1
1/16" seine	05/2002	19.5	9.1	488.5	194.3		3
1/16" seine	05/2003	23.1	11.4	558.0	133.0		1
1/16" seine	06/1998	26.0	5.9	628.0	207.0		6
1/16" seine	06/1999	26.5	9.6	633.0	507.0		2
1/16" seine	06/2000	24.8	8.9	493.5	261.9		8
1/16" seine	06/2001	22.4	11.3	513.5	157.5		2
1/16" seine	06/2002	26.7	6.6	687.7	240.0		3
1/16" seine	07/1998	32.5	10.5	541.0	386.0		4
1/16" seine	07/1999	25.6	6.7	607.5	291.0		2
1/16" seine	07/2000	26.1	7.8	495.3	648.0		3
1/16" seine	07/2001	24.4	8.0	611.6	89.0		10
1/16" seine	07/2002	27.2	8.7	449.9	83.8		14
1/16" seine	08/1999	21.9	8.2	530.0	142.0		1
1/16" seine	08/2000	29.5	9.4	425.2	119.7		3
1/16" seine	08/2001						27
1/16" seine	08/2002	25.7	7.3	436.0			8
3/8" seine	04/2002	20.6	17.1	630.0			1
3/8" seine	05/2002	17.2	9.3	495.5	203.7	84.5	4
3/8" seine	05/2003						2
3/8" seine	06/2001	24.5	10.4	593.8			14
3/8" seine	07/2001	28.6	7.4	579.5	718.0		11
3/8" seine	07/2002	29.6	12.4	1665.9	95.4	52.5	8
3/8" seine	07/2003	29.8	8.7	351.9			8
3/8" seine	08/2002	27.6	11.3	715.0			5
3/8" seine	08/2003	28.3	13.8	752.5			2
3/8" seine	09/2001	17.7	11.6	426.0			6

PALLID STURGEON HABITAT USE

A total of 15 pallid sturgeon were captured, 13 during this study and two fish, captured by the University of Nebraska Statewide stream fisheries inventory crew during their sampling of the lower Platte River. One specimen, captured on a trotline on April 2, 2004 was identified as a pallid sturgeon, but then it was lost before it could be measured. Habitat data were collected on the 13 fish from this study. The same habitat data were not collected on the pallid sturgeon captured on July 23, 2004 by the Statewide inventory crew because they used different measurement methodologies. This fish was not scanned for a PIT tag. However, the pallid sturgeon caught on September 25, 2004 was scanned for a PIT tag and the habitat where it was caught was measured according to the pallid sturgeon study protocol. Pallid sturgeon were caught in drifted gill nets (1), drifted trammel nets (4), and with trotlines (10). Most of the captures occurred in the spring of the year with the most fish being captured in April (9) and May (4). Table 16 provides the time and capture locations of all pallid sturgeon captured during this study and includes two pallid sturgeon captured by the statewide stream fisheries inventory project on July 23, 2004 and September 25, 2004. The specimens identified as “wild” showed no evidence of any type of tag, but it is possible that a PIT tag may have been lost.

In general, pallid sturgeon were most frequently captured in the deepest and swiftest runs of the river (Table17). The depth averaged almost 1.6 m and the mean current velocities approached 0.8 m/s. Within these areas of swift, deep water, pallid sturgeon were using bottom velocities similar to those found throughout the river. These values were above the average depths and velocities sampled by any gear type which suggests that shallow, slow moving water is not commonly selected habitat for pallid sturgeon in the lower Platte River. While these depths are not considered deep for the Missouri River, over 90% of the lower Platte River is less that 60 cm deep with an average depth of 26 cm (Peters et al. 1989). While pallid sturgeon captures were not observed in as close proximity to sandbar ledges or underwater dunes as shovelnose sturgeon, the deep runs where we captured most of the pallid sturgeon typically had a wide range of instream habitats (shallow and exposed sandbars) within 50 to 100 m of the capture locations. Our overall catch rate improved substantially in 2004 (12 of the 15 fish captured) when we began targeting the deepest, swiftest flow areas.

Our capture of pallid sturgeon began after the water temperature reached approximately 10 °C and stopped after it reached 17 °C (Table 18). Pallid sturgeon were captured in water with relatively high dissolved oxygen, high conductivity readings, and a range of turbidities. These water quality variables may reflect the spring time water conditions when pallid sturgeon are moving in the Platte River or may be actively selected by the fish. At this time it is not possible to differentiate from the data gathered.

The data gathered from random daily measurements around radio tagged pallid sturgeon provide a similar picture as the capture data (Tables 18 to 22). The fish were again found in deep, swift water although the average depth observed was slightly shallower (1.27 m as compared to 1.6 m). Pallid sturgeon were generally found over sand substrate and were observed within 10m of a sandbar ledges 15% of the time and among underwater dunes 76% of the time.

Table 16. Capture information for pallid sturgeon caught by this study and by the Nebraska stream fisheries inventory (*) in the Platte River between May 3, 2001 and September 25, 2004.

Species	Date Captured	Location	North GPS	West GPS	Method	Pit Tag #	Status
Pallid Sturgeon	5/3/2001	0.5 miles downstream from Hwy 50	41.01268	96.15036	Trotline	115551734A	Wild
Pallid Sturgeon	5/23/2002	0.5 mi upstream from Hwy 50	41.01027	96.1677	Gill net	422D7E243F	Wild
Pallid Sturgeon	4/3/2003	1 mile upstream from Hwy 75	41.06188	95.95645	Trotline	43114E287B	Wild
Pallid Sturgeon	4/2/2004	4 miles upstream from Hwy 75	41.0527	95.98572	Trotline	unknown	unknown
Pallid Sturgeon	4/7/2004	near Schilling WMA	41.05292	95.88122	Trotline	444411282B	Stocked
Pallid Sturgeon	4/8/2004	near Schilling WMA	41.05778	95.88575	Trotline	4262274C51	Stocked
Pallid Sturgeon	4/8/2004	near Schilling WMA	41.0568	95.88419	Trotline	4311594D2B	Wild
Pallid Sturgeon	4/13/2004	near Schilling WMA	41.05703	95.88486	Trotline	424E754E2A	Stocked
Pallid Sturgeon	4/14/2004	near Schilling WMA	41.05743	95.89998	Trotline	431156624B	Wild
Pallid Sturgeon	4/15/2004	1.25 miles downstream from Hwy 75	41.05693	95.90102	Trotline	4442685D64	Stocked
Pallid Sturgeon	4/15/2004	1.25 miles downstream from Hwy 75	41.05693	95.90102	Trotline	43115B1A46	Wild
Pallid Sturgeon	5/13/2004	near Cedar Creek, NE	41.05377	96.1018	Trammel net	44435F0919	Stocked
Pallid Sturgeon	5/13/2004	near Cedar Creek, NE	41.05168	96.1082	Trammel net	44233E4D32	Stocked
Pallid Sturgeon	7/23/2004*	2 miles upstream from Hwy 50	40.99528	96.2121	Trammel net	unknown	unknown
Pallid Sturgeon	9/25/2004*	4 miles upstream from Hwy 75	41.05972	95.96324	Trammel net	4311506852	Wild

Table 17. Habitat data collected in association with pallid sturgeon captures

Species	Method	Date captured	Average Depth (m)	Average Mean Velocity (m/s)	Average Bottom Velocity (m/s)
Pallid Sturgeon	Trotline	5/3/2001	1.46	1.02	0.54
Pallid Sturgeon	Trotline	4/3/2003	1.52	0.63	0.21
Pallid Sturgeon	Trotline	4/2/2004	1.74	0.85	0.38
Pallid Sturgeon	Trotline	4/7/2004	1.63	0.99	0.37
Pallid Sturgeon	Trotline	4/8/2004	2.22	1.21	0.38
Pallid Sturgeon	Trotline	4/8/2004	1.68	1.08	0.17
Pallid Sturgeon	Trotline	4/13/2004	2.42	0.37	0.29
Pallid Sturgeon	Trotline	4/14/2004	1.79	0.71	0.35
Pallid Sturgeon	Trotline	4/15/2004	1.71	0.85	0.34
Pallid Sturgeon	Trotline	4/15/2004	1.71	0.85	0.34
Pallid Sturgeon	Gill net	5/23/2002	0.39	0.50	0.23
Pallid Sturgeon	Trammel net	5/13/2004	1.51	0.74	0.46
Pallid Sturgeon	Trammel net	5/13/2004	1.92	0.76	0.17
Pallid Sturgeon	Trammel net	7/23/2004*			
Pallid Sturgeon	Trammel net	9/25/2004*	0.36	0.52	0.40
		Average	1.58	0.79	0.33

Table 18. Water quality data measured in association with pallid sturgeon captures.

Species	Method	Date captured	Water Temp (°C)	Dissolved Oxygen (mg/L)	Specific Conductivity (µS/cm)	Total Suspended Solids (mg/L)	Turbidity (NTU)
Pallid Sturgeon	Trotline	5/3/2001	17.2	8.9	745.5	336	
Pallid Sturgeon	Trotline	4/3/2003	17.2	11.1	542.5	110.5	92.8
Pallid Sturgeon	Trotline	4/2/2004	12.9	10.7	576.5	153	89.9
Pallid Sturgeon	Trotline	4/7/2004	15.5	12.1	635.5	158.5	75.1
Pallid Sturgeon	Trotline	4/8/2004	15.8	11.8	574.0	129	64.8
Pallid Sturgeon	Trotline	4/8/2004	16.3	12.6	634.0	129	64.8
Pallid Sturgeon	Trotline	4/13/2004	9.95	15.8	636.5		
Pallid Sturgeon	Trotline	4/14/2004	12.3	12.5	626.5	168.5	50.4
Pallid Sturgeon	Trotline	4/15/2004	14.4	11.7	648.5	115.5	45.8
Pallid Sturgeon	Trotline	4/15/2004	14.4	11.7	648.5	115.5	45.8
Pallid Sturgeon	Gill net	5/23/2002	16.6	11.9	617.0		
Pallid Sturgeon	Trammel net	5/13/2004	13.3	9.5	548.0	164	299
Pallid Sturgeon	Trammel net	5/13/2004	13.4	12.0	561.0	307	292
Pallid Sturgeon	Trammel net	7/23/2004	24.9	7.0	541.0		110
Pallid Sturgeon	Trammel net	9/25/2004	20.8	10.0	678.0		1040
		Average	15.0	11.6	619.4	171.5	196.4

Table 19. Habitat variables measured in association with pallid sturgeon during random daily telemetry contacts.

Fish	Date	Average depth (m)	Average mean velocity (m/s)	Average bottom velocity (m/s)	Average % Silt	Average % sand	Average % gravel	Presence of ledges	Presence of dunes	Daily mean discharge (CFS)
621	5/4/2001	1.83	1.14	0.59	0	100	0			16000
621	5/6/2001	1.49	0.76	0.54	0	100	0			31500
621	5/9/2001	1.24	0.62	0.35	0	100	0			23700
621	5/14/2001	1.40	0.76	0.54	0	100	0			13300
621	5/15/2001	0.90	0.84	0.52	26	74	0			11700
621	5/22/2001	1.00	0.75	0.57	0	100	0			12500
621	5/24/2001	1.81	0.96	0.61	0	100	0			8460
621	6/1/2001	0.96	0.78	0.59	0	100	0			11600
621	6/5/2001	0.98	0.88	0.68	0	100	0			8100
621	6/7/2001	0.73	0.76	0.46	0	100	0			8129
721	5/29/2002	1.19	0.82	0.51	0	100	0	No	Yes	7480
542	4/4/2003	1.35	0.78	0.44	0	100	0	Yes	No	7200
542	4/5/2003	1.18								7520
542	4/7/2003	0.78	0.70	0.57	0	100	0	No	No	6020
542	4/8/2003	1.20	0.99	0.48	0	100	0	No	No	5810
542	4/9/2003	1.07	0.77	0.46	0	100	0	No	Yes	6810
542	4/10/2003	0.89	0.79	0.45	0	100	0	No	Yes	6720
542	4/13/2003	0.91	0.65	0.22	0	100	0	No	Yes	7220
542	4/14/2003	1.96	1.11		0	100	0		Yes	7600
542	4/15/2003	0.62	0.40	0.26	0	100	0	Yes	Yes	9300
542	4/17/2003	1.18	0.71	0.41				No	Yes	7230
542	4/21/2003	0.62	0.58	0.30				No	Yes	6600
542	4/22/2003	1.11	0.75	0.06				Yes	Yes	6610
542	4/23/2003	0.79	0.65	0.14	0	100	0	No	Yes	6340
542	4/24/2003	1.35	1.02	0.53	0	100	0	No	No	6190
542	4/25/2003	0.84	0.71	0.42	0	100	0	No	Yes	5960
542	4/26/2003	1.51	0.86	0.48	0	100	0	No	Yes	5810

Table 19 (continued)

Fish	Date	Average depth (m)	Average mean velocity (m/s)	Average bottom velocity (m/s)	Average % Silt	Average % sand	Average % gravel	Presence of ledges	Presence of dunes	Daily mean discharge (CFS)
291	4/12/2004	1.11	0.61	0.40	0	100	0	No	Yes	4360
291	4/13/2004	1.47	0.78	0.30	0	100	0	No	Yes	4460
260	4/14/2004	1.13	0.52	0.21	0	100	0	No	No	4890
291	4/14/2004	1.16	0.95	0.53	0	100	0	No	No	4890
231	4/15/2004	1.74	0.73	0.44	0	100	0	No	Yes	4620

Table 20. Individual and combined average habitat variables measured in association with pallid sturgeon during daily random telemetry contacts.

Fish	Average depth (m)	Average mean velocity (m/s)	Average bottom velocity (m/s)	Average % Silt	Average % sand	Average % gravel	Daily mean discharge (CFS)
231	1.74	0.73	0.44	0	100	0	4620
260	1.13	0.52	0.21	0	100	0	4890
291	1.25	0.78	0.41	0	100	0	4570
542	1.08	0.76	0.37	0	100	0	6809
621	1.23	0.82	0.55	2.6	97.4	0	14499
721	1.19	0.82	0.51	0	100	0	7480
Average	1.27	0.74	0.41	0.4	99.6	0	7145

Table 21. Water quality variables measured in association with pallid sturgeon during random daily telemetry contacts.

Fish	Date	Water Temp (°C)	Dissolved Oxygen (mg/L)	Specific Conductivity (µS/cm)	Turbidity (NTU)
621	5/4/2001	14.8	8.74	510	876
621	5/6/2001	18.2	7.54	444	1208
621	5/9/2001	19.1	8.12	504	1228
621	5/14/2001	24.0	8.41	534	466
621	5/15/2001	24.9	8.75	549	432
621	5/17/2001	24.7	8.19	610	838
621	5/22/2001	15.8	12.22	528	574
621	5/24/2001	13.2	9.65	670	270
621	6/1/2001	16.1	8.80	514	503
621	6/5/2001	16.8	9.82	675	198
621	6/7/2001	18.5	7.80	621	445
721	5/29/2002	22.0	6.71	523	1172
542	4/4/2003	9.1	9.85	641	231
542	4/5/2003	7.9	10.34	582	236
542	4/7/2003	3.5	12.20	655	213
542	4/8/2003	6.5	11.46	510	305
542	4/9/2003	7.7	11.58	500	244
542	4/10/2003	9.8	10.70	559	236
542	4/13/2003	17.6	10.50	616	
542	4/14/2003	20.9	14.51	552	167
542	4/15/2003	20.2	10.67	548	156
542	4/16/2003	19.1	15.90	565	152
542	4/17/2003	13.2	11.54	701	168
542	4/21/2003	14.2	10.93	644	238
542	4/22/2003	15.1	12.28	474	226
542	4/23/2003	15.0	11.07	573	159
542	4/24/2003	12.7	11.81	712	192
542	4/25/2003	12.9	10.32	620	76
542	4/26/2003	16.1	11.05	645	74
291	4/12/2004	10.1	18.41	640	
291	4/13/2004	9.4	12.21	589	101
260	4/14/2004	14.3	12.48	655	114
291	4/14/2004	14.3	12.48	655	114
231	4/15/2004	15.0	12.47	584	86

Table 22. Individual and combined average water quality variables measured in association with pallid sturgeon during daily random telemetry contacts.

Fish	Water Temp (°C)	Dissolved Oxygen (mg/L)	Specific Conductivity (µS/cm)	Turbidity (NTU)
231	15.0	12.47	584	86
260	14.3	12.48	655	114
291	11.3	14.37	628	108
542	13.0	11.57	594	192
621	18.7	8.91	560	640
721	22.0	6.71	523	1172
Average	15.7	11.09	591	385

PALLID STURGEON MOVEMENT RESULTS:

Intensive gill net, trammel net and trot line sampling, captured a total of 15 pallid sturgeon from the lower Platte River between June 2000 and September 2004. Of these 15 pallid sturgeon, only eight were large enough to be implanted with a radio transmitter. Two of these fish that we radio tagged were previously PIT tagged, indicating to us that they were hatchery reared fish. Radio tagged pallid sturgeon were located seven times from the air and 42 times from the airboat (Table 23).

Of the seven pallid sturgeon that were not implanted with radio transmitters, four already carried either PIT tags, one escaped before it could be handled, one was captured by a crew that did not have authorization to implant a telemetry tag, and one showed no evidence of being tagged, but was too small to implant. The pallid sturgeon captured by the Nebraska stream inventory crew in a trammel net at River Mile 20 on July 23, 2004 was not scanned for tags. This fish was 590mm in length and was released at the same location as it was caught. The final small pallid sturgeon that was caught on September 25, 2004 carried no tags when it was caught in a trammel net at RM 4.5, and was presumed to be a wild fish. This fish was 363mm in length and weighed 150grams. It was PIT tagged (4311506852) and released at the same location as it was caught. The following accounts summarize the movement information gathered on the eight radio tagged fish and the stocking and capture locations of PIT tagged fish.

Table 23. Number of pallid sturgeon locations in the Platte River, Nebraska by survey method and year from 2000 to 2004.

Common Name	Survey Method	2000	2001	2002	2003	2004	Total Number of Locations
Pallid Sturgeon	Boat	2	11	7	17	5	42
Pallid Sturgeon	Plane	-	3	1	2	1	7
	Total	2	14	8	19	6	49

Radio Telemetry

Pallid sturgeon 621, a female (880 mm, 2.45 kg), was captured on a trot line, implanted, and released near Louisville, Nebraska at RM 16.2 on May 3, 2001 (Figure 15). Three days later (May 6, 2001) this fish was located 0.95 km downstream of the release site. Some local movement was observed, however the pallid remained within 0.25 km of this location from May 6 through May 24. Between May 3 and May 29, this fish moved at an average rate of 150 m/d, while from May 29 to June 9, 2001 it moved at an average downstream rate of 1940 m/d. This pallid sturgeon resided in the Platte River a minimum of 37 days, entering the Missouri River on June 9, 2001. This fish was considered to be a wild fish as it showed no identification tags.

Pallid sturgeon 721 (1030 mm, 4.1 kg. sex unknown), was captured on May 23, 2002 in a drifted gill net 800 m upstream from the capture site of pallid sturgeon 621 (Figure 16). This fish was implanted and released at Louisville at RM 16.2 and located 14.8 km downstream of the release site five days later. This pallid sturgeon resided in the Platte River at least 8 days, entering the Missouri River on May 30, 2002. This fish moved downstream at an average rate of 3,250 m/d. This fish was likely a wild fish as it showed no identification tags. General inspection during surgical implantation was unable to determine the sex of this fish. Because of the rapid downstream movement, it may have already spawned, but we were unable to confirm this.

Pallid sturgeon 542 (788 mm, 1.8 kg, sex unknown), was captured on a trotline, implanted, and released April 3, 2003 upstream of the mouth of the Platte River at RM 3.70 (Figure 17). This fish remained within 1 km of the release site until April 23; however, by April 27 the fish had entered the Missouri River. In comparison with pallid sturgeon tracked during 2001 and 2002, fish 542 entered the Missouri River considerably earlier in the year. Early movement out of the Platte River was possibly influenced by increased spring 2003 water temperatures. During the second week in April of 2003 river temperatures exceeded 20˚C. Temperatures in the Platte River during 2001 and 2002 did not exceed 20˚C until the second week of May. This fish was likely a wild fish as it had no identification tags.

Pallid sturgeon 291 (891 mm, 2.7 kg, sex unknown) was captured on April 8, 2004 on a trotline approximately 0.6 RM upstream from the mouth of the Platte River and released at that location (Figure 18). This fish was tracked on four different occasions before it entered the Missouri River. This fish was likely a wild fish as it showed no identification tags or markings.

Pallid sturgeon 910 (494 mm, 408g, sex unknown) was captured on April 8, 2004 on a trotline 0.6 RM upstream of the mouth of the Platte River and released at the site where it was captured. This pallid sturgeon (PIT tag number: 4262274C51) was hatched at Garrison National Fish Hatchery on June 26, 2001 and stocked at Boonville, MO (RM 195.1) on April 3, 2002. It was 200mm long when it was tagged. When we caught this fish on a trotline on April 8, 2004 near the mouth of the Platte River it had been at large for 736 days and had traveled a minimum of 399.9 miles. During that time it had grown 294mm in length. Since this fish was age 5 when it was captured its sex could not be determined. This fish was not located again after it was released.

Pallid sturgeon 260 (695 mm, 1.0 kg, sex unknown) was captured on April 13, 2004 on a trotline 0.72 RM upstream of the mouth of the Platte River and was released at this point (Figure 19). This pallid sturgeon was a recapture (PIT tag number:

424E754E2A) that had been stocked in the Missouri River at Boonville, Missouri (RM 195.1) on April 25, 2002. This fish had been at large for 719 days and had traveled a minimum of 400miles before we caught it. It had been hatched on June 14, 1999 at the Gavins Point Fish Hatchery and it was 580mm long and weighed 860 grams when it was tagged. During its time at large this fish had grown 115mm in length and gained about 140 grams in weight. Since this fish was age 5 when captured it was an immature fish and its sex could not be determined. This fish was tracked one time before it entered the Missouri River two days after it was released.

Pallid sturgeon 931 (497 mm, 0.4 kg, sex unknown) was captured on April 14, 2004 on a trotline 0.8 RM upstream from the mouth of the Platte River, implanted with transmitter number 931, and released at this point. This fish was not located after it was released. This fish had no PIT tags or other markings and was considered to be a wild fish.

Pallid sturgeon 231 (913 mm, 2.8 kg, sex unknown) was captured on April 15, 2004 on a trotline 0.9 RM upstream from the mouth of the Platte River (Figure 20). It was implanted with transmitter number 231 and released at this point. This fish was located once and followed to the Missouri River on the same day that it was released. This fish had no PIT tags or other markings and was considered to be a wild fish.

The pallid sturgeon implanted during April 2004 all apparently moved out of the Platte River by April 15, 2004 during the time when a back-flushing operation at the MUD water treatment plant released a white material into the river.

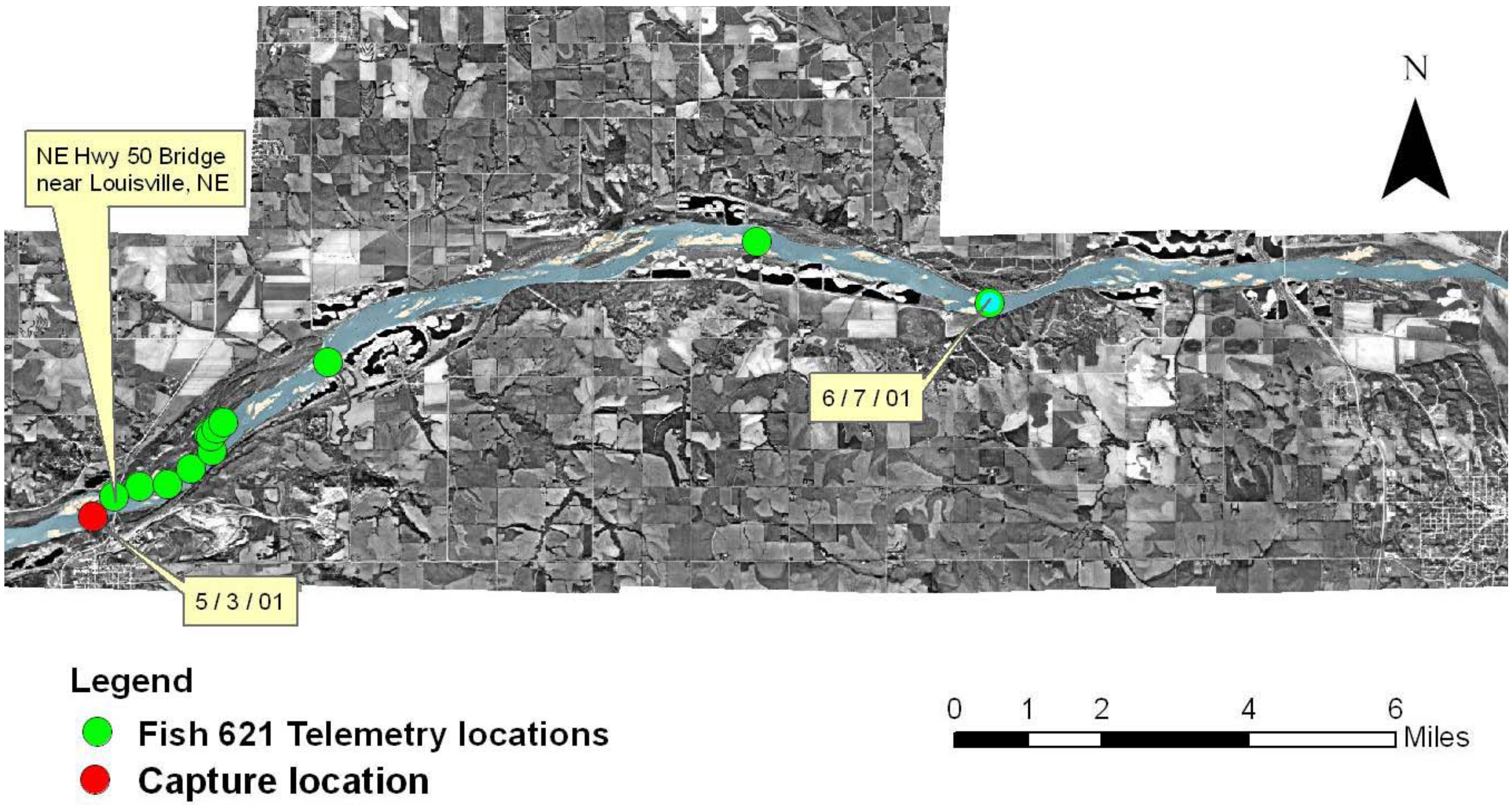

Figure 15. Capture and telemetry locations of pallid sturgeon #621 during May and June of 2001.

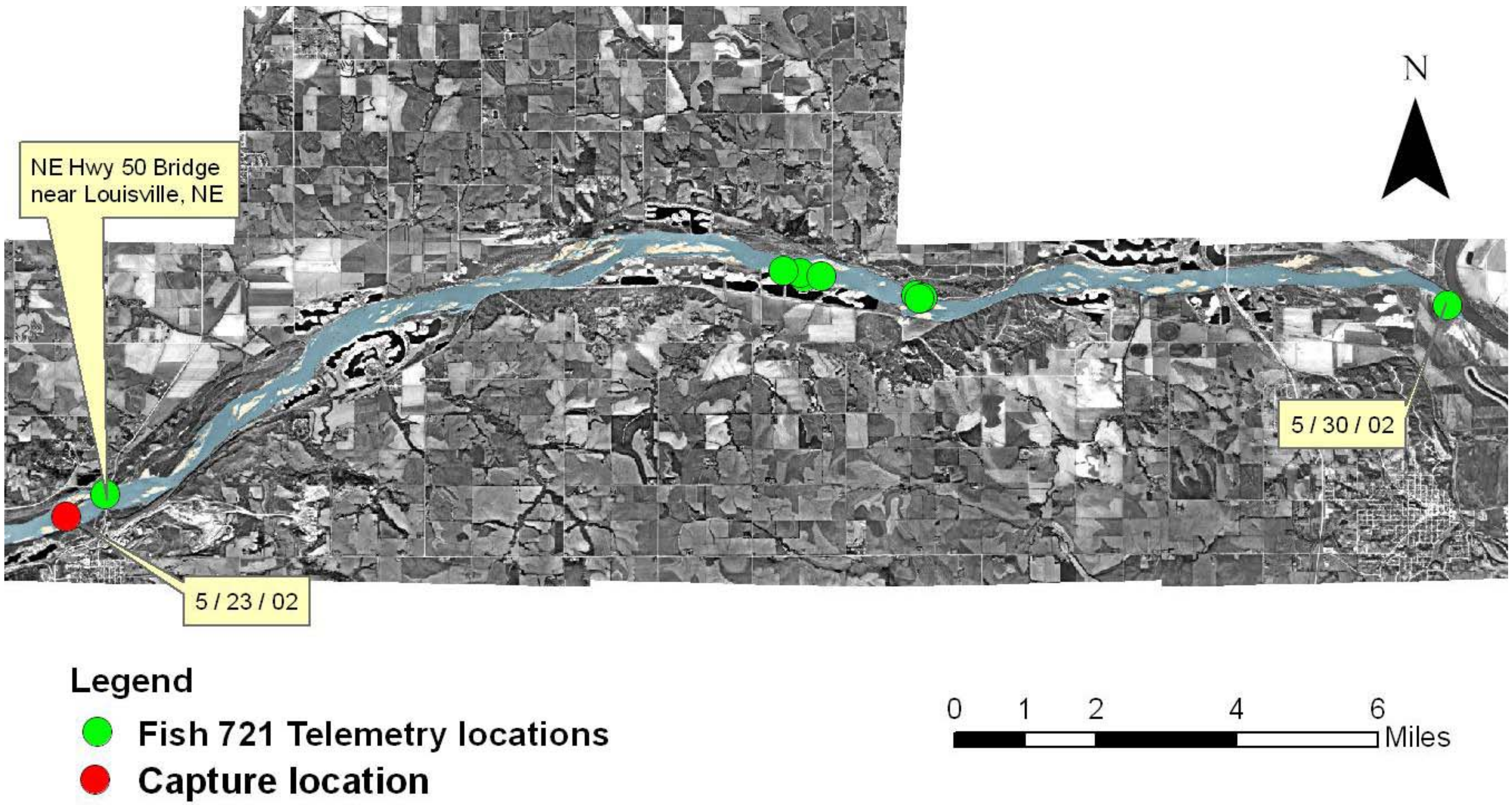

Figure 16. Capture and telemetry locations of pallid sturgeon #721 during May of 2002.

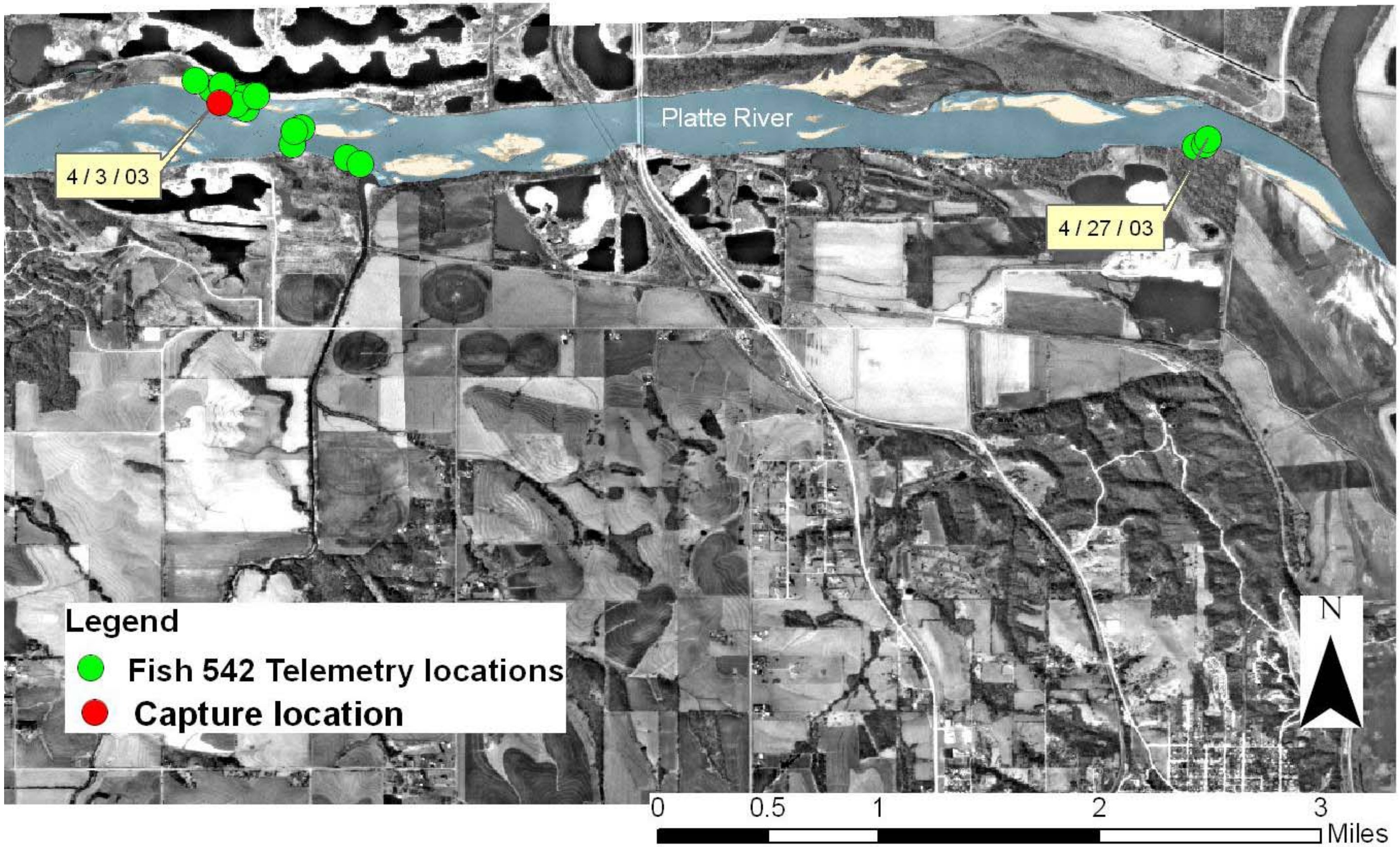

Figure 17. Capture and telemetry locations of pallid sturgeon #542 during April of 2003.

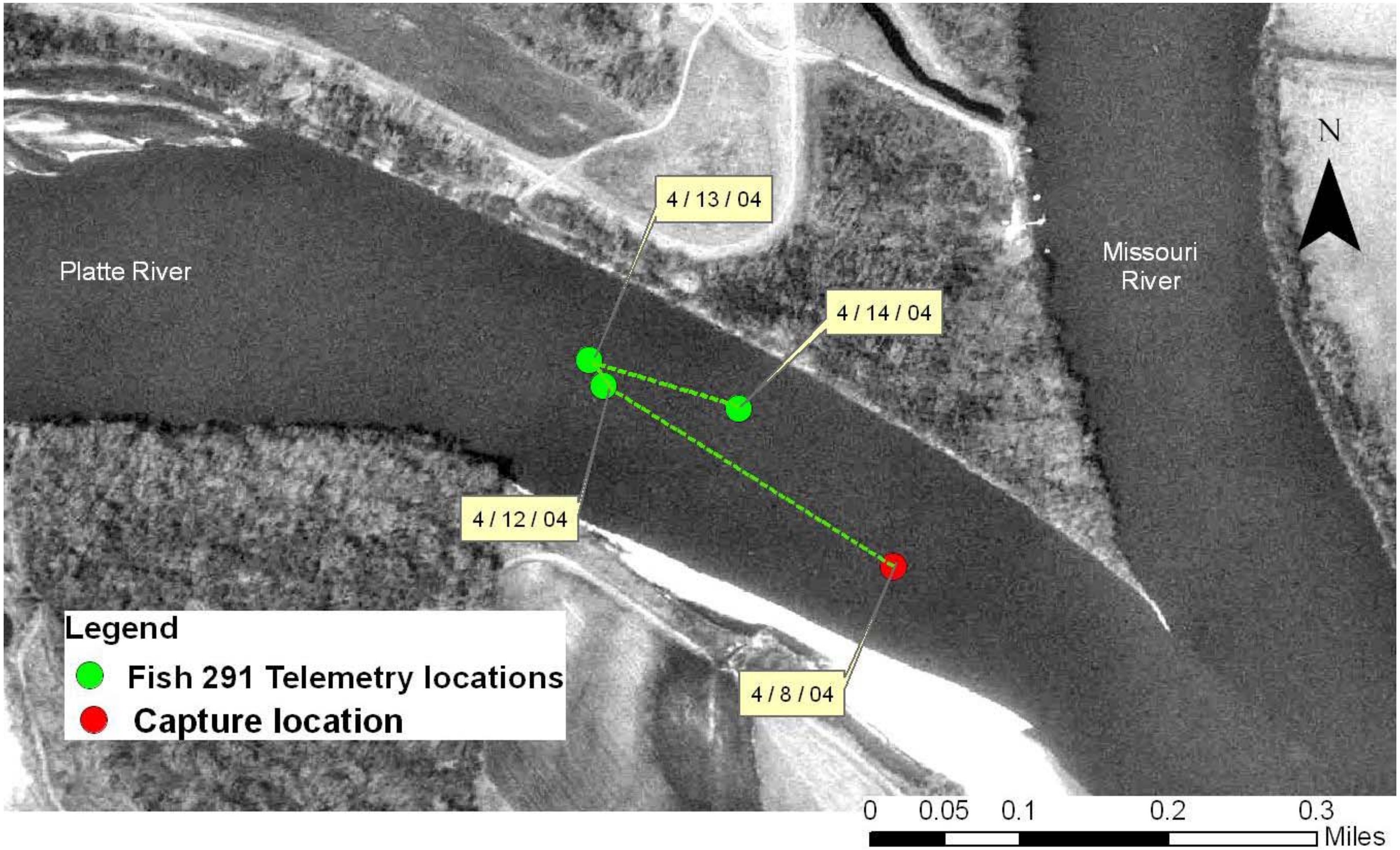

Figure 18. Capture and telemetry locations of pallid sturgeon #291 during April of 2004.

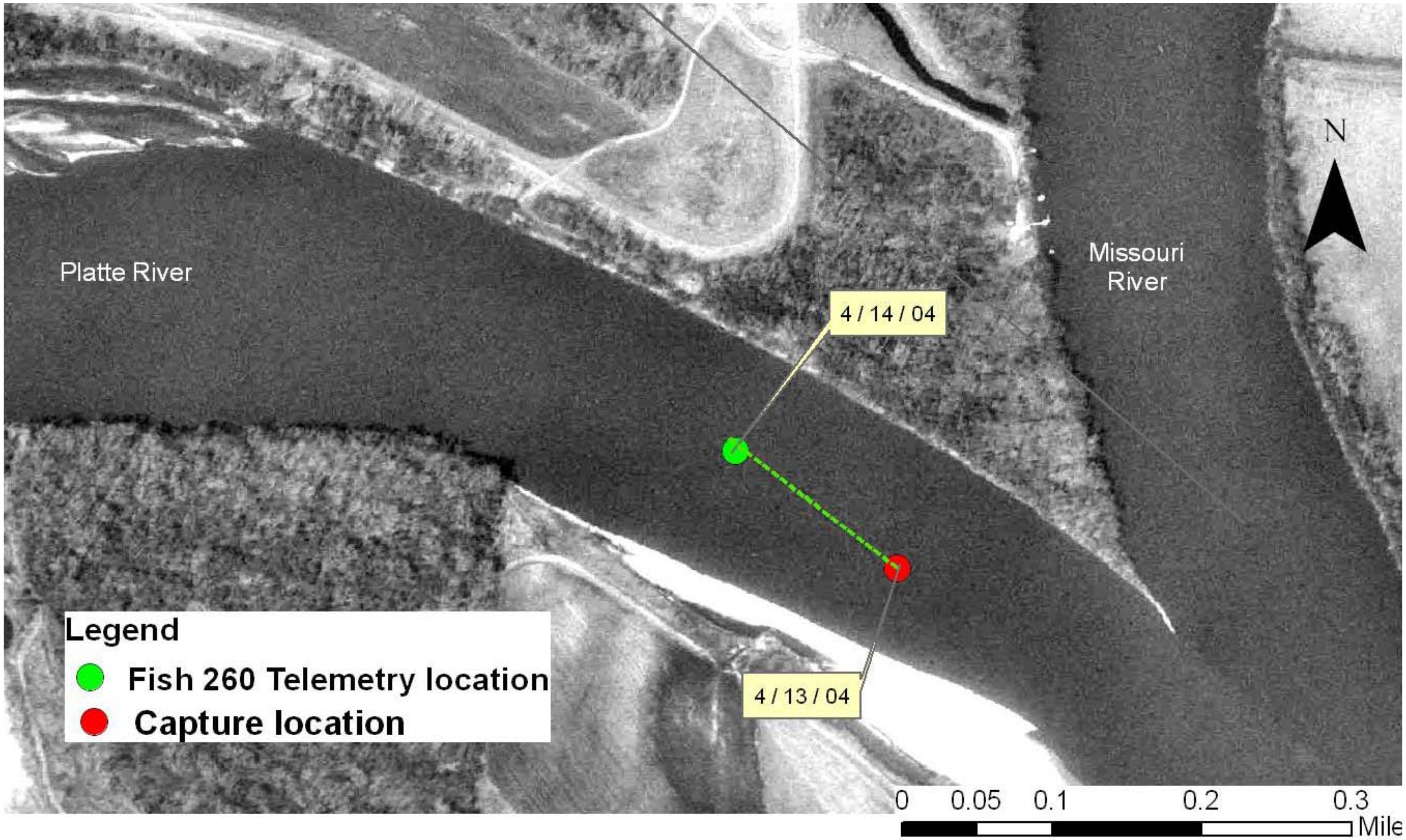

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Figure 19. Capture and telemetry locations of pallid sturgeon #260 during April of2004.

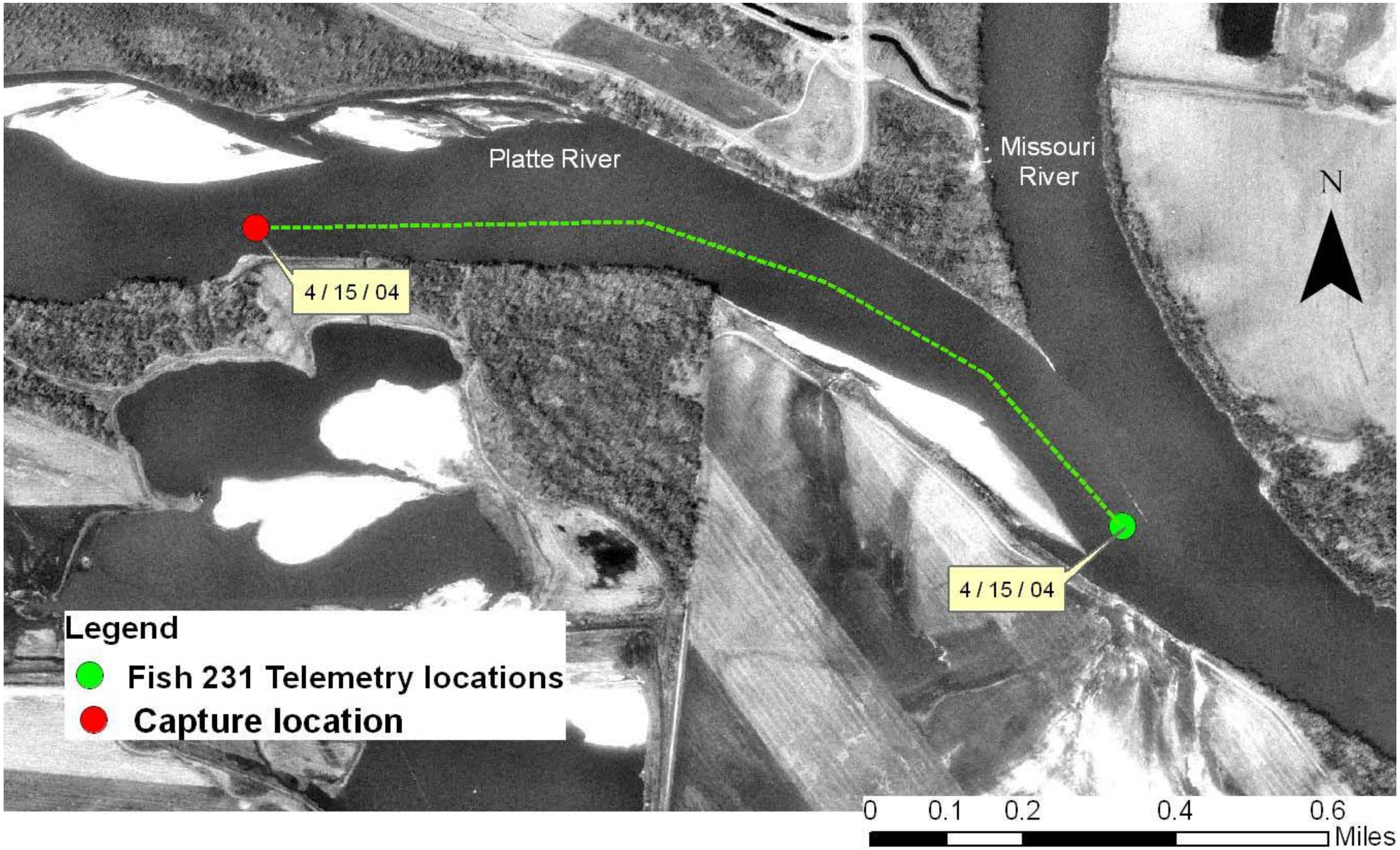

Figure 20. Capture and telemetry locations of pallid sturgeon #231 during April of 2004.

Recaptures of PIT tagged fish:

The pallid sturgeon recovery effort includes the stocking of hatchery reared individuals into the Missouri River and Platte River. During our sampling we captured six PIT tagged individuals and we were able to trace these tag numbers to specific hatchery sources and stocking locations and dates using the US Fish and Wildlife Service database. Two of these individuals were large enough to implant with radio transmitters and they are described in the previous section, but four were too small to implant with radio transmitters. These "recaptures" are described individually here.

The pallid sturgeon with PIT tag number 444411282B was hatched at Gavins Point National Fish Hatchery on June 22, 2002 and stocked at Bellevue, NE (RM 601.4) on September 4, 2003. It was 304 mm in length and weighed 118 grams when it was tagged. When we caught this fish on April 7, 2004 on a trotline at the mouth of the Platte River it was 333mm long and weighed 112grams. This fish had been at large for 216 days and was caught about 7 miles from its point of stocking. During that time it had grown 29mm in length and lost 6 grams in weight.

The pallid sturgeon with PIT tag number: 4442685D64 was hatched at Gavins Point National Fish Hatchery on June 22, 2002 and stocked at Bellevue, NE (RM 601.4) on September 4, 2003. It was 251mm long and weighed 63 grams when it was tagged. When we caught this fish on April 15, 2004 on a trotline in the Platte River (RM 1.3) it was 284mm long and weighed 100grams. This fish had been at large for 224 days and had traveled a minimum of 8.2 miles from where it was stocked before it was caught During that time it had grown 33mm in length and gained 37 grams in weight.

The pallid sturgeon with PIT tag number 44233E4D32 was hatched at Gavins Point National Fish National Hatchery on June 22, 2002 and stocked at Bellevue, NE (RM 601.4) on September 4, 2003. It was 287mm long and weighed 101 grams when it was tagged. When we caught this fish on May 13, 2004 in a trammel net run in the Platte River near Cedar Creek (RM 12.5) it was 329mm long and weighed 120grams. This fish had been at large for 252 days and had traveled a minimum of 19.4 miles before we caught it. During that time it had grown 42mm in length and gained 19 grams in weight.

The pallid sturgeon with PIT tag number 44435F0919 was hatched at Gavins Point National Fish Hatchery on June 22, 2002 and stocked at Bellevue, NE (RM 601.4) on September 4, 2003. It was 299mm long and weighed 105 grams when it was tagged. When we caught this fish on May 13, 2004 in a trammel net run in the Platte River near Cedar Creek (RM 12) it was 334mm long and weighed 119grams. This fish had been at large for 252 days and had traveled a minimum of 19.4 miles before we caught it. During that time it had grown 35mm in length and gained 15 grams in weight.

PALLID STURGEON MOVEMENT DISCUSSION:

Pallid sturgeon that use the Platte River appear to be mobile animals. Up to the year 2004 evidence pointed toward a conclusion that they may only be using the Platte River during the spring and early summer. This would agree with observations by Bramblett and White (2001) who found that pallid sturgeon moved upstream into the Yellowstone River from the Missouri River in the spring and downstream again later in the year. However, in 2004 one juvenile size pallid sturgeon was captured in the Platte River in July and another during September. Snook (2001) noted that two of the pallid sturgeon he was tracking during 1999 moved upstream during late September. Hofpar (1997) recorded similar movements in shovelnose sturgeon in the Platte River during the fall of 1996. Our limited sample size limits our ability to make definitive statements about the number of pallid sturgeon that use the Platte River, but the fact that we caught pallid sturgeon during spring, summer and fall months of the year indicates to us that the lower Platte River is an important part of RPA 4, (USFWS 1993) which includes all of the Missouri River downstream from Gavins Point Dam to its confluence with the Mississippi River (approximately 800 river miles).

The pallid sturgeon that carried PIT tags gave us some insights to the distances that this species travels. Four of the tagged fish had only traveled a short distance from Bellevue, NE (7-20 miles) but two of the fish we captured had traveled over 400 miles upstream from Boonville, MO to reach the Platte River. The distances moved and survival duration for pallid sturgeon provides support for two conclusions. First, pallid sturgeon stocked into the Missouri River are surviving and growing and that they do travel up tributary rivers. Second, the capture of six pallid sturgeon that were stocked into the Missouri River suggests that conditions in the Platte River are attractive to stocked pallid sturgeon. We captured 6 hatchery reared pallid sturgeon during 2004 while Krentz et al. (2005) recorded a total of 91 recaptures from all of RPA 4. That works out to 1 recapture / 2.1 miles of river in the Platte River and 1 recapture / 8.8 miles of river in the Missouri River.

Bramblett and White (2001) reported that movement rates in the Yellowstone and Missouri Rivers were highest in the spring (March 20–June 20) and lowest during the winter (December 21–March 19) for both shovelnose and pallid sturgeon. In addition, they speculated that long-range spring and summer movements by both species were associated with spawning activities. Although the pallid sturgeon in the Platte River were not tracked outside of spring months, our data support this theory. Following synchronized long-distance upstream movements by shovelnose tracked in 2001 and 2002, these radio-tagged fish were relatively sedentary between May 18 and June 13, 2001 and May 14–28, 2002. Collection of day-old larval *Scaphirhynchus* at rm 27.8 on May 23, 2001 and May 21, 2002 coincided with these dates. Water temperatures during sedentary periods ranged from 17.2 to 21.6°C (2001) and from 15.2° to 25.1°C (2002); encompassing reported temperatures for *Scaphirhynchus* reproduction (Moos 1978). Given this combination of evidence, reproduction by *Scaphirhynchus* sturgeon in the Platte River likely takes place between mid-May and early June.

Pallid sturgeon activity in the Platte River may also be attributable to reproduction. During spring months pallid sturgeon moved downstream in coordinated patterns, exhibited spring sedentary phases similar to shovelnose sturgeon, and one pallid sturgeon (fish 621) carried late-stage eggs. Although pallid sturgeon reproduction in the Platte River cannot be confirmed, additional efforts should continue to substantiate this speculation.

None of the implanted pallid sturgeon was detected moving out of the Platte River in one year and then returning into the Platte River the next year. However, this is not unexpected if they had spawned during the year when we caught them we would not expect them to return for as long as10 years to reproduce again (Keenlyne and Jenkins 1993). During the 5-year study no confirmed pallid sturgeon eggs or larval fish were sampled in the Platte River. However, as noted above *Scaphirhynchus* larvae were sampled.

STURGEON PULSED GASTRIC LAVAGE TEST RESULTS:

During 2001 and 2002, 211 shovelnose sturgeon ranging from 450 to 718 mm fork length were sampled using PGL. These stomach contents were comprised primarily of aquatic insects belonging to 36 genera, in 16 families from 6 orders along with a few terrestrial insects and larval fish. Very little detritus or inorganic matter was found in the stomachs of shovelnose sturgeon. In fact, in many cases the invertebrates were still alive when they were flushed from the stomachs of the sturgeon. While the use of PGL in the field proved successful in determining the diets of shovelnose sturgeon, additional laboratory tests on the survival of shovelnose sturgeon were conducted to see if this technique could be used in future studies for pallid sturgeon.

To test the survival of shovelnose sturgeon subjected to PGL, nine tests each containing eight fish were conducted. These 72 shovelnose sturgeon were captured in 56 gill net drifts (N=56 sturgeon) and four trammel net drifts (N=16 sturgeon).
No significant difference (p=0.7094) was detected between survival of PGL and control fish for all eight tests. Survival was 100% during tests 1, 2, 3, 4, 7, 8, and 9 (Table 25). Mortality during test 5 consisted of two PGL fish and no control fish for a mortality rate of 44%. During test 6 five of the six PGL fish and both control fish expired, for a mortality rate of 83%.

Water temperatures during the tests ranged from 14.7 to 28.1^{o}C with an overall mean of 20^{o}C. There was a significant difference of temperature among the nine tests (p=<0.0001), but the variation of temperature within a test remained relatively constant (Figure 24). However, there seemed to be no direct relationship between temperature during a test and mortality of the fish in the test, since tests 5 and 6, when mortality occurred were near the center of the temperature range. Dissolved oxygen concentrations during the tests ranged from 6.9 to 9.5 mg/l with an overall mean of 8.1mg/l. A significant difference among tests was detected for dissolved oxygen concentrations (p=<0.0016). However, no relationship between dissolved oxygen concentrations during a test and mortality was detected, since the concentrations for tests 5 and 6 were near the center of the range of values. Conductivity levels among tests were significantly different, but most of the difference is due to additions of sodium chloride to the water during tests 7, 8, and 9. Again, there was no detectable relationship between conductivity levels and mortality of sturgeon during the tests. Ammonia concentrations were significantly different among tests (p=0.0003). Again there were no detectable relationships between ammonia concentrations and sturgeon mortality during the tests. Nitrite concentrations afford the only potential cause and effect relationship between a chemical factor and mortality of test sturgeon. Concentrations of nitrite were significantly higher during tests 5 and 6 than during all other tests ($p<0.0001$). This corresponds to the times when sturgeon died during the nine test runs.

Table 24. Number of deaths and percent survival of shovelnose sturgeon subjected to pulsed gastric lavage during nine laboratory experiments with eight individuals per experiment.

	Control Deaths	Treatment Deaths	Control Percent surviving	Treatment Percent Surviving
Batch 1	0	0	100	100
Batch 2	0	0	100	100
Batch 3	0	0	100	100
Batch 4	0	0	100	100
Batch 5	0	2	100	67
Batch 6	2	5	0	17
Batch 7	0	0	100	100
Batch 8	0	0	100	100
Batch 9	0	0	100	100

STURGEON PULSED GASTRIC LAVAGE TEST DISCUSSION:

Recent advances in gastric lavage reported here from Shuman (2003) and colonic flushing (George et al. 2005) show that they hold great promise to understanding the food habits of pallid sturgeon in the lower Platte River. Although we were unable to sample stomach contents of pallid sturgeon, the information gained by a study of pallid sturgeon food habits may clarify whether pallid sturgeon choose habitats based on habitat characteristics or the presence of favorable food items. George et al. (2005) found that pallid sturgeon from the Mississippi River consumed speckled chub and this species is common in the lower Platte River.

Shuman (2003) found that there was no significant difference between survival of lavaged shovelnose sturgeon and non-lavaged shovelnose sturgeon in the laboratory. These results combined with other studies on pallid sturgeon formed the basis for the U.S. Fish and Wildlife Service's recommendation to allow gastric lavage on pallid sturgeon in the field as of 2004. Unfortunately, approval to lavage pallid sturgeon stomachs came too late for us to use this technique during 2004.

PALLID STURGEON POPULATION CHARACTERISTICS RESULTS AND DISCUSSION:

Length / Weight

During the 5 years of sampling we weighed and measured 14 pallid sturgeon. The mean condition factor (K(FL)) for these sturgeon was 0.349 and the fish ranged from 284 mm to 1030 mm fork length. The relationship between length and K(FL) exhibited a non-significant relationship ($t = 1.020$; $p = 0.328$) with a positive slope. However, the power of this test was low. The only other set of data available on lengths and weights of pallid sturgeon was for 74 hatchery reared pallid sturgeon from the Gavins Point National Fish Hatchery in Yankton, South Dakota. These fish ranged in size from 423 to 734 mm and had a mean K(FL) of 0.410. The relationship of K(FL) to fork length showed a significant, positive linear relationship ($t = 4.932$; $p < 0.001$). As expected, the condition factor of fish in the wild was lower than those from a hatchery, but because of the small sample size no statistical comparisons were made.

Morphometrics

Of the 15 pallid sturgeon caught between May 3, 2001 and September 25, 2004 13 were measured for calculation of the mCI. One specimen not measured was the pallid sturgeon that escaped before it could be measured and the other was captured by the statewide stream inventory crew on July 23, 2004. In general, the mCI did a reasonable job distinguishing the 13 pallid sturgeon that were measured from shovelnose, but there was some overlap. No fish that we considered to be pallid sturgeon exhibited mCI values over -0.19 (Figure 21), but some fish that we considered to be shovelnose sturgeon exhibited mCI values as low as -0.73. All of the fish that exhibited a mCI higher than a value of -1.0 were less than 334 mm fork length and four of these were hatchery reared fish with either elastomere or PIT tags. On the other hand, the fish we classified as shovelnose sturgeon that exhibited mCI values between -0.2 and -0.73 included a mixture of sizes, but many were over 500 mm fork length. It is possible that some of these fish may be hybrids, but we have not received confirmation of any hybrids from tissue samples submitted for analysis.

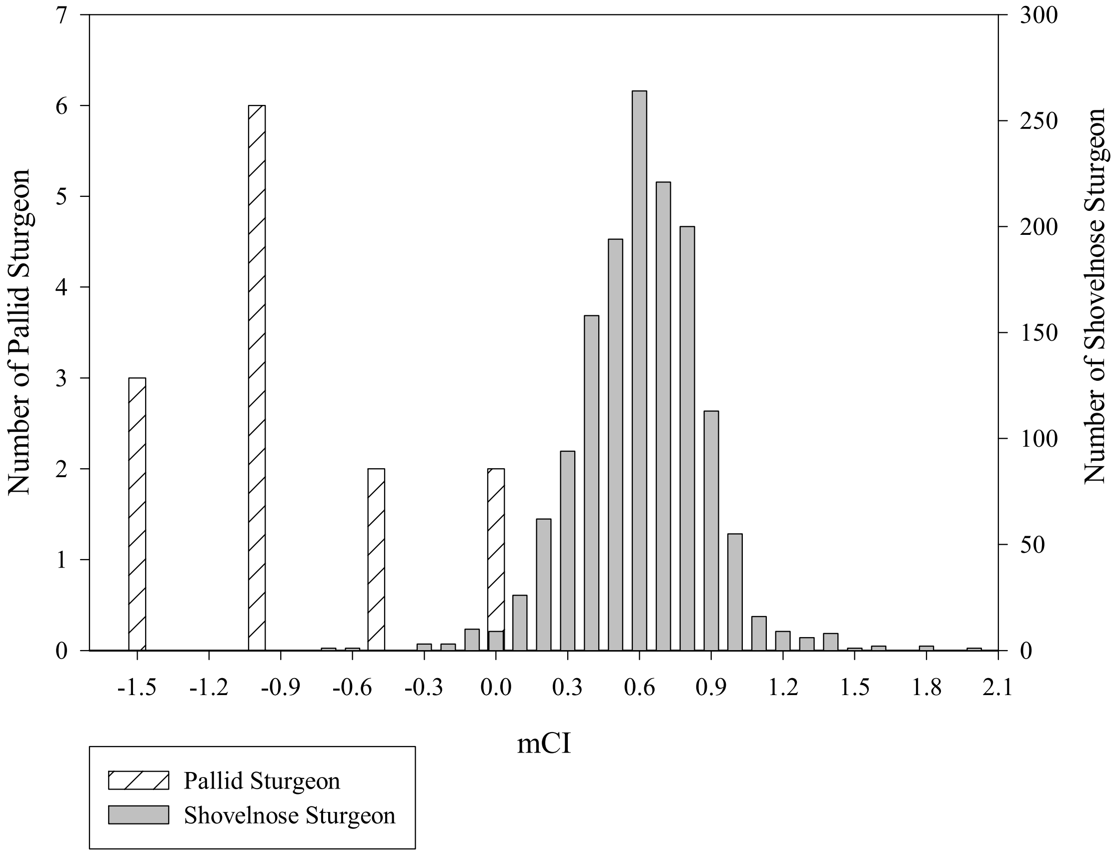

Figure 21. Comparisons of mCI values calculated from measurements on pallid and shovelnose sturgeon from the Platte River.

Species associated with pallid sturgeon captures:

Six species of fish were captured in the same gear along with pallid sturgeon during this study. Shovelnose sturgeon were captured on 12 of the 14 occasions when pallid sturgeon were captured on trotlines (8/9), in gillnets (1/1) and in trammel nets (3/4). Only trammel nets caught additional fish species and these were; shortnose gar (*Lepisosteus platostomus*) in 1 of 4 nets, goldeye (*Hiodon alosoides*) in 2 of 4 nets, grass carp (*Ctenopharyngodon idella*) in 1 of 4 nets, river carpsucker (*Carpiodes carpio*) in 1 of 4 nets, and blue sucker (*Cycleptus elongatus*) in 2 of 4 nets.

STURGEON CHUB POPULATION CHARACTERISTICS

RESULTS AND DISCUSSION

Age and Growth:

Even though we attempted to focus our collection efforts to sample sturgeon chub, we were able to capture only five during this study. Three of these specimens were collected with the help of Robert Hrabick when he demonstrated the use of the otter trawl in the lower Platte River (Table 25). One additional specimen was captured in 1987 (Peters et al. 1989). These fish ranged in size from 52.5 to 92.4 mm total length. There is not enough data to compile a meaningful histogram. Werdon (1992) found up to three age classes and Stewart (1981) found that age 0 sturgeon chub in the Powder River, Wyoming ranged from 38 to 48mm in length. Age 1 individuals ranged from 55.3 to 80mm, age 2 individuals ranged from 68.6 to 92.7mm and age 3 individuals ranged from 81.3 to 91.4mm. However, Everett (1999) found that age 3 individuals ranged from 73-86 mm. Based on these results, the smallest individual was probably age 1, while the rest of the specimens were either age 2 or age 3. This is supported by our observations that the 4 largest individuals were all sexually mature (3 females and 1 male) and the 52.5 mm specimen was apparently immature. Sturgeon chub may be similar to speckled chub in their life history with most of the individuals living only through two summer seasons and expiring after spawning at age one(Stewart 1981).

Length-Weight:

The small number of sturgeon chubs did not allow calculation of a meaningful length-weight regression. Condition factors for the three fish identified as female ranged from 0.70 to 0.77 and averaged 0.736 while the condition factor value for the male fish was 0.54. From data presented by Stewart (1981), we calculated condition factors for sturgeon chubs and they ranged from 0.29 to 0.87 with a mean of 0.59.

Population Density:

No estimate of density was attempted for sturgeon chubs.

Reproductive Status:

Only one sturgeon chub (64.4 mm) contained identifiable eggs. This fish was captured on August 20, 2000 and had a GSI value of 6.6 in contrast to the two other larger females captured on that same date which had GSI values of 1.2 and 1.4. This leads us to believe that these fish had already spawned for the year. This agrees with the observations of Stewart (1981) who collected no gravid females from the Powder River in Wyoming after July 26. The only fish that could be identified as a male was captured on May 30, 2002 and it had a GSI of 0.8 but there was no evidence of breeding tubercles on this specimen. Cross (1967) stated that male sturgeon chub collected in late June had well developed breeding tubercles.

Most studies of sturgeon chub spawning indicate that reproduction takes place from May to late June at water temperatures between 18 and 23°C (Werdon 1992). These temperatures are typically attained in the Platte River during late May and early June.

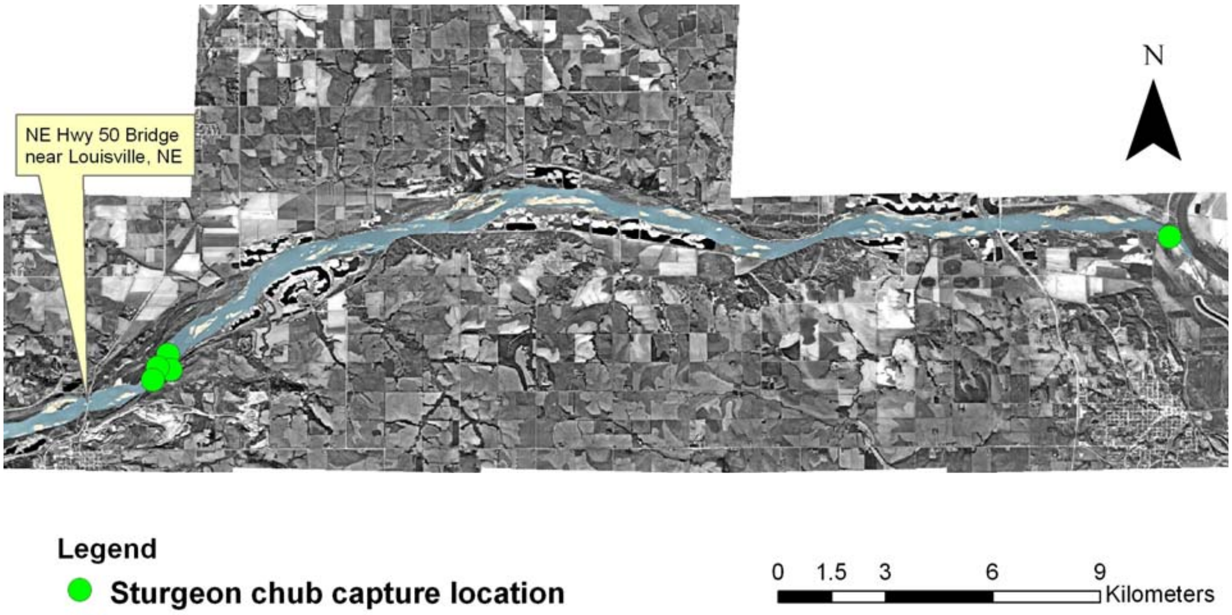

Figure 22. Map of locations where sturgeon chub were captured from 2000 to 2004

Habitat Use:

Water depths where sturgeon chubs were caught ranged from 1.04 to 1.4 meters and averaged 1.3 meters. Bottom velocities where sturgeon chubs were caught ranged from 0.21 to 0.46 m/s and averaged 0.30 m/s. Four of the five sturgeon chub were found at sites where substrates were composed of 90% sand and 10% gravel. The other sturgeon chub was found where the substrate was composed of 75% sand and 25% gravel.

The conditions where sturgeon chubs were collected during this study were deeper water and in slower velocities than that where Peters et al. (1989) collected a sturgeon chub in 1987. The sandy conditions were similar between our study and Peters et al. (1989). Other studies (Werdon 1992, Herzog and Ostendorf (2002) found sturgeon chubs in areas that have water velocities over 0.4m/s in depths less than 2 meters deep. The typical substrates in areas where these studies found sturgeon chubs were gravel and rubble.

One of the primary habitat characteristics noted during studies of sturgeon chub is their apparent dependence on turbid water (Stewart 1981, Werdon 1992). Turbidity at sites where sturgeon chub sampled during this ranged from 70 to 130NTU which was typical for the lower Platte River during the study period from 2000 to 2004, but these values are considerably lower than the 500JTU values reported by Werdon (1992) from the Powder River, Wyoming.

Table 25. Length, body weight, gonad weight, sex, Fulton's condition factor (K), and gonadosomatic index (GSI) for sturgeon chub collected in the Platte River, Nebraska, 2000-2002. (*= fish too small to determine values)

Date	Location	Length (mm)	Body weight (grams)	Gonad Weight (grams)	Sex	Fulton's K	GSI
8/20/2000	Louisville RM 15.5	64.4	2.065	0.137	Female	0.77	6.6
8/20/2000	Louisville RM 15.5	78.5	3.387	0.041	Female	0.70	1.2
8/20/2000	Louisville RM 15.5	80.9	3.936	0.056	Female	0.74	1.4
5/30/2002	Louisville RM 15.5	92.4	4.908	0.037	Male	0.54	0.8
6/26/2002	Schilling RM 0.5	52.5	0.785	*	*	0.62	*

Associated Species

We collected seven species, silver chub (*Macrhybopsis storeriana*), speckled chub (*M. aestivalis*), plains minnow (*Hybognathus placitus*), red shiner (*Cyprinella lutrensis*) sand shiner (*Notropis ludibundus*), channel catfish (*Ictalurus punctatus*), and sauger (*Sander canadensis*) in the same trawl hauls as sturgeon chub (Table 26). Collection records from the University of Michigan Museum of Zoology show that Schultz and DeLacy collected 12 species, plains minnow, brassy minnow (*H. hankinsoni*), red shiner, sand shiner, river shiner (*N. blennius*), bigmouth shiner (*N. dorsalis*), plains killifish (*Fundulus zebrinus*), plains topminnow (*F. sciadicus*), longnose dace (*Rhinichthys cataractae*), creek chub (*Semotilus atromaculatus*), green sunfish (*Lepomis cyanellus*) along with three sturgeon chub from the Platte River near Gothenburg, NE on September 8, 1931. Gould (1997) found literature references to 48 species that had been found associated with sturgeon chub. Several studies have mentioned strong associations with either flathead chub (*Platygobio gracilis*), (Stewart 1981, Werdon 1992) or speckled chub (Gelwicks et al. 1996, Werdon 1992, Peters et al. 1989). Associations with longnose dace seem surprising, since Werdon (1992) and Stewart (1981) both state that longnose dace apparently replace sturgeon chubs in clear water conditions.

Table 26. Species captured in trawl runs that also captured sturgeon chubs in the lower Platte River, Nebraska, 2000 – 2004.

SPECIES	RM 15.5 09/19/2000	RM 15.5 09/19/2000	RM 15.5 05/30/2002	RM 0.5 06/26/2002
Macrhybopsis gelida	1	2	1	1
M. aestivalis	11	7	0	1
M. storeriana	4	4	0	0
Hybognathus placitus	3	7	0	0
Cyprinella lutrensis	1	0	0	0
Notropis ludibundus	0	1	0	0
Ictalurus punctatus	1	5	0	2
Sander canadensis	0	1	0	0

LARVAL FISH RESULTS AND DISCUSSION

Six sites in the lower Platte River were sampled from 2000 to 2004. In addition, Reade (2000) also sampled sites near Columbus at RM 106 (32 samples) and North Bend at RM 72.5 (28 samples) in 1998 and 1999. The site near Two Rivers State Recreation Area at RM 41 was sampled from 1998 to 2002 (68 samples). The site at the US Highway 6 bridge (RM 27.9) was sampled from 1998 to 2004 (1,362 samples). The site downstream from the Nebraska Highway 50 bridge (RM 15.5) was sampled from 2000 to 2004 (193 samples). The site near Schilling WMA (RM 0.5 to 2.8) was sampled in 2002, and 2004 (154 samples).

Taxa of fish larvae and eggs, with numbers collected at sites from 2000 to 2004, are listed in Table 27. Chub larvae were collected at all sites up to Two Rivers. Sturgeon larvae were collected from the US Highway 6 site, the Nebraska Highway 50 site and the Schilling WMA site.

The number of larvae collected, by family, from 2000 to 2004, is summarized in Table 28 along with results from Reade (2000) who sampled at the same sites and using the same protocol as we used at the beginning of this study. This presentation includes fish from all sampling efforts in each year. The highest catch of larvae occurred in 2004 and the lowest catch of larvae occurred in 2001.

Between 2000 and 2004, 11 sturgeon (*Scaphirhynchus* spp.) larvae were collected (Table 28 and Figures 22 and 23) between the dates of May 15 and June 9. During 1998 and 1999 Reade (2000) collected three sturgeon larvae between the dates of May 26 during 1999 and June 23 and 24 during 1998 (Figures 22 and 23). In addition, Hofpar (1997) collected one sturgeon larva on June 10, 1996 near Fremont, NE (RM 57). The three larvae collected during the 2000 to 2002 sampling years were collected at the U.S. Highway 6 bridge (RM 27.9). Of the three larvae collected during 2003, one was collected at the U.S. Highway 6 bridge on May 15, and the other two were collected downstream of the Nebraska Highway 50 bridge at RM 15.5, one each on May 15 and May 23. In 2004, four out of the five *Scaphirhynchus* spp. larvae were collected on May 27 and 28 at the US Highway 75 bridge at RM 2.8. This location was sampled because, the Missouri River was running high and had backed the Platte River up to near the bridge. Usually we would have sampled at the Schilling WMA (RM 0.5). The fifth larva sampled in 2004 was collected on June 9 near the Nebraska Highway 50 bridge at RM 15.5.

Temperatures at which sturgeon larvae were collected ranged from 13.6°C in 2001 to 27.1°C in 2004 (Table 29). Reade (2000) collected sturgeon larvae between 20.5°C in 1999 and 27.4°C in 1998 (Table 29). All 11 sturgeon larvae collected during this study and the three collected by Reade (2000) came from sampling between 6:00PM (18:00hr) and 6:00AM (6:00hr). At the times sturgeon larvae were collected, mean daily discharge ranged from 3635 to 14,9767cfs (Figure 23). The sturgeon larvae we collected were all considered to be protolarvae and were probably less than one day post hatch. Larvae this young cannot be identified to species.

Based on morphological features, the sturgeon larvae we collected are probably less than 1 day post hatch (Darryl Snyder: personal communication). Sturgeon larvae this young can only be identified to genus and not to species unless DNA analysis is used. DNA analysis was not possible, because the samples were fixed in formalin. All sturgeon larvae, with one exception, were collected following increases in water temperature. Any relationship between sturgeon spawning and discharge is still unclear. In 2001, 2003, and 2004, collection sturgeon larvae occurred following peak discharges greater than 21,000 cfs. This agrees with the findings of Reade (2000) who collected larvae in 1998 and 1999. In 2000 and 2002, peak discharges greater than 21,000cfs were not present early in May, but sturgeon larvae were still collected.

A total of 9,321 chub larvae (*Macrhybopsis spp.*) were collected between 2000 and 2004. *Macrhybopsis* spp. larvae were collected from May 11 to August 15 at temperatures ranging from 13.6 to 31.0 °C (Figure 24). Mean daily discharge, when chubs were collected ranged from 1,412 to 34,947cfsFigure 25). Chub larvae in the Platte River were in low numbers during the discharge events and high following the peaks of these events. The highest numbers of chub larvae that Reade (2000) collected followed a large (34,947cfs) discharge event in 1999. Robinson et al. (1998) noted that larval stages of four native fishes in the Little Colorado River probably peaked during the descending limb of spring runoff peaks.

Species associated with sturgeon and chub larvae:

When sturgeon larvae were collected, there were two taxa of eggs, 16 taxa of larvae and 27 taxa of juvenile and adult life stages present during the same samplings (Table 30). Cyprinid (minnow larvae), catostomid (sucker) larvae and fish eggs were present during 100 percent of the samplings when sturgeon larvae were collected. Red shiner (*Cyprinella lutrensis*) juvenile/adults and common carp (*Cyprinus carpio*) larvae were present during 90 percent of the same samplings. River shiner juvenile/adults (*Notropis blennius*), chub larvae and freshwater drum (*Aplodinotus grunniens*) larvae were each present during 70 percent of the same samplings. The rest of the taxa were present during 60 percent or fewer of the sampling when sturgeon larvae were collected (Table 31).

Two taxa of eggs, 22 taxa of larvae, and 39 taxa of juvenile and adult life stages were collected during the same samplings as chub larvae (Table 30). Cyprinid larvae were present during 100 percent of the sampling when chub larvae were collected. Fish eggs were present in 98.1 percent of the same samplings, and catostomid larvae were present in 90.6 percent of the same samplings. Freshwater drum larvae, red shiner juvenile/adults, and gizzard shad (*Dorosoma cepedianum*) larvae were present in 81.1, 75.5, and 71.7 percent of the same samplings as chub larvae, respectively. Larval common carp and cyprinid juvenile/adults were present in 69.8 and 66.0 percent of the same samplings as chub larvae, respectively. The rest of the taxa and lifestages were present in less than 53 percent of the same samplings as chub larvae (Table 7.4).

The collection of sturgeon and chub larvae in the lower Platte River confirms the use of this river for reproduction by these taxa. However, since the larvae could not be identified to species, this does not confirm or eliminate the spawning of pallid sturgeon or sturgeon chub in the Platte River. It is probable, given the large number of adult shovelnose sturgeon and other chub species in comparison to pallid sturgeon and sturgeon chub that the larvae were not the species of concern. Yet the documentation of spawning by these genera suggests the potential for spawning by these rare species.

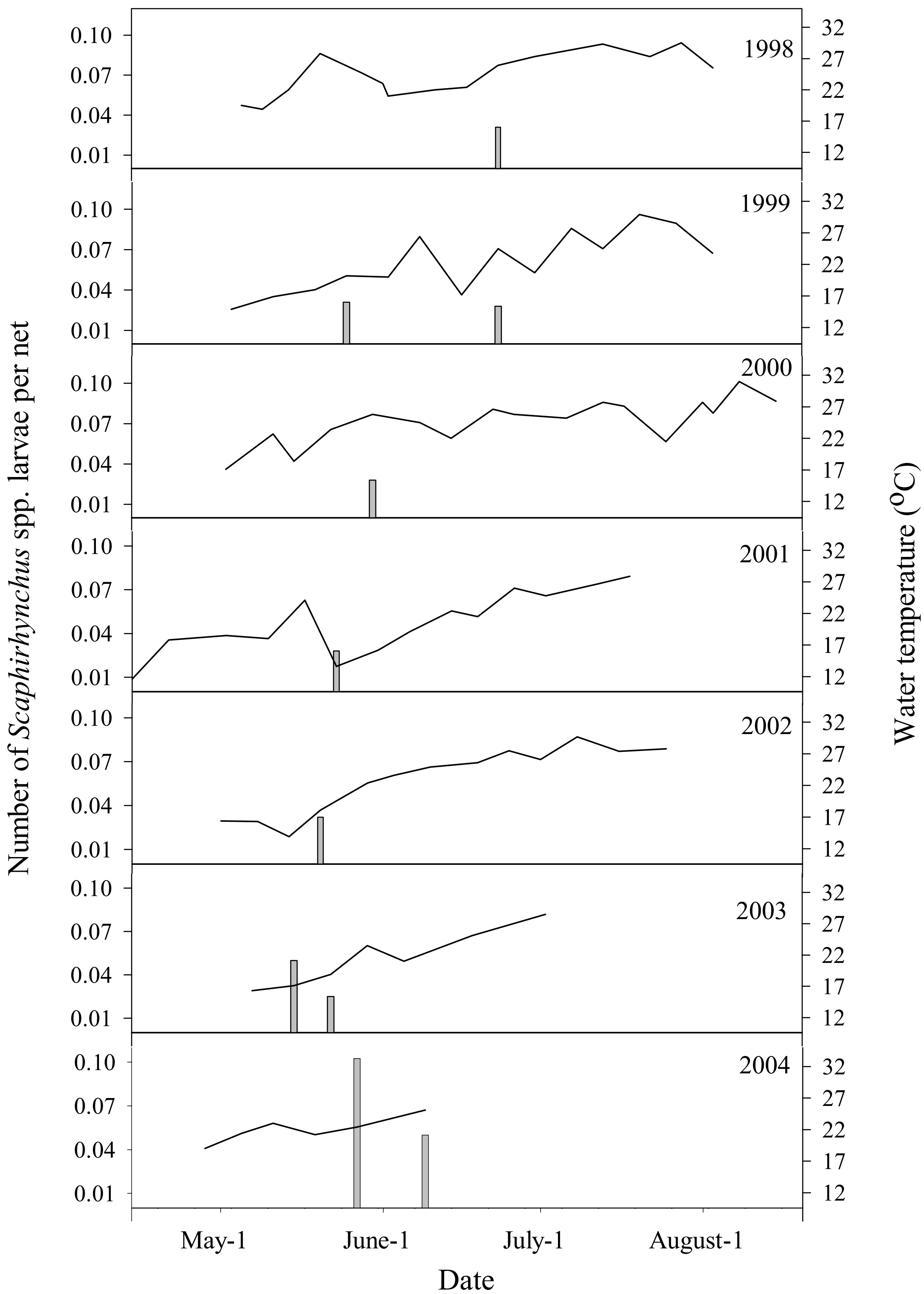

Figure 23. Number of sturgeon larvae per net (gray bars) and water temperature (lines) from 1998 through 2004 (1998 and 1999 data from Reade (2000)).

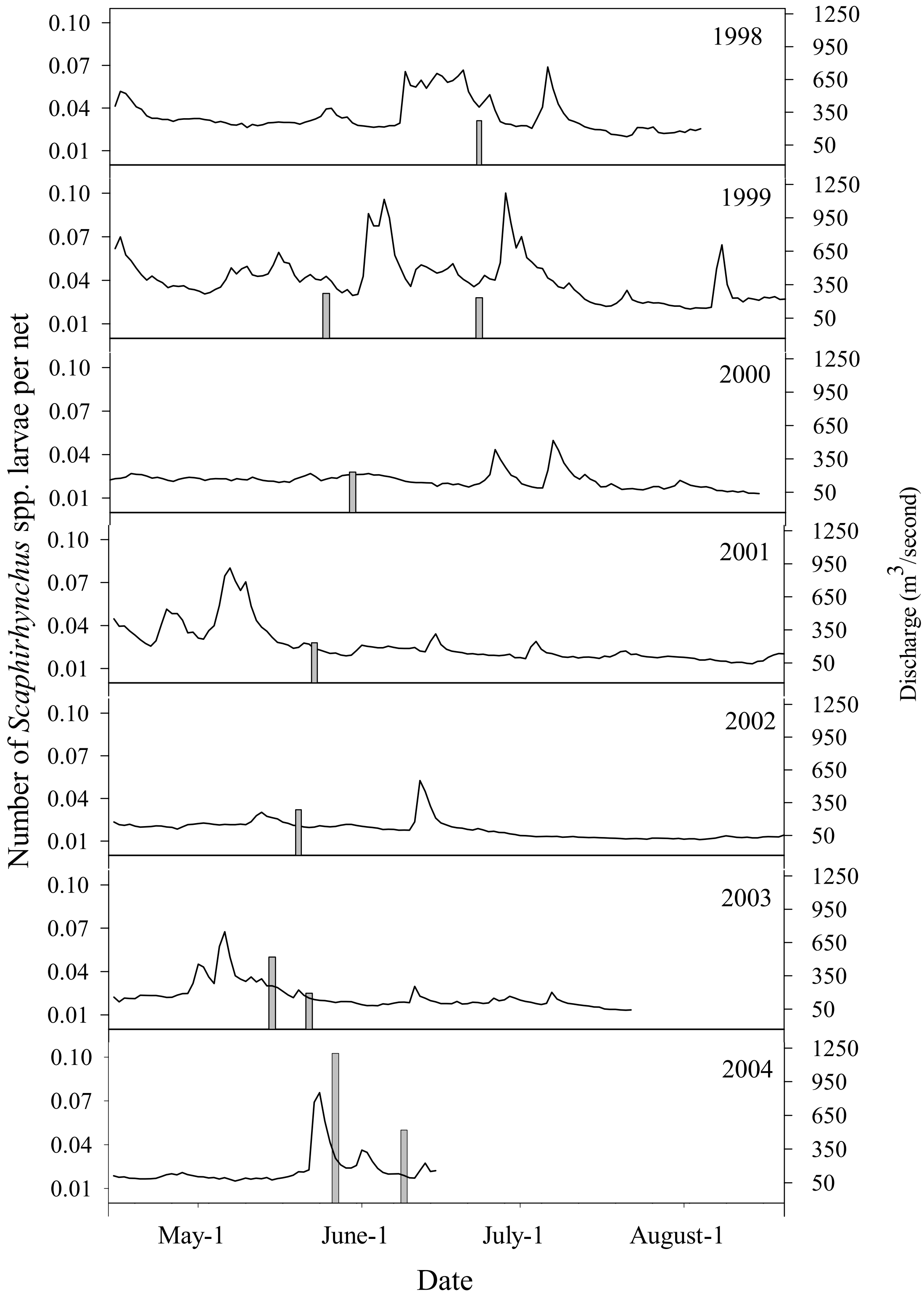

Figure 24. Number of sturgeon larvae per net (gray bars) and mean daily discharge (lines) from 1998 through 2004 (1998 and 1999 data from Reade (2000)).

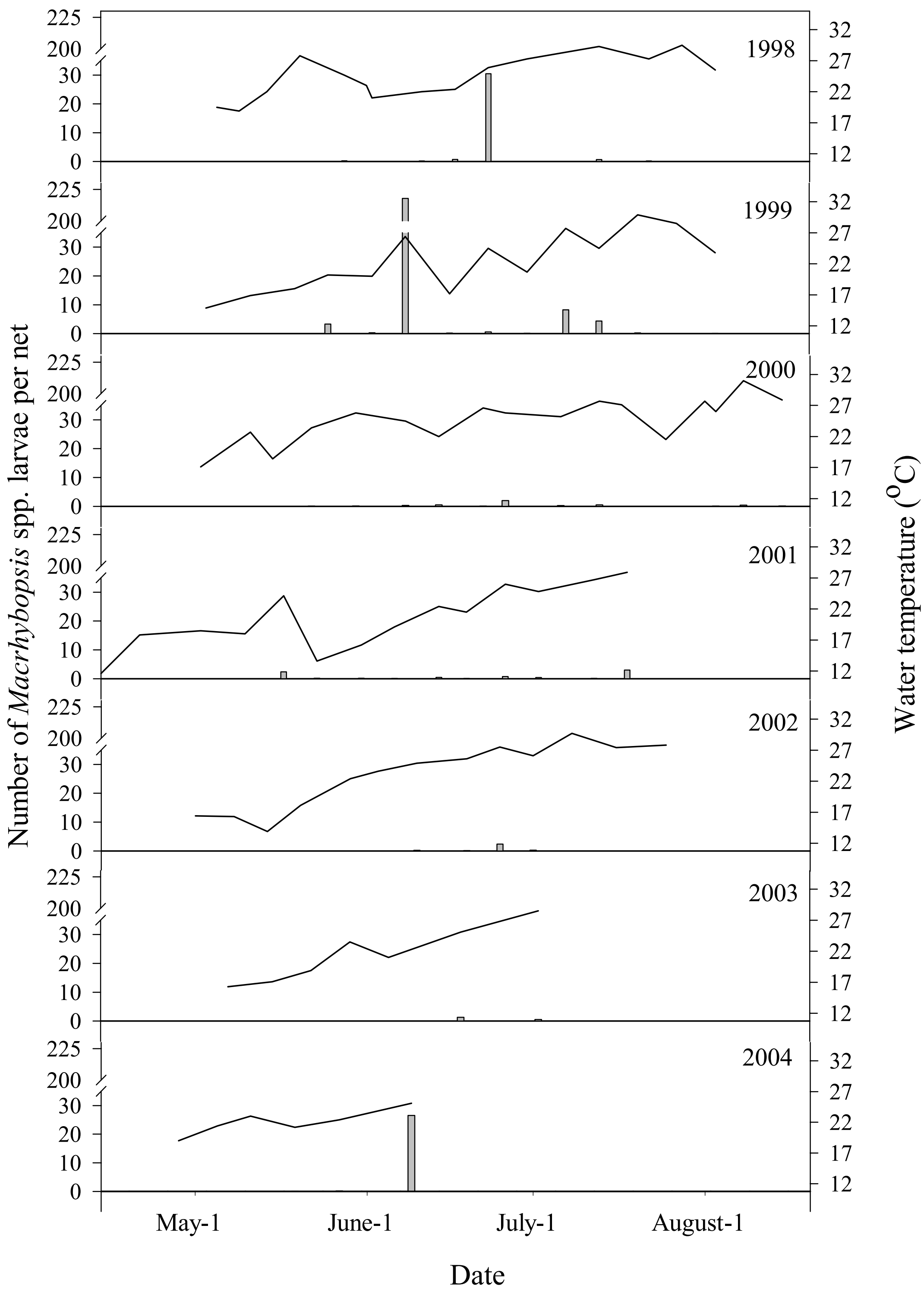

Figure 25. Number of chub larvae per net (gray bars) and water temperature (lines) from 1998 through 2004 (1998 and 1999 data from Reade (2000)).

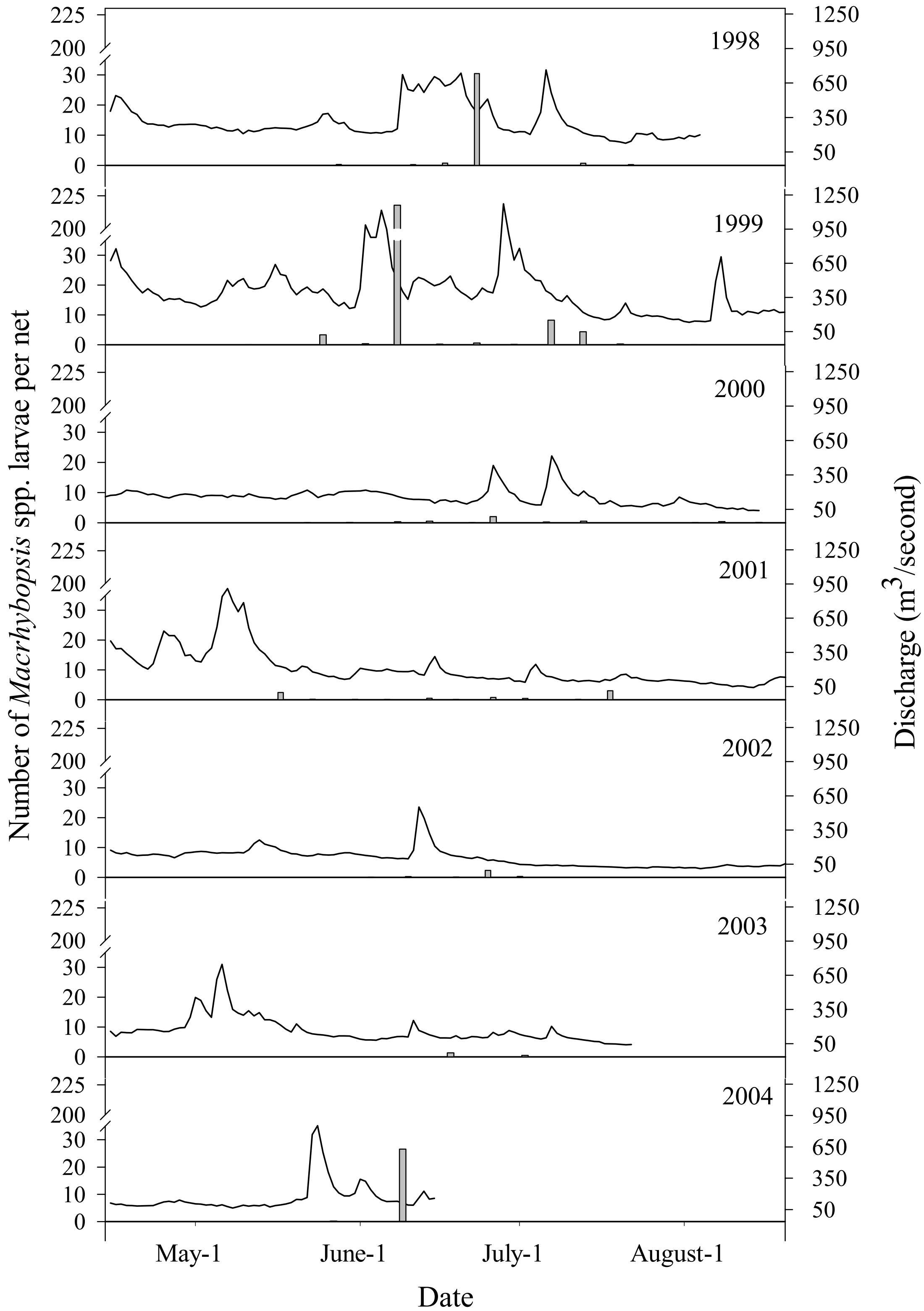

Figure 26. Number of chub larvae per net (gray bars) and mean daily discharge (lines) from 1998 through 2004 (1998 and 1999 data from Reade (2000)).

Table 27. Fish larvae and eggs collected at all study sites in the lower Platte River, Nebraska during larval drift net sampling from 2000 to 2004.

Larvae Taxon	Two Rivers	Ashland	Louisville	Schilling WMA
Scaphirhynchus spp.		4	3	4
Polyodon spathula		1		
Lepisosteus spp.		1		
Lepisosteus platostomus		15		
Hiodon alosoides		1		2
Dorosoma cepedianum	6	432	15	18
Cyprinids	256	13,607	5,946	858
Cyprinus carpio	3	4,556	225	54
Macrhybopsis spp.	27	8,625	594	74
Catostomids	30	2,534	1,970	668
Cycleptus elongatus		52	9	39
Ictalurids		4		
Ictalurus punctatus		73	4	
Pylodictis olivaris		15		
Gambusia affinis	1	0		
Labidesthes sicculus	1	8	2	
Centrarchids		18		9
Lepomis spp.	2	117	8	9
Micropterus salmoides		7		
Pomoxis spp.		19		1
Percids		1		
Etheostoma nigrum		1		
Perca flavescens	1	3		
Stizostedion spp.	3	3	3	1
Aplodinotus grunniens	36	579	337	83
Eggs Taxon				
Hiodon alosoides		628	1	15
unknown	739	22,083	3,927	3,773

Table 28. Summary of the number of larvae collected by family, from the lower Platte River, Nebraska during the years 2000 to 2004.

Family (Total water sampled m^3)	2000 (26,154)	2001 (26,730)	2002 (26,334)	2003 (25,834)	2004 (22,303)
Acipenseridae	1	1	1	3	5
Lepisosteidae	1	9	3	-	-
Hiodontidae	-	-	-	-	3
Clupeidae	113	181	196	24	3
Cyprinidae	2,267	1,671	3,619	3,409	4,546
Catostomidae	331	195	95	566	2,387
Ictaluridae	20	17	12	5	-
Atherinidae	1	-	2	1	-
Poeciliidae	9	-	-	-	-
Centrarchidae	12	27	13	-	-
Percidae	4	2	2	3	-
Sciaenidae	112	178	196	24	284
Total	**2,871**	**2,281**	**4,139**	**4,035**	**7,228**

Table 29. Year, (time of day) and water temperature (^{o}C) at the time when sturgeon larvae were captured in the lower Platte River, Nebraska, 1998 to 2004. Locations of sampling sites are near the US 73, 75 bridge (RM 2.8), near the NE 50 bridge (RM 15.5), and near the US 6 highway bridge (RM 27.9). Collections by Reade (2000) are indicated by an asterisk (*).

MONTH/ DAY	RM 2.8	RM 15.5	RM 27.9	TEMPERATURE
May 15	2003 (18:00)			18.1
May 15			2003 (21:00)	17.8
May 21			2002 (06:00)	15.8
May 23			2001 (21:00)	13.6
May 23	2003 (03:00)			18.5
May 26			1999 (00:00)*	20.5
May 27		2004 (18:00)		22.9
May 28		2004 (03:00)		21.3
May 28		2004 (03:00)		21.3
May 28		2004 (06:00)		20.7
May 31			2000 (03:00)	24.8
June 9	2004 (18:00)			27.1
June 23		1998 (21:00)*		27.4
June 24		1999 (03:00)*		25.2

Table 30. Percent occurrence of other taxa and life stages during sampling times when *Scaphirhynchus* spp. larvae were collected. Percentages are based on occurrence during the same samplings.

Taxa	Life stage	Percent occurrence
Unidentifiable	Eggs	100
Cyprinids	Larvae	100
Catostomids	Larvae	100
Cyprinella lutrensis	Juv/Ad	90
Cyprinus carpio	Larvae	90
Notropis blennius	Juv/Ad	70
Macrhybopsis spp.	Larvae	70
Aplodinotus grunniens	Larvae	70
Notropis stramineus	Juv/Ad	60
Dorosoma cepedianum	Larvae	60
Cyprinids	Juv/Ad	50
Cyprinus carpio	Juv/Ad	40
Lepomis macrochirus	Juv/Ad	40
Pomoxis spp.	Larvae	40
Carpiodes spp.	Juv/Ad	30
Culaea inconstans	Juv/Ad	30
Lepomis spp.	Juv/Ad	30
Micropterus salmoides	Juv/Ad	30
Cycleptus elongatus	Larvae	30
Lepomis spp.	Larvae	30
Hiodon alosoides	Eggs	20
Dorosoma cepedianum	Juv/Ad	20
Macrhybopsis aestivalis	Juv/Ad	20
Notropis atherinoides	Juv/Ad	20
Pimephales promelas	Juv/Ad	20
Catostomids	Juv/Ad	20
Centrarchids	Larvae	20
Hybognathus spp.	Juv/Ad	10
Hybognathus placitus	Juv/Ad	10
Macrhybopsis spp.	Juv/Ad	10
Notropis spp.	Juv/Ad	10
Ictalurus punctatus	Juv/Ad	10
Esox americanus vermiculatus	Juv/Ad	10
Gambusia affinis	Juv/Ad	10
Labidesthes sicculus	Juv/Ad	10
Pomoxis annularis	Juv/Ad	10
Etheostoma nigrum	Juv/Ad	10
Stizostedion canadense	Juv/Ad	10
Aplodinotus grunniens	Juv/Ad	10
Polyodon spathula	Larvae	10
Ictalurus punctatus	Larvae	10
Labidesthes sicculus	Larvae	10
Micropterus salmoides	Larvae	10
Etheostoma nigrum	Larvae	10
Perca flavescens	Larvae	10
Stizostedion spp.	Larvae	10

Table 31. Percent occurrence of other taxa and life stages during sampling times when chub larvae (*Macrhybopsis* spp.) were collected. Percentages are based on occurrence during the same samplings.

Taxa	Life stage	Percent occurrence
Cyprinids	Larvae	100.0
unidentifiable	Eggs	98.1
Catostomids	Larvae	90.6
Aplodinotus grunniens	Larvae	81.1
Cyprinella lutrensis	Juv/Adult	75.5
Dorosoma cepedianum	Larvae	71.7
Cyprinus carpio	Larvae	69.8
Cyprinids	Juv/Adult	66.0
Notropis blennius	Juv/Adult	52.8
Lepomis spp.	Larvae	49.1
Ictalurus punctatus	Juv/Adult	47.2
Notropis stramineus	Juv/Adult	39.6
unidentifiable	Larvae	39.6
Cyprinus carpio	Juv/Adult	37.7
Carpiodes spp.	Juv/Adult	37.7
Lepomis spp.	Juv/Adult	34.0
Macrhybopsis aestivalis	Juv/Adult	32.1
Pimephales promelas	Juv/Adult	32.1
Dorosoma cepedianum	Juv/Adult	28.3
Notropis spp.	Juv/Adult	26.4
Pomoxis annularis	Juv/Adult	26.4
Notropis atherinoides	Juv/Adult	24.5
Lepomis macrochirus	Juv/Adult	24.5
Micropterus salmoides	Juv/Adult	24.5
Macrhybopsis spp.	Juv/Adult	22.6
Aplodinotus grunniens	Juv/Adult	22.6
Ictalurus punctatus	Larvae	22.6
Hybognathus placitus	Juv/Adult	18.9
Macrhybopsisi storeriana	Juv/Adult	17.0
Pomoxis spp.	Larvae	17.0
Hybognathus spp.	Juv/Adult	15.1
Culaea inconstans	Juv/Adult	15.1
Centrarchids	Larvae	15.1
Catostomids	Juv/Adult	13.2
Scaphirhynchus spp.	Larvae	13.2
Labidesthes sicculus	Larvae	13.2
Pylodictis olivaris	Juv/Adult	11.3
Lepisosteus platostomus	Larvae	9.4
Labidesthes sicculus	Juv/Adult	7.5
Centrarchids	Juv/Adult	7.5
Cycleptus elongatus	Larvae	7.5
Carpiodes carpio	Juv/Adult	5.7
Moxostoma macrolepidotum	Juv/Adult	5.7
Stizostedion vitreum	Juv/Adult	5.7

Table 31. (continued)

Taxa	Life stage	Percent occurrence
Ictalurids	Larvae	5.7
Pylodictis olivaris	Larvae	5.7
Micropterus salmoides	Larvae	5.7
Hiodon alosoides	Eggs	3.8
Gambusia affinis	Juv/Adult	3.8
Lepomis cyanellus	Juv/Adult	3.8
Perca flavescens	Juv/Adult	3.8
Lepisosteus osseus	Juv/Adult	1.9
Lepisosteus platostomus	Juv/Adult	1.9
Notropis blennius	Juv/Adult	1.9
Esox americanus vermiculatus	Juv/Adult	1.9
Micropterus	Juv/Adult	1.9
Etheostoma nigrum	Juv/Adult	1.9
Stizostedion spp.	Juv/Adult	1.9
Stizostedion canadense	Juv/Adult	1.9
Lepisosteus spp.	Larvae	1.9
Percids	Larvae	1.9
Etheostoma nigrum	Larvae	1.9
Perca flavescens	Larvae	1.9
Stizostedion spp.	Larvae	1.9

AMBIENT RIVER HABITAT RESULTS

Temperature:

Average weekly temperature values for the Platte River at Leshara, the Elkhorn River at Waterloo, Salt Creek at Greenwood, and the Platte River at Louisville for the time period September 2000 through June 2004 are displayed on Figures 27, 28, 29 and 30, respectively. Water temperatures at all four sites followed basically the same pattern from year to year, peaking in July at the two Platte River sites and the Elkhorn River site at temperatures >30 °C. The Salt Creek site tended to warm faster and remain above 30 °C from June to August. In the Platte River, the highest water temperatures occurred in 2002 (Figures 26 and 29) and this coincided with the periods of lowest discharge (Figures 2 and 5). Salt Creek contrasted with the other three sites during winter, since it seldom had temperatures down to 0 °C.

Figures 31 to 35 display data from the temperature recorders installed at the Louisville site during 2000, 2001, 2002, 2003, and 2004, respectively. Note that the scales on the axes vary from one figure to the other. Unfortunately, there are gaps in the data due to lost or destroyed recorders and the data presented is the record of only one recorder. Fortunately, the times of critically high temperatures during the period of the study have been recorded. The other major value of these records is the amount of temperature fluctuation that is recorded within a day and from day to day in the lower Platte River.

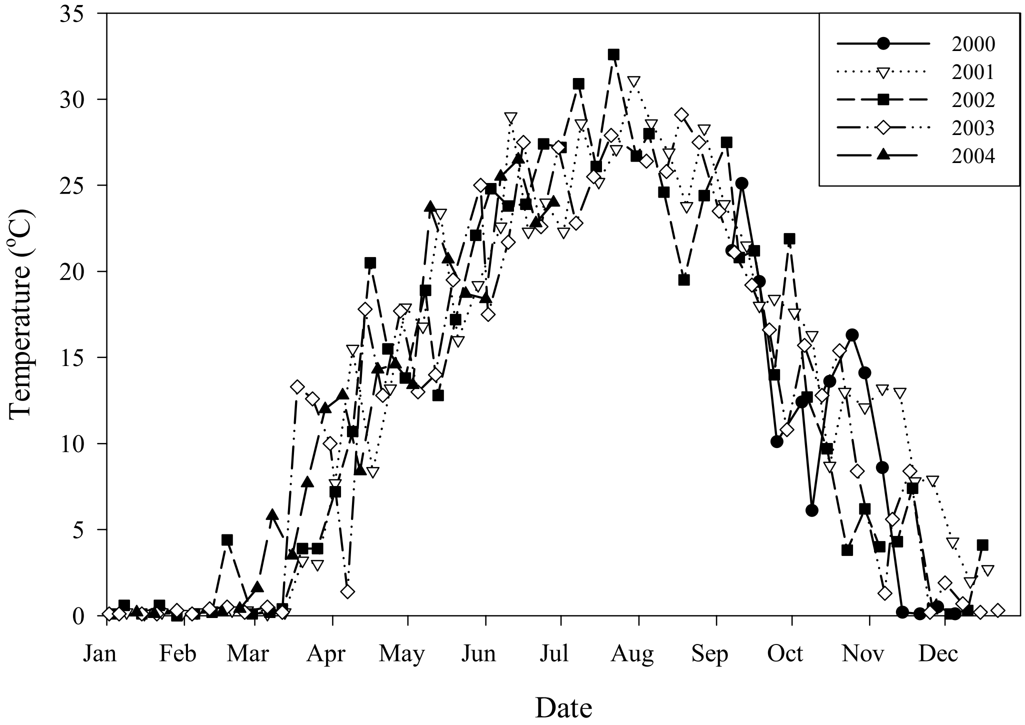

Figure 27. Platte River at Leshara average water temperature, September 2000 to June 2004.

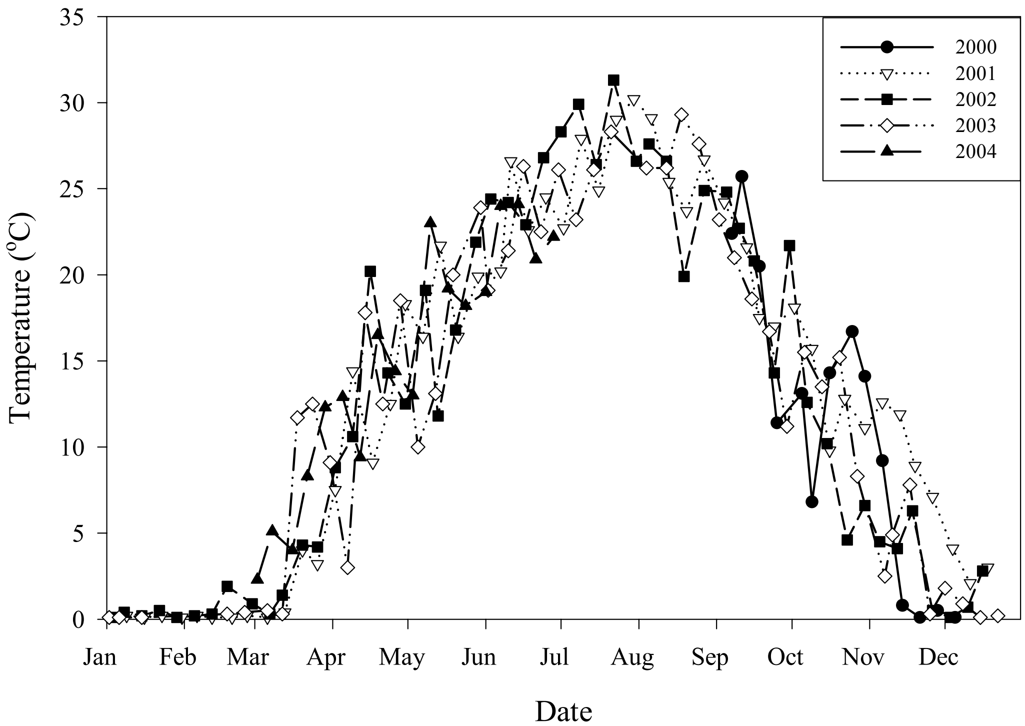

Figure 28. Elkhorn River at Waterloo average water temperature, September 2000 to June 2004.

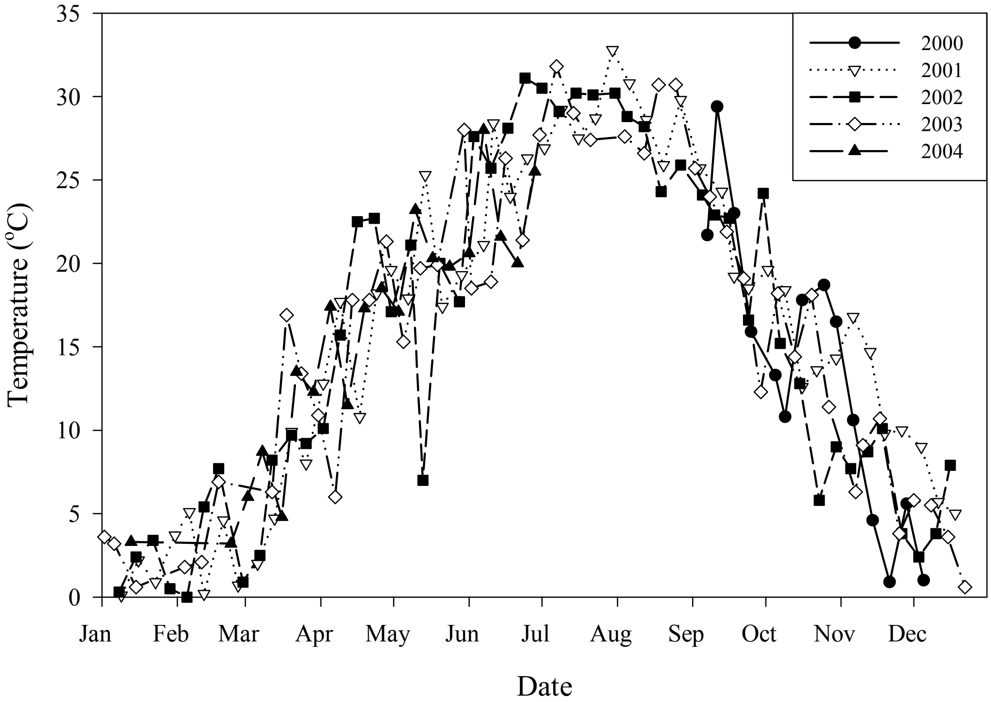

Figure 29. Salt Creek at Greenwood average water temperature, September 2000 to June 2004.

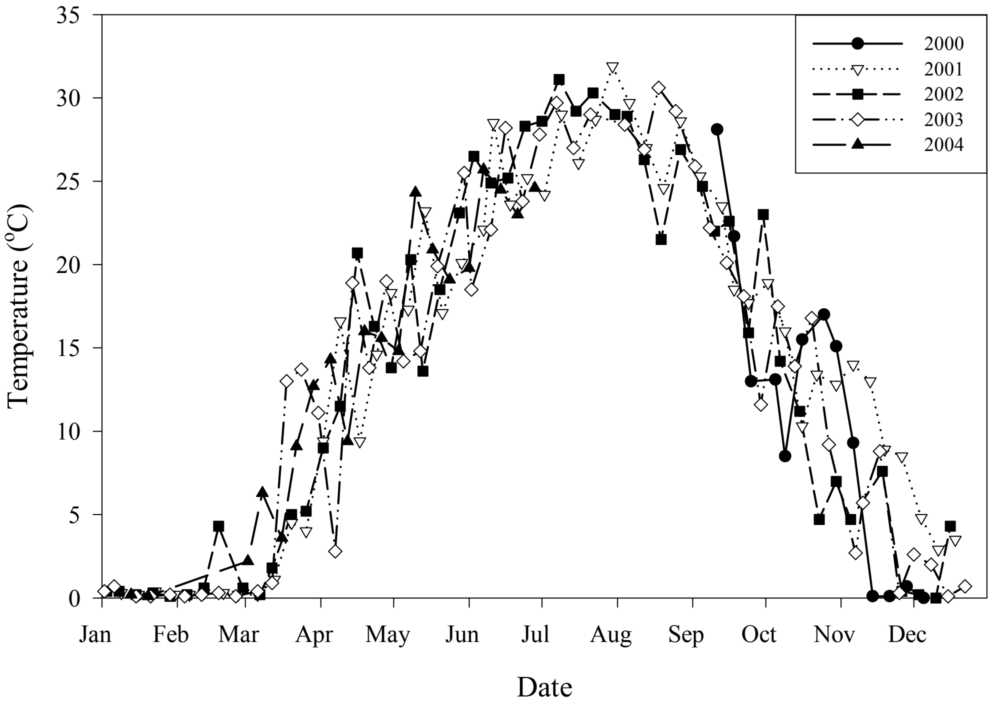

Figure 30. Platte River at Louisville average water temperature, September 2000 to June 2004.

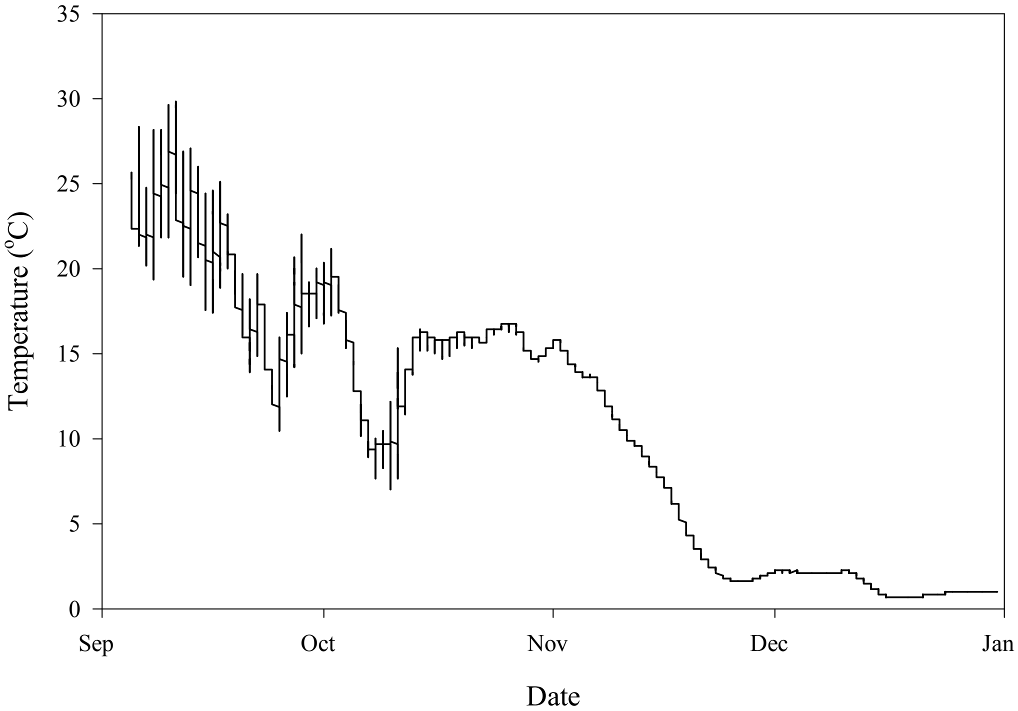

Figure 31. Platte River temperature probe data from September 5, 2000 to December 31,2000 at Louisville, Nebraska.

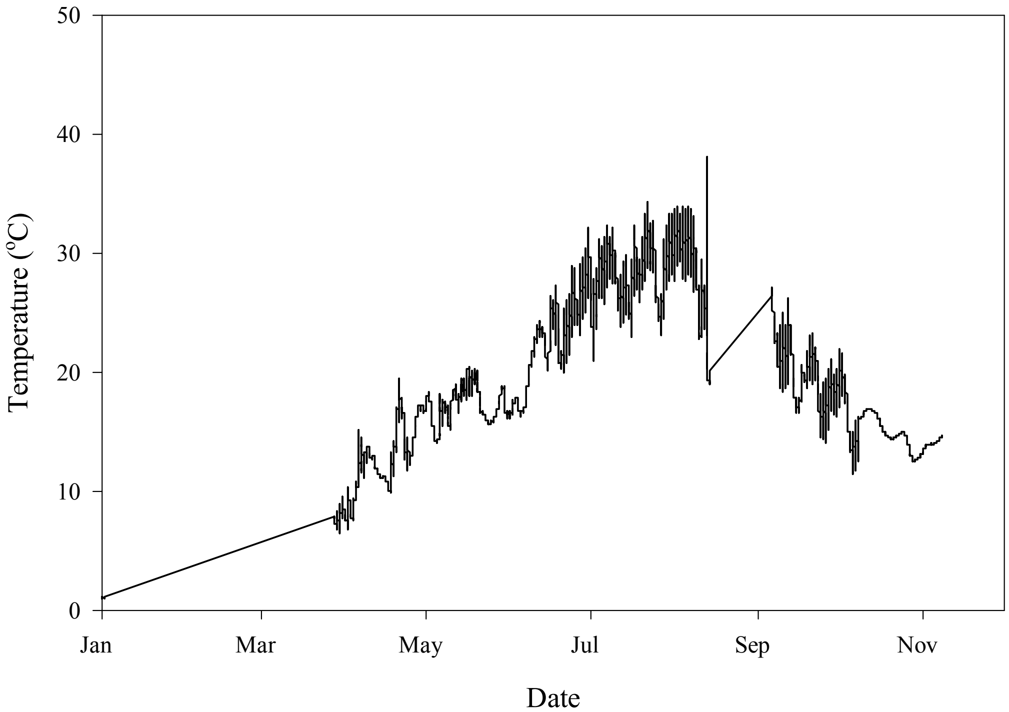

Figure 32. Platte River temperature probe data fromJanuary1, 2001 to November 8, 2001 at Louisville, Nebraska.

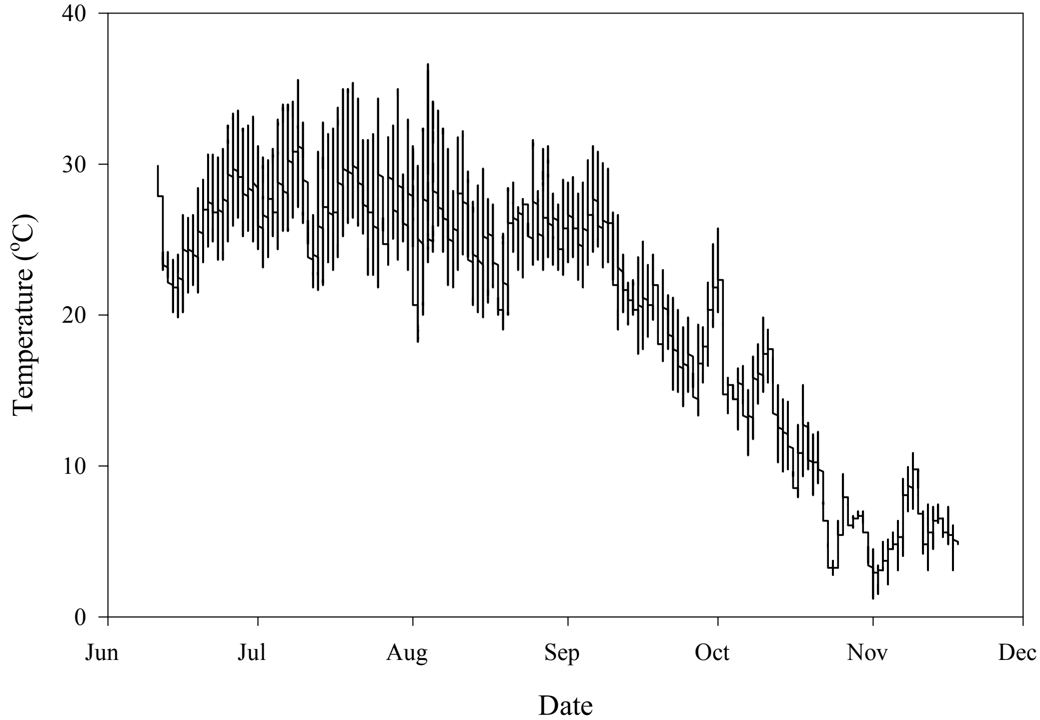

Figure 33. Platte River temperature probe data from June 11, 2002 to November 18, 2002 at Louisville, Nebraska.

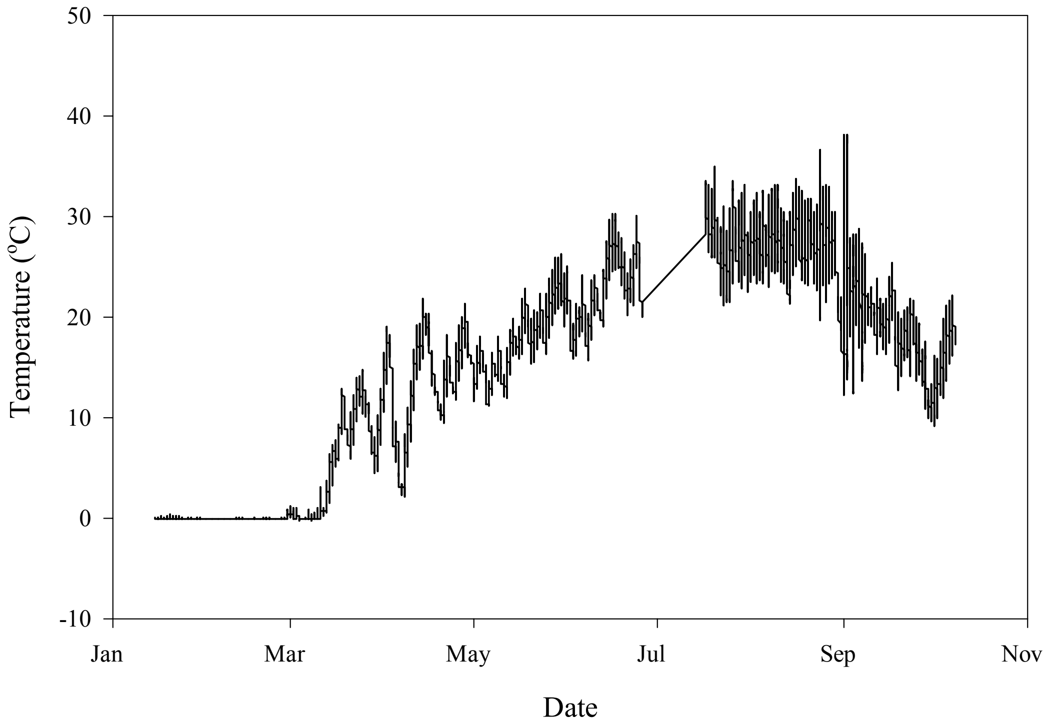

Figure 34. Platte River temperature probe data from January 15, 2003 to October 8, 2003 at Louisville, Nebraska.

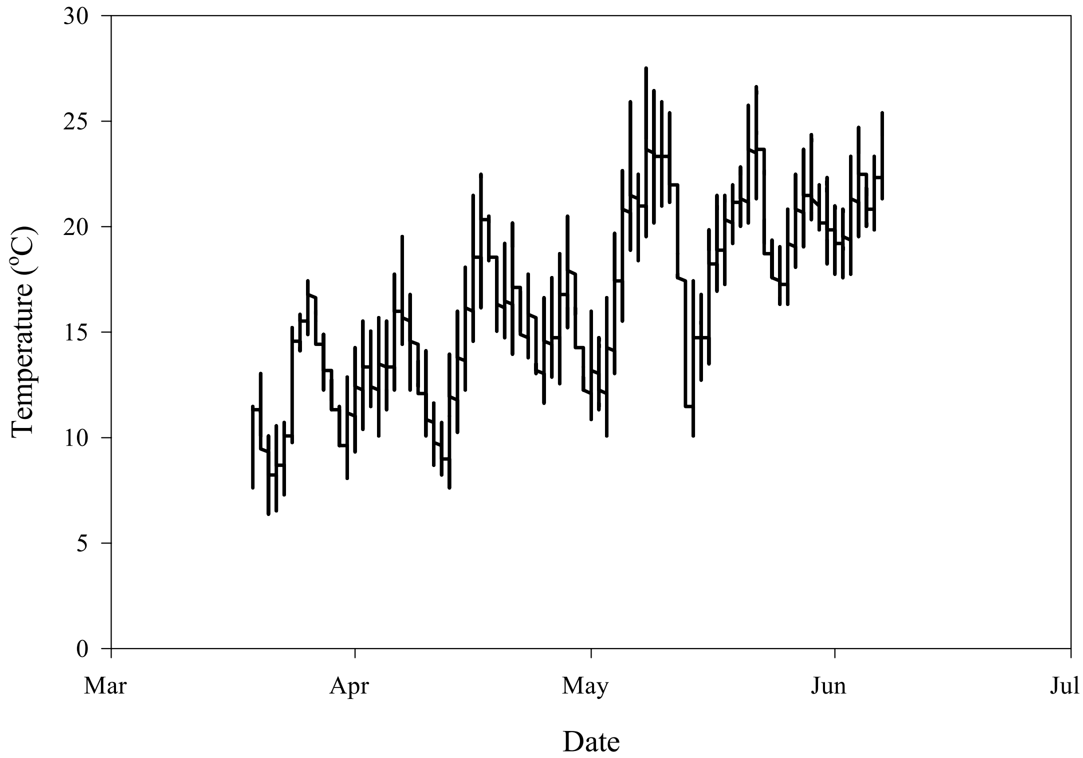

Figure 35. Platte River temperature probe data from March 19, 2004 to June 7, 2004 at Louisville, Nebraska.

Dissolved Oxygen:

Average weekly dissolved oxygen values for the Platte River at Leshara, the Elkhorn River at Waterloo, Salt Creek at Greenwood, and the Platte River at Louisville for the time period September 2000 through June 2004 are displayed on figures 36, 37, 38, and 39, respectively. Dissolved oxygen concentrations do not appear to be a limiting factor in the Platte River proper, since no concentrations below 5 mg/L were measured and this is the generally recognized lower limit for aquatic life (Boyd 1979). However, the Elkhorn site had concentrations below 5 mg/L during May and July 2003 and May 2004 The Salt Creek site had the most severe dissolved oxygen conditions with concentrations below 5 mg/L in November 2000, July and August 2002, June 2003 and May 2004.

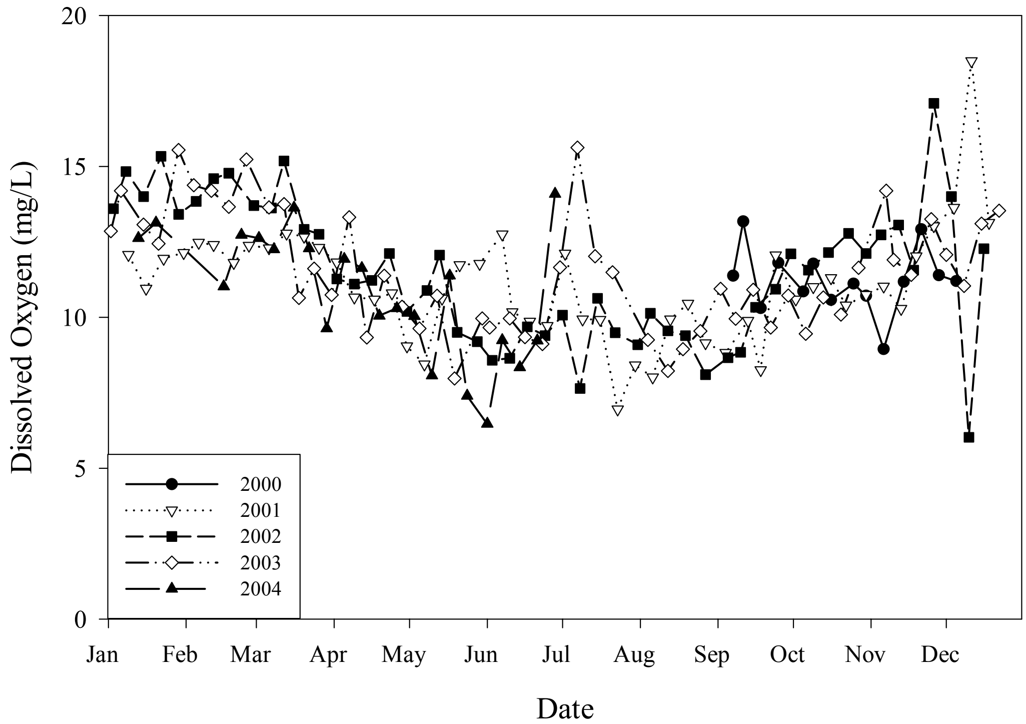

Figure 36. Platte River at Leshara average dissolved oxygen, September 2000 to June 2004.

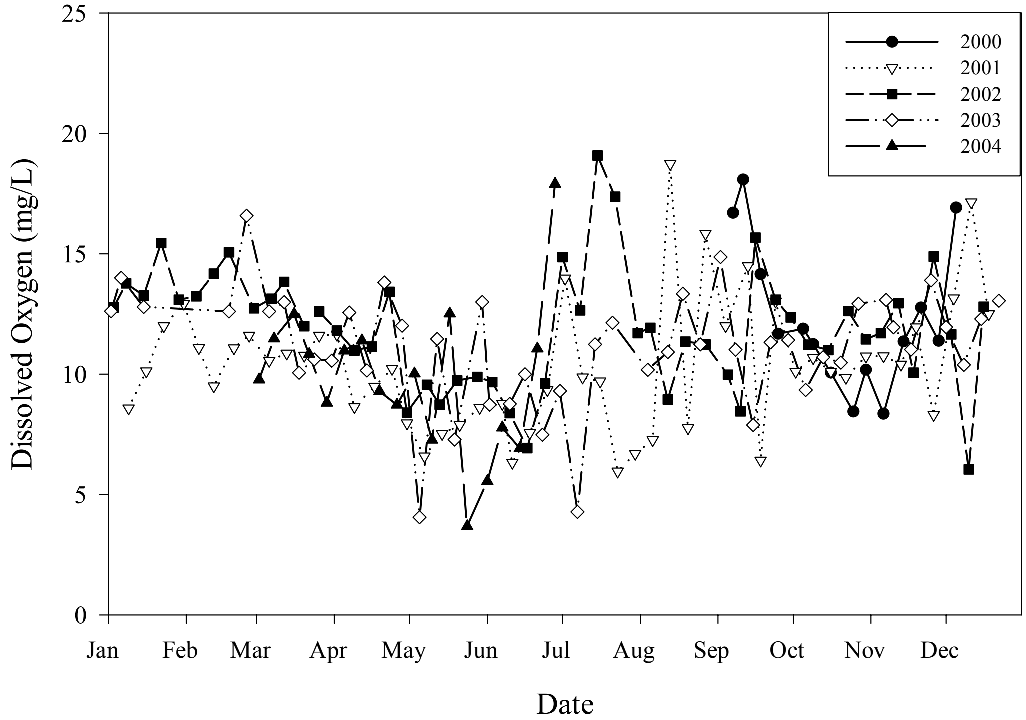

Figure 37. Elkhorn River at Waterloo average dissolved oxygen, September 2000 to June 2004.

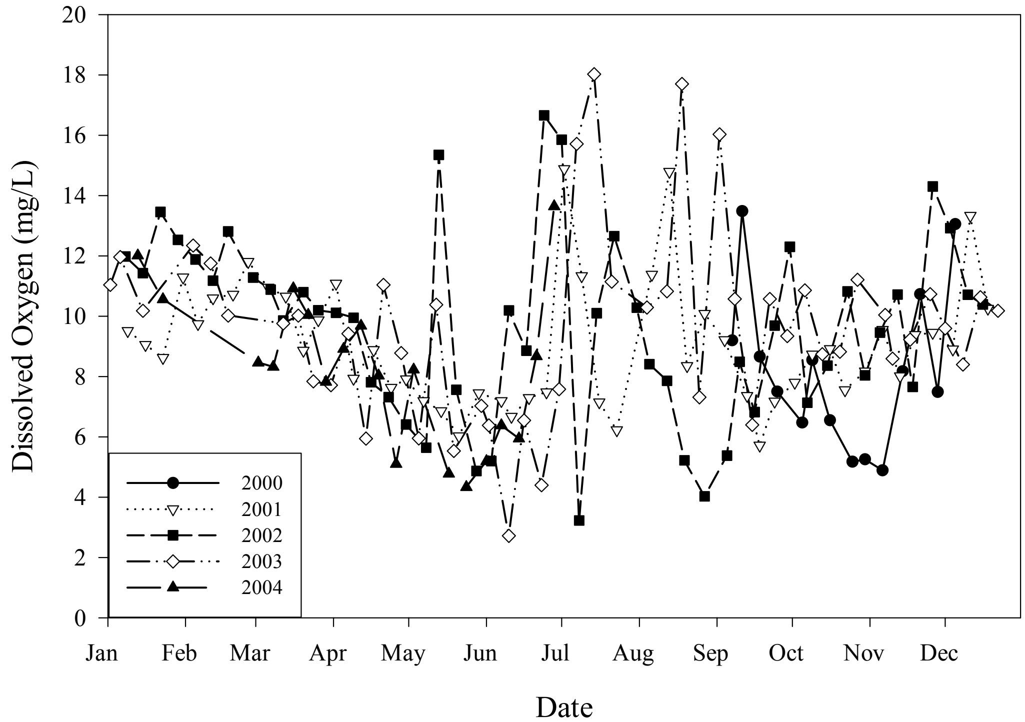

Figure 38. Salt Creek at Greenwood average dissolved oxygen, September 2000 to June 2004.

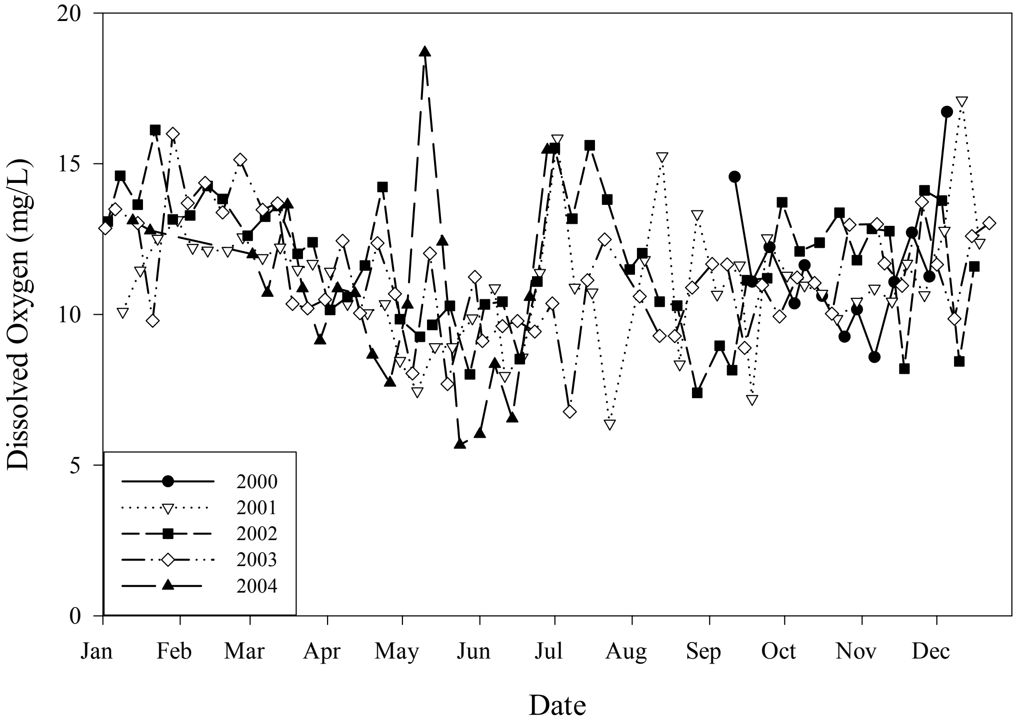

Figure 39. Platte River at Louisville average dissolved oxygen, September 2000 to June 2004.

Specific Conductivity:

Average weekly specific conductivity values for the Platte River at Leshara, the Elkhorn River at Waterloo, Salt Creek at Greenwood, and the Platte River at Louisville for September 2000 through June 2004 are displayed on Figures 40, 41, 42 and 43, respectively (note that the scales on the Y-axes vary at each site). Conductivity values rarely exceeded 600µS/cm at the Leshara site on the Platte River and 700µS/cm at the Elkhorn River site. In contrast, the Salt Creek site seldom had conductivity values less than 1000 µS/cm. Since the Louisville site is downstream from the confluence of the Platte River with Salt Creek, conductivity values there reflect the mixing of low conductivity and high conductivity water sources.

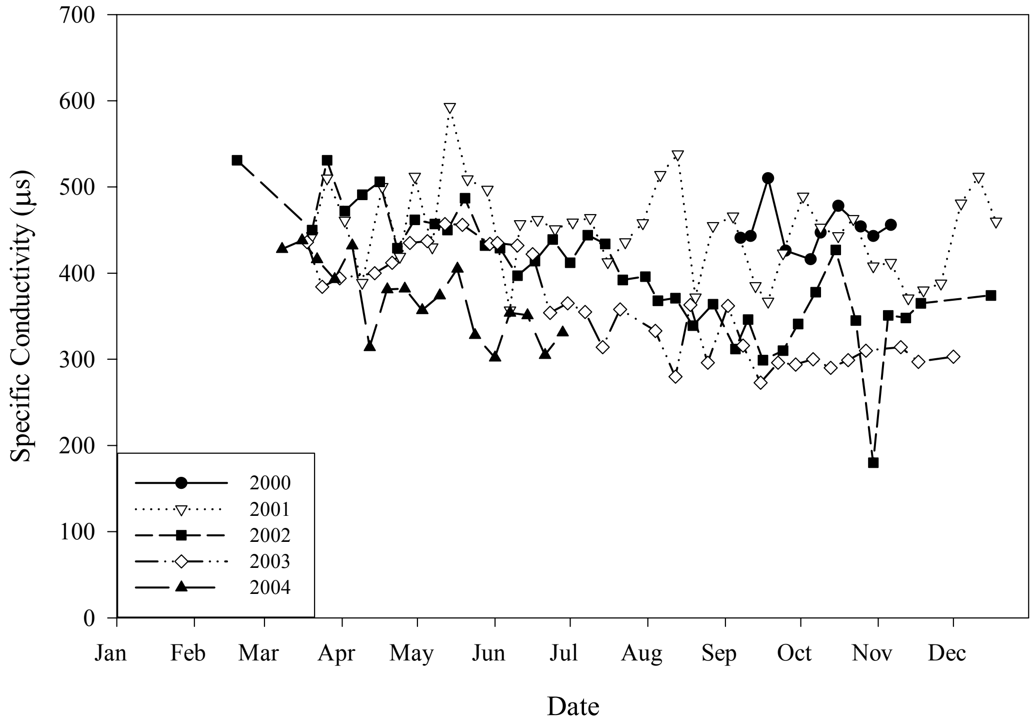

Figure 40. Platte River at Leshara average specific conductivity, September 2000 to June 2004.

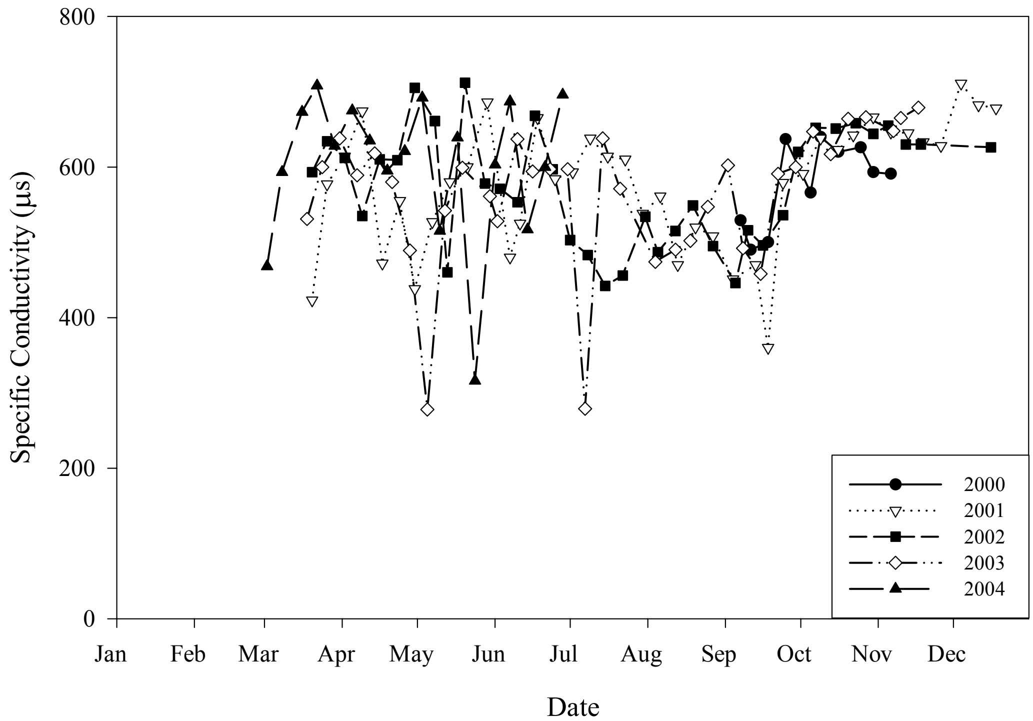

Figure 41. Elkhorn River at Waterloo average specific conductivity, September 2000 to June 2004.

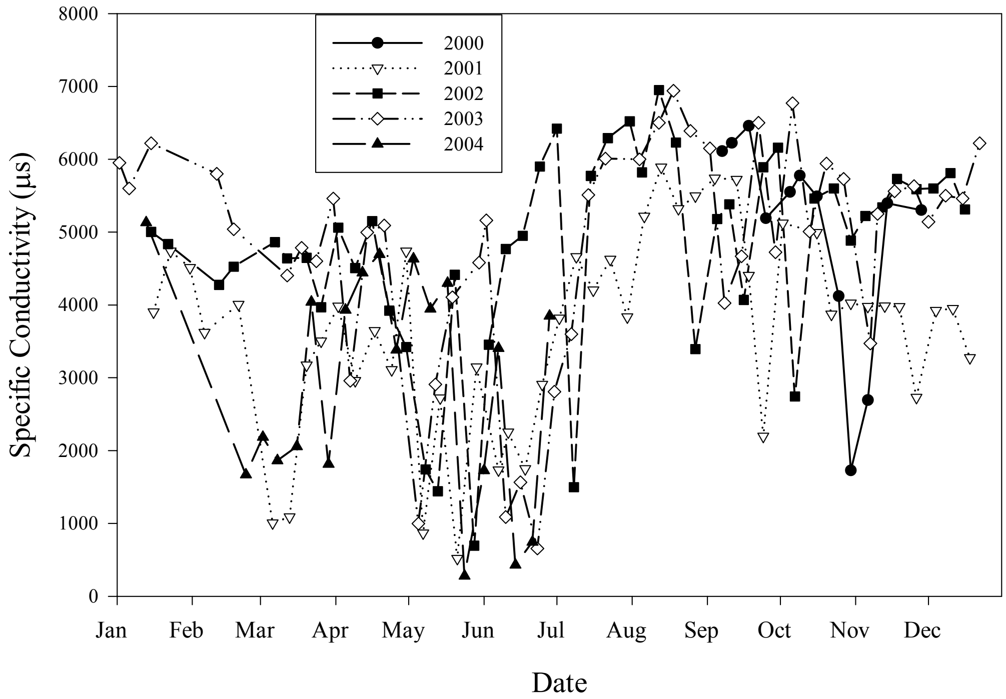

Figure 42. Salt Creek at Greenwood average specific conductivity, September 2000 to June 2004.

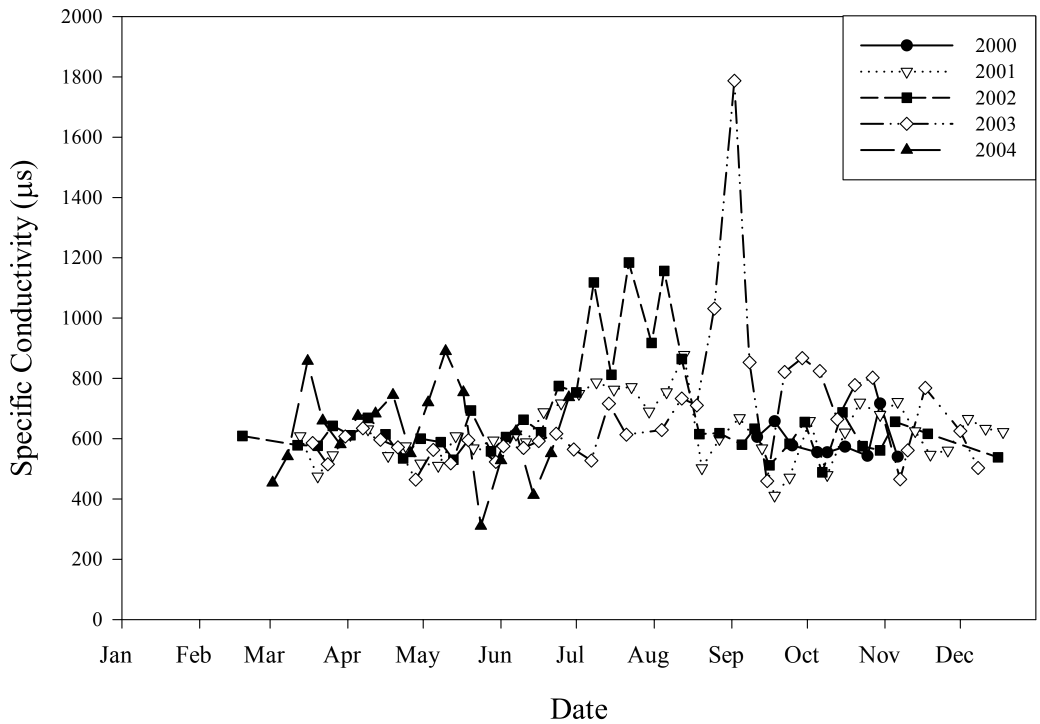

Figure 43. Platte River at Louisville average specific conductivity, September 2000 to June 2004.

Salinity:

Average weekly salinity values for the Platte River at Leshara, the Elkhorn River at Waterloo, Salt Creek at Greenwood, and the Platte River at Louisville for September 2000 through June 2004 are displayed on Figures 44, 45, 46, and 47, respectively (note that the scales on the Y-axes vary at each site). As expected, salinity values for the Leshara site on the Platte River were the lowest, ranging from 0.1 ppt up to 0.3 ppt with the majority of values at 0.2 ppt. The Elkhorn River site salinity ranged from 0.1 ppt to 0.4 ppt with most values at 0.3 ppt. Salinities in Salt Creek were the highest and most variable with most values above 2.0 ppt and some up to nearly 4 ppt. The influence of Salt Creek can be seen at the Louisville site on the Platte River where most salinity values ranged from 0.2 to 0.4 ppt, with some spikes at or above 0.6 ppt.

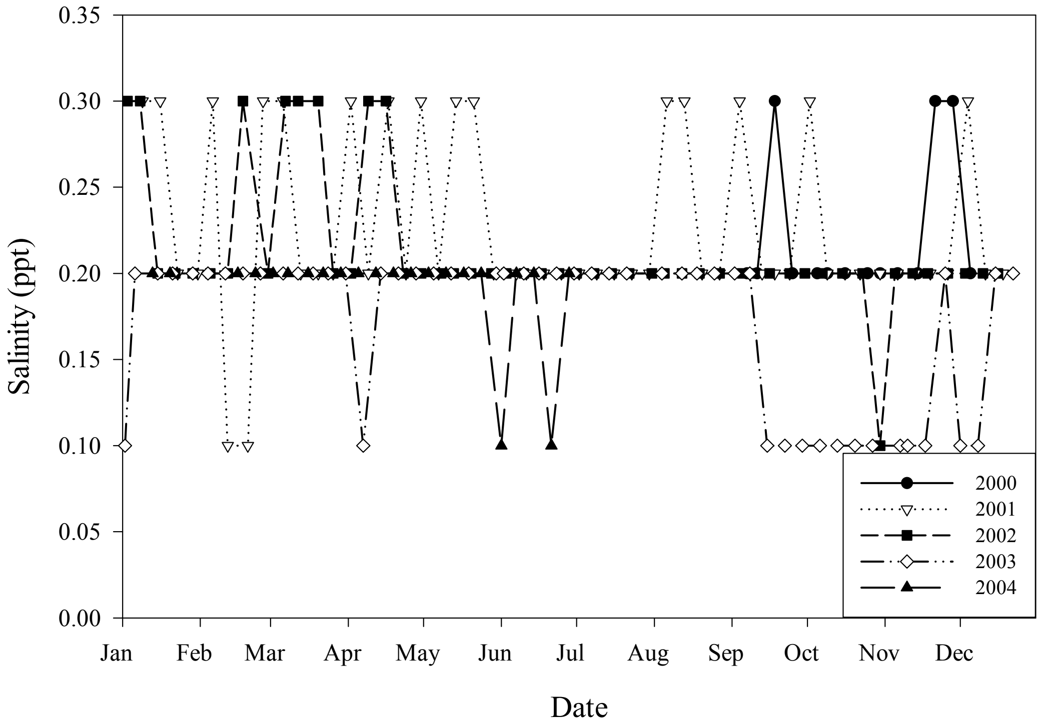

Figure 44. Platte River at Leshara average weekly salinity, September 2000 to June 2004.

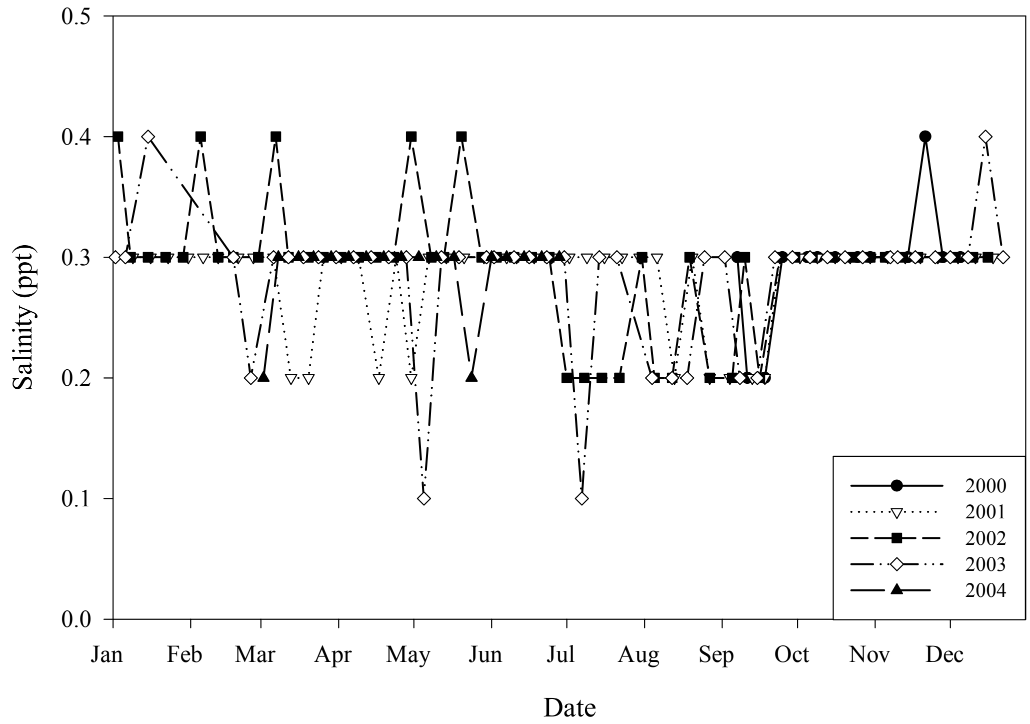

Figure 45. Elkhorn River at Waterloo average weekly salinity, September 2000 to June 2004.

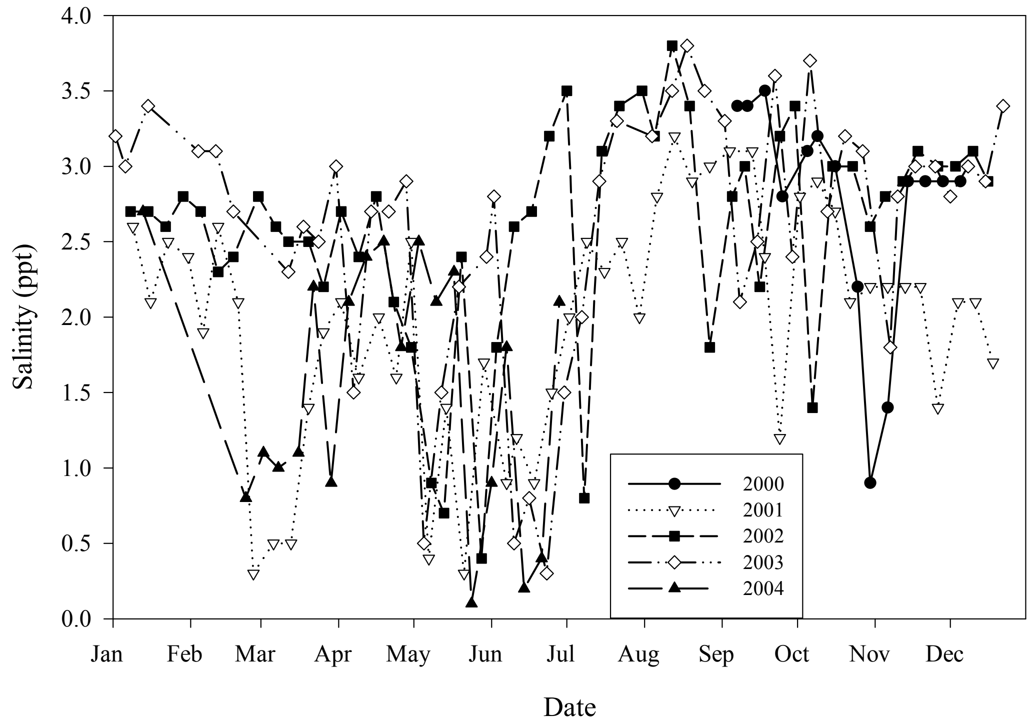

Figure 46. Salt Creek at Greenwood average weekly salinity, September 2000 to June 2004.

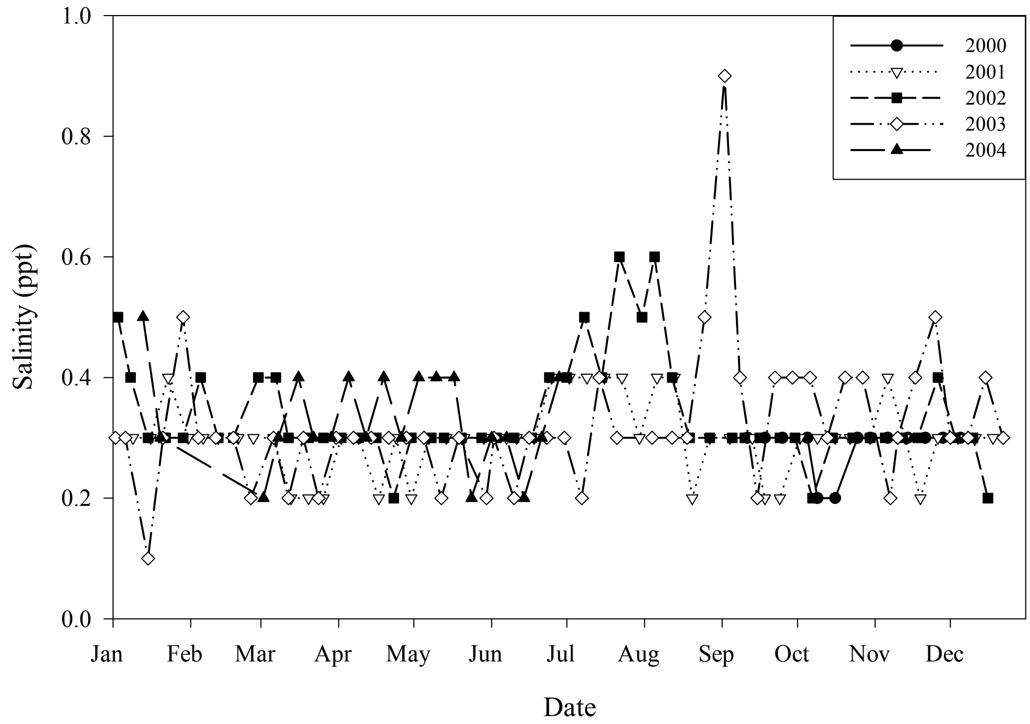

Figure 47. Platte River at Louisville average weekly salinity, September 2000 to June 2004.

Suspended solids:

Average weekly suspended solids values for the Platte River at Leshara, the Elkhorn River at Waterloo, Salt Creek at Greenwood, and the Platte River at Louisville for September 2000 through June 2004 are displayed on Figures 48, 49, 50, and 51, respectively (note that the scales on the Y-axes vary at each site). Suspended solids loads are related to runoff events upstream from the site at which they are measured because peaks are often related to erosion silt being transported into the river channel. Peaks in suspended solids at the Louisville site (Figure 51) reflect the inputs of materials from the three other sampling sites (Figures 48 - 50), even though all three may not be contributing solids at the same rate.

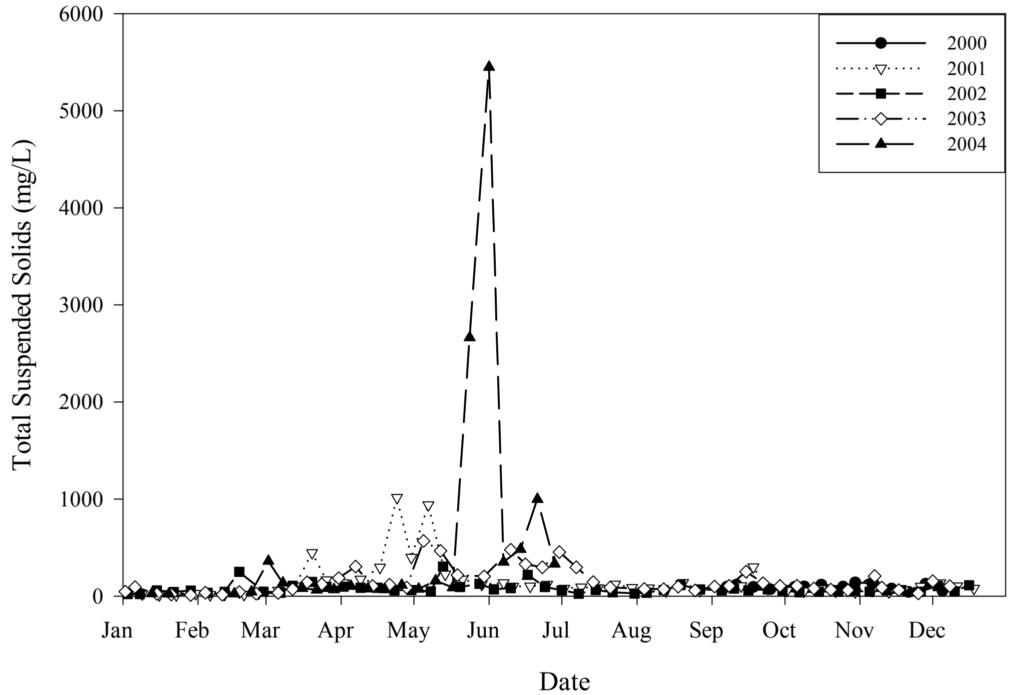

Figure 48. Platte River at Leshara average weekly total suspended solids, September 2000 to June 2004.

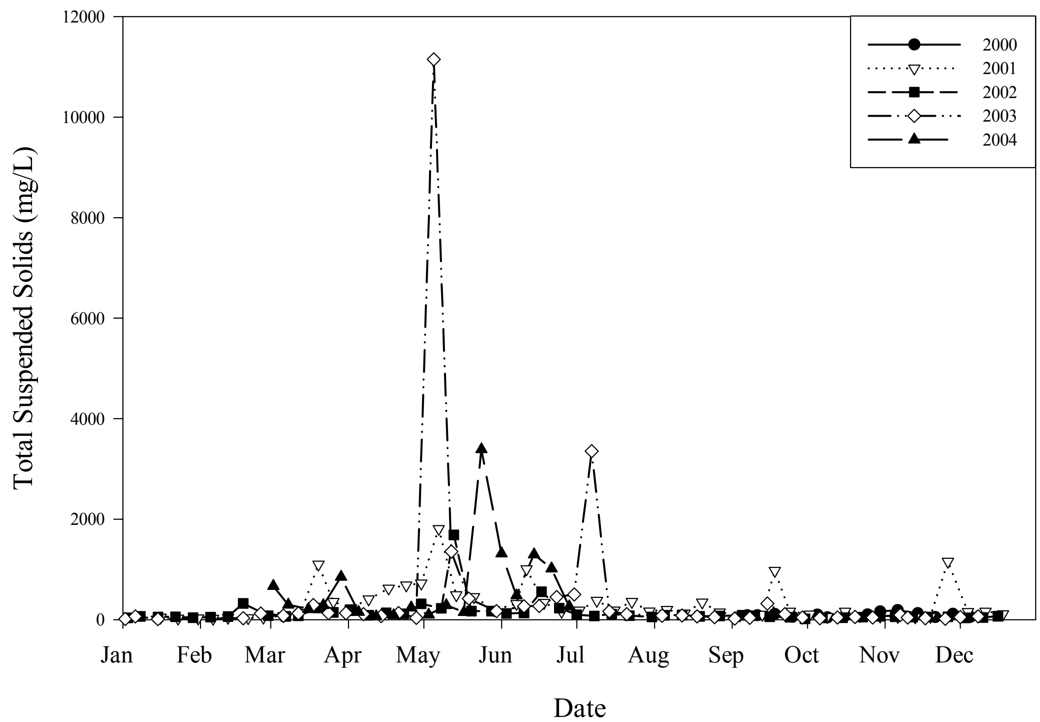

Figure 49. Elkhorn River at Waterloo average weekly total suspended solids, September 2000 to June 2004.

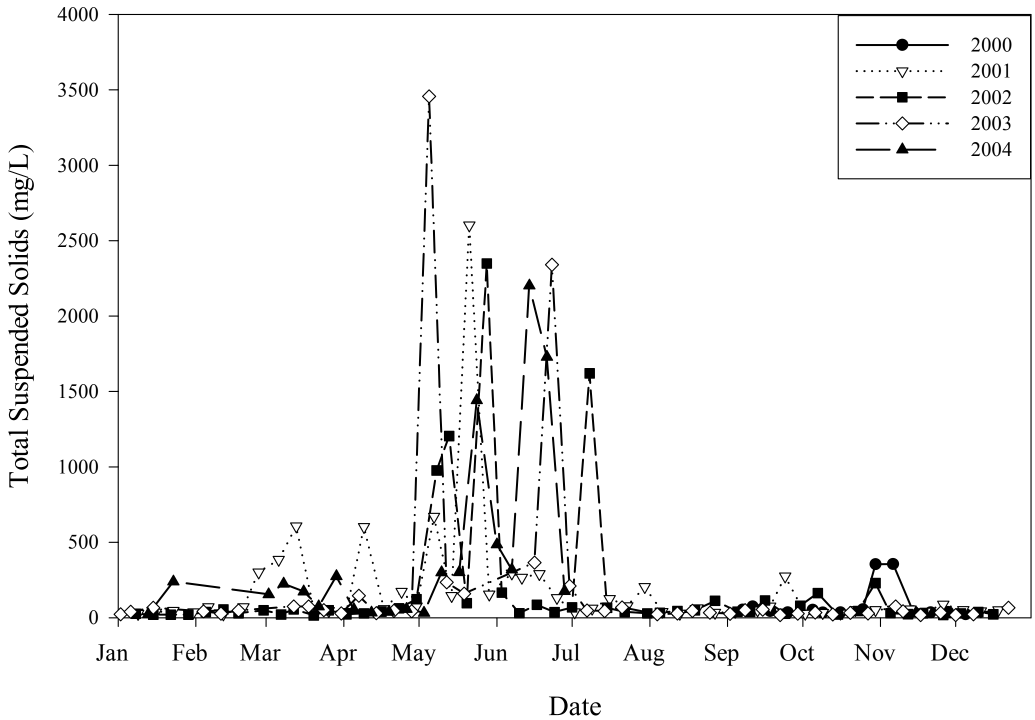

Figure 50. Salt Creek at Greenwood average weekly total suspended solids, September 2000 to June 2004.

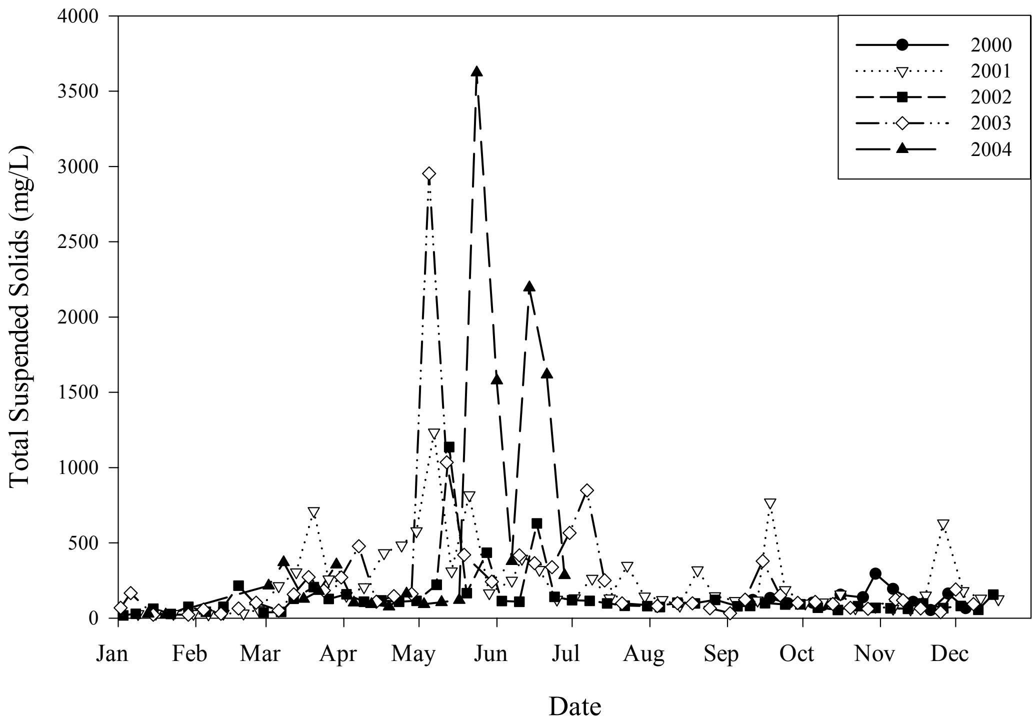

Figure 51. Platte River at Louisville average weekly total suspended solids, September 2000 to June 2004.

Turbidity:

Average weekly turbidity values (NTU) for the Platte River at Leshara, the Elkhorn River at Waterloo, Salt Creek at Greenwood, and the Platte River at Louisville for July 2001 through June 2004 are displayed on Figures 52, 53, 54, and 55, respectively (note that the scales on the Y-axes vary at each site). Turbidity values follow the suspended solids loads measured at each of the sites.

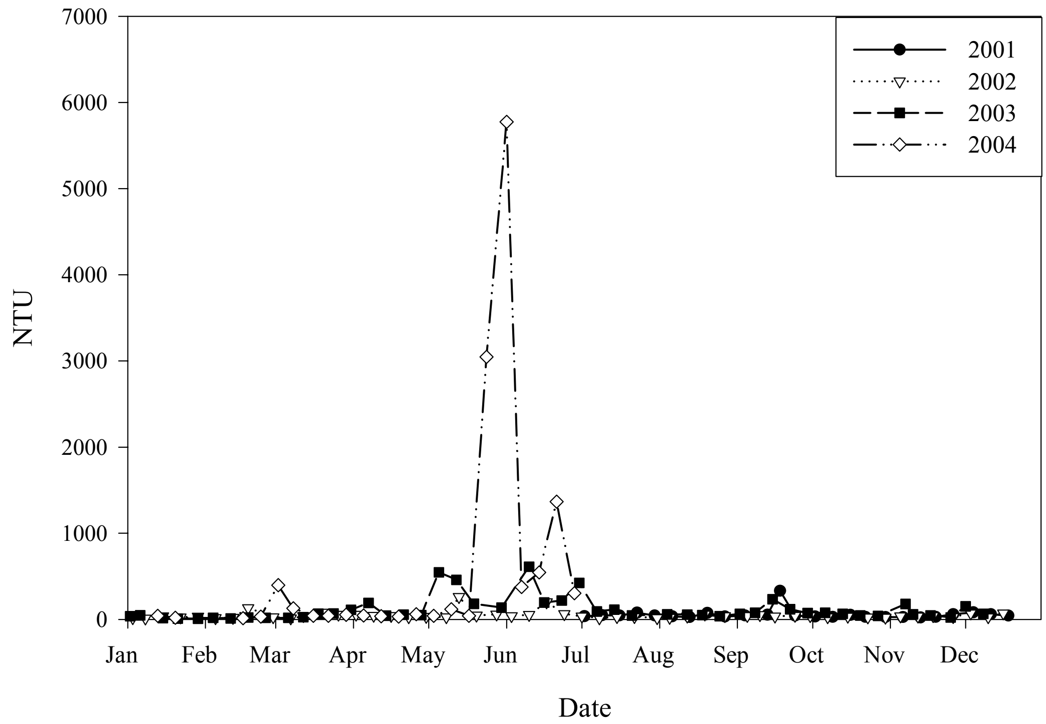

Figure 52. Platte River at Leshara average weekly NTU, September 2000 to June 2004.

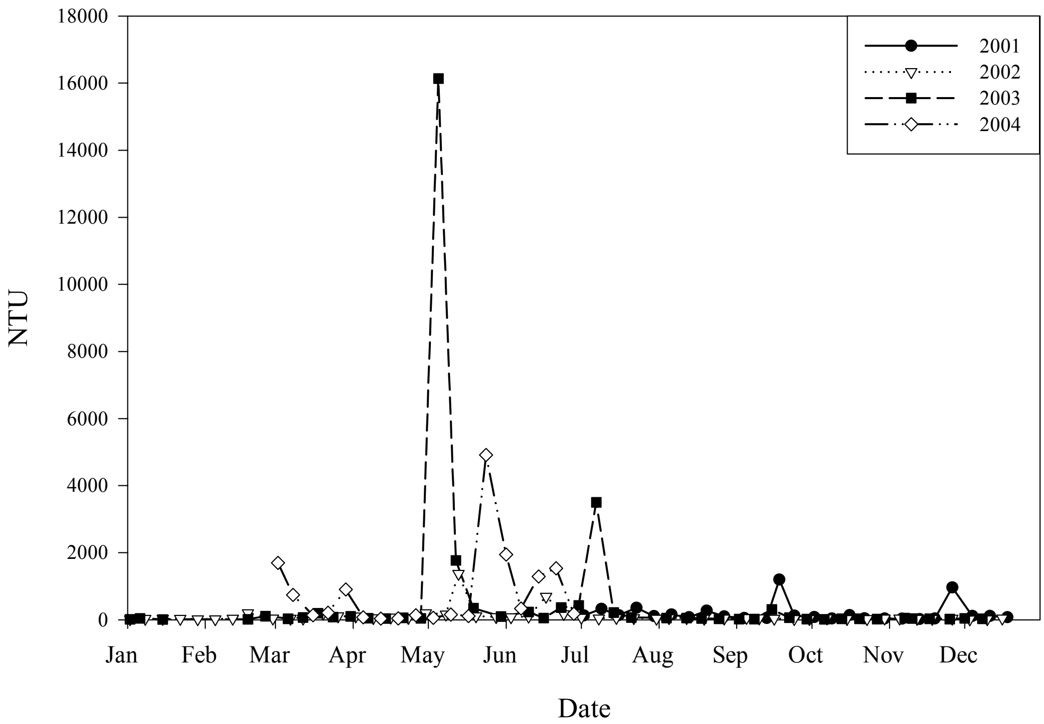

Figure 53. Elkhorn River at Waterloo average weekly NTU, September 2000 to June 004.

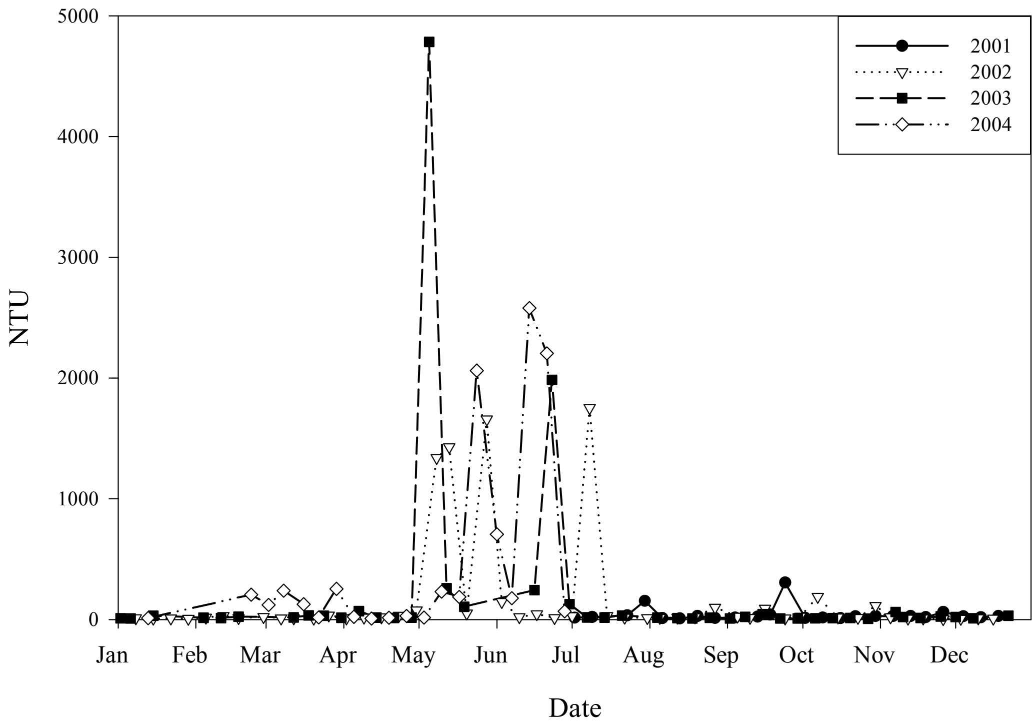

Figure 54. Salt Creek at Greenwood average weekly NTU, September 2000 to June 2004.

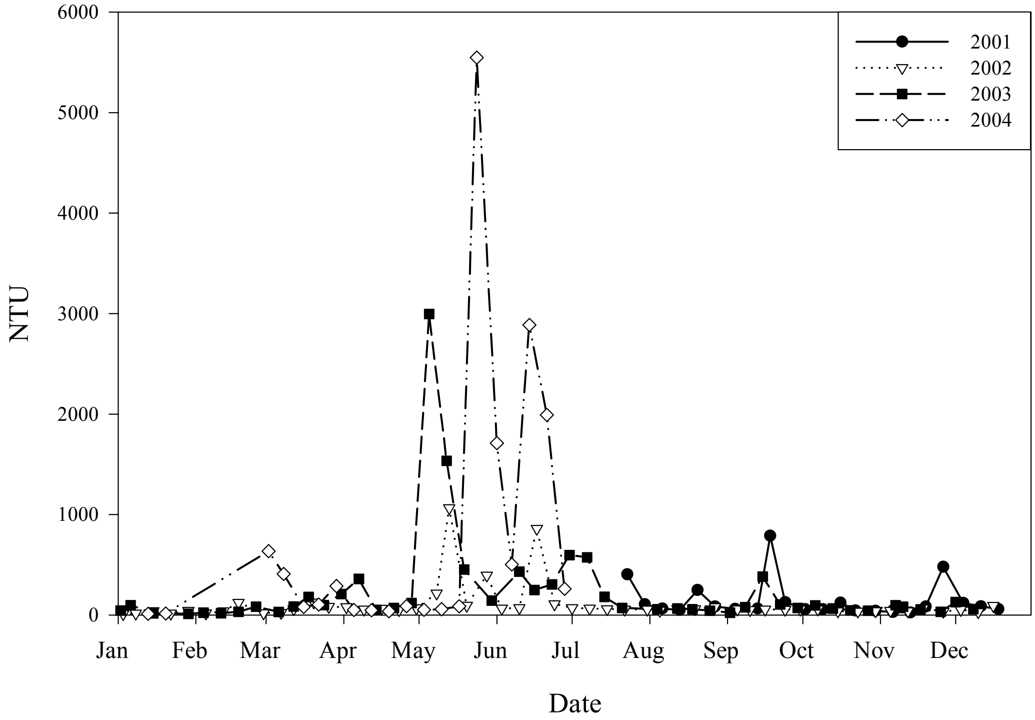

Figure 55. Platte River at Louisville average weekly NTU, September 2000 to June 2004.

Substrate:

Table 32 summarizes the substrate composition for all sites. Substrate composition expressed as percent of total sample weight for silt (<230), fine sand (230), sand (60), coarse sand (18) and gravel (10) along transects across the channels for the Platte River near North Bend (Nebraska highway 79), the Platte River at Leshara (Nebraska highway 64), the Elkhorn River at Waterloo, the Platte River near Ashland (US highway 6), Salt Creek at Greenwood, and the Platte River at Louisville (Nebraska highway 50) for July /August 2003, October 2003 and March 2004, are displayed as Figures 56 through 73, respectively.

The majority of Platte River substrate is sand and fine sand. The general trend at all sites was that core samples from locations with greater mean column velocities tended to have higher percentages of gravel and coarse sand. Conversely, sample locations with lower mean column velocities tended to have higher percentages of silt and fine sand.

NORTH BEND SITE ON THE PLATTE RIVER: The North Bend site (Figures 56, 57, 58) is the upstream most site sampled for substrate in this study and is located near the Nebraska State Highway 79 bridge. Here the river ranged from 403 to 447 m wide with depths up to 1.6 m, and was dissected by three or more bars up to 70 m wide. The substrate was dominated by sand and fine sands. Coarse sand and gravel were generally present but, in combination seldom exceeded 40% by weight in any one sample. Silt was most frequently present in shallow or exposed bar samples

The pairwise multiple comparison procedure showed that the North Bend site had significantly higher percentages of coarse sand than the Elkhorn River site ($p<0.001$) and significantly lower percentages of sand than the Salt Creek site ($p<0.001$). Percentages of fine sand at North Bend were significantly lower than those at the Elkhorn River site (p=0.002) and significantly higher than those at the Salt Creek site (p<0.001).

LESHARA SITE ON THE PLATTE RIVER: The Leshara site is located near the Nebraska State Highway 64 bridge. The river channel ranged from 503 to 580 m wide and up to 2 m deep at this site (Figures 59, 60, 61). The channel was dissected by one or more exposed bars up to 100 m in width. Sand and fine sand dominated most of the sample locations but, exposed bars were primarily fine sand and silt.

The pairwise multiple comparison procedure showed that substrate samples from the Leshara site on the Platte River had significantly higher percentages of coarse sand than the Elkhorn River site (p=0.004). The Leshara site also had significantly lower percentages of sand (p<0.001) and significantly higher percentages of fine sand (p<0.001) than the Salt Creek site.

ELKHORN RIVER SITE: The Elkhorn River site is located near the Nebraska State Highway 64 bridge in the town of Waterloo, Nebraska. The river at this site ranged from 58 to 66 m wide and was up to 1.5 m deep (Figures 62, 63, 64). No exposed bars were found at this site. Fine sand and sand size materials dominated the substrate in the July 2003 samples and the composition shifted to sand during the October 2003 and March 2004 samples. On these dates fine sand and silt was found in higher percentage in samples from shoreline locations.

The pairwise comparison procedure showed that the Elkhorn River site had significantly lower percentages of coarse sand than the Salt Creek site (p=0.001) and indeed all of the sites along the Platte River as detailed below. The percentage of fine sand at the Elkhorn River site was significantly higher than that at the Salt Creek site (p<0.001) and all the Platte River sites, except the one at Leshara as detailed below. The percentage of sand at the Elkhorn River site was significantly lower than tat at the Salt Creek site (p<0.001).

ASHLAND SITE ON THE PLATTE RIVER: The Ashland site is located near the US Highway 6 bridge over the Platte River. The channel ranged from 390 to 420 m wide and up to 1 m deep. In contrast to the other sites on the Platte River, there were no exposed bars that divided the river into smaller channels. However, there were exposed bars on the bank-line areas up to about 100 m wide (Figures 65, 66, 67). Silt was confined to exposed bar locations. Coarse sand and gravel was most abundant in the deeper, faster sections of the channel.

The pairwise comparison procedure showed that the site at the U. S. Highway 6 bridge on the Platte River had significantly higher percentages of coarse sand than the Elkhorn River site (p<0.001). This site also had significantly lower percentages of sand than the Salt Creek site (p<0.001). The percentage of fine sand was significantly lower than those found in the Elkhorn River site (p=0.001) and significantly higher than those found at the Salt Creek site (p<0.001).

SALT CREEK SITE: The Salt Creek site is located just north of Greenwood, Nebraska. This site ranged from 39 to 41 m wide and up to 0.7 m deep (Figures68, 69, 70). The channel was divided by an exposed bar with the July and October 2003 samples. Although sand was by far the largest component of the substrate, silt commonly occurred in the samples more frequently than the other sites.

LOUISVILLE SITE ON THE PLATTE RIVER: The Louisville site is located near the Nebraska State Highway 50 bridge on the Platte River. It was the most downstream location in the Platte River that was sampled for substrate composition during this study. The channel at this site ranged from 407 to 516 m wide and up to 1.1 m deep (Figures 71, 72, 73). The channel at this site was divided by several small bars during the July 2003 sample but, no exposed bars were found during October 2003 or March 2004. From July 2003 to March 2004, there appeared to be a shift toward a finer substrate composition.

The pairwise comparison procedure showed that the substrate at the Louisville site on the Platte River had significantly higher percentages of gravel than the Elkhorn River site ($p<0.001$) and the Salt Creek site ($p=0.004$). Percentages of coarse sand at Louisville were significantly higher than those found at the Elkhorn River site ($p=0.001$) and at the Leshara site on the Platte River ($p=0.004$). The percentage of sand at the Louisville site was significantly lower than at the Salt Creek site ($p=0.001$). The percentage of fine sand at the Louisville site was significantly lower than the percentages at the Elkhorn River site ($p<0.001$) and the Leshara site on the Platte River ($p<0.001$) and significantly higher than at the Salt Creek site ($p=0.005$).

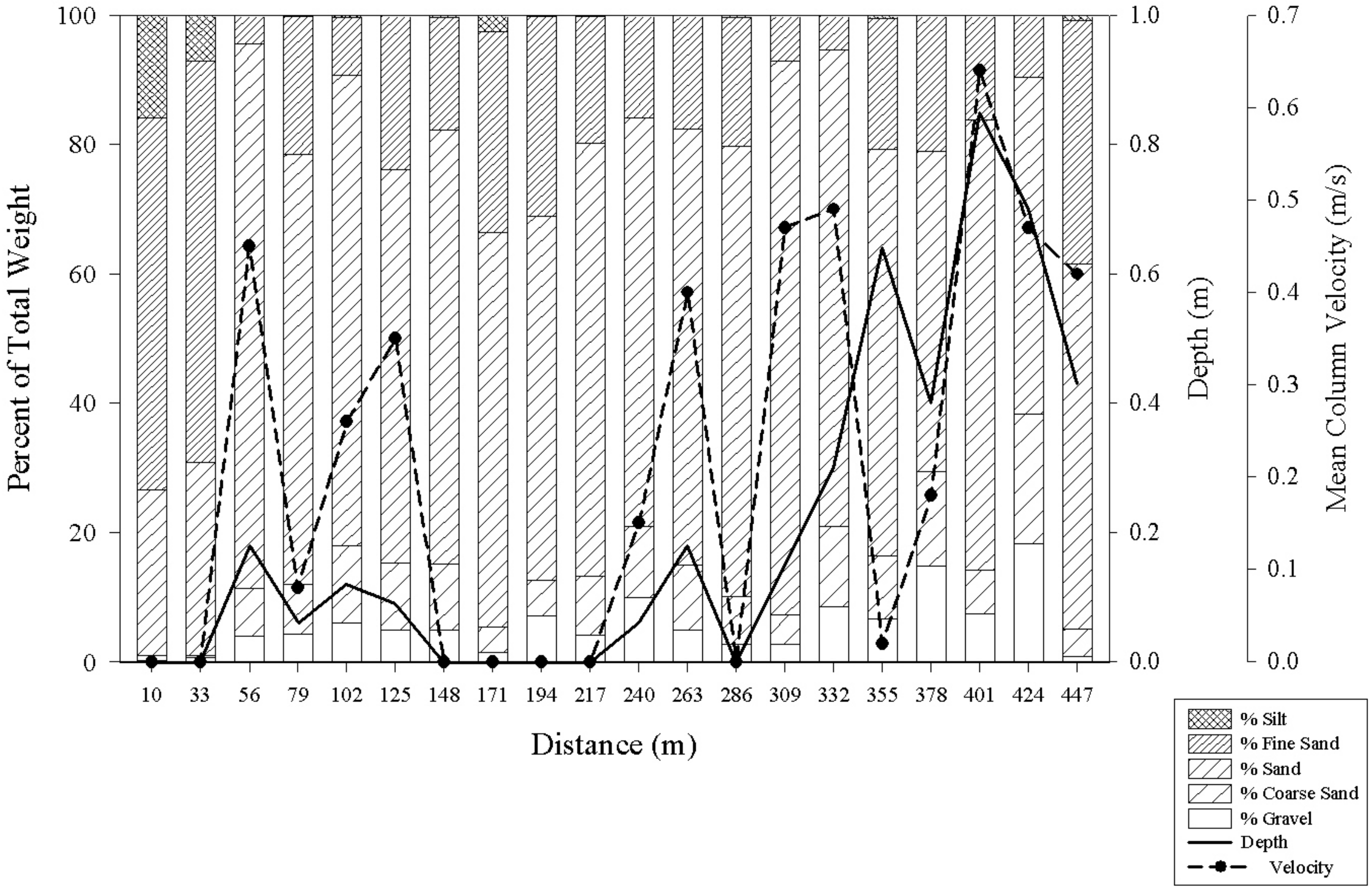

Figure 56. Percent substrate composition (Silt, Fine Sand, Sand, Coarse Sand, Gravel) from core samples, depth and mean column velocities measured along a transect across the Platte River near Nebraska State Highway 79 Bridge August 5, 2003.

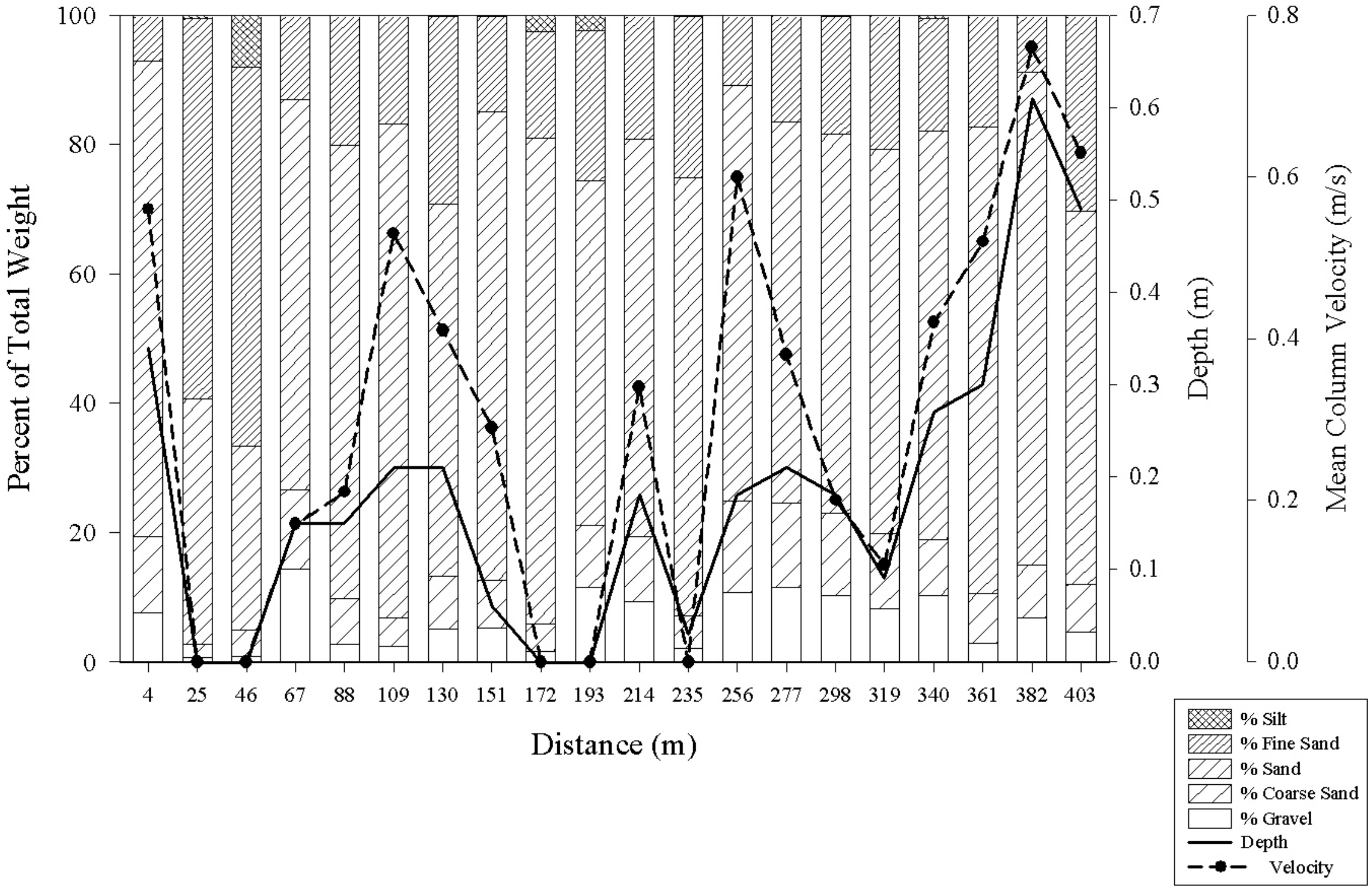

Figure 57. Percent substrate composition (Silt, Fine Sand, Sand, Coarse Sand, Gravel) from core samples, depth and mean column velocities measured along a transect across the Platte River near Nebraska State Highway 79 Bridge October 24, 2003.

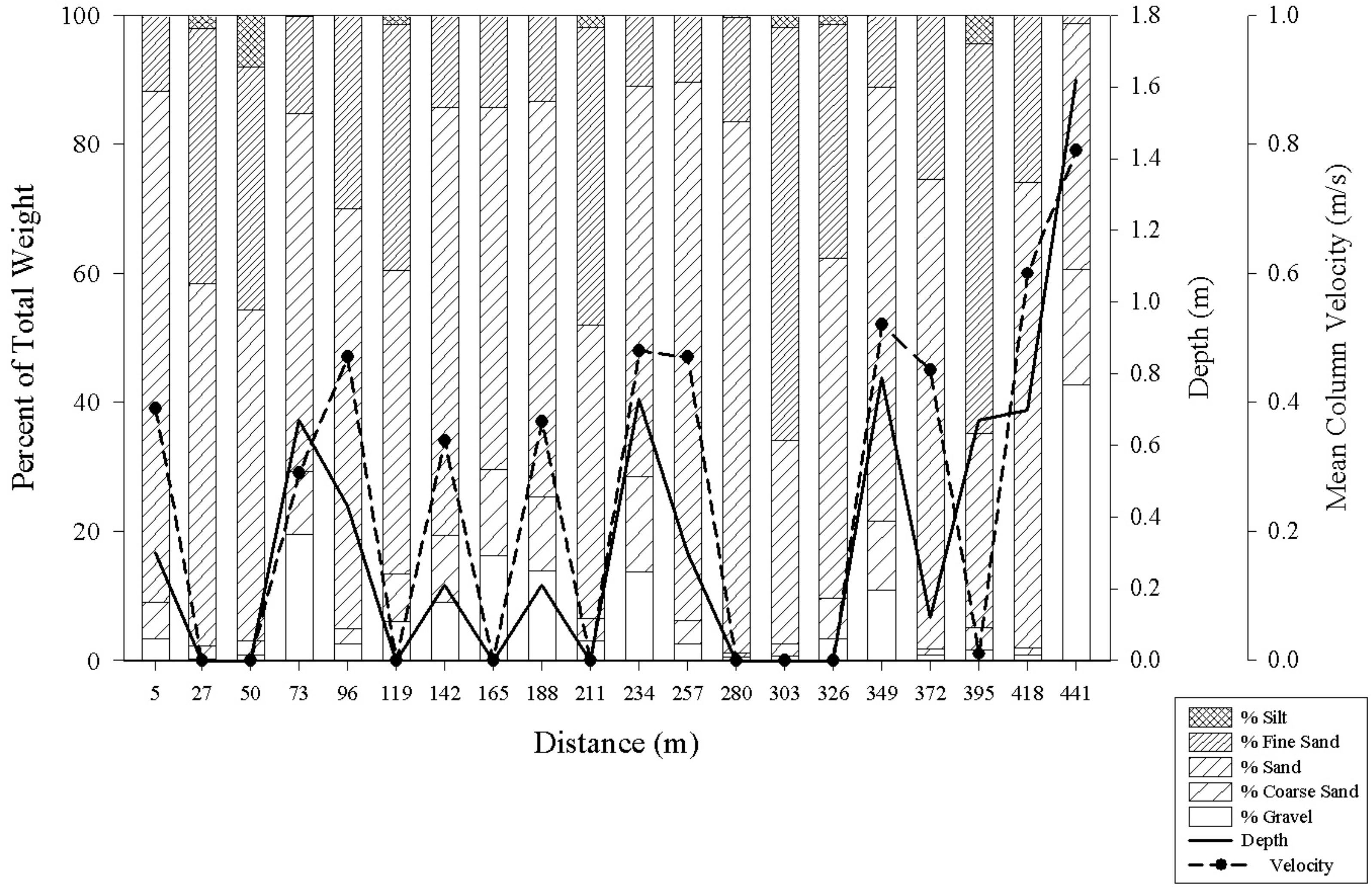

Figure 58. Percent substrate composition (Silt, Fine Sand, Sand, Coarse Sand, Gravel) from core samples, depth and mean column velocities measured along a transect across the Platte River near Nebraska State Highway 79 Bridge March 12, 2004.

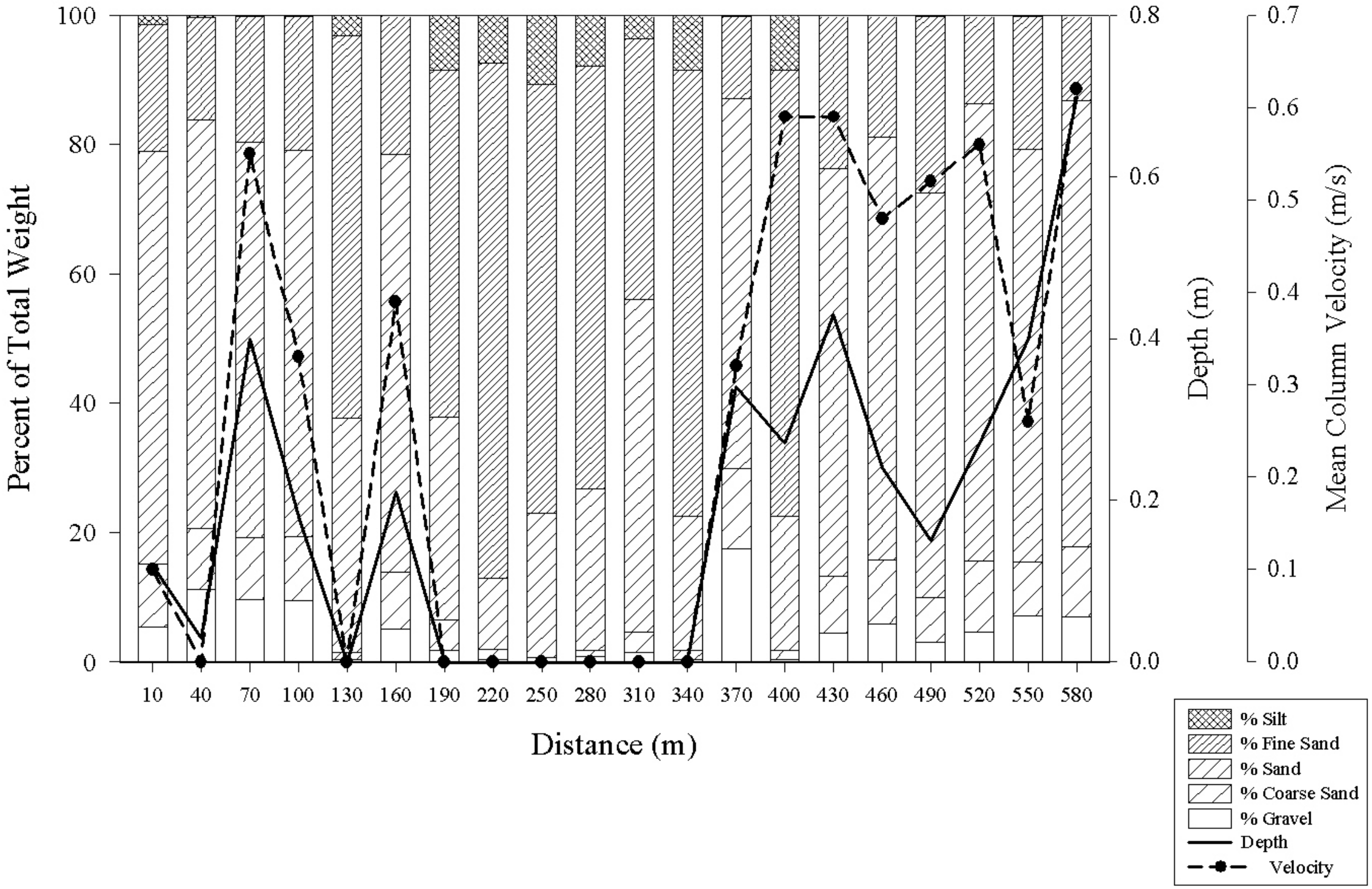

Figure 59. Percent substrate composition (Silt, Fine Sand, Sand, Coarse Sand, Gravel) from core samples, depth and mean column velocities measured along a transect across the Platte River near Nebraska State Highway 64 Bridge August 15, 2003.

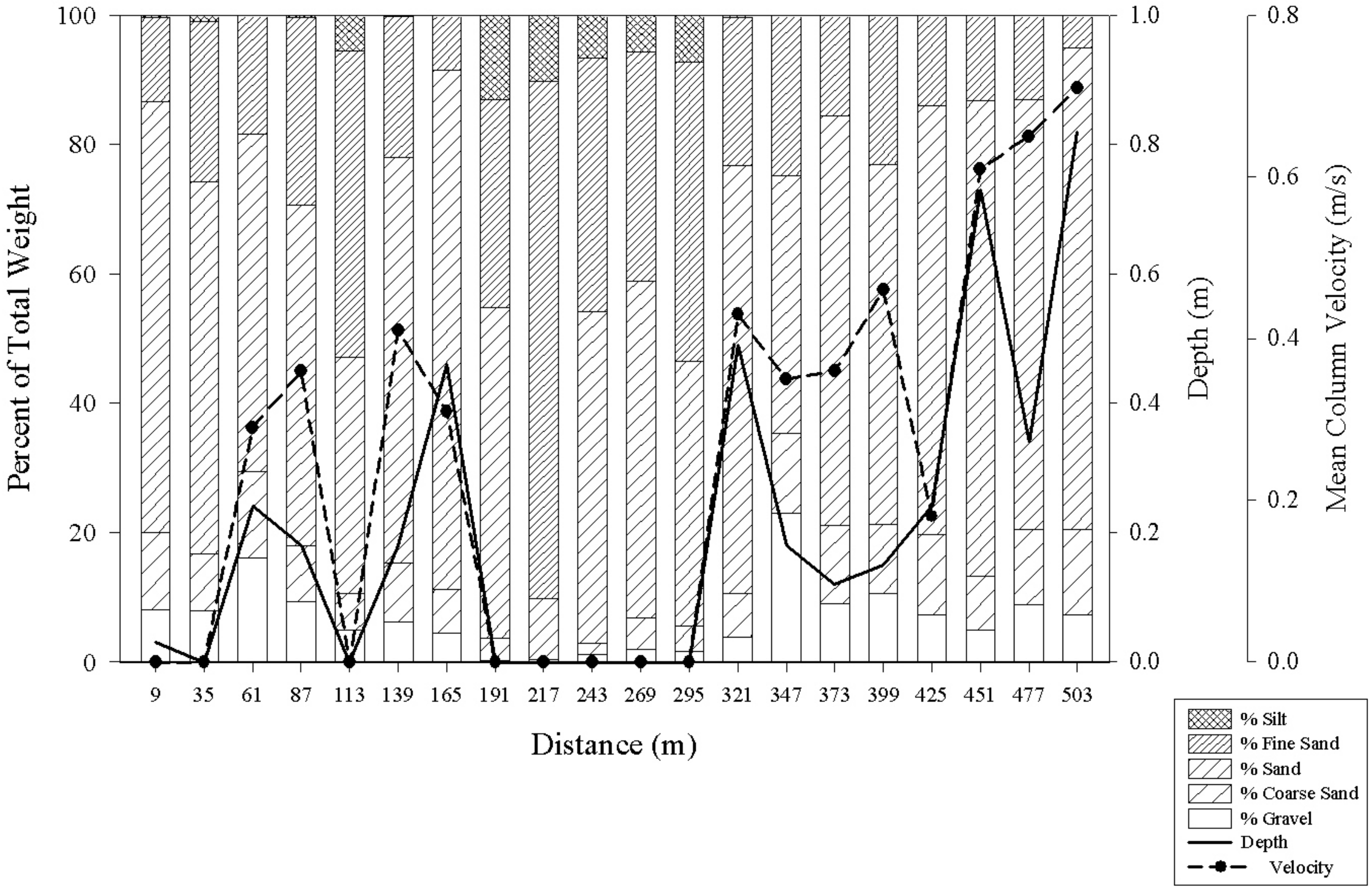

Figure 60. Percent substrate composition (Silt, Fine Sand, Sand, Coarse Sand, Gravel) from core samples, depth and mean column velocities measured along a transect across the Platte River near Nebraska State Highway 64 Bridge October 24, 2003.

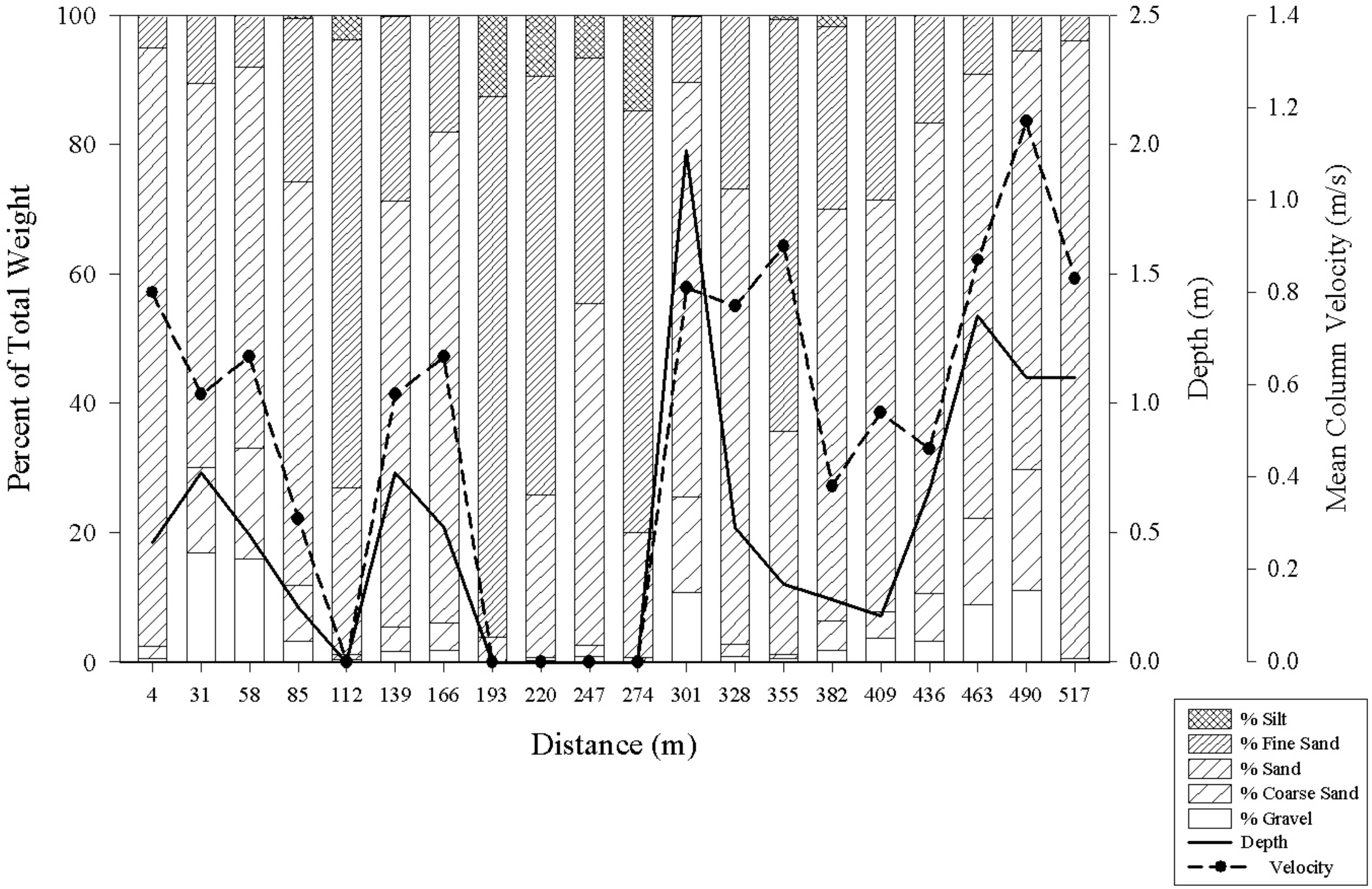

Figure 61. Percent substrate composition (Silt, Fine Sand, Sand, Coarse Sand, Gravel) from core samples, depth and mean column velocities measured along a transect across the Platte River near Nebraska State Highway 64 Bridge March 30, 2004.

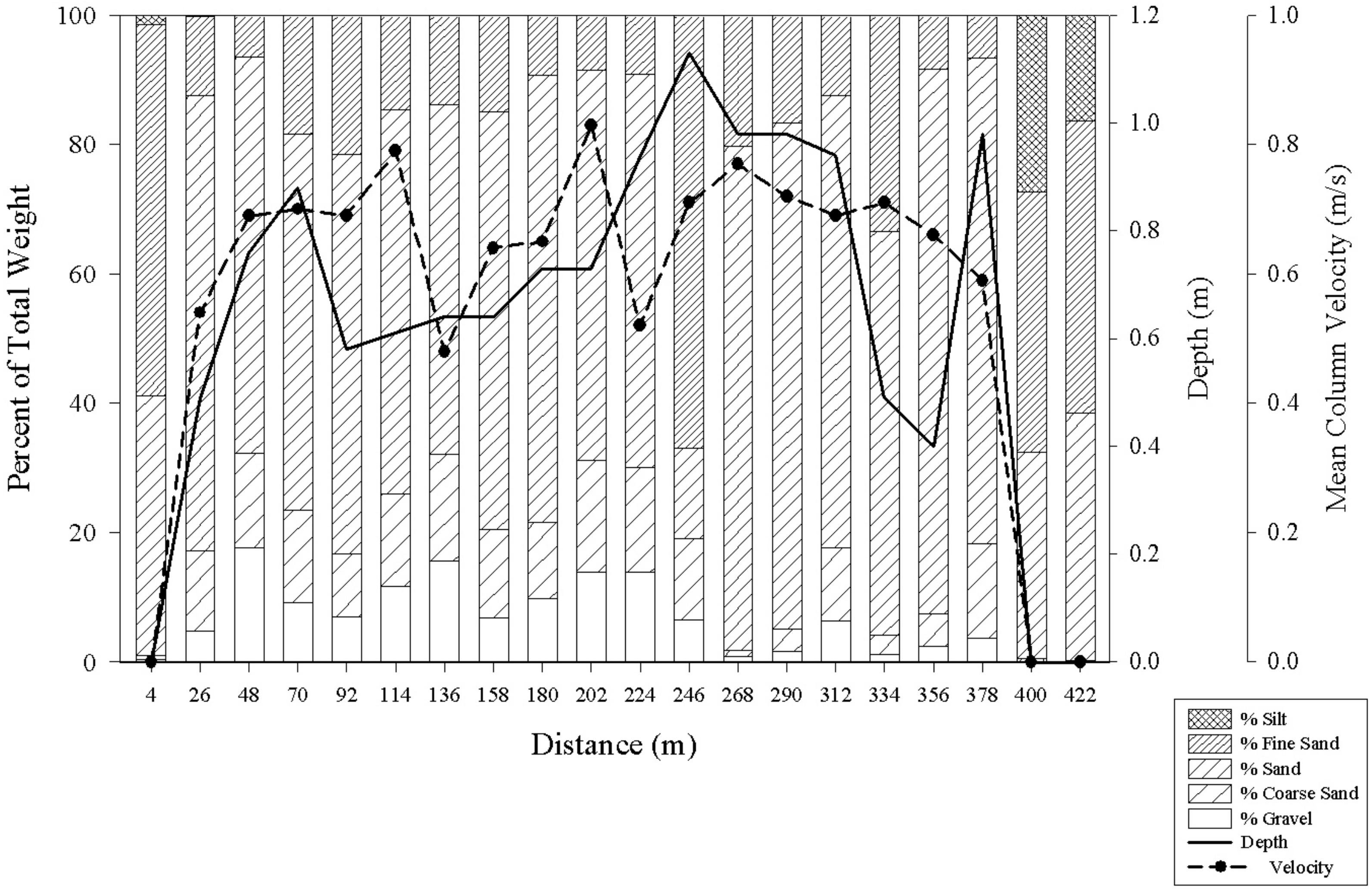

Figure 62. Percent substrate composition (Silt, Fine Sand, Sand, Coarse Sand, Gravel) from core samples, depth and mean column velocities measured along a transect across the Platte River near US Highway 6 Bridge July 31, 2003.

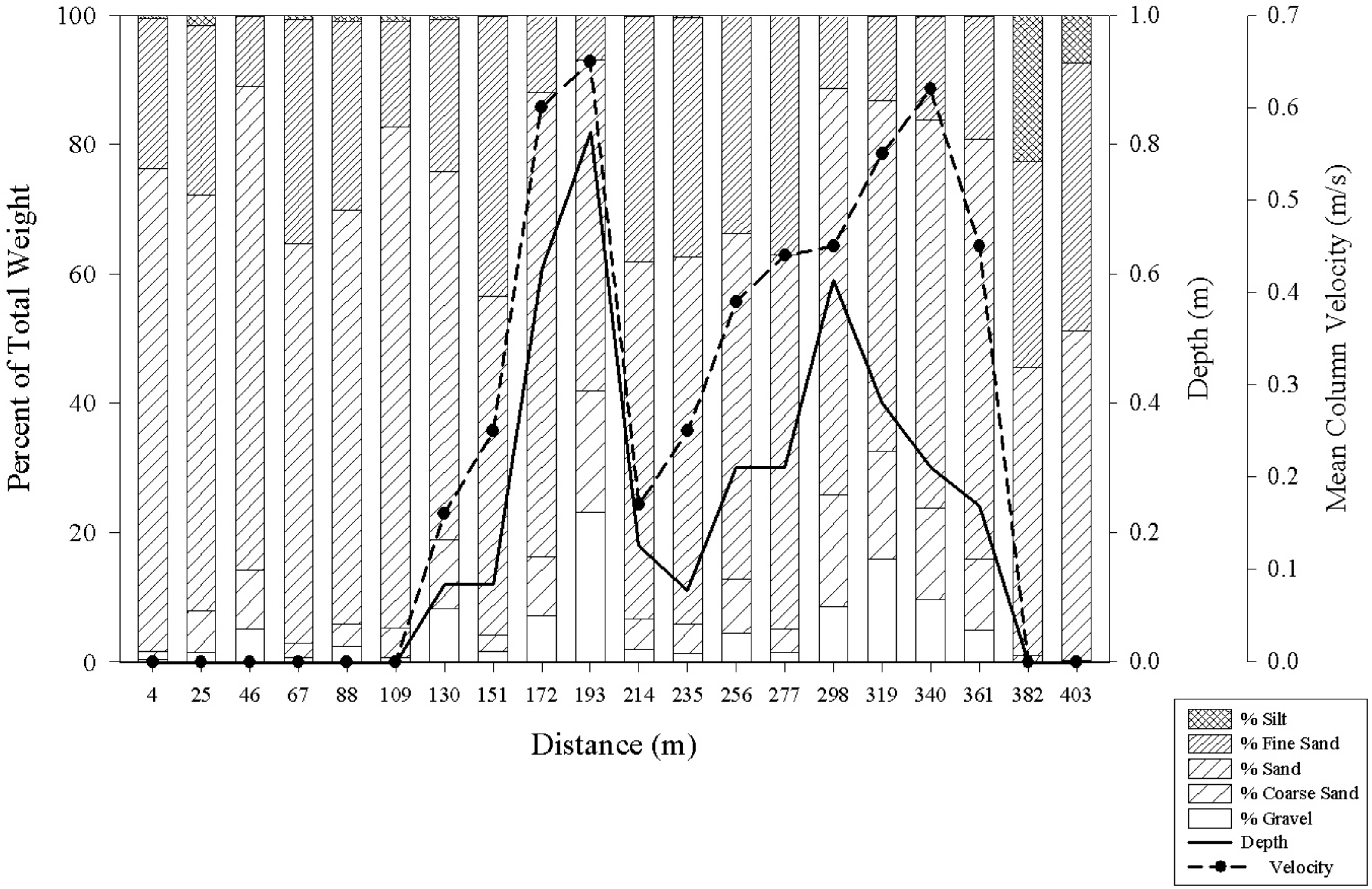

Figure 63. Percent substrate composition (Silt, Fine Sand, Sand, Coarse Sand, Gravel) from core samples, depth and mean column velocities measured along a transect across the Platte River near US Highway 6 Bridge October 10, 2003.

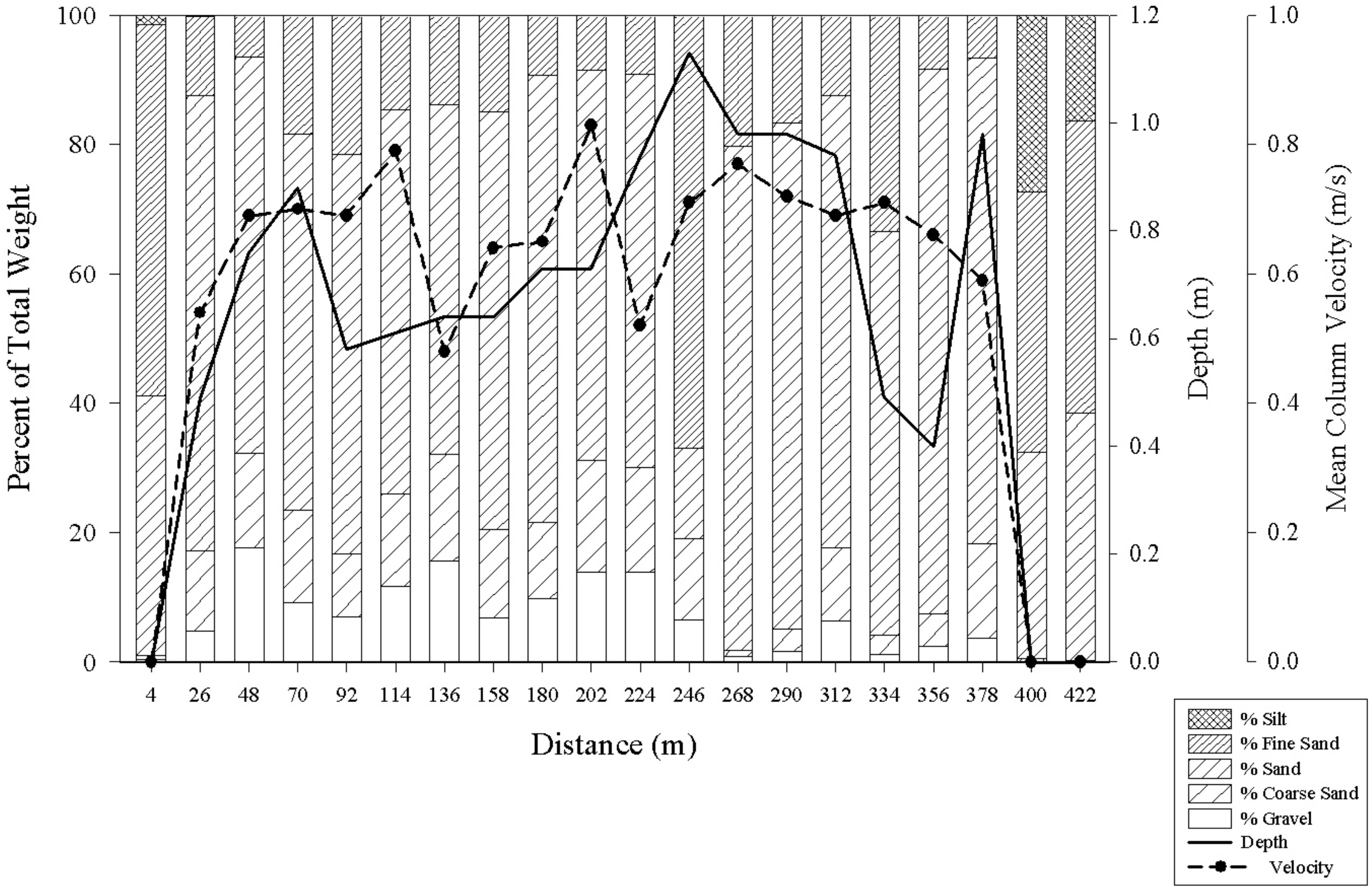

Figure 64. Percent substrate composition (Silt, Fine Sand, Sand, Coarse Sand, Gravel) from core samples, depth and mean column velocities measured along a transect across the Platte River near US Highway 6 Bridge March 19, 2004.

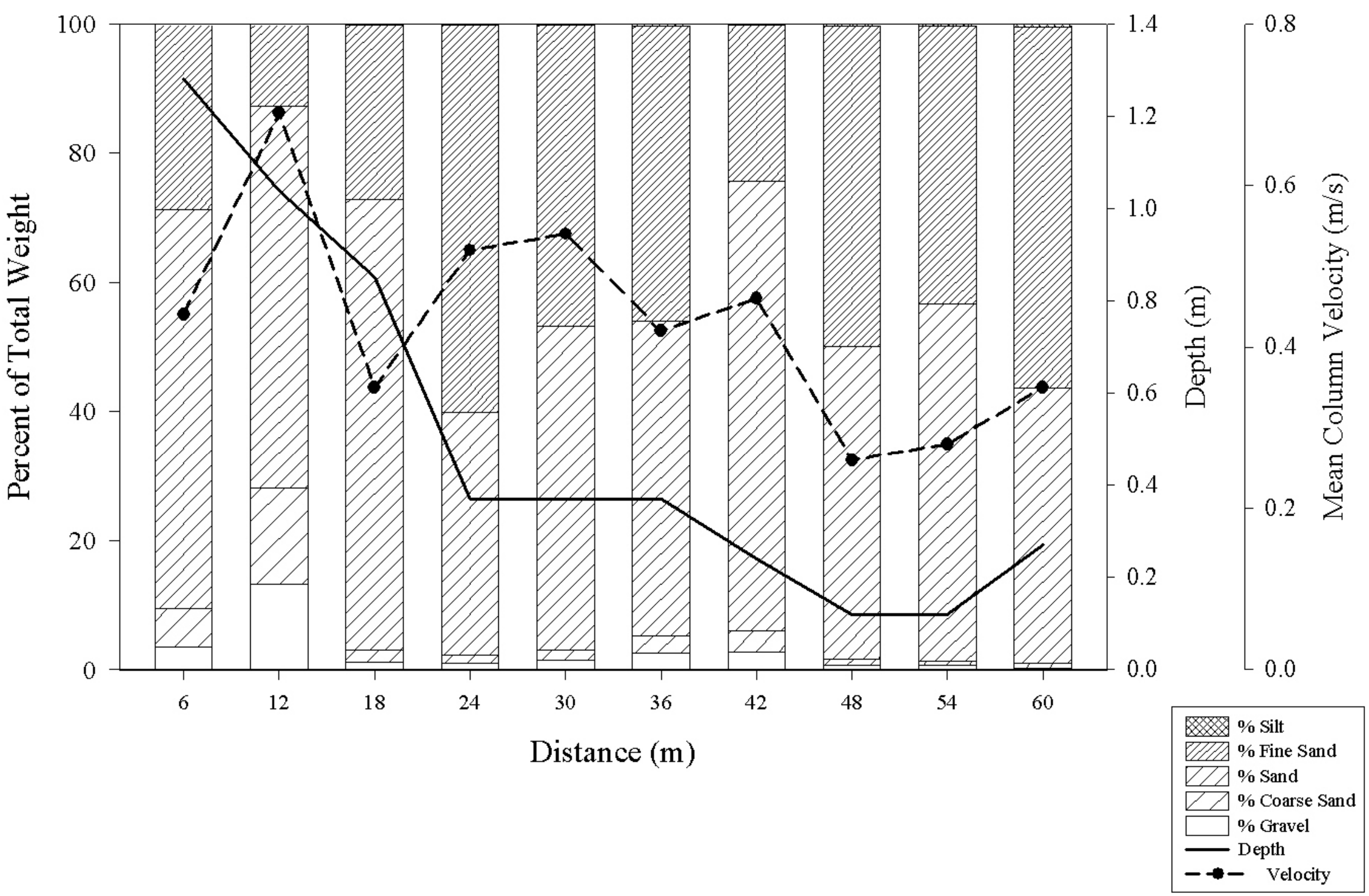

Figure 65. Percent substrate composition (Silt, Fine Sand, Sand, Coarse Sand, Gravel) from core samples, depth and mean column velocities measured along a transect across the Elkhorn River near Nebraska State Highway 64 Bridge July 23, 2003.

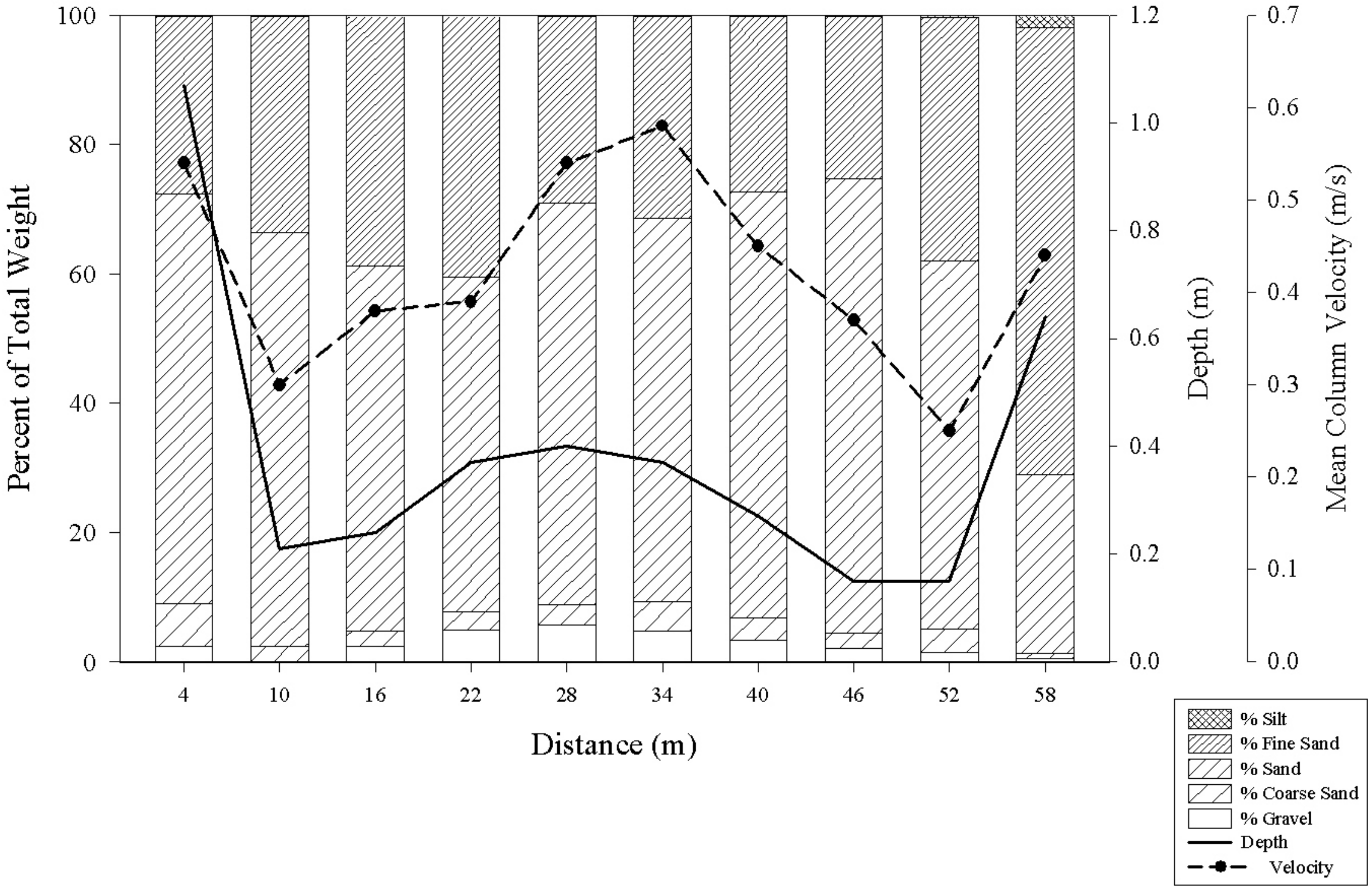

Figure 66. Percent substrate composition (Silt, Fine Sand, Sand, Coarse Sand, Gravel) from core samples, depth and mean column velocities measured along a transect across the Elkhorn River near Nebraska State Highway 64 Bridge October 8, 2003.

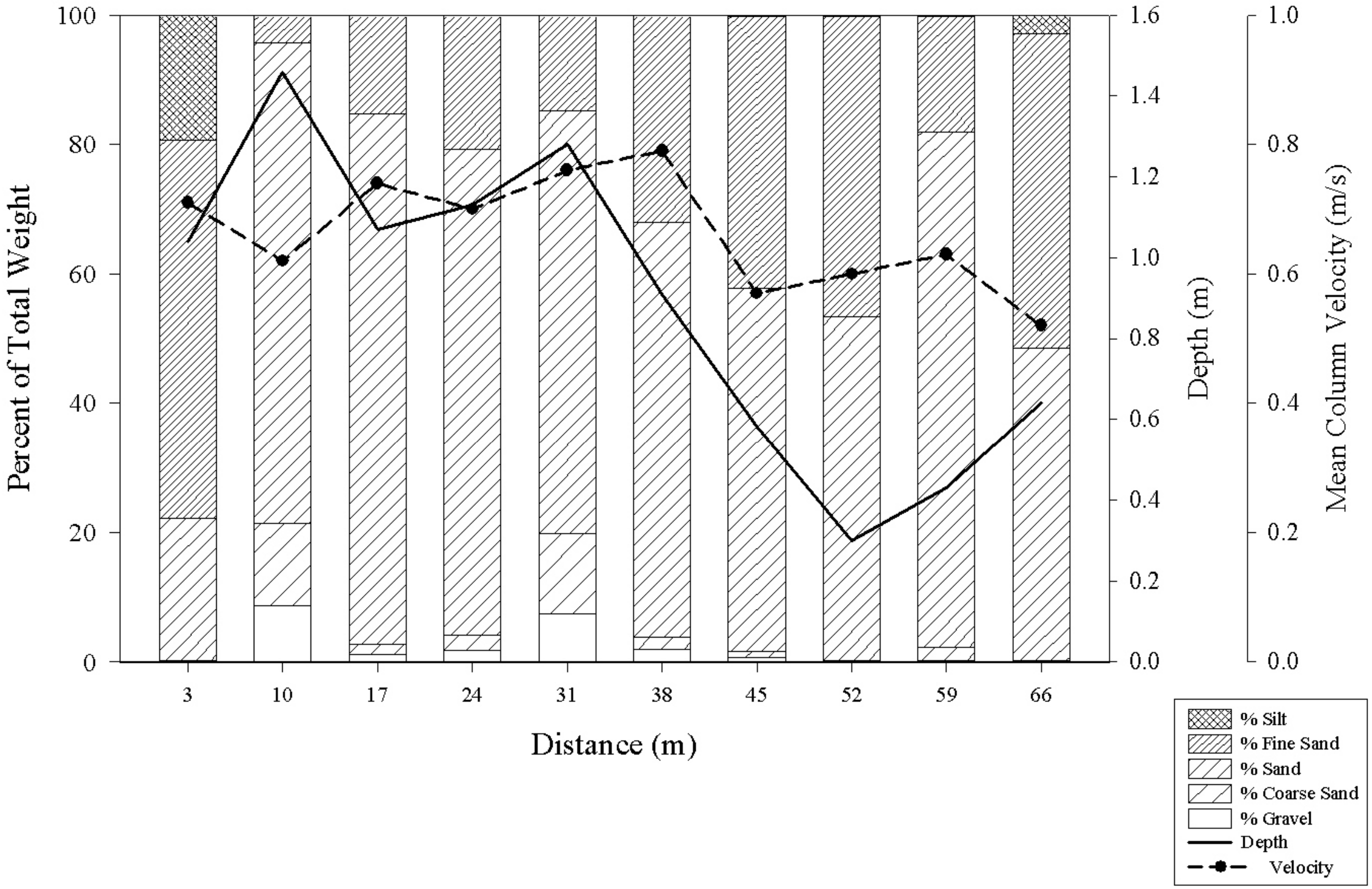

Figure 67. Percent substrate composition (Silt, Fine Sand, Sand, Coarse Sand, Gravel) from core samples, depth and mean column velocities measured along a transect across the Elkhorn River near Nebraska State Highway 64 Bridge March 31, 2004.

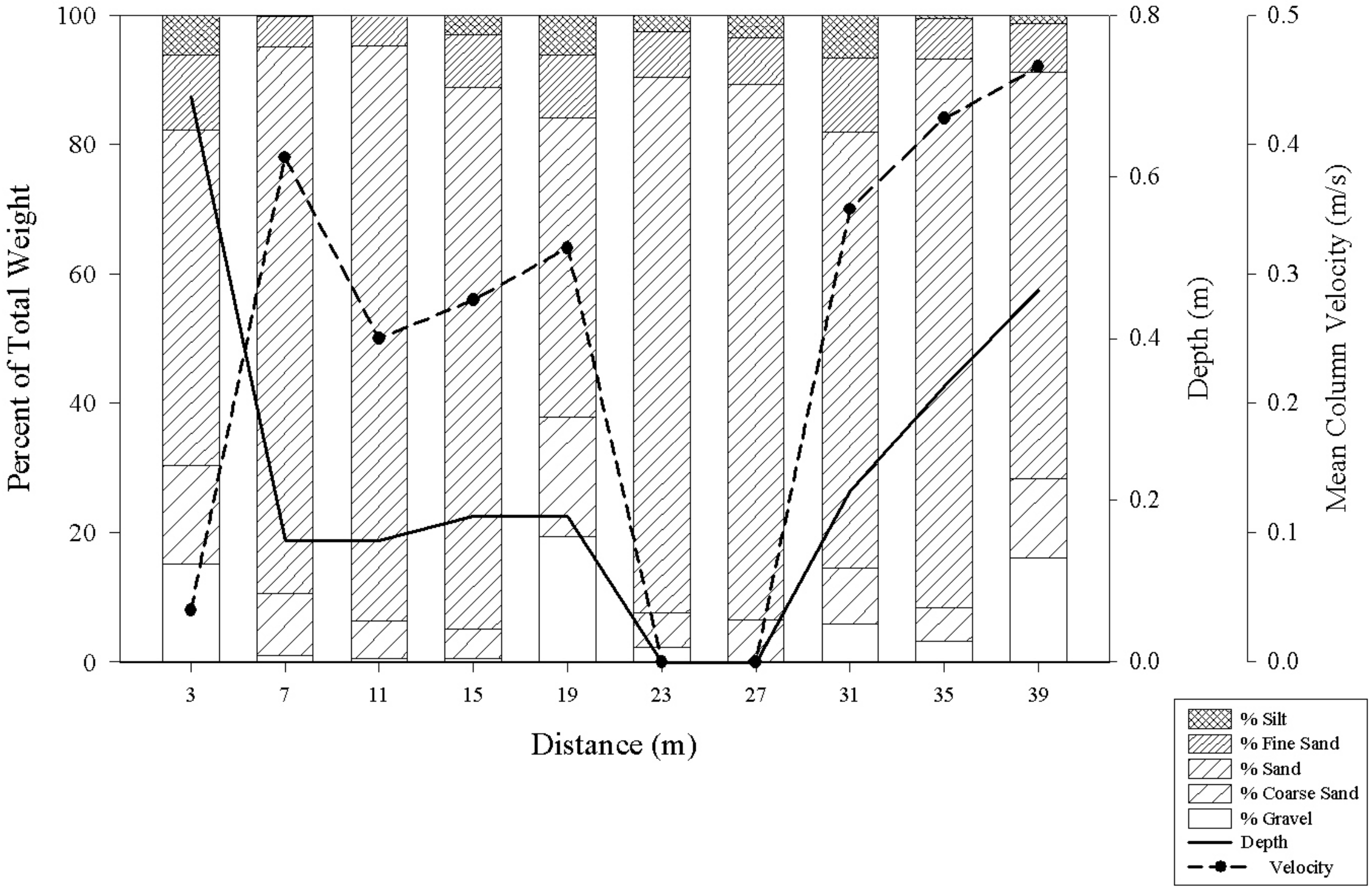

Figure 68. Percent substrate composition (Silt, Fine Sand, Sand, Coarse Sand, Gravel) from core samples, depth and mean column velocities measured along a transect across Salt Creek near Greenwood July 30, 2003.

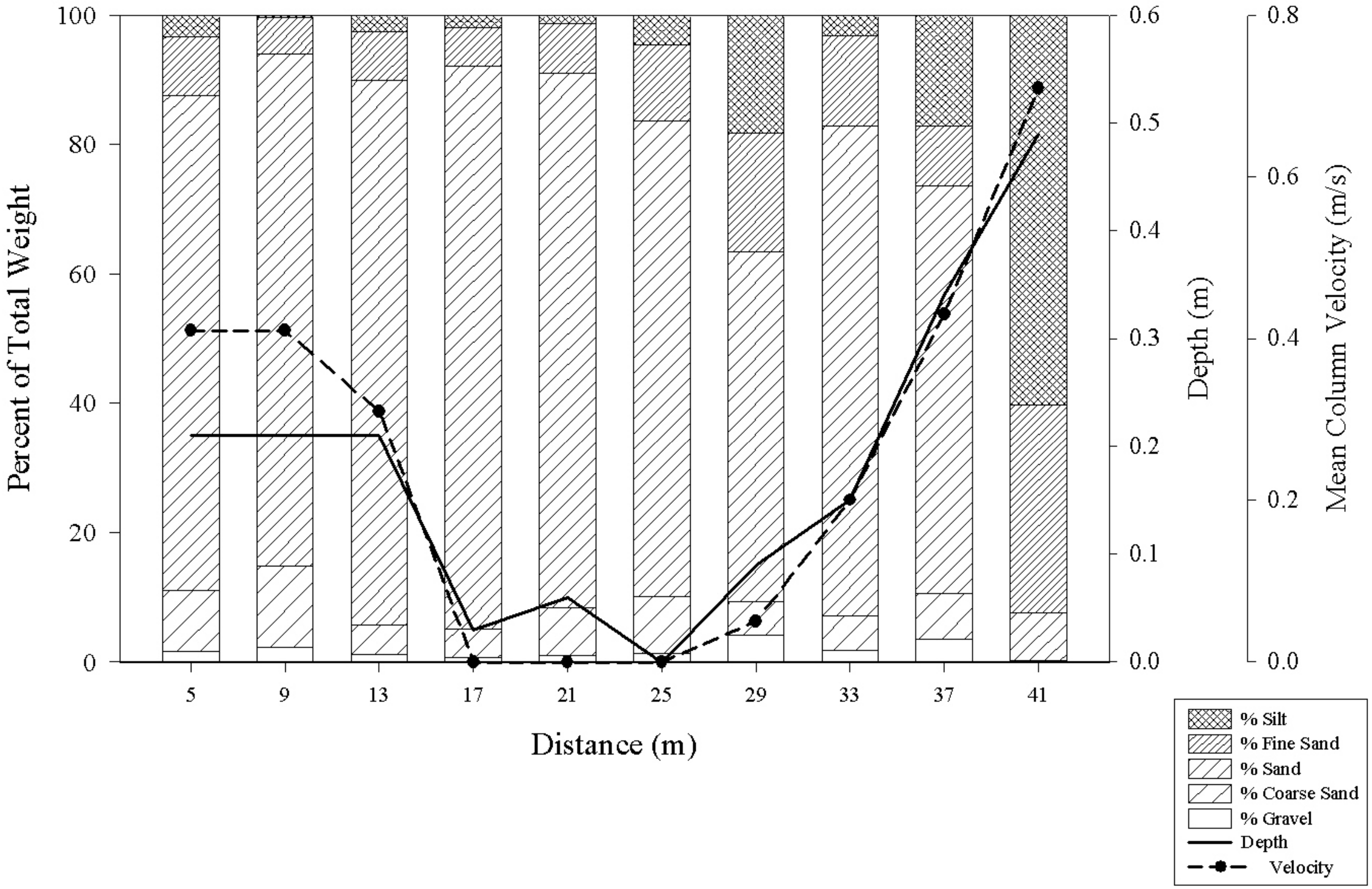

Figure 69. Percent substrate composition (Silt, Fine Sand, Sand, Coarse Sand, Gravel) from core samples, depth and mean column velocities measured along a transect across Salt Creek near Greenwood October 8, 2003.

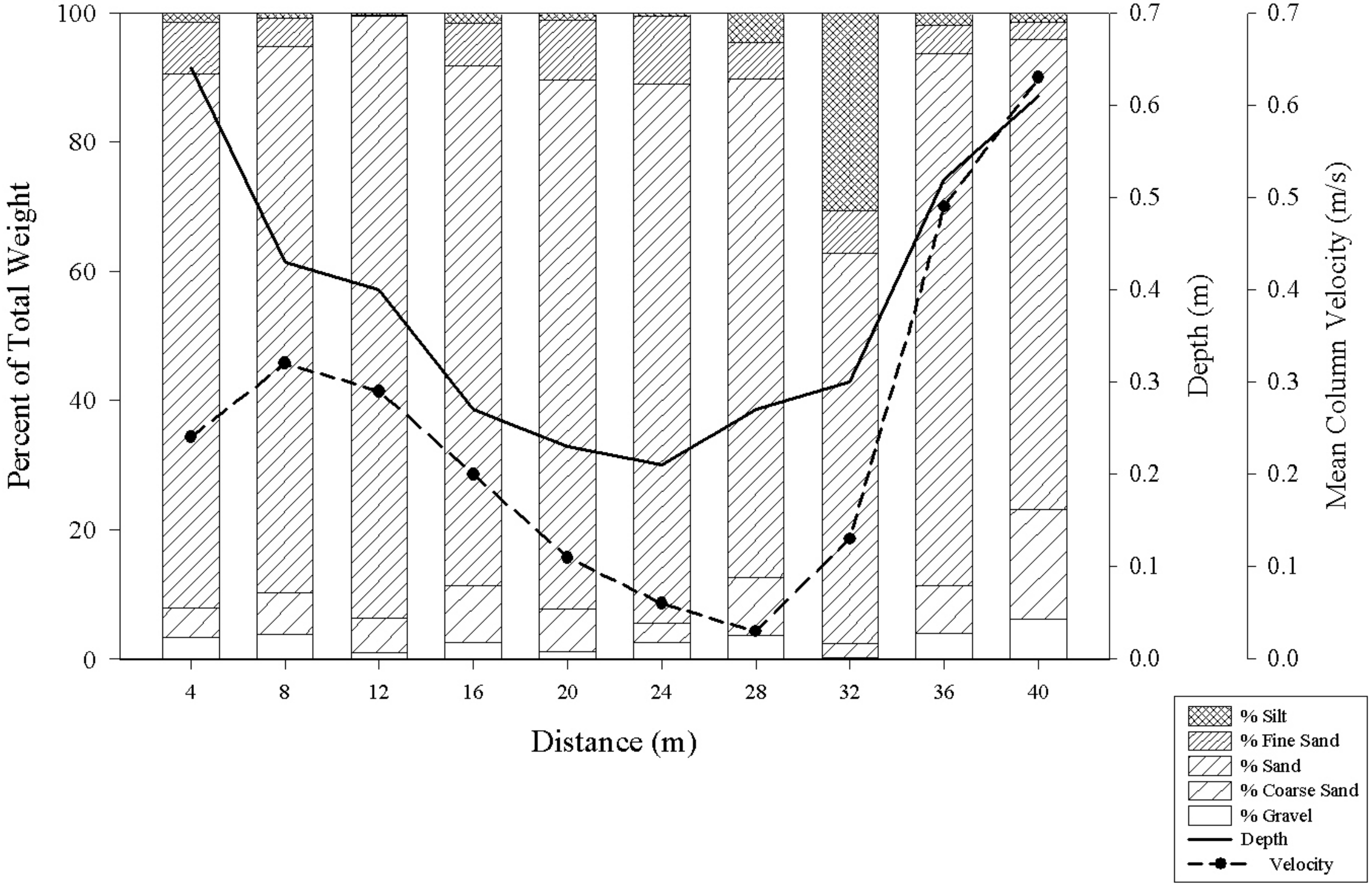

Figure 70. Percent substrate composition (Silt, Fine Sand, Sand, Coarse Sand, Gravel) from core samples, depth and mean column velocities measured along a transect across Salt Creek near Greenwood March 11, 2004.

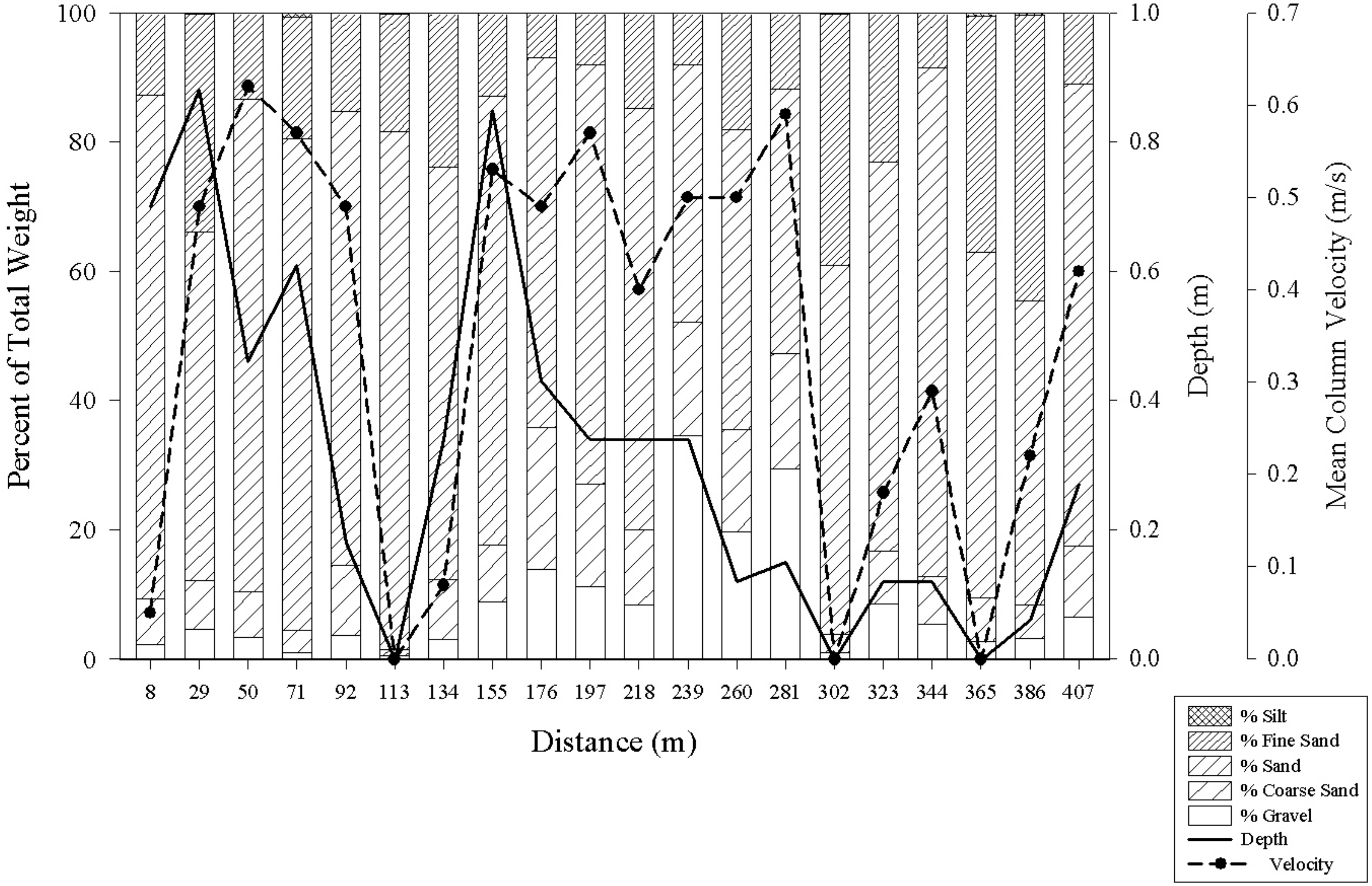

Figure 71. Percent substrate composition (Silt, Fine Sand, Sand, Coarse Sand, Gravel) from core samples, depth and mean column velocities measured along a transect across the Platte River near Nebraska State Highway 50 Bridge July 23, 2003.

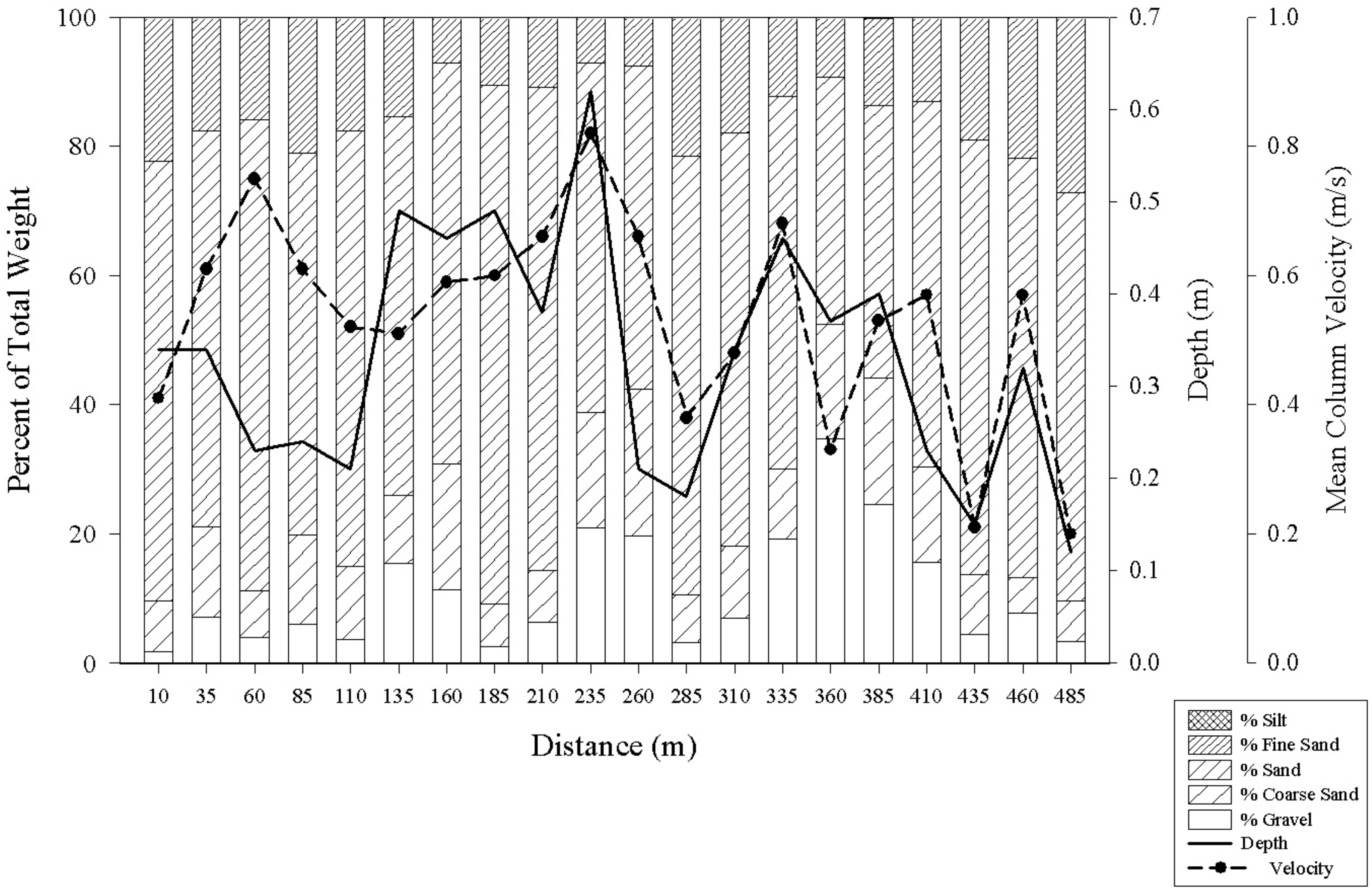

Figure 72. Percent substrate composition (Silt, Fine Sand, Sand, Coarse Sand, Gravel) from core samples, depth and mean column velocities measured along a transect across the Platte River near Nebraska State Highway 50 Bridge October 10, 2003.

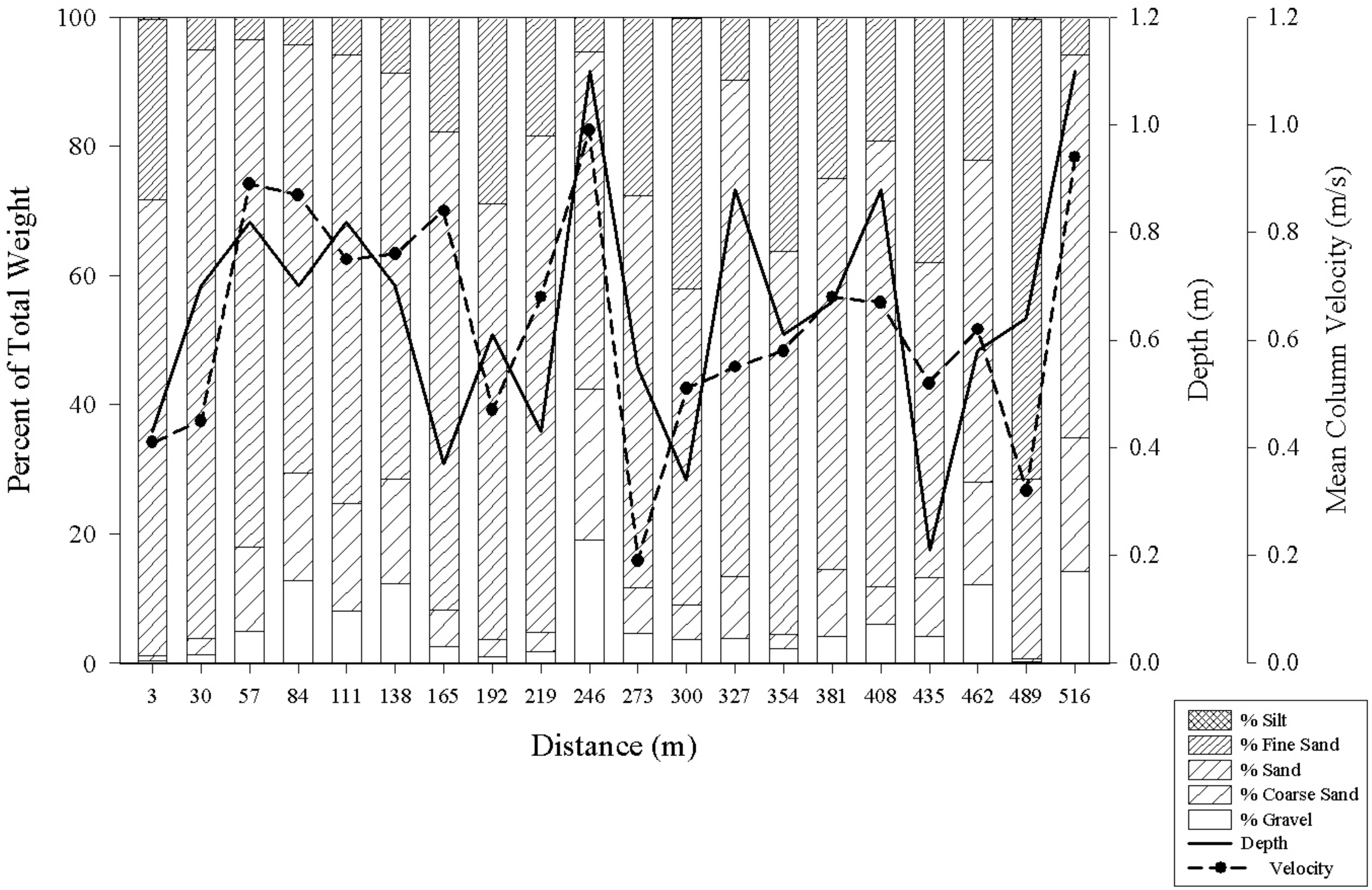

Figure 73. Percent substrate composition (Silt, Fine Sand, Sand, Coarse Sand, Gravel) from core samples, depth and mean column velocities measured along a transect across the Platte River near Nebraska State Highway 50 Bridge March 17, 2004.

Table 32. Average percent by weight for fractions of core samples retained by number 10, 18, 60, and 230 sieves, and the fraction passing through the number 230 sieve (<230) collected from the Elkhorn River at Waterloo, Salt Creek at Greenwood, and the Platte River at North Bend, Leshara, the US Highway 6 Bridge, and Louisville, Nebraska during the summer and fall of 2003 and the spring of 2004.

Location and screen mesh size	Summer 2003	Fall 2003	Spring 2004	Mean
Elkhorn River at Waterloo, NE				
10 mesh	2.754	2.795	2.239	2.596
18 mesh	2.366	3.196	3.425	3.329
60 mesh	54.359	57.768	62.018	58.048
230 mesh	39.310	35.897	30.024	35.077
<230 mesh	0.211	0.345	2.292	0.949
Salt Creek at Greenwood, NE				
10 mesh	6.408	1.748	2.851	3.669
18 mesh	9.127	6.485	7.006	7.539
60 mesh	76.633	68.338	79.901	74.957
230 mesh	7.815	12.132	5.833	8.593
<230 mesh	3.015	11.301	4.410	6.242
Platte River at North Bend, NE				
10 mesh	5.761	6.450	7.633	6.615
18 mesh	8.345	8.447	6.439	7.744
60 mesh	62.106	62.254	58.755	61.038
230 mesh	22.355	22.105	26.070	23.510
<230 mesh	1.431	0.744	1.103	1.093
Platte River at Leshara, NE				
10 mesh	4.813	6.835	4.127	5.258
18 mesh	6.492	8.310	5.885	6.896
60 mesh	49.180	55.974	56.988	54.047
230 mesh	36.464	26.347	30.454	31.088
<230 mesh	3.050	2.532	2.544	2.709
Platte River at US Highway 6				
10 mesh	5.177	4.963	6.665	5.602
18 mesh	6.932	7.466	9.603	8.000
60 mesh	63.772	60.515	59.649	61.312
230 mesh	22.430	25.209	21.797	23.145
<230 mesh	1.689	1.848	2.287	1.941
Platte River at Louisville, NE				
10 mesh	8.598	10.929	5.943	8.490
18 mesh	9.846	12.093	9.347	10.429
60 mesh	62.533	61.533	63.578	62.548
230 mesh	18.892	15.407	21.067	18.455
<230 mesh	0.131	0.036	0.065	0.077

AMBIENT RIVER HABITAT DISCUSSION:

Other sources of information on the chemical constituents in the water of the Platte River include the annual publications of the USGS (Water Resources Data – Nebraska such as Hitch et al. (2003). Of particular note to this study are the surface-water stations on the Platte River at North Bend (06796000), the Platte River near Leshara (06796500), the Elkhorn River at Waterloo (06800500), the Platte River near Ashland (06801000), Salt Creek at Greenwood (06803555) and the Platte River at Louisville (06805500). The stations on the Platte River near Leshara and Salt Creek at Greenwood only measure discharge. The stations on the Elkhorn River at Waterloo and the Platte River at Louisville measure discharge and, in the 2002 water year, both sites also sampled chemistry, temperature and suspended solids as part of their regular operations on a monthly basis from October through March and twice monthly April through September.

The Louisville station sampled specific conductance, water temperature and suspended sediment concentrations on a daily basis from November 1974 to September 1981. During this time period specific conductance readings varied from a low of 254µS/cm to a high of 3,450µS/cm. Our records at Louisville were well within this range. The high temperature recorded by USGS at Louisville was 36°C on 24 July 1977(Hitch et al. 2003). Our daily temperature records are 38°C on 31 August and 1 September 2003. Suspended solids concentrations measured by USGS at Louisville ranged from 60 mg/L to 11,600 mg/L. Our highest suspended solids measurement was less than 3,800 mg/L during June 2004.

During the 2002 water year, USGS measured turbidity at the Louisville station ranging from 24 to 2,200 NTU, while our values for the same time period ranged from <50 to just over 1,000 NTU. Dissolved oxygen measurements by USGS ranged from 5.5 to 14.0 mg/L while ours ranged from 7.0 to 17.0 mg/L. The highest temperature reading recorded by USGS at Louisville during 2002 was 27.0°C on 27 July and our high was 31°C on 10 July. Specific conductance values measured by USGS at Louisville ranged from 410 to 1,990 µS/cm, while our values ranged from 400 to1,200 µS/cm. Suspended solids concentrations measured by USGS ranged from 31 to 1,940 mg/L, while our measurements ranged from 17 to about 1,372 mg/L.

The Elkhorn River at Waterloo was sampled for a similar suite of water quality parameters during the 2002 water year. The highest water temperature measured by USGS at this station was 28°C on 10 July and our highest for this time period was 32°C on 20 July. Dissolved oxygen concentrations measured by USGS at Waterloo ranged from 1.5 to 14.3 mg/L, while our measurements ranged from 6.8 to 19.0 mg/L. Specific conductance measurements by USGS ranged from 286 to 668µS/cm, while ours ranged from 420 to 720µS/cm. Suspended solids measured by USGS ranged from 45 to 6,910 mg/L, while our measurements ranged from 16 to 1,808 mg/L for the same time period. Turbidity measurements by USGS ranged from 20 to 3,500 NTU, while our measurements ranged from 16.2 to 1,412 NTU.

Other accounts of water quality in the lower Platte River include Peters et al. (1989) who measured water temperature, dissolved oxygen, specific conductance and suspended solids while collecting data on fish and invertebrate habitat use in the reach of the lower Platte from Rogers to Fremont, Nebraska in 1986 and 1987. They measured water temperatures up to 32 °C during both years. Dissolved oxygen concentrations that they measured ranged from 2 to 14 mg/L. Specific conductance values in this reach of the Platte River ranged from 200 to 890µS/cm. However, in a related study (Holland and Peters 1989), they found a gradient in conductivity values from north to south across the Platte River. Typical conductivity values on the north were 315µS/cm and 550µS/cm on the south. They concluded that low conductivity water from the Loup River and Loup Power Canal were the source of low conductivity (283µS/cm) water that did not mix evenly with the higher conductivity water from the Platte River (922µS/cm) for up to 32 km downstream. A similar gradient may be established downstream from the confluence of Salt Creek with the Platte River near Ashland, but the volume of Salt Creek is considerably smaller than the Loup River. Monthly mean suspended solids concentrations were less than 500mg/L in the Rogers to Fremont reach, but reached 5,563 mg/L on 1 July 1986. Maximum concentrations exceeded 3,000mg/L in June 1986 and in May 1987.

Fessell (1996) found that only three of 19 fish species that he tested from the Platte River had mean critical thermal maxima that exceeded 38^{o}C. These were the plains topminnow (*Fundulus sciadicus*), the plains killifish (*F. zebrinus*) and the western mosquitofish (*Gambusia affinis*). Species most closely related to sturgeon chub had mean critical thermal maxima of 35.2^{o}C for flathead chub, 35.5^{o}C for speckled chub, and 37.4^{o}C for silver chub.

Yu (1996) evaluated the relationships between several chemical and physical parameters and habitat use by fishes in the lower Platte River. His analysis encompassed sites in the lower Platte River at Columbus, Rogers, North Bend, and Louisville during 1992 and 1993. In addition, he summarized habitat conditions for sampling done in the vicinity of North Bend from 1987 to 1993. Although most of the measurements for this data set are from sites upstream from the areas sampled in our 2001-2004 study, the values for maximum temperature, specific conductance, total suspended solids and dissolved oxygen fit within the ranges we found at the Platte River site near Leshara.

The substrate composition among the sites along the lower Platte River from North Bend to Louisville is quite consistent. The only significant differences indicated through the pairwise comparisons were between the Louisville site and the Leshara site for the coarse sand and fine sand fractions. However, substrate composition at the Elkhorn River site and the Salt Creek site differed significantly from the four Platte River sites on at least one substrate fraction.

The lower Platte River is a diverse complex of habitats that support species adapted to living in variable environments. To survive and prosper here they must be able to accommodate wide changes in temperature while they feed and reproduce in turbid conditions with fluctuating water levels. By many standards it is a harsh environment, but most of the native species have evolved under these conditions and they are apparently disadvantaged when changes in water management results in cooler, clearer water that favors non-native species.

PLATTE RIVER CREEL SURVEY RESULTS AND DISCUSSION

A total of 247 anglers was surveyed during this study. In 2002, we surveyed 89 anglers over the course of 23 days, 11 days in April and 12 days in May. In 2003, we surveyed 81 anglers over 32 days, 16 each in April and May. And during 2004, we surveyed 77 anglers over 20 days, 10 each in April and May. All of these anglers were fishing from the shore. The majority of anglers were fishing at the Schilling WMA (199), followed by Schramm SRA (35) and then Louisville SRA (13). Generally the highest number of anglers counted was during the late afternoon and evening hours (1700 to 2000 hrs).

Those 247 anglers reported catching 84 shovelnose sturgeon during the 2002-2004 creel survey period. Of those, 72 were reported from Schilling WMA and 12 from Schramm SRA. Anglers at Schilling WMA reported keeping 34 of the 72 sturgeon (48.6% harvest rate) that they caught and those at Schramm SRA reported keeping only one sturgeon (8.3% harvest rate). Total shovelnose sturgeon catch by year was 26 in 2002, 18 during 2003 and 40 in 2004. Only during 2002 were more sturgeon caught during April than May (15 vs. 11). The next two most common species caught by anglers in our surveys were channel catfish (64) and freshwater drum (43). Those three species comprised over 88% of the 216 total fish reported in the creel.

Expanding the creel reports by month by year gives us an estimate of the total catch of sturgeon during the period surveyed. Table 33 summarizes the estimated number of shovelnose sturgeon, channel catfish, and freshwater drum caught by anglers during April and May 2002 to 2004. Based on the estimated total catch of 900 shovelnose sturgeon during this study and the overall estimated percent harvested of 43%, we estimate that 387 of these fish were harvested over the three year period.

The test of angler's ability to distinguish shovelnose from pallid sturgeon showed a marked difference between anglers fishing for sturgeon and those just fishing in the lower Platte River. Sturgeon anglers were able to correctly identify shovelnose and pallid sturgeon an average of 87% of the time while other anglers were able to correctly identify the species an average of 66% of the time. However, on a year by year basis the general anglers improved their correct response rate from 55% in 2002 to 64% in 2003, and 78% in 2004. In contrast, sturgeon angler responses were 86% in 2002, 86% in 2003, and 88% in 2004.

Our collections of sturgeon in the Platte River over the past four years (2000 to 2004) have captured 15 pallid sturgeon and 1,541 shovelnose sturgeon. This equals a less than 1% chance that any sturgeon caught is going to be a pallid sturgeon. The creel information indicates a probable catch of about 300 sturgeon per year by anglers in the lower Platte River. If their catch is approximately the same as ours, they may be capturing about 3 pallid sturgeon per year. The worst that anglers scored on the identification quiz was 55% correct and the best was 88%. Using these figures, the worst case scenario estimates that anglers in the Platte River may harvest two pallid sturgeon per year by mistake and the best case estimate is that they may harvest one. With the educational materials that we and the NGPC have distributed, it seems that most current anglers are aware of the importance of protecting pallid sturgeon.

Table 33. Estimated numbers of shovelnose sturgeon, channel catfish, and freshwater drum caught from the lower Platte River during April and May, 2002-2004.

YEAR	Shovelnose sturgeon		Channel catfish		Freshwater drum	
2002	April 164	May 112	April 164	May 52	April 228	May 2
2003	April 36	May 100	April 172	May 48	April 76	May 8
2004	April 216	May 272	April 84	May 100	April 60	May 60

RECOMMENDATIONS

The final objective of the Pallid Sturgeon / Sturgeon Chub Task Force in funding this research was to develop educational materials and management recommendations to facilitate appropriate recovery efforts for pallid sturgeon and sturgeon chub in the lower Platte River. At the time when this research was initiated there was a proposal to list the sturgeon chub as a federally endangered species. Subsequent to the initiation of this project, additional information about sturgeon chub populations resulted in the withdrawal of this listing proposal at the federal level, but sturgeon chub is still a state listed endangered species.

EDUCATIONAL MATERIALS AND PRESENTATIONS:

During the course of this project, we developed signs that were placed along the Platte River to inform anglers and others about the importance of being able to distinguish pallid from shovelnose sturgeon. In addition, we worked with NGPC biologists at the Ak-Sar-Ben Aquarium to develop brochures that informed anglers and others visiting the aquarium about the studies being done. These were handed to anglers that we met during the creel survey and other people that we met along the Platte River during our work. The quiz that we developed enabled us to inform people one on one about the project.

Besides these efforts, news releases from the University of Nebraska and newspaper stories in the Lincoln Journal-Star and the Omaha World-Herald afforded the project statewide attention. In electronic media, we obtained coverage via the Nebraskaland show on NETV and from interviews of Ed Peters after UNL Water Center seminar presentations.

Presentations by students and other investigators on this project have been given at local, state, regional, national and international meetings. Theses arising from this research are:

Kopf, S. M. 2003. Habitat use by chubs of the genera *Macrhybopsis* and *Platygobio* in the lower Platte River, Nebraska. M.S.

Shuman, D. A. 2003. The age, size distribution, condition, and diet of the shovelnose sturgeon in the lower Platte River, Nebraska. M.S.

Swigle, B. D. 2003. Movements and habitat use by shovelnose and pallid sturgeon in the lower Platte River, Nebraska. M. S.

Manuscripts are either in preparation or have been submitted by each of these students for publication in journals or symposia.

MANAGEMENT RECOMMENDATIONS:

The following ideas represent our considered opinions about how the management of the Platte River can foster the continued existence of pallid sturgeon and sturgeon chub and the ecosystem upon which they depend. These recommendations are based upon the results of this biological study and their implementation will require comprehensive balancing of the socio-economic and ecological context of the lower Platte River basin by the diverse interests within the basin.

It is apparent from the analysis in this report and other publications that no one collection gear is sufficient to sample all life stages of fish species including pallid sturgeon and sturgeon chub. In fact, it is increasingly apparent that one sampling gear will not perform equally in different bodies of water. This means that in order to document the benefit (or detriment) of any management action, future sampling in the Platte River will require a multi-gear approach, such as we have used.

1. We recommend using a combination of drifted trammel nets, trawls, and trotlines to monitor the long term trends in pallid sturgeon populations and habitat use. This monitoring should also be coordinated with ongoing efforts in the Missouri River, since it is also apparent that Platte River pallid sturgeon populations are continuous with those in the Missouri River system. To monitor the health of sturgeon chub populations trawl and seines would be the most effective gears.

Objective 1: Recommendations

The existence of this ecosystem depends upon a continuing reliable flow of water in the lower Platte River at a magnitude and timing of discharge that maintain the shifting sand bar habitat and scour channels that allow for production of food organisms, creation of suitable habitats, and enable movement of pallid sturgeon and sturgeon chub adults and fry.

2. We recommend the protection of deep and swift water habitats located within the natural shifting sandbar habitat mosaic found in the lower Platte River. In addition to the protection of this specific habitat, river discharges need to be maintained at a level sufficient to allow pallid sturgeon to move between these habitats, especially during the months of April, May, and June.

3. We recommend a continuation of telemetry efforts for pallid sturgeon in the lower Platte River. This seems to be a very prudent emphasis of continuing research. Any future studies in the Platte River should be coordinated with the efforts of USGS researchers that are using telemetry technology that allows depth and water temperature to be monitored during critical phases of the sturgeon's life cycle. Work in the Platte River could provide excellent opportunities to locate spawning sites for pallid sturgeon and then to monitor the fate of larval and juvenile life stages. It will also allow the evaluation of pallid sturgeon stocking programs as these fish develop into adults.

4. We recommend that studies be initiated to evaluate pallid sturgeon food habits in the lower Platte River to coincide with similar studies on the Missouri River. The habitats used by pallid sturgeon are also used by other fish species, especially speckled chub, which other studies indicate they depend upon for food. Now that gastric lavage

and colonic flushing are available as tools for evaluating food consumption by sturgeons in general, and pallid sturgeon in particular, the significance of this observation can be evaluated. This could lead to studies to determine potential energy budgets in different river habitats. If the appropriate food for pallid sturgeon in the Missouri River system is in limited supply, then such studies may aid in understanding the importance of the lower Platte River to the recovery of pallid sturgeon.

Objective 2: Recommendations

5. We recommend a continuation of larval and juvenile fish sampling in coordination with the ongoing efforts on the Missouri River. Because the *Scaphirhynchus* larvae we captured every year during this study were less than one day old we know that sturgeon spawning is taking place in the Platte River at least as far upstream as the US highway 6 bridge. Yet to be answered is the question of how important the Platte River is to the overall recovery of the pallid sturgeon.

Objective 3: Recommendations

6. We recommend that water discharges from a variety of sources, especially those related to municipal water treatment facilities, be studied to evaluate their effects on pallid sturgeon populations and life histories. Overall the water quality appeared to be relatively good in the lower Platte River during this study. However, in 2004 we observed an apparent reaction of pallid sturgeon to a treated water discharge. What are the materials in the discharge that could cause the pallid sturgeon's reaction and how can future events be avoided?

7. We recommend development of a comprehensive hydrologic and geomorphologic study to determine how management of the Platte River discharges influence pallid sturgeon and sturgeon chub. We think that this study should address discharges needed to maintain the braided channel habitat and the impacts of anthropogenic fluctuations in discharge and proposed depletions in discharge from additional water withdrawals on the reproduction, recruitment, and growth of fishes and invertebrates in the lower Platte River.

Objective 4: Recommendations

8. We recommend that State and Federal officials employ a combination of coordinated educational and legal approaches to ensure that anglers can accurately identify pallid sturgeon to avoid unintentional take and minimize angling threats to this species.

9. We further recommend that angling regulations be reviewed to evaluate ways to protect pallid sturgeon populations.

OVERALL RECOMMENDATIONS:

The lower Platte River is one of the last shifting sandbar rivers characteristic of the Great Plains. The lower Platte River is also the only shifting sandbar river that is connected to a free flowing section of the Missouri River. As a result, the lower Platte

River under present conditions retains a relatively intact native biota making it a unique but stressed ecosystem. We recommend protection for and enhancement of existing habitats in the Platte River ecosystem by carefully evaluating any changes in management that may alter discharge, sediment supply, and the mosaic of instream habitats. We think that this management is critical to the recovery of pallid sturgeon and sturgeon chub as part of the overall Platte River ecosystem. This can ensure that other members of the Platte River biota do not become imperiled.

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COMMENTS ON THE FINAL PS/SC STUDY REPORT

Nebraska Public Power District
On page 13 the term “lower Platte River” is used to describe the Platte River from the confluence of the Loup and Platte Rivers (near Columbus, NE) to the Missouri River (approximately 103 river miles). We acknowledge the author’s discretion to apply this naming convention, however, when describing pallid sturgeon and sturgeon chub sampling, habitat parameters, ambient river conditions, creel survey areas, etc. a variety of different river reaches of varying lengths are described, yet the same “lower Platte River” term is applied throughout the report. It is correct that some or all of these activities/descriptions occurred at some areas below the confluence of the Loup and Platte Rivers. Of most interest though is the fact that all pallid sturgeon and sturgeon chub sampled in the Platte River as a direct result of the Task Force efforts, occurred below the mouth of the Elkhorn River (located at River Mile 33), not the entire 103 miles of river below the confluence of the Loup and Platte Rivers. This intensive 5-year study appears to support angling records which show that pallid sturgeon do on occasion move out of the Missouri River and use the lower 33 miles of the Platte River for brief periods of time. Despite the fact that pallid sturgeon and sturgeon chub were not sampled above the Elkhorn River the authors make certain recommendations which apply to the “lower Platte River” up to the Loup and Platte River confluence. We believe such recommendations are not supported by the data.

The authors indicate that the lower Platte River is one of the remaining remnants of a braided river connected to the main stem Missouri River and as such, may play a role in pallid sturgeon reproduction. While the data collected during this study indicate fish can be found in the spring of the year in the Missouri River, at the mouth of the Platte, this 5-year study does not substantiate pallid sturgeon spawn in the Platte River. During the course of this study, no Platte River tagged pallid sturgeon that left the Platte for the Missouri River returned to the Platte River. We believe that the data shows a small amount of use, but believe additional sampling is needed to determine if reaches of the Platte River below the mouth of the Elkhorn play any significant role (or ever did) in the life cycle of the pallid sturgeon.

From 1994-2004, 68,815 pallid sturgeon were stocked in Priority Management Area (PMA) 4 of the Missouri River. Six of the 68,815 stocked fish stocked in the Missouri River were sampled in the Platte River during the Task Force study effort. This report makes two conclusions, the first being that pallid sturgeon stocked in the Missouri River are surviving and growing and do travel up tributary rivers. Second, the capture of 6 pallid sturgeon that were stocked into the Missouri River suggest that conditions in the Platte River are attractive to stocked pallid sturgeon. Based on the small sample size (6 stocked fish sampled in the Platte River v. 68,815 fish stocked in the Missouri River) and based on the location where the fish were sampled in the Platte River, it is not clear how or to what extent stocked fish find Platte River conditions attractive. Additional sampling is needed to determine the validity of the second conclusion.

Papio-Missouri River NRD and Lower Platte North NRD
The Papio-Missouri River NRD concurs with the comments submitted by the Nebraska Public Power District that are included in this section of the Final Report, and wishes to add the following.

The "Management Recommendations" shown on pages 152-154 of the final report contain some rather broad statements that may be interpreted differently by different readers. Recommendations 2, 7, and "overall" are of particular concern. Therefore, we offer the following comments:

1. Recommendation #2 talks about protecting "deep and swift water habitats" and also maintaining river discharges to allow pallid sturgeon to move between different habitats. This recommendation implies that any change in deep and swift water habitat and the connectivity between habitats would be detrimental to the pallid sturgeon. Based on information collected as part of this study, no clear patterns of microhabitat use or habitat preference were documented, nor were movement patterns between specific habitat types identified. Based on historic discharge data, it is apparent that the current hydrologic regime is sufficient to support pallid sturgeon and sturgeon chub as they occasionally use the Platte River below the confluence of the Elkhorn River. We believe this issue needs to be studied further to better determine the characteristics and extent of these habitats.

2. Recommendation #7 promotes a comprehensive hydrologic and geomorphologic study to determine how management of Platte River discharge influences the pallid sturgeon and sturgeon chub. We believe this study needs to be coordinated with the study called for above to determine minimum levels needed by the species.

3. The Overall Recommendation includes the statement, "…protection for and enhancement of existing habitats in the Platte River ecosystem by carefully evaluating any changes in management that may alter discharge, sediment supply, and the mosaic of instream habitats." This very broad statement implies that any change in the river will be detrimental to these species. We believe that additional studies are needed to determine the various parameters, their magnitude, and the effects each has on the Platte River ecosystem before a statement that "any" change may be detrimental to the species.

Lower Elkhorn NRD
After review and some discussion, the Lower Elkhorn NRD has decided to support the comments made in the July 14, 2006 memo proposed by original submitted by NPPD and supported by Papio and Lower Platte North NRD.

Nebraska Game & Parks Commission
The staff of the Nebraska Game and Parks Commission (NGPC) acknowledges the Report of the Pallid Sturgeon/Sturgeon Chub Task Force as a component of a much larger research study effort commissioned by NGPC and conducted by Dr. Ed Peters entitled "The Ecology and Management of Sturgeon in the Lower Platte River". The NGPC will publish a peer reviewed Technical Series report based on all of the research data, findings and conclusions from Dr. Peter's total work. Thus, the Technical Series report will represent a more complete and comprehensive report. Future biological determinations and fisheries management actions on the lower Platte River by NGPC will be based in part, on the Technical Series report. NGPC appreciates the Task Force funding contributions supporting expanded research efforts that broadened the knowledge of pallid sturgeon and sturgeon chub in the lower Platte River.

Upper Elkhorn NRD
The Upper Elkhorn NRD concurs with the comments submitted by the Nebraska Public Power District and the Papio-Missouri River NRD on the Final Report. The Upper Elkhorn NRD is looking forward to seeing other comments that may have been overlooked by the UENRD. Upon reviewing those comments the District may be submitting support to those items that are upon agreement.

Central Platte NRD
Central Platte NRD concurs with the comments submitted by Nebraska Public Power District and Papio-Missouri River NRD concerning the final Task Force Report. Further, we find the comments submitted by the Nebraska Game and Parks Commission (NGPC) staff to be both perplexing and disconcerting. The Task Force study and Report were undertaken in the spirit of cooperation and were intended to bring about consensus on important issues. The NGPC encouraged the Interlocal Cooperative Agreement that established the Task Force and funding for Dr. Peter's study, helped direct the efforts of the Task Force, helped refine the study plan, and helped coordinate the independent peer review of this final Task Force Report. Now, at the conclusion of this effort, the NGPC staff comments appear to discount the purpose and content of the Task Force Report. Central Platte NRD remains committed to the spirit of cooperation behind the Task Force Report and hopes all other participants share that commitment.

Loup Power District
After review, Loup River Public Power District supports comments made by the Nebraska Public Power District, and concur with the Papio-Missouri River NRD that the final report contains some rather broad statements that may be interpreted differently by different readers, as outlined in their comments.