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The Nebraska Stream Fishery Surveys: Being a Comparison of the First Statewide Collections of Raymond Johnson (1939-1941) with a Recent Resurvey (2003-2005)

Steven C. Schainost
Nebraska Game and Parks Commission, Alliance, NE, steve.schainost@nebraska.gov

Edward J. Peters

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By

Steven C. Schainost

and

Dr. Edward J. Peters

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INTRODUCTION

The Great Plains extend from Canada south to Texas and from the Missouri River west to the Rocky Mountains. Within this semi-arid region water and flowing streams have always been valuable. European immigrants looked on water as a resource to be harnessed and exploited. First with irrigation diversions then followed by dams and extensive canal systems and, most recently, groundwater pumping. The land itself was heavily modified in the course of converting native prairie to agriculture. The result has been altered flow regimes, increased siltation and pollution as well as physical alterations like stream channelization and damming. These have all had impacts on the fishes and other aquatic animals that live in streams.

So, why do we sample streams and stream fishes? Sampling streams is our method of assessing the health of a stream and it's watershed as well as tracking changes in the fish community over time. Samples collected today may be compared to similar samples collected historically. Have species disappeared? Have new species appeared? Is a once-common species now rare or, conversely, a once-rare species now common? A true "historical" sample; one that was collected before European settlement would be most useful. However, none exist so we use the oldest statewide stream sampling data that we have. For Nebraska , these data are the 1939-41 survey of Raymond Johnson. [Two surveys done in the early 1890's provide some interesting data but they covered only a small portion of the state (Evermann and Cox 1894, Meek 1894).]

OVERVIEW OF NEBRASKA

The State of Nebraska covers 77,227mi^2 and lies in the center of the United States between 95^o and 103^o West Longitude and 40^o and 43^o North Latitude. It slopes from just over 5,000 feet above sea level in the west to about 880 feet in the southeast corner. Precipitation ranges from about 14 inches in the northwest to over 35 inches in the southeast. The growing season, expressed as number of frost free days, ranges from just over 100 days in the northwest to over 180 days in the southeast. Current land use in Nebraska is 51% rangeland and pasture, 41% cultivated cropland, 2% woodlands, 5% developed land (urban, sub-urban, industrial, etc.) and <1% water surface (Nebraska Department of Natural Resources).

Most of Nebraska was covered by grasslands at the time of original European settlement and supported large numbers of bison, wapiti and other grazing species. Riparian areas along rivers and streams supported cottonwood, willow, and red cedar across much of Nebraska. The eastern portion of the State supports several eastern deciduous forest species as far west as the Little Blue River basin.

Most of Nebraska lies within four primary (Level III) ecoregions (Chapman et al. 2001). The western panhandle region and southwestern part of Nebraska are in the Western High Plains ecoregion (Figure 1). This arid to semiarid area was originally covered with short to mixed grass prairie. Today, this area supports extensive areas of winter wheat agriculture. The south-central portion of Nebraska lies in the Central Great Plains ecoregion and the north-central portion of the state lies in the Nebraska Sand Hills ecoregion. Both of these were characterized by mixed grass prairies. Most of the Sand Hills ecoregion region remains in grassland for grazing animals, while the Central Great Plains ecoregion supports extensive areas of irrigated corn and soybean agriculture. Much of eastern Nebraska is in the Western Corn Belt Plains ecoregion which, before European settlement, was dominated by tall grass prairie but is now over 90% row crop agriculture.

In addition, the extreme northwestern corner of Nebraska and a small portion of north central Nebraska north of the Niobrara River, comprise specific portions of the Northwestern Great Plains ecoregion. The extreme northeastern portion of Nebraska lies in the Northwestern Glaciated Plains ecoregion (Figure 1).

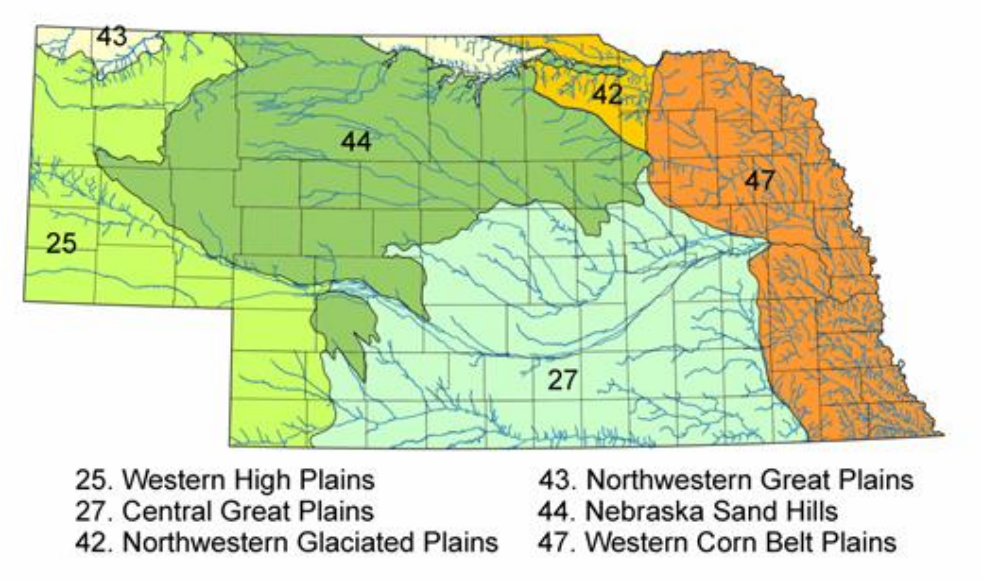


Figure 1. State of Nebraska with Level III ecoregions highlighted.

Figure 2 shows that the rivers of Nebraska flow generally from west to east following the slope from the Rocky Mountains in the west to the Missouri River in the east. Detailed summaries of the river basins are found in Appendix I. The information used in these summaries was gleaned from US Geological Survey Water Resources Data reports, Nebraska Department of Environmental Quality Water Quality Reports, Chapman et al. (2001), and Bentall (1999).

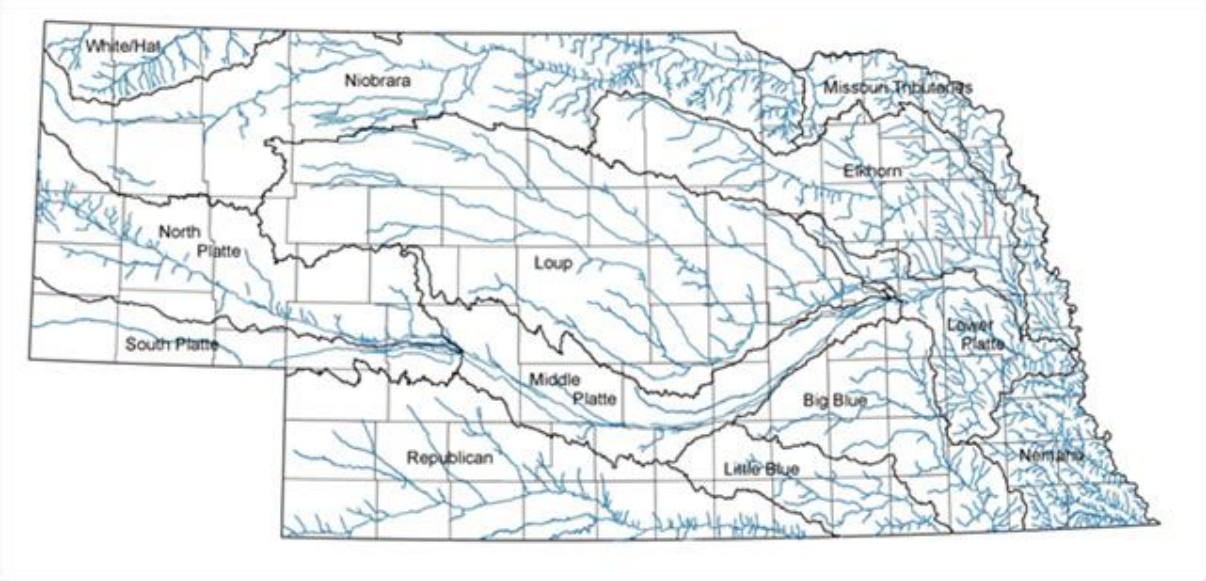


Figure 2. Map of Nebraska illustrating the 13 river basins and the stream drainages with those basins.

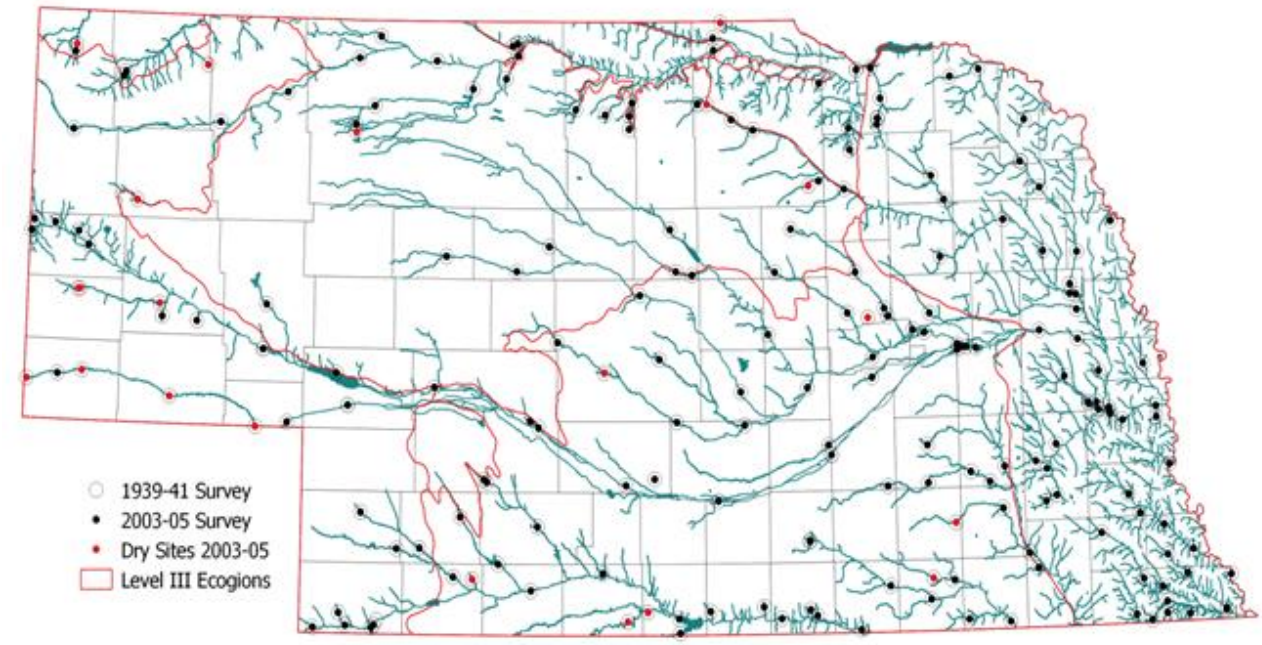


Figure 3. Fish collection sites from 1939-41 stream fishery survey revisited during the 2003-05 survey. Note that 22 of the 1939-41 sites were dry in the 2003-05 survey.

The 1939-41 Stream Survey – Raymond Johnson:

The first comprehensive state-wide survey of Nebraska's fishes was conducted by Raymond E. Johnson between 1939 and 1941 (Figure 3). Born in Peru, Nebraska, on 26 October 1914, in 1939 he was a graduate student at the University of Michigan and conducted the survey for his PhD thesis, "The Distribution of Nebraska Fishes" completed in 1942. His thesis was never published outside of the original copy in the library of the University of Michigan. In 1997, Dr. Johnson loaned his original field notebook to me (SCS) and I took the opportunity to scan the pages before returning it to him. Subsequently, he also loaned an album of the photographs that he took during the three summers of his survey to the Fisheries Division of the Nebraska Game and Parks Commission which were digitized.

The field notes record that he had one assistant during each of the three summers of work. During 1939, Raymond Johnson and Russell Wallace sampled some 149 sites. In 1940, he and Paul Romberg did 99 sites while in 1941, B.B. Johnson helped with a final 21 sites.

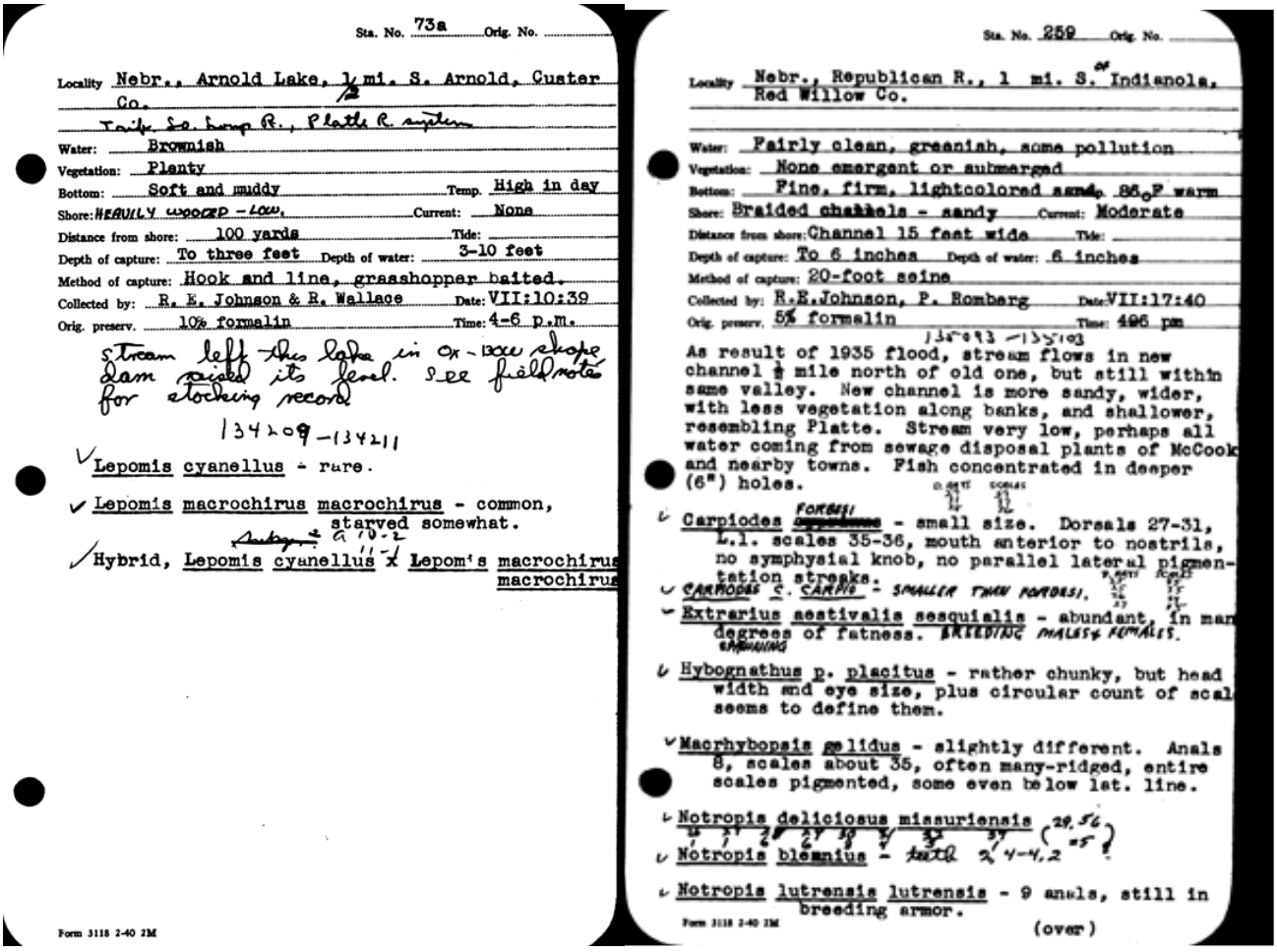
The 1939-41 Stream Survey - The Field Notes:

In his stream fishery survey of 1939-41, Raymond Johnson must have recorded his notes in a field notebook which he later typed up onto University forms. A sampling of two field data sheets is shown in Figure 4. One record is for Station 73a, Arnold Lake, ½ mi. S. Arnold, Custer Co. for VII:10:39. The second is for Station 259, Republican River, 1 mi. S. Indianola, Red Willow Co. The date of the sample is VII:17:40 or 17 July 1940. In the lower left we see that these were "Form 3118 2-40 2M". The "2-40" suggests that the forms were printed in February 1940. This is supported by noting that,

interspersed in the notebook, there are a small number of the same forms which are marked "Form 3118 7-38 2M". This suggests that these forms were printed in July 1938 and that this was a standard form used by the museum (and printed in lots of 2,000?).

As noted above, Raymond Johnson and his team members took quite a few photographs during their summer surveys. Among these is a single photo titled "Russell typing in city park, Chadron. August 3, 1939". It shows Russell Wallace sitting on a park bench with a portable typewriter in his lap with some papers spread out beside him. Our assumption is that he is typing their hand-written field notes onto the museum's forms. Please note also that there is a handwritten notation for Station 73a that says to "See field notes for stocking record" which confirms that there was a field notebook that was later typed onto the standard museum form. The fate of the field notebook is unknown so we must depend on the typed data sheets for the clues they can provide as to the field techniques used.

Recorded on these field notes is the "Method of Capture". Table 1 shows a tally of their equipment as Raymond Johnson recorded them. It shows a variety of seines used over the three field seasons. While a seine does not take up a lot of space, this is still a lot of seines for a two-person team whose



Sta. No. 73a Orig. No.

Locality Nebr., Arnold Lake, ½ mi. S. Arnold, Custer Co.
Trib. to Loup R., Platte R. system
Water: Brownish
Vegetation: Plenty
Bottom: Soft and muddy Temp. High in day
Shore: HEAVILY WOODED - LOW. Current: None
Distance from shore: 100 yards Tide:
Depth of capture: To three feet Depth of water: 3-10 feet
Method of capture: Hook and line, grasshopper baited.
Collected by: R. E. Johnson & R. Wallace Date: VII:10:39
Orig. preserv. 10% formalin Time: 4-6 p.m.

Stream left this lake in ox-bow above dam raised its level. See field note for stocking record

13420 9 - 13421 1

✓ Lepomis cyanellus - rare.

✓ Lepomis macrochirus macrochirus - common, starved somewhat.

✓ Hybrid, Lepomis cyanellus ♀ x Lepomis macrochirus ♂ macrochirus

Form 3118 2-40 2M

Sta. No. 259 Orig. No.

Locality Nebr., Republican R., 1 mi. S. of Indianola, Red Willow Co.

Water: Fairly clean, greenish, some pollution
Vegetation: None emergent or submerged
Bottom: Fine, firm, lightcolored sand, 86°F warm
Shore: Braided chahhels - sandy Current: Moderate
Distance from shore: Channel 15 feet wide Tide:
Depth of capture: To 6 inches Depth of water: 6 inches
Method of capture: 20-foot seine
Collected by: R.E.Johnson, P. Romberg Date: VII:17:40
Orig. preserv. 5% formalin Time: 496 pm

13499 - 13503

As result of 1935 flood, stream flows in new channel ½ mile north of old one, but still within same valley. New channel is more sandy, wider, with less vegetation along banks, and shallower, resembling Platte. Stream very low, perhaps all water coming from sewage disposal plants of McCook and nearby towns. Fish concentrated in deeper (6") holes.

✓ Carpiodes forbesi - small size. Dorsals 27-31, L.l. scales 35-36, mouth anterior to nostrils, no symphysial knob, no parallel lateral pigmentation streaks.

✓ Carpiodes c. carpio - smaller than forbesi.

✓ Extrarius aestivalis aestivalis - abundant, in many degrees of fatness. Breeding males & females.

✓ Hybognathus p. placitus - rather chunky, but head width and eye size, plus circular count of scales seems to define them.

✓ Macrhybopsis gelidus - slightly different. Anals 8, scales about 35, often many-ridged, entire scales pigmented, some even below lat. line.

✓ Notropis deliciosus missuriensis

✓ Notropis blennius - teeth 2, 4-4, 2

✓ Notropis lutrensis lutrensis - 9 anals, still in breeding armor.

Form 3118 2-40 2M (over)

Figure 4. Examples of the field data sheets used by Raymond Johnson during his 1939-41 survey of Nebraska fishes.

entire set of equipment fit into a single two-door coupe (along with all their personal gear and camping equipment). It is probable that the "Seine", "Small seine", and "Large seine" refer to one of the "_x_ foot" seines listed in the table. It is also possible that the "25 foot seine" and the "25 foot bag seine" were the same seine. His survey did include the sampling of several lakes, pits and ponds where he states that the 50 foot seine and the hook and line were used. In two instances a site was impossible to seine due to debris and it was in these that he resorted to rotenone. The main point is that, with few exceptions, his fish collections were done with a seine.

He seldom recorded any numbers collected unless only one or two fish were found. Otherwise, he used terms like "abundant", "common", "very common", or "scarce". Did he ID in field and preserve a voucher sample? Probably. Did he preserve all fishes for later ID? Not likely. Subsequently, I (SCS) searched online museum catalogs and found much of his material in the University of Michigan Museum of Zoology plus a few in other museums. The museum records included the numbers of fish that had been preserved. Comparing these numbers with the notations in the Field Notes, it appears that they did a lot of their identifications in the field. Later, after his return to the museum, the specimens were re-examined as here we can see handwritten notations as to the museum catalog numbers and on counts of fin rays, scales, pharyngeal teeth, etc. So it appears that the numbers subsequently entered into the current database are probably incomplete and the numbers of fish actually collected in the 1939-1941 survey were greater than what can be found after tallying those in museum records and on the field notes. In contrast, the actual numbers collected in the 2003-05 survey were recorded and entered into the database. Any comparisons of numbers collected between the two surveys have to keep this disparity in mind.

50 foot seine	2
30 foot seine	3
25 foot bag seine	29
25 foot seine	14
20 foot seine	57
15 foot seine	1
10 foot seine	20
6 foot seine	28
Small seine	30
Large seine	11
Seine	52
Dip net	5
Hook and line	5
Rotenone	2

Table 1. Fish collection gears recorded on field data sheets of 1939-41 stream fishery survey.

The 2003-05 Stream Survey – fish collection methods:

One of the dilemmas of those who desire to replicate a historical fishery survey are concerns with differences in the collection methods. For instance, in this case, the 1939-41 survey was done with seines whereas the 2003-05 survey relied on electrofishing. Smith et.al. (2014) addressed this point and noted that other studies have found that, in spite of differences in methods, the same fish communities were sampled. The fish collection methods shown here were taken directly from the final report for the 2003-05 survey. This detailed desc ription of the methods is included for the benefit future workers who may wish to repeat the survey.

So, a second issue is that of 1) actually locating the original sample locations, 2) whether to sample <u>all</u> sites and 3) obtaining landowner permission to sample. In the original survey, a number of oxbow lakes, ponds, pits and reservoirs were sampled. Some of these no longer exist while others could not be found. Many of the remainder have been stocked

with fishes or otherwise undergone changes such that a comparison survey would be meaningless. All of these were deleted from consideration. The original survey included sampling of the Missouri River. While the results of this sampling are very interesting, the Missouri River has been subjected to physical alteration to the point that we see now is not the same river that was sampled in 1939-41. Additionally, a separate section of the Fisheries Division of the Nebraska Game and Parks Commission is dedicated solely to sampling and monitoring changes in the Missouri River's fish communities. Therefore the Missouri River sites were deleted from consideration. A small number of the original sites either could not be located or permission to sample was denied. Finally, several of the original sample sites were dry during the 2003-05 survey.

The original sample sites were sequentially numbered so getting a count of the original sites sampled in 1939-41 should have been easy. But there were complications. Raymond Johnson resampled a few sites several times, giving each sample a new number. He sampled some streams several times then combined the results into a single site number. He deliberately or accidentally did not number some sites. And, a couple of times, he sampled successive sites but gave them the same number, differentiating them with an "A" or "B". The final count was 270 total sites of which 43 were lakes, seven were Missouri River, 22 were dry and six were not done for various reasons. That leaves 192 of the 1939-41 sites which were sampled in 2003-05.

Fish Collection

A typical site sampling crew consisted of three members, but more were required to sample larger river stations. Fish were collected, identified, enumerated, and examined for external anomalies. The backpack electroshocker was the preferred sampling gear in wadeable streams. When water depths exceeded a wadeable depth, a boat and barge type of electroshocking equipment along with other nets, was employed.

The following protocol was followed at each sampling site:

1. Nobody enters the stream (unless performing stream width measurements) until the sample area is identified and marked, and upper and lower block nets are in place. The downstream block net is set first. The upstream block net is set last or at the same time as the lower block net. The persons setting the block nets should walk overland to the locations were the net is to be set.
2. The fisheries team may begin work when the block nets are in place. Electroshocking will begin at the downstream end of the reach and continue upstream, parallel to the current to the end point, which was previously identified. Sweep the electrodes from side to side in the water sampling all available habitat areas with special attention to under-cut banks, snag areas, as well as pools and riffles.
3. Adjust voltage and wave form output according to sampling effectiveness and incidental mortality to specimens. In case of an overload, release the anode switch and adjust voltage and waveform and continue fishing.
4. Netters follow along beside or slightly behind person operating electroshocker and net stunned fish which are then transferred into separate buckets or handling tanks. Minnow seines, blocknets, and kicknets may be used to block in riffles, pools and snags.
5. If fish begin to show signs of stress, stop at intervals and work up catch. Be sure to release fish downstream of block nets to reduce likelihood of resampling. This should only be necessary on extremely warm days, in long reaches or if very large numbers of fish are captured.

Once electrofishing was complete crew members recorded electrofishing time to the nearest half minute (approximately 0.01 hr). Total area of stream sampled was recorded. This should be approximately equal to the wetted mean width times

the length of the reach. An estimate of the percentage of sample site electrofished was also recorded. Percentage of sample site wadeable was also documented.

All fish captured for this study fell into two categories "EZ" and "ID" fish. EZ fish are those which, based upon their large size and/or easily recognized characteristics, can be confidently identified in the field. ID fish are those, which due to their small size and/or indistinguishable characteristics, cannot be easily and confidently identified to species level in the field. Fish for identification were placed into one-gallon jugs with 10% formalin for preservation and later identification. They were covered with preservative and did not occupy more than 50% of the container.

Species collected:

The results of the two stream surveys include species found, total number of sites where they were found and total numbers of fish collected. These data can give us information on the status of the fishes. Are the fishes holding their own or have they increased/decreased over the past 60 years? One thing we have to keep in mind is that fish surveys seldom collect 100% of the species living in the stream. Some species, the Sand Shiner for example, are often abundant and easy to collect in large numbers. Other species, such as the darters, are generally few in number and live on the stream bottom in areas with rocks or debris that make them difficult to collect. Still others, particularly the large-bodied strong swimmers, can avoid capture by leaving the area. And there are the rare species which can be missed because they are so scattered in distribution and few in number. Stream topography can complicate sampling. Small clear streams can be easy to sample effectively, especially with electroshockers, because the fish are easy to see. Large, fast, turbid streams are difficult to sample. Seines are hard to manage in fast, deep water. Electroshocking is less effective because you simply cannot see the fish. So, in a nutshell, we strive for a representative sample of what is there.

Now let us look at what the data tells us. To start, we can look at the species found and the number of sites where they were found. Table 2 is a list of all the species of fish that have been collected in Nebraska and contains five columns. First we can see not gaps in what these two surveys covered. The first three columns list the families, common names and scientific names of all species of fish that have been collected from Nebraska waters. These are followed by two columns listing those species that were collected in the two stream surveys. There were several species of fish that were not collected in the surveys. Some of these are “big river” fishes such as the lampreys, Paddlefish, Blue Sucker, American Eel or Skipjack Herring. The odds of finding these species in streams other than the Missouri River or Lower Platte River are negligible. Some species, while having been collected within the state in the years before 1900, were extirpated or nearly so by the time of the 1939-41 survey. These include the Hornyhead Chub, Blackside Darter and Lake Chub. There are a number of species such as the Silver Carp, Rudd, Brook Silverside and Lake Chubsucker that are not native to the state and were introduced after the 1939-41 survey. Then there are a few species such as the Bowfin that are apparently native to the state but are rarely seen.

The numbers in the final two columns are the number of sites where a species was collected during each survey. Comparing these two columns will give an indication as to whether a species has increased, decreased or stayed the same over the years. Sport fishes like Smallmouth/Largemouth bass and the trouts are routinely stocked so differences in how often they were found in these surveys are irrelevant.

Table 2. Species of fish that have been collected from Nebraska streams compared to collections during the stream surveys of 1939-1941 and 2003-2005. The numbers are the number of sites where the species was found. A blank cell indicates the species was not collected during the particular survey.

Family	Common name	*Scientific name*	1939-1941 Survey	2003-2005 Survey
Lampreys	Chestnut Lamprey	*Ichthyomyzon castaneus*		
	Silver Lamprey	*Ichthyomyzon unicuspis*		
Sturgeons	Lake Sturgeon	*Acipenser fulvescens*		
	Pallid Sturgeon	*Scaphirhynchus albus*		2
	Shovelnose Sturgeon	*Scaphirhynchus platorynchus*	3	4
Paddlefish	Paddlefish	*Polyodon spathula*		
Gars	Longnose Gar	*Lepisosteus osseus*		12
	Shortnose Gar	*Lepisosteus platostomus*	5	23
Bowfins	Bowfin	*Amia calva*		
Mooneyes	Goldeye	*Hiodon alosoides*	9	8
	Mooneye	*Hiodon tergisus*		
Eels	American Eel	*Anguilla rostrata*		
Herrings	Skipjack Herring	*Alosa chrysochloris*		
	Gizzard Shad	*Dorosoma cepedianum*		17
Minnows	Central Stoneroller	*Campostoma anomalum*	26	40
	Northern Redbelly Dace	*Chrosomus eos*	1	
	Finescale Dace	*Chrosomus neogaeus*	3	2
	Lake Chub	*Couesius plumbeus*		
	Red Shiner	*Cyprinella lutrensis*	121	137
	Spotfin Shiner	*Cyprinella spiloptera*		1

	Western Silvery Minnow	*Hybognathus argyritis*	23	8
	Brassy Minnow	*Hybognathus hankinsoni*	42	25
	Plains Minnow	*Hybognathus placitus*	58	38
	Common Shiner	*Luxilus cornutus*	6	
	Sturgeon Chub	*Macrhybopsis gelida*	6	
	Shoal Chub	*Macrhybopsis hyostoma*	15	13
	Sicklefin Chub	*Macrhybopsis meeki*		
	Silver Chub	*Macrhybopsis storeriana*	7	10
	Northern Pearl Dace	*Margariscus nachtreibi*	5	3
	Hornyhead Chub	*Nocomis biguttatus*		
	Golden Shiner	*Notemigonus crysoleucas*	8	3
	Emerald Shiner	*Notropis atherinoides*	14	28
	River Shiner	*Notropis blennius*	33	66
	Bigmouth Shiner	*Notropis dorsalis*	60	68
	Blacknose Shiner	*Notropis heterolepis*	1	
	Spottail Shiner	*Notropis hudsonius*		
	Silverband Shiner	*Notropis shumardi*		
	Sand Shiner	*Notropis stramineus*	137	156
	Topeka Shiner	*Notropis topeka*	3	
	Suckermouth Minnow	*Phenacobius mirabilis*	21	38
	Bluntnose Minnow	*Pimephales notatus*	1	8
	Fathead Minnow	*Pimephales promelas*	152	141
	Flathead Chub	*Platygobio gracilis*	53	28
	Longnose Dace	*Rhinichthys cataractae*	26	32
	Western Blacknose Dace	*Rhinichthys obtusus*	1	4
	Creek Chub	*Semotilus atromaculatus*	65	80

Old World Minnows	Goldfish	*Carassius auratus*	1	
	Grass Carp	*Ctenopharyngodon idella*		4
	Common Carp	*Cyprinus carpio*	36	98
	Bighead Carp	*Hypophthalmichthyes nobilis*		
	Silver Carp	*Hypophthamichthyes molitrix*		
	Rudd	*Scardineus erythophthalmus*		
Suckers	River Carpsucker	*Carpiodes carpio*	36	67
	Quillback	*Carpiodes cyprinus*	17	29
	Longnose Sucker	*Catostomus catostomus*	3	6
	White Sucker	*Catostomus commersonii*	45	70
	Mountain Sucker	*Catostomus platyrhynchus*	1	
	Blue Sucker	*Cycleptus elongatus*		
	Lake Chubsucker	*Erimyzon sucetta*		
	Smallmouth Buffalo	*Ictiobus bubalus*	1	
	Bigmouth Buffalo	*Ictiobus cyprinellus*	3	
	Black Buffalo	*Ictiobus niger*		
	Shorthead Redhorse	*Moxostoma macrolepidotum*	7	39
Catfishes	Black Bullhead	*Ameiurus melas*	58	39
	Yellow Bullhead	*Ameiurus natalis*	5	26
	Brown Bullhead	*Ameiurus nebulosus*		
	Blue Catfish	*Ictaluras furcatus*		1
	Channel Catfish	*Ictaluras punctatus*	38	86
	Stonecat	*Noturus flavus*	12	41
	Tadpole Madtom	*Noturus gyrinus*	7	3

	Flathead Catfish	*Pylodictus olivaris*	5	24
Pikes	Grass Pickerel	*Esox americanus*	3	10
	Northern Pike	*Esox lucius*		7
Trouts	Cutthroat Trout	*Oncorhynchus clarki*		
	Rainbow Trout	*Oncorhynchus mykiss*	6	6
	Brown Trout	*Salmo trutta*	2	8
	Brook Trout	*Salvelinus fontinalis*		
Cods	Burbot	*Lota lota*	1	
Silversides	Brook Silverside	*Labidesthes sicculus*		3
Killifishes	Plains Topminnow	*Fundulus sciadicus*	40	16
	Northern Plains Killifish	*Fundulus kansae*	35	30
Livebearers	Western Mosquitofish	*Gambusia affinis*		23
Sticklebacks	Brook Stickleback	*Culaea inconstans*	7	12
Temperate basses	White Perch	*Morone americana*		
	White Bass	*Morone chrysops*		
	Yellow Bass	*Morone mississippiensis*		
	Striped Bass	*Morone saxatilis*		
Sunfishes	Rock Bass	*Ambloplites rupestris*	2	3
	Sacramento Perch	*Archoplites interruptus*		
	Green Sunfish	*Lepomis cyanellus*	37	115
	Pumpkinseed	*Lepomis gibbosus*	1	6
	Orangespotted Sunfish	*Lepomis humilis*	14	7
	Bluegill	*Lepomis macrochirus*	12	53
	Redear Sunfish	*Lepomis microlophus*		

	Smallmouth Bass	*Micropterus dolomieu*		2
	Iargemouth Bass	*Micropterus salmoides*	12	39
	White Crappie	*Pomoxis annularis*	7	8
	Black Crappie	*Pomoxis nigromaculatus*	6	3
Perches	Iowa Darter	*Etheostoma exile*	8	8
	Johnny Darter	*Etheostoma nigrum*	3	15
	Orangethroat Darter	*Etheostoma spectabile*	8	19
	Yellow Perch	*Perca flavescens*	5	1
	Blackside Darter	*Percina maculata*		
	Sauger	*Sander canadensis*	2	
	Walleye	*Sander vitreus*	1	3
Drums	Freshwater Drum	*Aplodinotus grunniens*		22

Table 3 shows the total numbers of each species caught and recorded in the two surveys. As noted earlier, keep in mind that the numbers of fish collected in the 1939-41 survey may not represent all fish caught. Even so, some of the results are tell us that the abundance of several species have changed markedly in the years between the two surveys. In particular, at the bottom of the table are several species that are highlighted in yellow. If we assume that the numbers recorded for the 1939-41 survey may not be complete while those of the 2003-05 survey are accurate, then any declines in numbers must be taken seriously. Several species at this lower end of the table are represented by relatively few fish and any differences could be an accident of sampling. But when we see a change of 22 to 0 (Mountain Sucker), 82 to 32 (Orangespotted Sunfish) or 68 to 0 (Common Shiner), we have to consider that the decline is real.

Table 3. Species of fish collected showing the total number of each species collected in each stream survey and the right column shows the difference in the numbers. The rows were then sorted by the differences in the numbers found.

Species	1939-1941 Survey	2003-2005 Survey	Difference
Sand Shiner	5654	37216	31562
Red Shiner	2999	34512	31513
Bigmouth Shiner	1721	12197	10476
Fathead Minnow	3966	9416	5450
Creek Chub	843	3181	2338

Central Stoneroller	387	2452	2065
Longnose Dace	170	2233	2063
White Sucker	584	2585	2001
River Shiner	387	2355	1968
Green Sunfish	81	1696	1615
Channel Catfish	132	1271	1139
Northern Plains Killifish	1691	2639	948
Common Carp	151	1090	939
River Carpsucker	133	974	841
Western Mosquitofish	0	711	711
Bluntnose Minnow	11	668	657
Orangethroat Darter	46	696	650
Brook Stickleback	7	533	526
Suckermouth Minnow	150	675	525
Largemouth Bass	28	551	523
Bluegill	40	519	479
Black Bullhead	155	421	266
Longnose Sucker	11	263	252
Gizzard Shad	0	201	201
Shorthead Redhorse	8	190	182
Brown Trout	2	183	181
Emerald shiner	278	430	152
Johnny darter	3	130	127
Freshwater Drum	0	126	126
Yellow Bullhead	14	138	124
Stonecat	13	107	94
Western Blacknose Dace	10	76	66
Pumpkinseed	1	63	62
Iowa Darter	24	79	55
Quillback	72	125	53
Rainbow Trout	9	59	50
Longnose Gar	0	46	46
Grass Pickerel	9	53	44
Rock Bass	3	36	33
Pearl Dace	59	89	30
Silver Chub	12	36	24
Shortnose Gar	15	35	20
Shovelnose Sturgeon	4	24	20
Flathead Catfish	7	21	14
Northern Pike	0	14	14
Finescale Dace	11	24	13

Green Sunfish x Bluegill	0	13	13
White Crappie	12	18	6
Brook Silverside	0	4	4
Grass Carp	0	4	4
Goldeye	17	19	2
Pallid Sturgeon	0	2	2
Smallmouth Bass	0	2	2
Spotfin Shiner	0	2	2
Walleye	1	3	2
Blue Catfish	0	1	1
Burbot	1	0	-1
Creek Chub x Stoneroller	1	0	-1
Orangespotted x Green Sunfish	1	0	-1
Smallmouth Buffalo	1	0	-1
Sauger	2	0	-2
Bigmouth Buffalo	3	0	-3
Northern Redbelly Dace	3	0	-3
Topeka Shiner	4	0	-4
Goldfish	5	0	-5
Yellow Perch	7	2	-5
Blacknose Shiner	7	0	-7
Northern Redbelly x Finescale	10	0	-10
Tadpole Madtom	14	4	-10
Black Crappie	20	9	-11
Mountain Sucker	22	0	-22
Orangespotted Sunfish	82	32	-50
Common Shiner	68	0	-68
Golden Shiner	98	4	-94
Sturgeon Chub	107	0	-107
Shoal Chub	276	69	-207
Plains Topminnow	516	183	-333
Western Silvery Minnow	819	93	-726
Flathead Chub	962	217	-745
Brassy Minnow	1263	410	-853
Plains Minnow	1660	739	-921

Now let us see if we can figure out what these data are saying. Table 4 looks at these same data from Table 2 in a slightly different way. In this table you may note the total collections and rankings of each species in both surveys. Note that some species such as Largemouth Bass, Northern Pike and Bluegill are sport fishes that are commonly stocked in lakes and ponds. Therefore, their presence in tributary streams may be higher in the 2003-05 survey because of this.

This table shows that some species showed little change over the years. For instance, the Sand Shiner, Red Shiner and Fathead Minnow were the most commonly collected species in both surveys. Other species, such as Plains Minnow, Western Silvery Minnow and Flathead Chub, have declined in both frequency of occurrence and ranking. Two species, the White Sucker and Quillback, increased in frequency of occurrence but had the same ranking.

Table 4. Species of fish collected in the two surveys showing the number of sites where each was collected (frequency of occurrence). Next to that is a column showing the ranking of that species from most commonly collected to least common. The results for the 1939-41 survey were sorted from highest to lowest. [Species that were collected from the same number of sites got the same ranking]. In the adjacent columns are the results of the 2003-05 survey in the same order. Species that were collected in one survey but not in the other were left blank.

1939-41 Stream Survey	**Total sites**	**Rank**		**2003-05 Stream Survey**	**Total sites**	**Rank**
Fathead Minnow	**152**	**1**		**Fathead Minnow**	**141**	**2**
Sand Shiner	**137**	**2**		**Sand Shiner**	**156**	**1**
Red Shiner	**121**	**3**		**Red shiner**	**137**	**3**
Creek Chub	**65**	**4**		**Creek Chub**	**80**	**7**
Bigmouth Shiner	**60**	**5**		**Bigmouth Shiner**	**68**	**9**
Black Bullhead	**58**	**6**		**Black Bullhead**	**39**	**15**
Plains Minnow	**58**	**6**		**Plains Minnow**	**38**	**16**
Flathead chub	**53**	**7**		**Flathead Chub**	**28**	**20**
White sucker	**45**	**8**		**White Sucker**	**70**	**8**
Brassy Minnow	**42**	**9**		**Brassy Minnow**	**25**	**22**
Plains Topminnow	**40**	**10**		**Plains Topminnow**	**16**	**28**
Channel Catfish	**38**	**11**		**Channel Catfish**	**86**	**6**
Green Sunfish	**37**	**12**		**Green Sunfish**	**115**	**4**

Common Carp	**36**	**13**		**Common Carp**	**98**	**5**
River Carpsucker	**36**	**13**		**River Carpsucker**	**67**	**10**
Northern Plains Killifish	**35**	**14**		**Northern Plains Killifish**	**30**	**18**
River Shiner	**33**	**15**		**River Shiner**	**66**	**11**
Central Stoneroller	**26**	**16**		**Central Stoneroller**	**40**	**14**
Longnose Dace	**26**	**16**		**Longnose Dace**	**32**	**17**
Western Silvery Minnow	**23**	**17**		**Western Silvery Minnow**	**8**	**33**
Suckermouth Minnow	**21**	**18**		**Suckermouth Minnow**	**38**	**16**
Quillback	**17**	**19**		**Quillback**	**29**	**19**
Shoal Chub	**15**	**20**		**Shoal Chub**	**13**	**30**
Emerald Shiner	**14**	**21**		**Emerald Shiner**	**28**	**20**
Orangespotted Sunfish	**14**	**21**		**Orangespotted sunfish**	**7**	**34**
Bluegill	**12**	**22**		**Bluegill**	**53**	**12**
Largemouth Bass	**12**	**22**		**Largemouth Bass**	**39**	**15**
Stonecat	**12**	**22**		**Stonecat**	**41**	**13**
Goldeye	**9**	**23**		**Goldeye**	**8**	**33**
Golden Shiner	**8**	**24**		**Golden Shiner**	**3**	**38**
Iowa Darter	**8**	**24**		**Iowa Darter**	**8**	**33**
Orangethroat Darter	**8**	**24**		**Orangethroat Darter**	**19**	**26**
Brook stickleback	**7**	**25**		**Brook Stickleback**	**12**	**31**
Shorthead Redhorse	**7**	**25**		**Shorthead Redhorse**	**39**	**15**
Silver Chub	**7**	**25**		**Silver Chub**	**10**	**32**
Tadpole cadtom	**7**	**25**		**Tadpole Madtom**	**3**	**38**
White Crappie	**7**	**25**		**White Crappie**	**8**	**33**
Black Crappie	**6**	**26**		**Black Crappie**	**3**	**38**
Common Shiner	**6**	**26**				
Rainbow Trout	**6**	**26**		**Rainbow Trout**	**6**	**35**

Sturgeon Chub	**6**	**26**				
Flathead catfish	**5**	**27**		**Flathead Catfish**	**24**	**23**
Northern Pearl Dace	**5**	**27**		**Northern Pearl Dace**	**3**	**38**
Shortnose Gar	**5**	**27**		**Shortnose Gar**	**23**	**24**
Yellow Bullhead	**5**	**27**		**Yellow Bullhead**	**26**	**21**
Yellow Perch	**5**	**27**		**Yellow Perch**	**1**	**40**
Bigmouth Buffalo	**3**	**28**				
Finescale Dace	**3**	**28**		**Finescale Dace**	**2**	**39**
Johnny Darter	**3**	**28**		**Johnny Darter**	**15**	**29**
Longnose Sucker	**3**	**28**		**Longnose Sucker**	**6**	**35**
Northern Redbelly x Finescale Dace	**3**	**28**				
Grass Pickerel	**3**	**28**		**Grass Pickerel**	**10**	**32**
Shovelnose sturgeon	**3**	**28**		**Shovelnose Sturgeon**	**4**	**37**
Topeka Shiner	**3**	**28**				
Brown Trout	**2**	**29**		**Brown Trout**	**8**	**33**
Rock Bass	**2**	**29**		**Rock Bass**	**3**	**38**
Sauger	**2**	**29**				
Blacknose shiner	**1**	**30**				
Bluntnose minnow	**1**	**30**		**Bluntnose Minnow**	**8**	**33**
Burbot	**1**	**30**				
Goldfish	**1**	**30**				
Mountain Sucker	**1**	**30**				
Northern Redbelly Dace	**1**	**30**				
Orangespotted x Green Sunfish	**1**	**30**				
Pumpkinseed	**1**	**30**		**Pumpkinseed**	**6**	**35**
Smallmouth Buffalo	**1**	**30**				
Walleye	**1**	**30**		**Walleye**	**3**	**38**

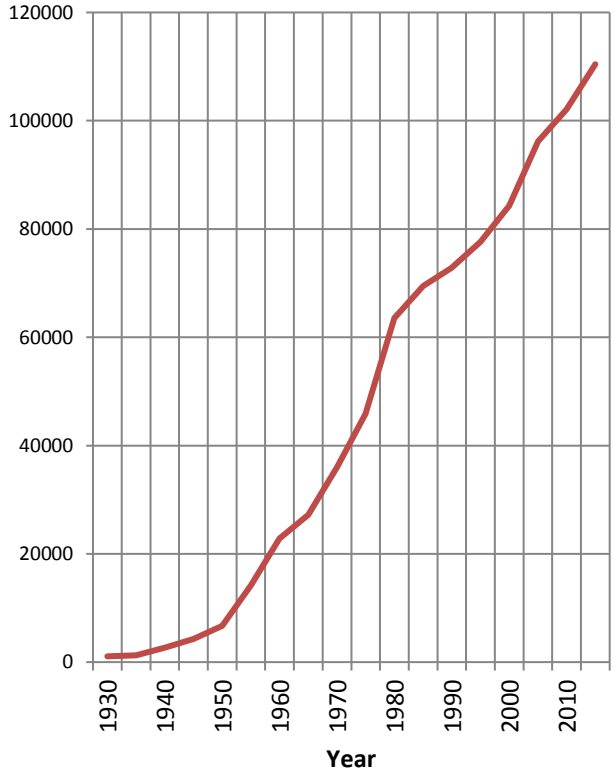
Western Blacknose Dace	**1**	**30**		**Western Blacknose Dace**	**4**	**37**
				Western Mosquitofish	**23**	**24**
				Freshwater Drum	**22**	**25**
				Gizzard Shad	**17**	**27**
				Longnose Gar	**12**	**31**
				Northern Pike	**7**	**34**
				Green Sunfish x Bluegill	**5**	**36**
				Grass Carp	**4**	**37**
				Brook Silverside	**3**	**38**
				Bluegill x Green Sunfish	**2**	**39**
				Pallid Sturgeon	**2**	**39**
				Smallmouth Bass	**2**	**39**
				Blue Catfish	**1**	**40**
				Spotfin Shiner	**1**	**40**

CHANGES IN NEBRASKA'S RIVERS AND STREAMS

It is difficult to quantify all the changes in land use and the landscape that have affected the state's streams and stream biota. That is because these changes can vary by region and basin and watershed. But some general comments can help to illustrate these affects.

Groundwater and surface water are hydrologically connected. As Harnsberger et.al. (1973) noted: "[A]ll water is interrelated and interdependent. If groundwater were red, most streams would be various shades of pink". For instance, Ray Bentall (1991) observed that the Snake River, Middle Loup River, North Loup River, Calamus River, Elkhorn River and Birdwood Creek are mostly groundwater fed streams. On the other hand, streams in the Republican, Little Blue, Big Blue and Nemaha

Figure 5. Cumulative number of wells drilled in Nebraska.



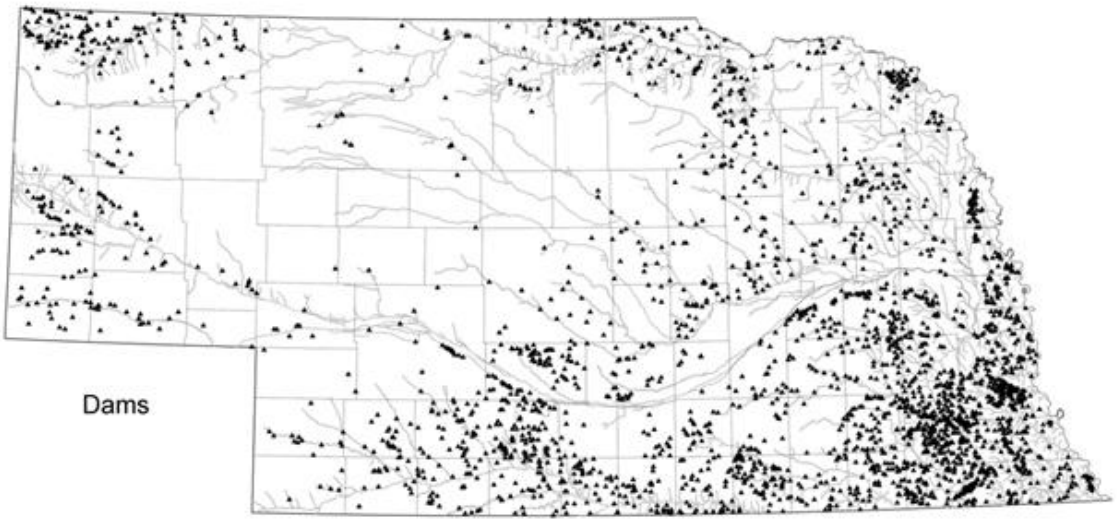


Figure 7. Map of dams in Nebraska. Data is from the Nebraska Department of Natural Resources and does not include most farm ponds or other low-hazard dams.

basins are dominated by overland flow rather than groundwater. Groundwater pumping can have a significant impact on the flow of streams. Three streams in the Nebraska Panhandle (Lodgepole Creek, Pumpkin Creek and Snake Creek) have been completely or significantly dewatered by groundwater pumping. The Nebraska Department of Natural Resources (NeDNR) maintains a database of all registered groundwater wells in the state. The graph in Figure 5 shows the cumulative total of wells that have been drilled in Nebraska since 1930. In 1940, there were less than 3,000 registered wells in the state. Currently, there are over 110,000. Figure 6 shows all registered wells in Nebraska. These are a combination of domestic and irrigation wells. Domestic wells probably have little impact on groundwater

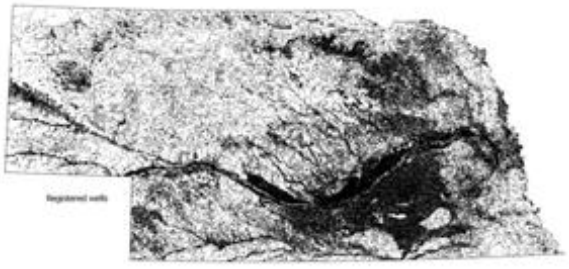


Figure 6. Distribution of registered ground water wells in Nebraska.

levels. On the other hand, high capacity irrigation wells (wells than can pump more than 50 gallons per minute), particularly those concentrated into the darker areas on the map, would have a large impact on groundwater and streamflow.

Dams are another man-made impact on streams and stream biota. They alter the flow and temperature regimes of streams downstream from the dam. Many species of fish need long stretches of free-flowing stream to prosper and dams keep fishes and other organisms from using the full length of a stream. The NeDNR maintains a database of some 2,800 dams. They state that most of these (85%) were built since 1960. Figure 7 was constructed using their data. They are not clear as to which dams are in the data layer used here but it appears to represent only those dams for which they have jurisdiction. That means dams with a total height of 25 feet or more or impound 50 acre-feet of water or more. Therefore the thousands of smaller farm dams are not shown.

Lakes and ponds impounded by dams are often stocked with sport fishes. These sport fishes can and will swim up into the inflowing stream or escape with outflow into the stream below where they can alter the fish community. One extreme

example of this was recently noted in the upper Niobrara River. Box Butte Reservoir is on the Niobrara River in Dawes County. The river above the reservoir, especially in the stretch through the Agate Fossil Beds National Monument, supported a diverse community of fishes. The Reservoir had been stocked regularly with Northern pike over the years. Sometime before 2008, a flood allowed the pike to pass over a diversion dam on the river above the reservoir. As a result, the fish community dropped from nine species to two, the most numerous being Northern Pike (Pegg and Pope 2008).

Overall, land use in Nebraska is about 42% cropland and 51% pasture/rangeland. The conversion of native prairie to cropland had a large impact on streams. Many of these changes were already evident by 1939 when Raymond Johnson began his survey. While farming practices have changed over the past 70+ years, connecting changes in fish communities to these changes is a major challenge. The challenge is that the changes were so gradual that they went unnoticed. We will discuss a few here.

Stream straightening: Also known as channelization, this is the dredging and straightening of a stream channel. It is done for various reasons. These include the desire to make the land easier to farm with increasingly larger equipment. Sometimes it may be done in an attempt to put more land into crops. Some may believe that a straightened channel will eliminate flooding.

Whatever the reason, the results are predictable. Straightening a stream channel removes the bends and shortens the stream causing a steeper channel gradient. Water now flows faster, increasing its erosive power resulting in bed degradation (deepening) of the stream channel. As the channel deepens, the banks become unstable, especially after floods, and collapse. The bed erosion extends upstream in a process called "head-cutting". The process continues until the bed reaches an erosion-resistant material like rock or clay hardpan. The shortened channel has lower flood capacity so floods and flood damage become more frequent, especially downstream. The impact on fishes and other organisms is that habitat (spawning, rearing, protection from predation) is lost. Species disappear or decline. New species appear that are tolerant of these harsh conditions or are present only periodically.

Extensive stream straightening began in the early 1900's in the Nemaha River basin (Moore 1917). This activity and its impacts were well underway by the time Raymond Johnson made his survey. But the process has continued in one form or another over the years.

Of particular note was the channelization of the Missouri River. The U.S. Corps of Engineers had been working on "improving" navigation in the Missouri since the mid-1800's. But extensive floods in 1943 resulted in a major intensification of that process. Beginning in the 1950's, the banks were lined with rock and revetments and wing dams were constructed to confine and straighten the channel (Morgan 2013). Raymond Johnson saw the river and its tributaries before this happened. The channelization resulted in bed degradation of the Missouri River. The beds of the tributaries to the Missouri also degraded so that now they are deeply entrenched with limited instream fish habitat. In addition, access to side channels and sloughs was cut off and most of these are now dry. (Kendle 1970)

Sedimentation: When the prairies were plowed, the process of silt running off the land into streams began. Cropped land has less capacity to slow and absorb rainfall than did the prairie. Rainfall more quickly washes off the land causing streams to flood more quickly and flood stages to be higher. In the process the water washes soil (sheet erosion) into the stream channel, filling pools, covering riffles and increasing turbidity. Agricultural chemicals (fertilizer, pesticides) are also washed off the land and into the stream channel which causes increase algae growth (fertilizer) and decreased numbers of bugs and fish (pesticides).

The conversion of prairie to row crops was well advanced during Raymond Johnson's survey. Perhaps one major difference between then and

now is that, then, fields tended to be smaller with more fences. Vegetation was allowed to grow along fences and they may have helped retard erosion. Over the years, the use of increasingly larger equipment has resulted in increasingly larger fields and the increased the use of agricultural chemicals. On the other hand, erosion reducing practices such as terracing, minimum-tillage and no-till farming are more common.

Altered Hydrology: It was noted above that groundwater pumping (wells) and impoundments alter stream hydrology. But land use changes also alter hydrology.

Native prairie slowed the movement of water from rain and melting snow. Much of this had a chance to soak into the soil and groundwater. Gradually this would percolate laterally and eventually emerge in a neighboring stream. Floods still occurred as is evident in the accounts of western migrants on the Oregon Trail. Furthermore, streams often meandered across the landscape. Flood flows were retarded in their progress downstream and a fair amount of water would saturate the banks (bank storage). When the flood receded, this water would seep back into the stream. In a nutshell, streams reached flood stage slowly and stream flows dropped gradually as the stream returned to normal discharge.

On the other hand, there is little to impede the movement of water off cultivated lands. Except for the crop, the soil is kept bare and free of vegetation. During most of the year, the soil is kept bare and free of vegetation. Rainfall flows quickly off the land with little time to soak into the soil. Flood stage is reached more quickly and stages are higher as a result. If the stream has been straightened, the high flows would degrade the bed. The banks of the deeper channel would be steeper and the saturated banks would now be unstable and would often collapse. Stream flows would more quickly drop and now, with little water stored in the soils, flows would now be lower. The long term result is that high flows are higher and low flows are lower.

Some historical accounts support this. In 1859, J.G. Jacob wrote a biography of Patrick Gass who was the last surviving member of the Lewis and Clark Expedition (Jacob 1859). Patrick Gass was born in Pennsylvania but, when still a child, his family moved to Ohio to a place on a stream called Catfish Camp. Quoting from the book, "Catfish at that day was a bold stream of many times its present dimensions and indeed, the diminution of the streams is one of the most singular incidents connected with the settlement of this country. The stream in question, has dwindled from a powerful stream to an insignificant brook".

METHODS AND RESULTS OF 2003-05 STREAM HABITAT DATA COLLECTION

In a broad sense, physical habitat in streams includes all those physical attributes that influence or provide sustenance to organisms in the stream. The protocol used during the 2003-05 survey was intended to evaluate physical habitat of wadeable streams in a standard way. The protocol was most efficiently applied during low flow conditions and during times when terrestrial vegetation is active. The protocol defined the length of each sampling reach proportionally to the stream width and then systematically places measurements to statistically represent the entire reach. A total of five transects (cross sections) were established at equal distances throughout the reach to assist in the sampling. Habitat is evaluated within an imaginary box centered

on the transect, extending 5 meters up and downstream and 10 meters left and right from each streambank. Aquatic habitat such as substrate and cover only look at the portion within the banks of the stream. Terrestrial habitat such as bank characteristics and riparian vegetation look at the dry land portion of the box.

For both aquatic and terrestrial habitat, a visual estimation procedure to evaluate cover and vegetation was used. There were five ratings including “0” (none or absent), “1” (sparse or <10%), “2” (moderate or 10-40%), “3” (heavy or 40-75%) and “4” (very heavy or >75%). Aquatic habitat includes measurements or visual estimates of cross-section dimensions, substrate, fish cover and canopy (shading). This also included measurement of the stream gradient and compass bearings between transects. Terrestrial habitat included measurements of bank angles and heights as well as visual estimates of vegetation such as ground cover, shrubs and small and large trees.

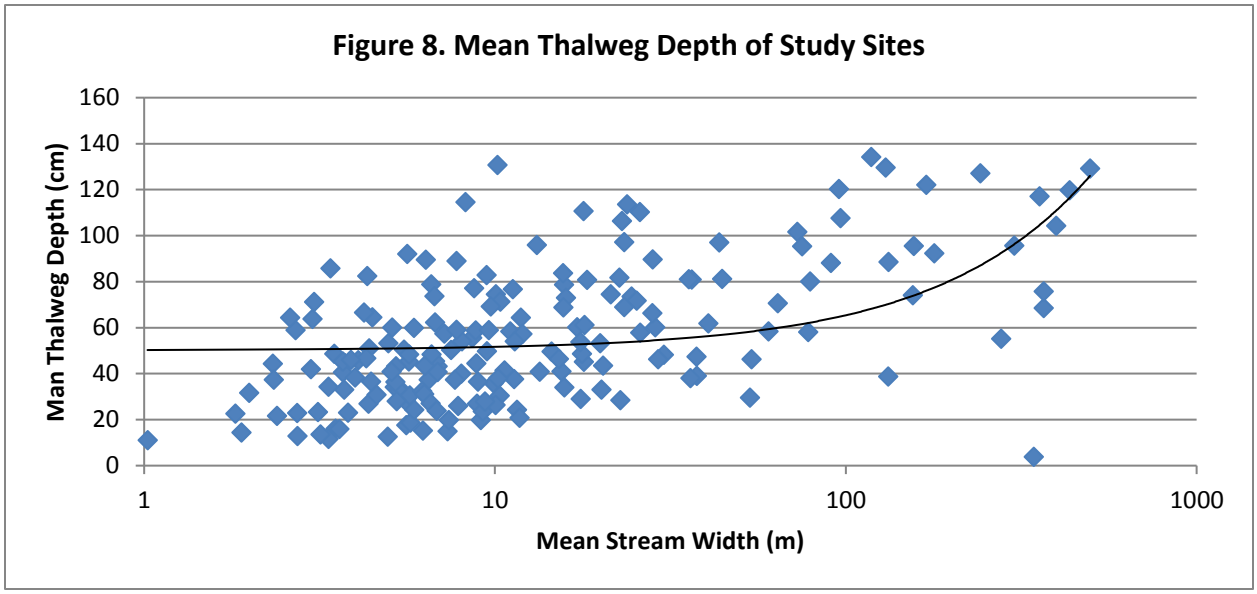
The thalweg profile ignores the “boxes”. The thalweg is the deepest portion of the channel which can meander from bank to bank within the channel. The profile is a longitudinal survey of depth, width, habitat class and presence of soft/fine sediment at 50 to 75 equally spaced intervals along the thalweg.
Water quality parameters were collected 10 meters below the downstream end of the sampling reach before the physical habitat and fish collections were made. Water quality parameters measured included dissolved oxygen, temperature, conductivity, salinity, and turbidity. The use of a standard calibrated meter was used to measure the first four parameters while a turbidimeter was used to measure turbidity.

Streamflow was collected at a section of the stream that was reasonably straight, had good flow and no obstructions. It was not necessary to get a streamflow measurement within the boundary of the sampling reach. It was acceptable to remove rocks or other debris to get a cleaner flow pattern. The procedure was as follows:

1. From one bank, string a measuring tape perpendicular to the stream flow, wetted edge to wetted edge. Up to 30 measurements "verticals" will be made along this tape transect.
2. Record date, time, site number, stream width, and all discharge measurements data.
3. Place wading rod in first "vertical" which is at the water.s edge.
a. Hold wading rod straight upright with the meter parallel to the flow direction.
b. Stand 18 inches or more downstream from the wading rod and behind meter.
c. Avoid standing in water if feet and legs occupy a considerable percentage of the cross section.
4. Evenly space up to 30 verticals along the transect. This ensures that the velocity measured at each vertical is no more that 5% of the flow. However, verticals should not be spaced less than 0.3 feet (4 inches) apart. This will mean less than 30 vertical in small streams.
5. At depths less than 2.5 ft, a measurement will be taken at 0.6 of the depth from the waters surface.
6. At depths 2.5 ft or greater a measurement will be taken at 0.2 and 0.8 of the depth from the water’s surface at each vertical. The average of these two measurements will be used as the mean vertical velocity.
7. At each vertical record depth and velocity for later discharge calculation.

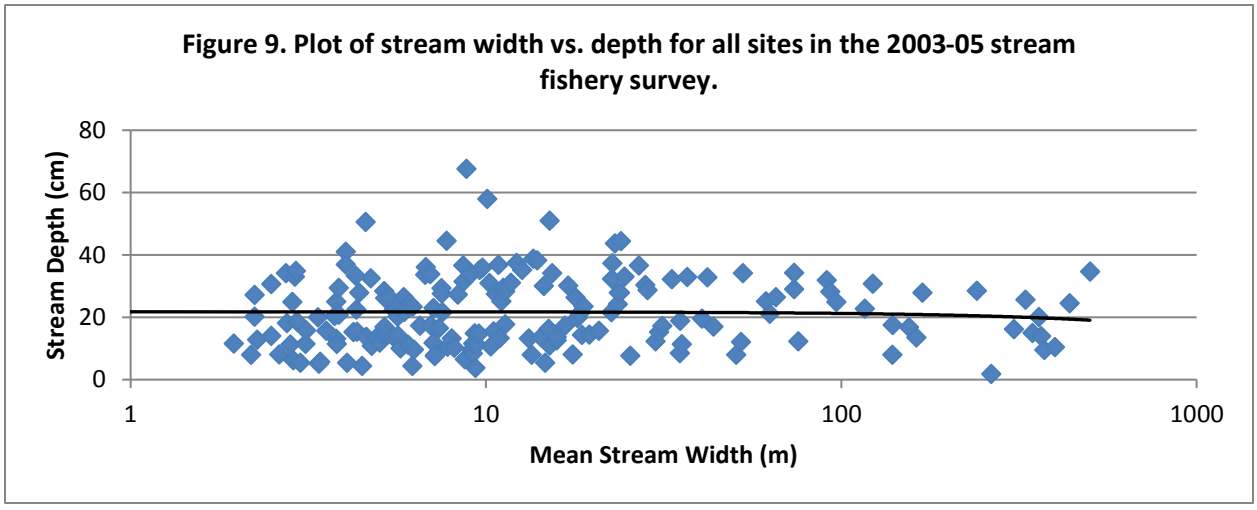
All pertinent information was recorded on the appropriate data sheet. For quality control it was advisable to set a staff gage to

note if water levels fluctuated during the measurement. Record the quality of the measurement as good, fair, or poor and note why. "Good - straight channel smooth bottom" or "Poor - lots of rocks, bottom very uneven, and narrow deep channel was hard to measure."



THALWEG PROFILE

The thalweg refers to the flow path of the deepest water in a stream channel. The thalweg profile is a longitudinal survey of maximum depth at 50-75 equally spaced points along the centerline of the stream between the two ends of the stream reach. The mean thalweg depths of the study sites are plotted in Figure 8. The stream width was also measured at each of these points. All thalweg measurements for each site were averaged as were the stream widths. These were plotted in Figure 9. Because most streams were narrow and clumped together, the horizontal scale is logarithmic so that they could be spread out. It is interesting to note in Figure 8 that while the depth of the main channel tended to increase with increasing stream width, they were all under 140 cm (4.6 ft). This is the deepest portion of the channel, not the mean



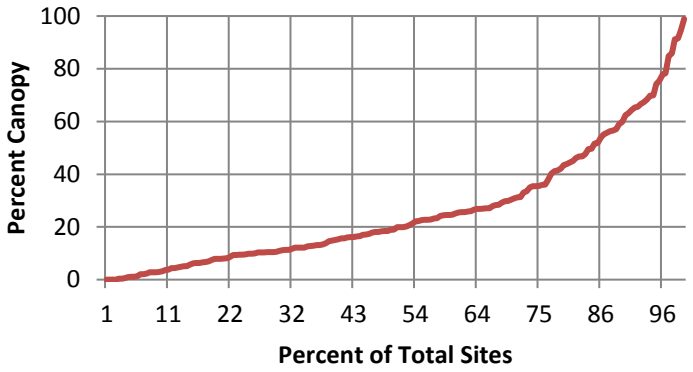
depth. The mean depths in Figure 9 have a trend line that shows the mean depths tended to decrease with increasing width. The majority were under 40 cm which might help to explain why there are so few boat ramps on Nebraska streams. Except for shallow-draft craft like airboats and canoes, most streams are too shallow for powerboats and are considered to be wadeable.

CANOPY COVER MEASUREMENTS

Canopy is the amount of shading provided by overhanging trees. Shade does not cool a stream but does slow warming on sunny days. A spherical crown densiometer is a small convex mirror on which is scribed a grid of lines. This grid is modified by blocking off all but 17 of the 37 original intersections which can then be used to provide a 90° view of the canopy. This instrument is held level, just above the waistline while grid intersections covered by tree canopy are counted (0 to 17). This is done at the center of the stream in the upstream, downstream, right, and left directions at each stream cross-section which gives a 360° view of the canopy at that point. This is then repeated at each bank with the stream to your back. Total canopy estimates are determined for each stream site by adding all six canopy counts for the five transects then dividing by 102.

The results for all study sites are plotted in Figure 10. This chart shows that about half the streams have 20% or less canopy cover and roughly 80% have less than 50% canopy cover. This says that most of Nebraska's streams will be strongly affected by solar warming, especially in summer when the sun is high and days are long. (Note that the odd intervals on the x-axis are selected by Microsoft Excel and cannot be adjusted.)

Figure 10. Canopy cover measurements for the stream sites in the 2003-05 stream fishery survey.



RIPARIAN VEGETATIVE STRUCTURE

This assessment is used to evaluate the health and level of disturbance of the stream corridor. It also indicates the present and future potential for various types of organic inputs and shading. Observations to assess riparian vegetation apply to a "box" on either side of the stream extending upstream and downstream 5 meters from the transect and 10 meters shoreward. Thus we have a 10 m X 10m riparian plot on each side of the stream.

The riparian vegetation is divided into three layers: canopy (> 5 m high), understory (0.5- to 5 m high) and ground cover « 0.5 m high). "Canopy" here means large trees while "understory" mostly refers to small trees and shrubs. Before estimating the aerial coverage of the layers, the type of vegetation (Deciduous, Coniferous, Mixed, or None) in each of the two taller layers (canopy and understory) was tallied. The layer was "mixed" if more than 10% of the aerial coverage is made up of the alternative vegetation type.

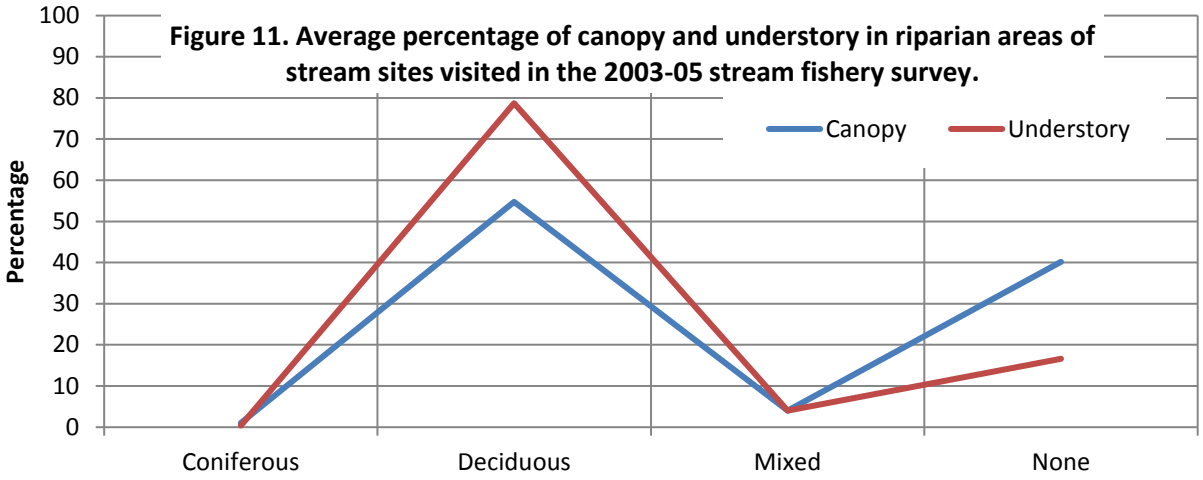
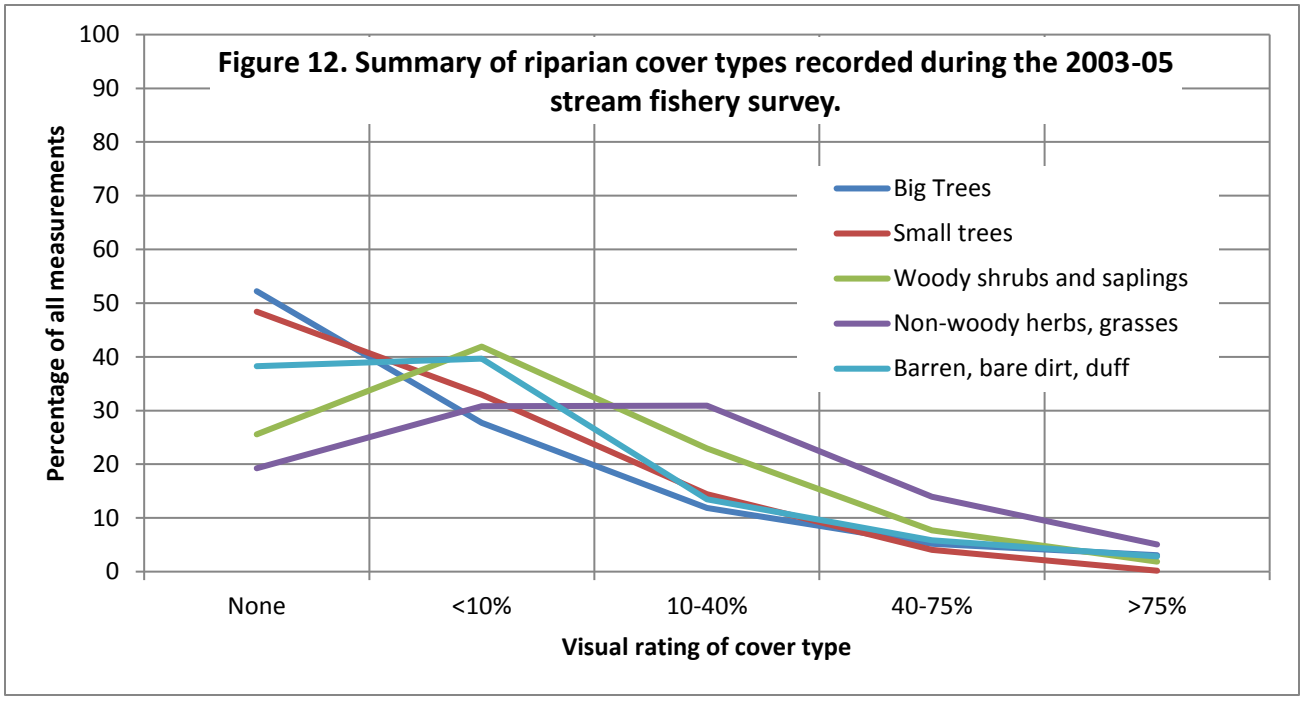


Figure 11 summarizes the vegetation types found in these two layers. Not unexpectedly, the majority of streams had deciduous trees and shrubs in their riparian areas. Coniferous vegetation (usually cedars) were rare. Almost 40% of sites had no canopy while roughly 20% of sites had none in the understory. The results of the riparian cover rankings are summarized in Figure 12. Note that this is a compilation of all riparian plots at all sites for the whole state. What this chart does not show is the interaction between the cover types. For instance, if "Big trees" are very heavy, that means the canopy cover is dense and the resultant heavy shade limits the growth of small trees, shrubs and herbaceous vegetation. If canopy is thin or absent (about 50% of transect "boxes" had no trees), herbaceous vegetation and shrubs have will become the dominant riparian cover types.

So what is the chart saying? If we look at "Big trees" we can see that just over 50% of the riparian plots had no big trees. About 28% had a few (<10%) and a bit over 10% had moderate numbers



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SUBSTRATE

This procedure was a systematic selection of five substrate samples from each of the channel cross-sections. The water depth and substrate were measured at the Left Bank, Left Center, Center, Right Center and Right Bank on each cross-section with a meter stick. During the depth measurement, whatever substrate item the meter stick touched was classified into one of the nine categories summarized in the table at right. It shows that sand and fines (silt) were the most common substrates (86.7%) found in Nebraska streams. Gravels were found at 10.1%.

Substrate type	Percent
Smooth Bedrock	0.7
Rough Bedrock	0.2
Boulder	0.3
Cobble	1.6
Coarse Gravel	3.8
Fine Gravel	6.3
Sand	64.7
Fines	21.9
Wood	0.2

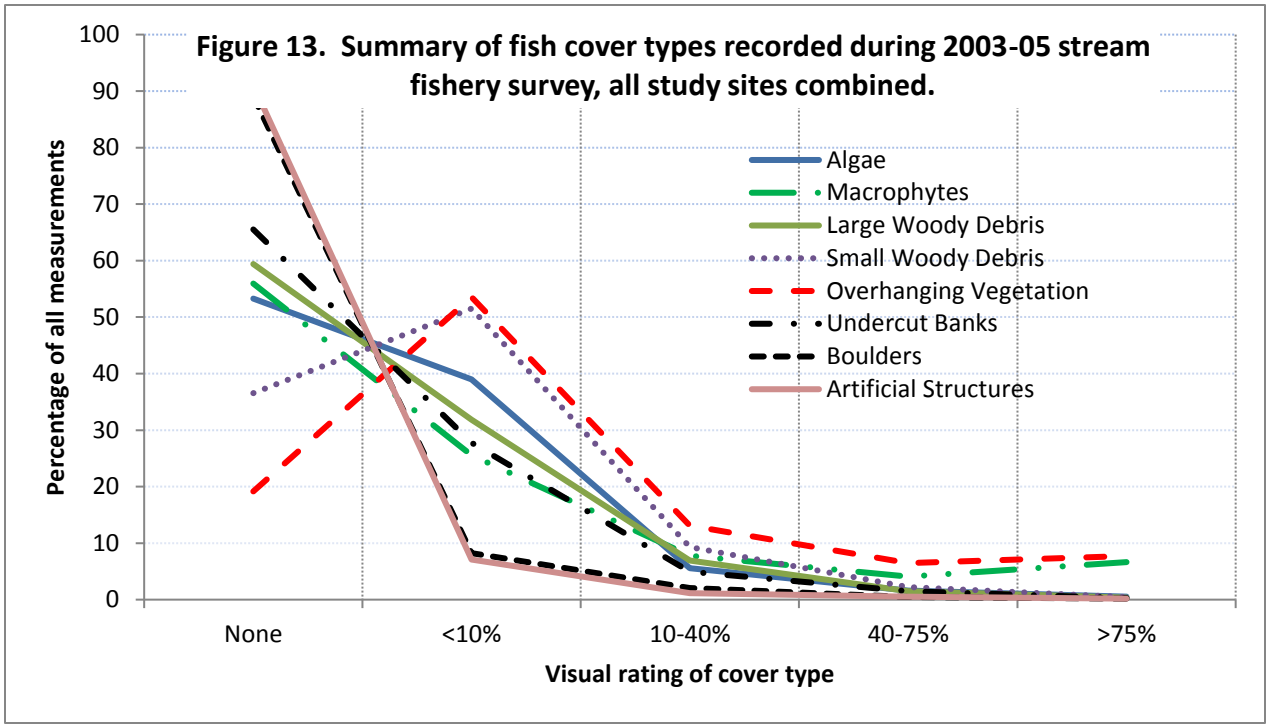
Table 5. Substrate types recorded in 2003-05 stream survey, all study sites combined.

FISH COVER, ALGAE, AND AQUATIC MACROPHYTES

The protocol included a visual estimation of the type and amount of important cover types for fish and macroinvertebrates . As with the other habitat features, observations to assess fish cover and other in-channel features apply to the channel area five meters upstream and downstream from each cross-section.

There were eight cover types. **Filamentous algae** are the long streaming alga that often occurs in slow moving waters. **Aquatic macrophytes** are water-loving plants in the stream that could provide cover/substrate for fish and/or macroinvertebrates. **Large woody debris** includes larger pieces of wood (more than 30 cm in diameter) that can influence cover and stream morphology. **Small woody debris** pertains to the smaller wood that primarily affects cover but not morphology. **Overhanging vegetation** are the grass, brush, twigs, small debris etc. that is not in the water but is close to the stream and provides cover. In some places, such things as dense roots have tied the soil together tightly. An **undercut bank** is where the water has eroded underneath this leaving a cavity**. Boulders** are typically basketball to car sized rocks. Some streams have **artificial structures** in them designed for fish habitat. Streams may also have in-channel structures for diversions, impoundments and other purposes.

At each site, five transects were rated for the eight cover types. These were totaled and the averages were computed. The results are shown in Figure 13. You can see that there isn't a lot of fish cover in Nebraska streams as, for six of the eight cover types, "None" was the most common rating. Figure 13 also shows that "Boulders" and "Artificial structures" are the least common cover types with some 90% of transects having none. For two cover types, "Small woody debris" and "Overhanging vegetation", "<10%" outranked "None" though this isn't a great deal of cover.



HUMAN INFLUENCE IN THE RIPARIAN AREA

The field evaluation of the presence and proximity of various important types of human land-use activities in the stream riparian area is used to assess the potential degree of disturbance of the sample site. At each of the channel cross-sections, evaluate the presence/absence and the proximity of 10 categories of human influence. Confine your observations to the stream and riparian area within 5 m upstream and 5 m downstream from the site. "B" is used to for any and all items you observe on the stream bank. "C" is used for any and all items that you observe within 10m from the stream bank. "P" is used for those items that are present, but farther than 10 m from the bank. While "0" is used for those not present. Evaluate and record separately the left and right sides of the channel and banks. For human influence items outside the riparian plot mark "P" for each and every cross-section where they are visible, even if you are observing the same item from cross-section to cross-section.

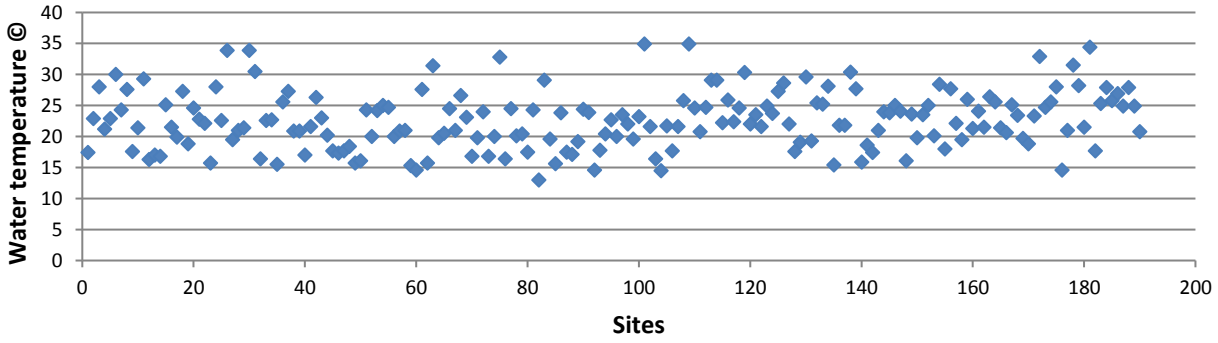
WATER TEMPERATURE

Water temperature was recorded in Centigrade degrees (°C) at one location at each survey site. The results are summarized in Figure 14 and Table 5. Overall, temperatures ranged from 13 ºC to almost 35 °C (Figure 14). In Table 5 the results were sorted by month (three September samples were combined with August). The mean and maximum

Table 5. Monthly stream temperatures (°C) recorded during the 2003-05 fishery survey.

	Samples	Mean	Minimum	Maximum
May	38	19.3	14.6	25.6
June	66	22.3	13.0	34.4
July	61	25.0	14.5	34.9
August	23	23.1	15.9	34.9

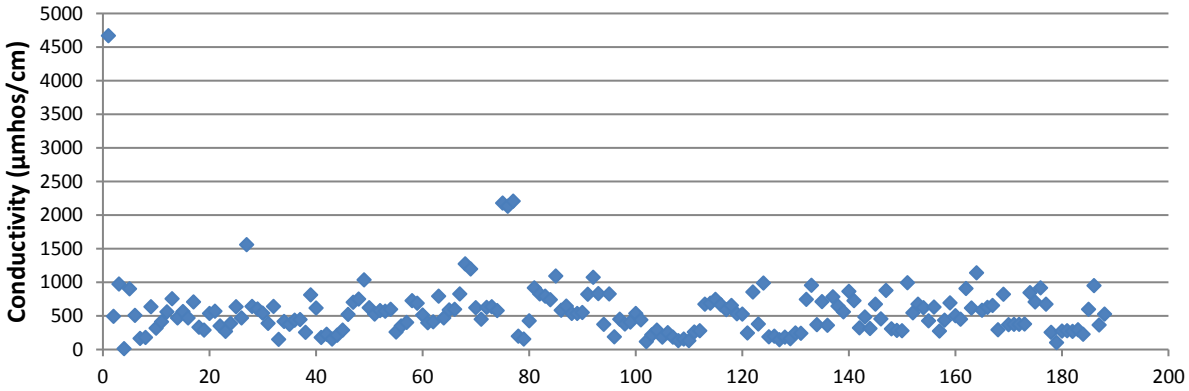
Figure 14. Temperatures recorded at each sample site during the 2003-05 stream survey.



temperatures show that May was the coolest and July was the warmest month for stream temperatures. This is consistent with solar warming of our wide, shallow streams with limited canopy cover. The minimum temperatures, which did not vary much by month, probably indicate spring-fed streams which are minimally impacted by solar warming.

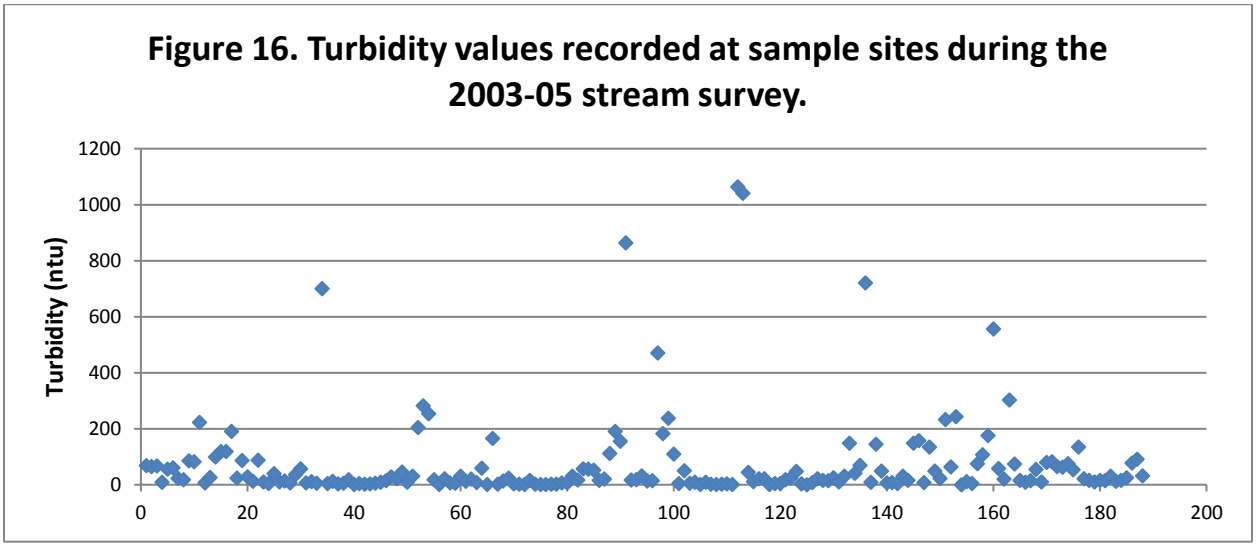
CONDUCTIVITY

Figure 15. Specific conductance values recorded at sample sites during the 2003-05 stream survey.



Conductivity is a direct measure of the ability of water to carry an electrical current and, indirectly, a measure of the salinity of the water. As a rule, levels below 200 are considered to be low, 200 to 1,000 are moderate and above 1,000 are high. Most streams in Nebraska are in the 100 to 1,000 range though there are a number that are a lot higher. Values actually measured ranged from 14.6 to 4,672 µmhos/cm (Figure 15) with a median value of 530 µmhos/cm.

TURBIDITY



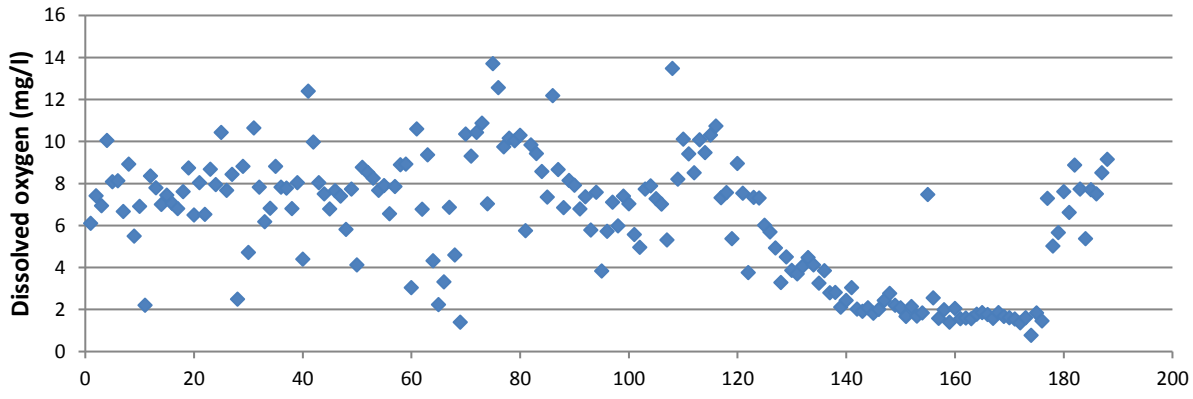
Turbidity is a measure of the ability of light to pass through water. Any particulate matter in the water will cause the light to scatter and make the water appear to be murky or "turbid". Some typical causes of turbidity in Nebraska waters are suspended sediments such as clay or silt, organic matter such as the tannins commonly seen in Sand Hills streams or algae. One way to measure turbidity is to use an electronic meter that shines a light at one side of a sample and a photocell at 90 degrees to measure how much of the light got through. Turbidity is reported as nephelometric turbidity units (NTU). Turbidities measured during the 2003-05 stream survey ranged from 0.15 to 1,063 NTU (Figure 16) and the median value was 20.6 NTU. Depending on the material in the water, water that is under 100 NTU still appears to be fairly clear. Over 1,000 is really dirty.

DISSOLVED OXYGEN

Dissolved oxygen (DO) is what it says, oxygen dissolved in the water. Oxygen can enter water by a variety of means such as turbulence, direct absorption from the air and photosynthesis of algae. It is measured by an electronic meter that reports levels in milligrams per liter (mg/l) or parts per million (ppm) [which is the same thing].

Dissolved oxygen levels can vary from 0 to 18. Levels below 4 mg/l are stressful or lethal to most fish. Levels above 7 mg/l are usually considered to be the best. Figure 17 shows DO levels recorded during the 2003-05 survey which ranged from 0.8 to 13.7 mg/l and the median value was 6.2 mg/l.

Figure 17. Dissolved oxygen values recorded at the sample sites for the 2003-05 stream survey.



LABORATORY ANALYSIS:

During the 2003-2005 survey, all specimens and data were returned to the laboratory in Lincoln, NE for analysis. Fish specimens were identified to species and enumerated. Aquatic invertebrates were identified to the lowest practicable taxonomic category and enumerated. Habitat information and additional taxonomic information from data sheets was transferred to a database for further analysis and storage. All data were cross-referenced to collection site locations for future comparisons.

Voucher specimens were catalogued into the University of Nebraska State Museum collections.

FISH DATA ANALYSIS

The data collected in the 2003-05 survey was subjected to a detailed analysis in a paper by Quist et.al.(2014). If interested, you are encouraged to obtain a copy and read the full paper. In summary, they looked at trends in fish assemblages using data from the 1939-41 and the current survey. In general, they found declines in specialist species and increases in generalists, nonnatives and sport species. Fish assemblages were more similar in the recent survey, indicating increased homogenization of fish communities. They noted that these changes are probably not surprising given the changes in land use and water quality since European settlement of the state.

SPECIES ASSOCIATIONS:

When you spend years collecting fishes from all types of streams, you begin to notice patterns in the fishes you find. Some are only found in large rivers like the Missouri. Some are found in larger streams like the Platte, the Loups and the Niobrara as well as the lower ends of tributaries to these. Others are found only in small, headwater streams. When sampling a stream, of any size, you come to expect to see certain fishes or groups of fishes. Should you

collect something that you don't expect, it gives you pause. You wonder how it got there and why.

There have been numerous papers published that look at statistical methods examining co-occurrence or species associations. That is, species that typically are found in association with other species. That is not to suggest that some fish species have any particular affinity for hanging out with other fish species, though there are associations of this nature (e.g. the Topeka shiner's preference for spawning in sunfish nests). Rather, fish species tend to have habitat preferences that overlap with the preferences of other species. As a result, we have co-occurring species groups or assemblages.

There is an analysis package in "R" called Co-occurrence that examines this. R is an "open-source" (i.e. free) programming language that can be used for statistical analyses of data. Legions of independent statisticians are writing statistical packages that R can retrieve so that you can do your own analyses. "Co-occurrence" is one of these. Co-occurrence was run separately on the 1939-41 and 2003-05 data and the results are the two matrices shown in Figures 14 and 15. The blue squares show positive associations; where two species were found together more often than they should have if the collections were truly random. The orange squares show the opposite or negative associations. The gray squares indicate no significant association, either positive or negative. Not all species show up in these matrices as the matrices do not include those species for which had no positive or negative associations.

A lot of these associations, either positive or negative, do make sense. The Channel Catfish is considered to be a "big river" fish which is not often found in small creeks. For the 1939-41 survey, the Channel Catfish had positive associations with River Carpsucker, Flathead Chub, Plains Minnow, Quillback, River Shiner, Emerald Shiner, Shoal Chub, Common Carp and Shorthead Redhorse. These are all fishes that tend to prefer large streams. The Channel Catfish had negative associations for Creek Chub and Longnose Dace, both small stream fishes. Two positive associations were a little odd as they included Red Shiner and Black Bullhead which are more common in smaller streams though they are generalists that use a wide variety of habitats.

We could spend all day looking at the matrices and making lists of co-occurrence. However, there are published studies that concluded that the statistical evaluation of co-occurrence may actually produce a lot of bogus associations (see Pitta et.al. 2012). These suggest that many (if not most) of these associations are as much a product of coincidence as they are of real associations. So, rather than spend a great deal of time making lists of associated species, I will leave it to you to study the matrices and come to your own conclusions.

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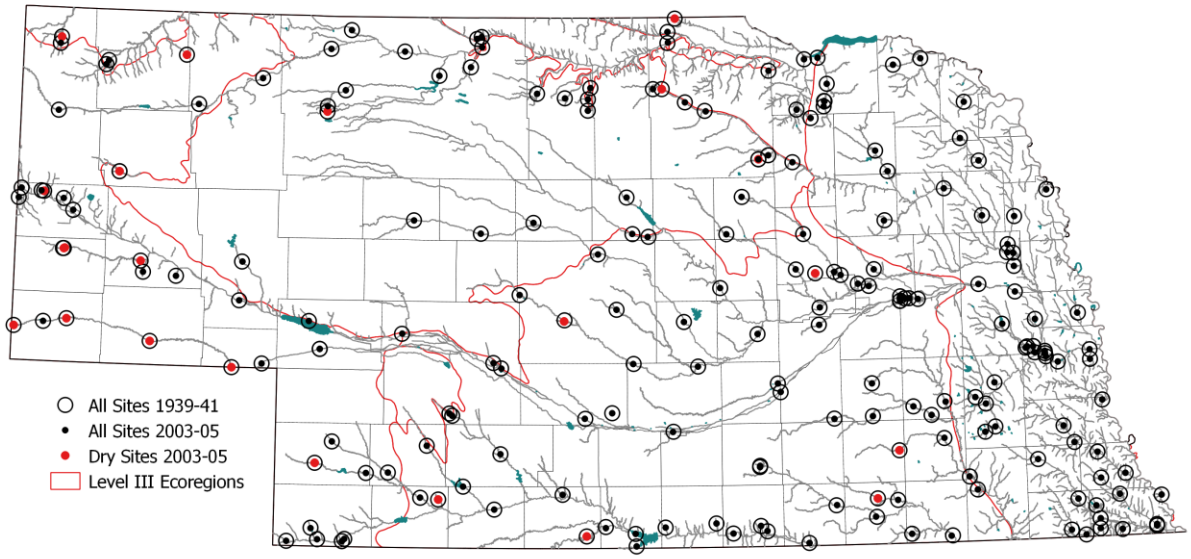
SPECIES ACCOUNTS

Description of format of species accounts



Locations of all sites visited in 1939-41 by Raymond Johnson and revisited during the 2003-05 stream fishery survey.

All species accounts begin with a distribution map and a table like those shown here. All sites where a species was collected in the 1939-41 survey are indicated by an open circle. All sites were a species was collected in the 2003-05 survey are indicated by a black dot. All 1939-41 sample sites that were dry during the 2003-05 survey are indicated by a red dot.

1939-41	0
2003-05	0
Matches	0
Missing	0
New sites	0
Dry sites	22

Species collected from a given site in both surveys are indicated by a dot-in-circle bullseye which is called a "match" in the table. Species collected in 1939-41 but not in 2003-05 are indicated by an open circle and is called "missing" in the table. Species collected in 2003-05 but not in 1939-41 are indicated by a single black dot which is called a "new site" in the table. Sample sites for 1939-41 that were dry in 2003-05 are indicated by a red dot-in-circle which is called a "dry site" in the table. The table tallies the number of sites where a species was found in the two surveys as well as the number of "matches", "missing", "new" and "dry" sites.

As noted earlier, during the 2003-05 survey, several water quality measurements were recorded. These included temperature, specific conductance, turbidity and dissolved oxygen. The table on the next page looks at the results of these as well as the discharge and stream dimensions. Also in the table will be the maximum value, the minimum value, the median value and exceedance values.

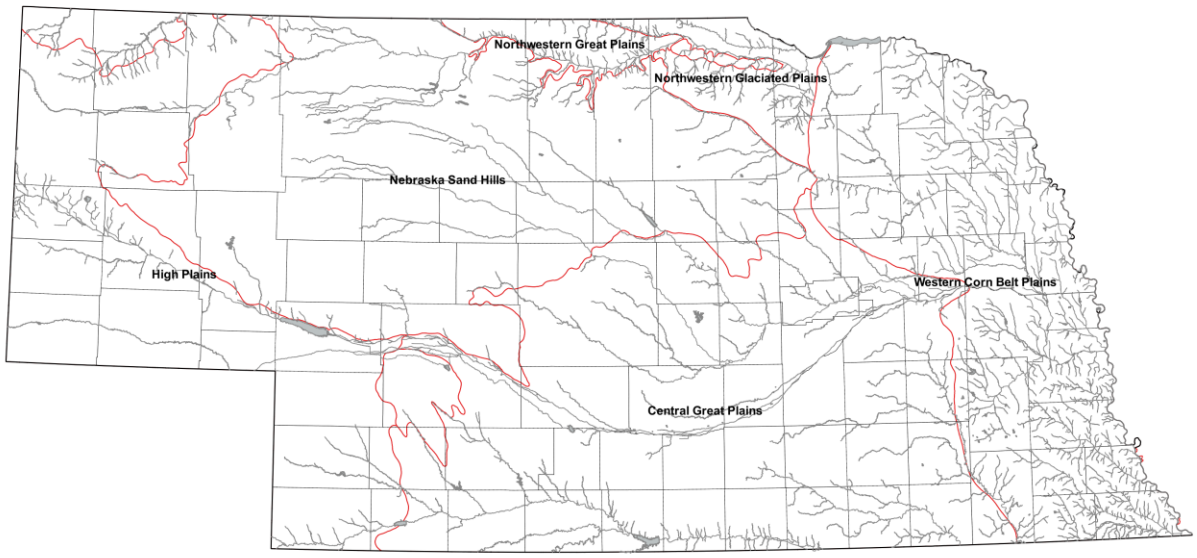
Exceedance is the amount of time that a particular value is exceeded in the data. In the table below, a Water Temperature 90% Exceedance value of 17ºC means that 90% of all values are higher than this. The number of sites where a species was collected ranged from 1 to 156. So a sliding scale was used in the calculation of exceedance values. For species that were collected at more than 60 sites, exceedance values of 90% and 10% were used. For 20 to 59 sites, exceedance values of 80% and 20% were used. For 8 to 19 sites, exceedance values of 75% and 25% were used. For seven sites or less, the raw data was listed without any analysis.

Habitat conditions of water quality, discharge and stream dimensions for all of the 2003-05 stream survey sites.

	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (umhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	**13.0**	**0.8**	**14.1**	**0.1**	**0.0**	**1.0**	**1.8**
Maximum	**34.9**	**13.7**	**4672.0**	**1063.0**	**4210.0**	**500.8**	**67.6**
Median	**22.3**	**6.9**	**530.5**	**20.4**	**16.2**	**9.6**	**20.1**
90% Exceedance	**17**	**1.8**	**214.5**	**2.6**	**0.8**	**3.4**	**9**
10% Exceedance	**29.1**	**10.1**	**919**	**190**	**508.6**	**139.3**	**34**

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half are higher, half are lower). The **90% Exceedance** means 90% of the recorded values were higher than this value while **25% Exceedance** means 25% of the recorded values were higher than this.

The species accounts include the analyses of Smith et.al.(2014) wherein the status of each species within each of the ecoregions (increasing, decreasing) is presented. Therefore species distribution maps include a layer showing the Level III Ecoregions of Chapman et.al. (2001). These are outlined in red in the map below and also shown in Figure 1. [Note that the small area in the extreme northwest is an extension of the Northwestern Great Plains.]

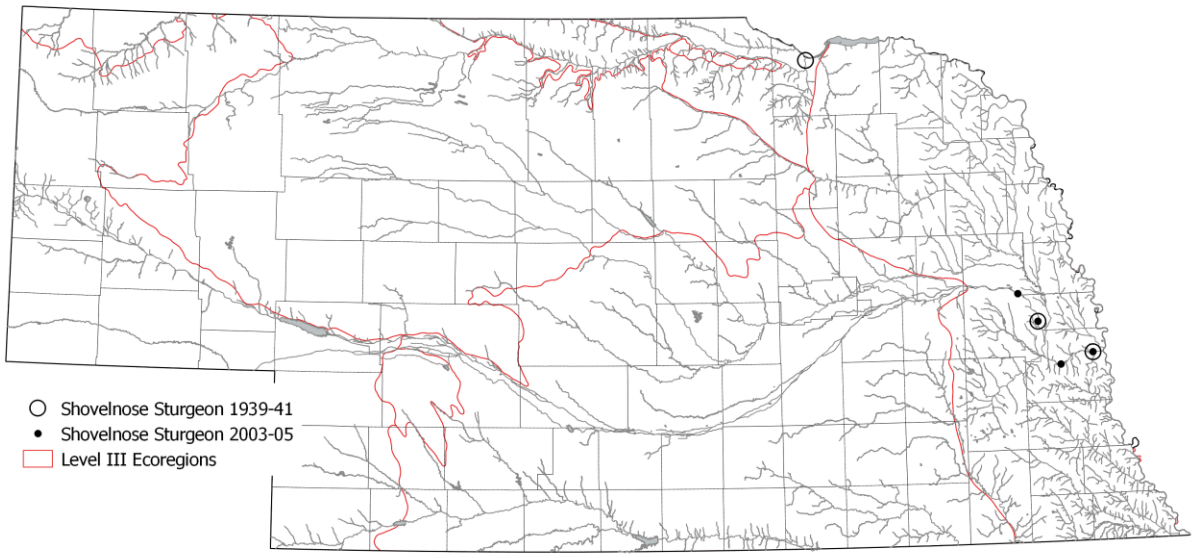


Level III Ecoregions

One final note: The species accounts are organized by Family and then by Species. The Families are presented in their phylogenetic order beginning with the most primitive, the Sturgeons, and ending with the most developed, the Drums. Within each Family group, the Species are sorted alphabetically by their Common Name.

ACIPENSERIDAE
Sturgeon Family

Shovelnose Sturgeon, *Scaphirhynchus platorynchus*



Shovelnose Sturgeon, Scaphirhynchus platorynchus

1939-41	3
2003-05	4
Matches	2
Missing	1
New sites	2
Dry sites	0

The Shovelnose Sturgeon prefers large, turbid rivers in areas of strong current over sand or gravel substrate. They are native to the Mississippi River system. It's global status is G4 and its Nebraska status is S4.

The Shovelnose Sturgeon was collected twice in the 1939-1941 survey and four times in the 2003-2005 survey. As noted in the habitat preference, they are typically found in the Missouri River and also use the lower ends of large tributaries like the Platte River. They may have disappeared or, at least, declined in the Missouri River upstream of Gavins Point Dam and it's associated Niobrara River. Historically, they were found in the Platte River as far west as Casper, Wyoming. Dams and dewatering have restricted them to the lower Platte River.

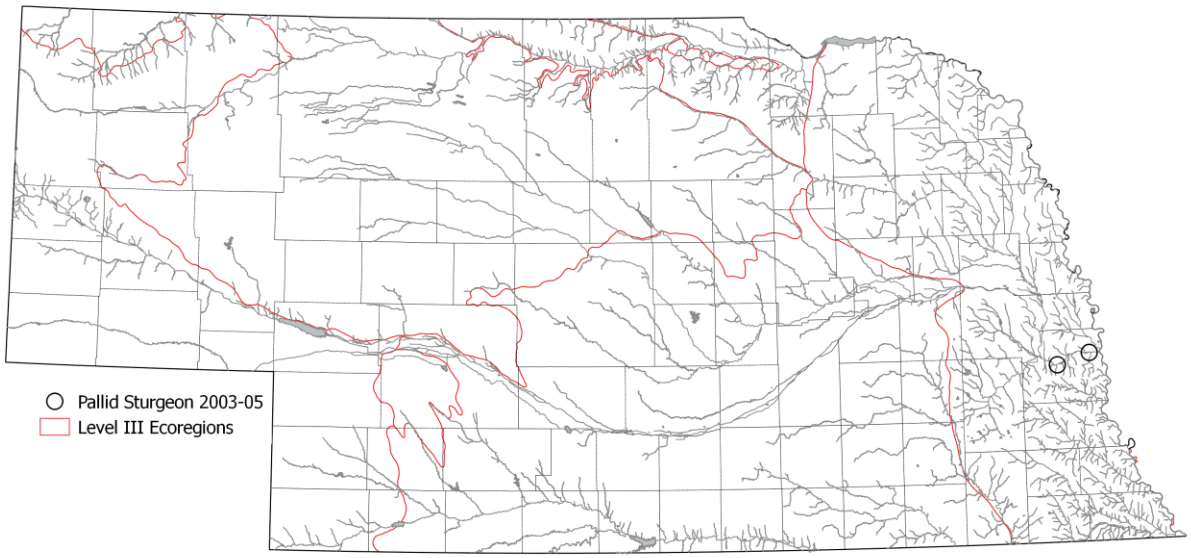
Looking at the results by ecoregion, Smith et.al. (2014) noted that they were only able to do evaluations for three regions. For the Northwestern Glaciated Plains they found a 100% decline (one was collected in the 1939-41 survey and none in the 2003-05 survey). The Western Corn Belt Plains had a 100% increase (two collected in the 1939-41 survey and four in the 2003-05 survey). The overall change was +33%. The species is thinly distributed and uncommon in samples so these numbers really don't mean a whole lot.

The table on the next page shows the water quality, discharge and stream size data. They were found in large streams (>2,000 cfs and wider than 350 meters). In spite of the large size of the streams, the mean depths were less than 40 cm. One stream was quite turbid, while the remaining three were fairly clear.

Habitat conditions of water quality, discharge and stream dimensions where Shovelnose Sturgeon were collected during the 2003-05 stream survey. The values are the actual recorded values.

Shovelnose Sturgeon	Water Temperature (ºC)	Dissolved Oxygen (mg/L)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Site 4	24.9	7.03	541	109.9	3900	500.8	35
Site 24	26.9	7.4	411.1	237	1770	439.2	25
Site 25	27.9	5.99	381.3	182	2090	398.8	10
Site 214	20.8	10.08	678	1040	4210	360.0	20

Pallid Sturgeon, *Scaphirhynchus albus*



Pallid Sturgeon, Scaphirhynchus albus

1939-41	0
2003-05	2
Matches	0
Missing	0
New sites	2
Dry sites	0

The Pallid Sturgeon prefers the turbid waters of the mainstem of the Missouri and Mississippi Rivers where it uses areas with strong currents over a sand bottom. The range of the Pallid Sturgeon is the Missouri River and lower Mississippi River. It's global status is G2 and its Nebraska status is S1.

The Pallid Sturgeon's preference for the mainstem Missouri River may be why there were none collected in the 1939-1941 survey. The species will use the lower Platte River and the recent stocking efforts may be why two were collected in the 2003-2005 survey. Even with total restoration to a G5/S5 status, it is unlikely that many would be collected in any of the state's interior streams. If it follows the pattern of historical collections of it's cousins, the Shovelnose Sturgeon and Lake Sturgeon, it's range will continue to be the Missouri River and, perhaps, the larger tributaries like the Platte and Elkhorn.

Looking at the results by ecoregion, Smith et.al.(2014) noted that the species was not found in the historical survey so changes could not be evaluated.

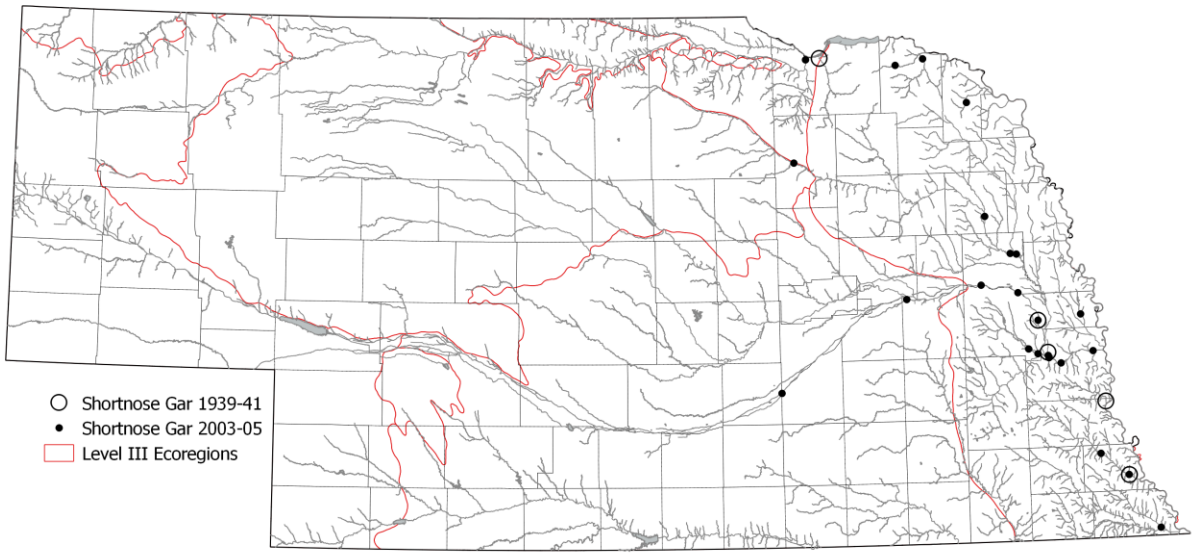
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Pallid Sturgeon was collected during the 2003-05 stream survey. It is a "big river" species and the data show that. Discharges were greater than 3,900 cfs and stream widths over 350 meters even though the mean depths were less than 40 cm. One stream was very turbid, the other wasn't.

Habitat conditions of water quality, discharge and stream dimensions where Pallid Sturgeon were collected during the 2003-05 stream survey. The values are the actual recorded values.

Pallid Sturgeon	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Site 4	24.9	7.03	541	109.9	3900	500.8	35
Site 214	20.8	10.08	678	1040	4210	360.0	20

LEPISOSTIIDAE
Gar Family

Shortnose Gar, *Lepisosteus platostomus*



Shortnose Gar, Lepisosteus platostomus

1939-41	5
2003-05	23
Matches	2
Missing	3
New sites	21
Dry sites	0

The Shortnose Gar prefers the quiet water areas of large warmwater rivers including shallow backwaters, oxbows and pools. They are native to the Mississippi River system. It's global status is G5 and its Nebraska status is S5.

The Shortnose Gar was collected at five sites in the 1939-1941 survey and 23 sites in the 2003-2005 survey. The total number collected tripled from 15 in 1939-1941 and 35 in 2003-2005 but the number per site actually dropped. The Shortnose Gar is commonly found in the Missouri River and the lower ends of its tributaries. That it sometimes moves a considerable distance upstream into tributaries as evidenced by the collections in the Middle Platte River and the upper Elkhorn. Overall, in spite of the increase in the number of sites where it was collected, the distribution probably hasn't changed much.

Looking at the results by ecoregion, Smith et.al.(2014) noted a net change of zero in the Northwestern Glaciated Plains and an increase of 375% in the Western Corn Belt Plains. The overall change was +360%. The Shortnose Gar is a larger-bodied fish that typically swims near the surface of the stream. As such, they might be able to avoid a seine but larger bodied fishes can also be adept at avoiding an electrofishing crew. So, whether this increase is real or an artifact of the sampling is not known.

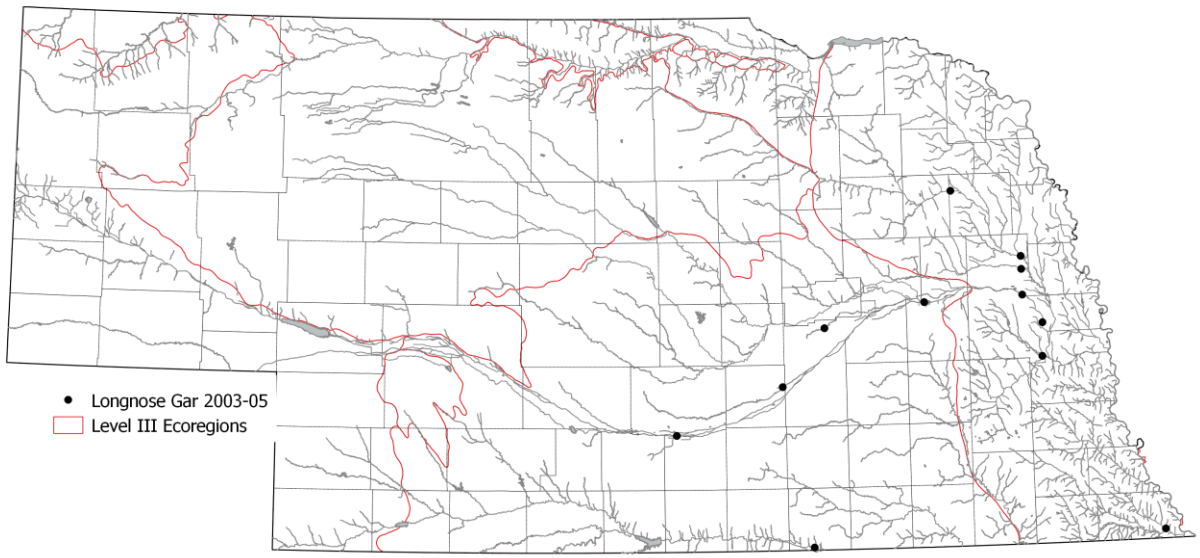
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Shortnose Gar was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Shortnose Gar was collected during the 2003-05 stream survey.

Shortnose Gar	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	16.4	1.4	270	4.0	5.4	6.3	2
Maximum	34.9	10.4	1143	1040	4210	501	37
Median	24.9	7.1	623	65	97.9	36.8	23
80% Exceedance	20	2.4	375	28	19.4	11.3	12
20% Exceedance	28	8.9	741	119	594	264.3	29

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). 80**% Exceedance** means 80% of recorded values were higher than this value while **20% Exceedance** means 20% of recorded values were higher.

Longnose Gar, *Lepisosteus osseus*



Longnose Gar, Lepisosteus osseus

1939-41	0
2003-05	12
Matches	0
Missing	0
New sites	12
Dry sites	0

The Longnose Gar prefers low to medium gradient streams and rivers where it inhabits the main stream as well as oxbows and off-channel areas. It is tolerant of moderate currents and prefers clearer waters. The Longnose Gar is widespread throughout the eastern US from Texas to Florida to New York and Minnesota. It's global status is G5 and its Nebraska status is S4.

The Longnose Gar was not collected in the 1939-1941 survey. It was found 12 times in 2003-2005, mainly in the Platte, Elkhorn and Loup Rivers with single collections in the Big Nemaha and Republican Rivers. Despite having only 12 data points, the map is a fair representation of it's range in Nebraska where it is most commonly found in the Missouri River and Platte River. Raymond Johnson comments on collections of the Longnose Gar in Nebraska but did not find any himself. Our collections data actually shows only two collections in the 1960's and none before then. Since then there have been some 150. Of these, 54 were from the Missouri River and 68 were from the Platte River. The data suggests that the species has increased it's range in Nebraska.

Looking at the results by ecoregion, Smith et.al.(2014) did not evaluate them since there were no historical collections.

The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Longnose Gar was collected during the 2003-05 stream survey.

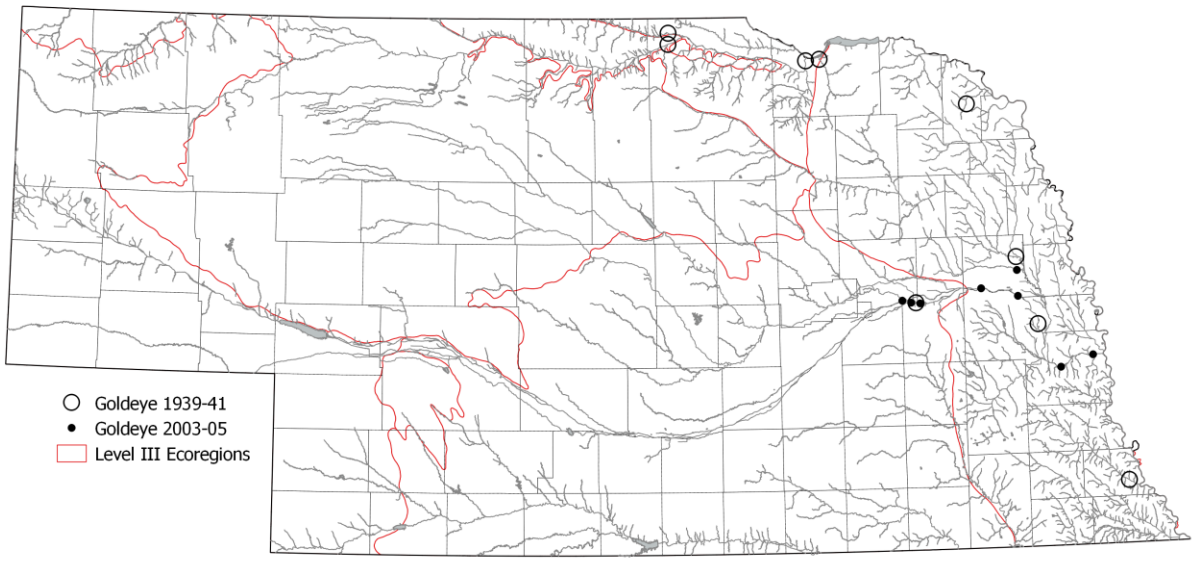
Habitat conditions of water quality, discharge and stream dimensions where Longnose Gar were collected during the 2003-05 stream survey.

Longnose Gar	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	19.1	1.6	370.5	8.2	5.0	5.8	8
Maximum	32.9	7.7	1143	237	2090	439.2	37
Median	27.4	1.8	622	25.3	47.6	18.7	20
75% Exceedence	24.3	1.6	381.3	9.9	8.7	11.1	10
25% Exceedence	28.6	4.1	746	73.8	494	116.3	25

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **75% Exceedance** means 75% of recorded values were higher than this value while **25% Exceedance** means 25% of recorded values were higher.

HIODONTIDAE
Mooneye Family

Goldeye, *Hiodon alosoides*



Goldeye, Hiodon alosoides

The Goldeye prefers medium to large rivers where it lives in areas with fast current. It is tolerant of turbidity. It's occasional collection in smaller tributaries may be due to spawning migrations. The Goldeye is native to the Mississippi River basin though it ranges up into Canada. It's global status is G5 and its Nebraska status is S5.

1939-41	9
2003-05	8
Matches	1
Missing	8
New sites	7
Dry sites	0

The Goldeye is native to the Missouri River where it is most often found. It does range westward into the Platte River and up the Elkhorn which the map above supports. The two collections in 1939-1941 in the southeast and northeast were smaller tributaries which the Goldeye may enter at times. The species may have disappeared from the Niobrara River.

Looking at the results by ecoregion, Smith et.al.(2014) noted that the Goldeye had disappeared from the Northwestern Glaciated Plains (-100%) and the Northwestern Great Plains (-100%). They had doubled in the Central Great Plains and had also increased in the Western Corn Belt Plains (+25%). The overall change was a decrease of 11%.

The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Goldeye was collected during the 2003-05 stream survey. Only minimum, maximum and median values are shown as there were not enough collections to do 75% and 25% exceedance.

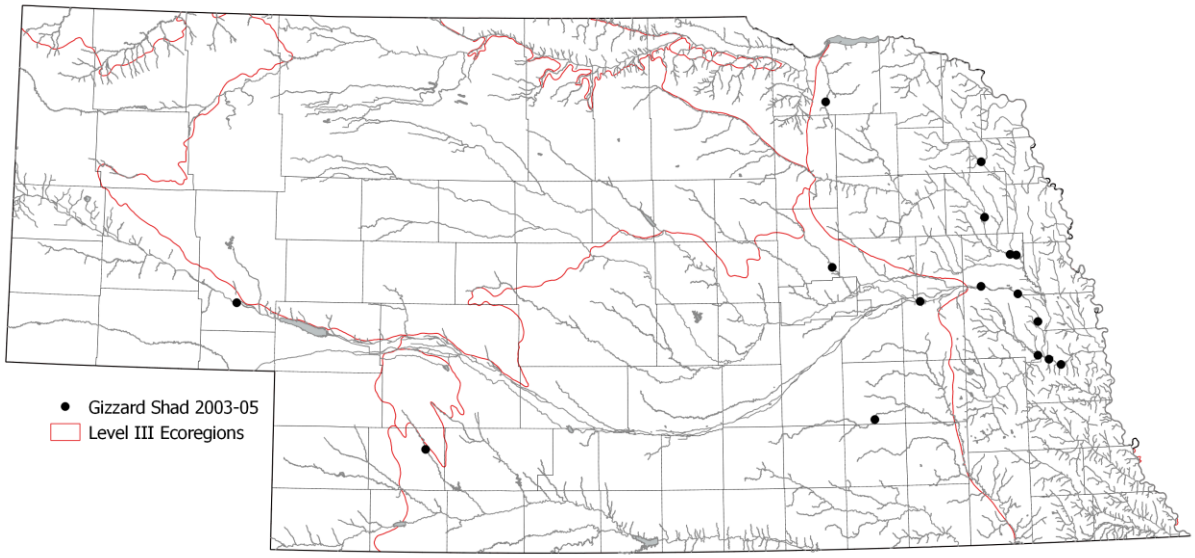
Habitat conditions of water quality, discharge and stream dimensions where the Goldeye was collected during the 2003-05 stream survey.

Goldeye	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	19.1	1.58	281.3	14.9	16.1	18.6	10
Maximum	27.9	10.08	994	1063	4210	500.8	35
Median	24.9	6.51	599.5	207.5	1620	362.3	17
75% Exceedence	24.3	1.6	381.3	9.9	8.7	11.1	10
25% Exceedence	28.6	4.07	746	73.8	494.0	116.3	25

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **75% Exceedance** means 75% of recorded values were higher than this value while **25% Exceedance** means 25% of recorded values were higher.

CLUPEIDAE
Herring Family

Gizzard Shad, *Dorosoma cepedianum*



Gizzard Shad, Dorosoma cepedianum

1939-41	0
2003-05	17
Matches	0
Missing	0
New sites	17
Dry sites	0

The Gizzard Shad prefers the quieter waters such as lakes, oxbows, and sloughs or slow current areas in rivers. They tolerate both clear and turbid water so long as plankton production is good. The Gizzard Shad is native to much of North America from the Great Plains to the Atlantic and Mexico to Canada. It's global status is G5 and its Nebraska status is S5.

While the map doesn't show them, the Gizzard Shad was collected numerous times in the 1939-1941 survey. It is just that the collections came from the Missouri River or lakes which were not done in the 2003-2005 survey. The species has been stocked into reservoirs as a prey fish and the two collections in western Nebraska derive from these. The collections from the lower Platte River, the Elkhorn River, the Loup basin and Bazile Creek to the north probably originated in the Missouri but are now residents of these streams. The collection from the West Fork Big Blue River is hard to explain as that is the only time this species has been found in this river basin. Overall, the range of the Gizzard Shad has expanded greatly since the 1939-1941 survey.

Looking at the results by ecoregion, Smith et.al.(2014) did not calculate in changes because there were no historical collections from the interior streams.

The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Gizzard Shad was collected during the 2003-05 stream survey.

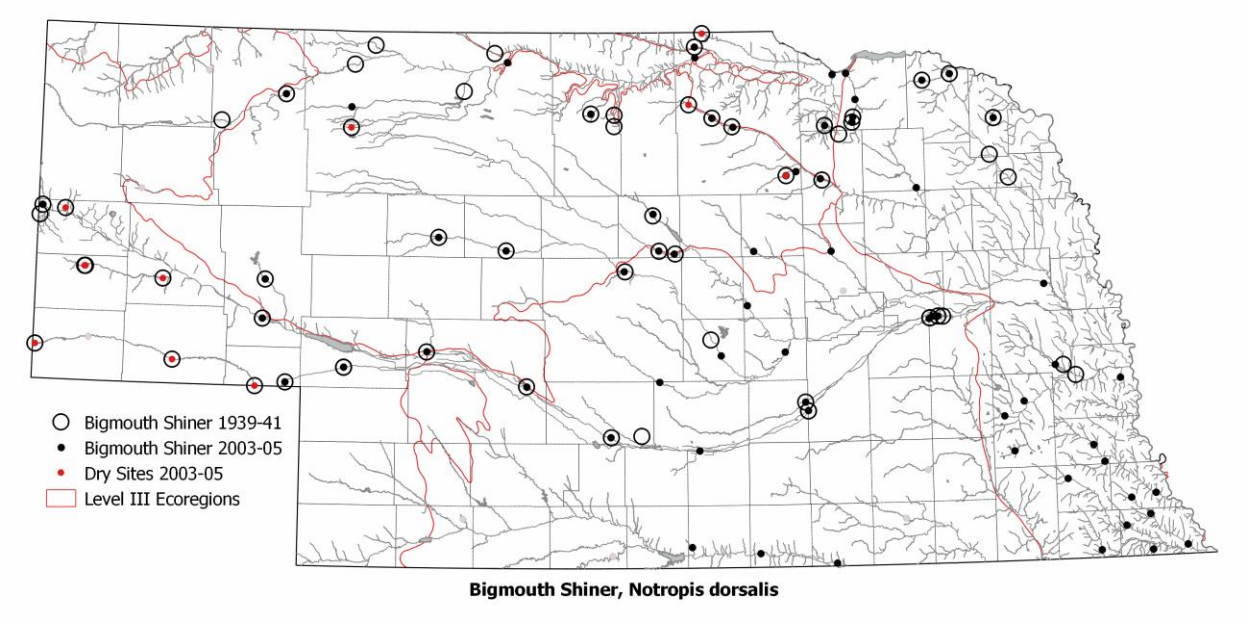
Habitat conditions of water quality, discharge and stream dimensions where the Gizzard Shad was collected during the 2003-05 stream survey.

Gizzard Shad	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	17.7	1.37	367.5	13.6	3.7	5.6	8
Maximum	31.5	9.47	1143	470	3900	500.8	35
Median	25.4	6.51	529	79	81.7	54.4	23
75% Exceedance	22,7	1.6	376.5	30.7	16.1	11.3	18
25% Exceedance	28	7.5	658	109.9	594.3	139.3	25

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **75% Exceedance** means 75% of recorded values were higher than this value while **25% Exceedance** means 25% of recorded values were higher.

CYPRINIDAE
Minnow Family

Bigmouth Shiner, *Notropis dorsalis*



Bigmouth Shiner, Notropis dorsalis

Raymond Johnson noted that the Bigmouth Shiner showed a preference for small streams with a sand bottom and higher flows. He also distinguished two subspecies, *Notropis dorsalis dorsalis* and *Notropis dorsalis pipolepis*. He found *N.d.pipolepis* in the Horse and Pumpkin Creek tributaries to the North Platte River. *N.d.dorsalis* was mainly found in the Elkhorn and lower Platte Rivers. The rest of his collections were intergrades. These two subspecies were subsequently synonymized as *Notropis dorsalis*.

1939-41	62
2003-05	64
Matches	32
Missing	20
New sites	32
Dry sites	10

The Bigmouth Shiner was collected at 62 sites in 1939-41 and at 64 sites in 2003-05 of which half matched the 1939-41 collection sites. In the 1939-41 survey, it was the sixth most commonly collected species. In the 2003-05 survey, despite an increase in the number of sites where it was collected, it dropped slightly to ninth in frequency of occurrence.

The pattern of the collections suggest an expansion of the range of the species in the Lower Platte, Nemaha and Republican River basins. The "missing" sites in the middle reaches of the Niobrara have the appearance of a decline of the species in that area. The new sites in the north-central and north-east are bracketed by historic collections.

Looking at the results by ecoregions Smith et.al. (2014) noted declines in the Western High Plains (-38%), Nebraska Sand Hills (-14%) and Northwestern Great Plains (-33%). They noted increases in the Central Great Plains (+36), Northwestern Glaciated Plains (+33%) and Western Corn Belt Plains (+23%). The overall change was +23%.

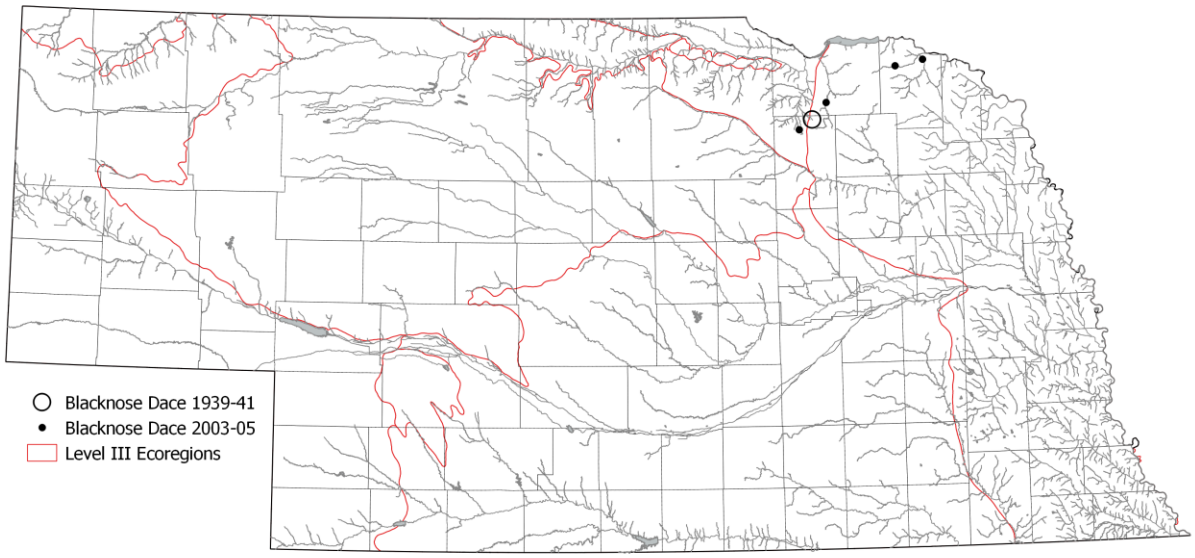
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Bigmouth Shiner was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Bigmouth Shiner was collected during the 2003-05 stream survey.

Bigmouth Shiner	Water Temperature (C)	Dissolved Oxygen (mg/L)	Specific Conductance (umhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	14.6	1.58	14.1	0.19	0.3	2.3	1.8
Maximum	34.9	13.7	2180	1063	1160	372.7	51
Median	22	7.01	472	15.3	37.0	16.9	14.3
90% Exceedance	19.8	4.07	262	7.9	8.5	7.2	10
10% Exceedance	25.6	8.04	665	49	112.0	43.7	25

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). 90**% Exceedance** means 90% of recorded values were higher than this value while 10**% Exceedance** means 10% of recorded values were higher.

Blacknose Dace, *Rhinichthys atratulus*



Blacknose Dace, Rhinichthys atratulus

1939-41	1
2003-05	4
Matches	0
Missing	1
New sites	4
Dry sites	0

The Blacknose Dace prefers cool, clear perennial streams with sand and gravel beds. The Blacknose Dace is native to the northern US and southern Canada from North Dakota to Maine and south down the Appalachians to Georgia. It's global status is G5 which means it is "Common, widespread and abundant (although it may be rare in parts of it's range)".

The Blacknose Dace was collected at one site in the 1939-41 and four sites in 2003-2005. There isn't too much one can say about this species. The Nebraska populations are disjunct from the nearest populations in central Iowa and southwest Minnesota.

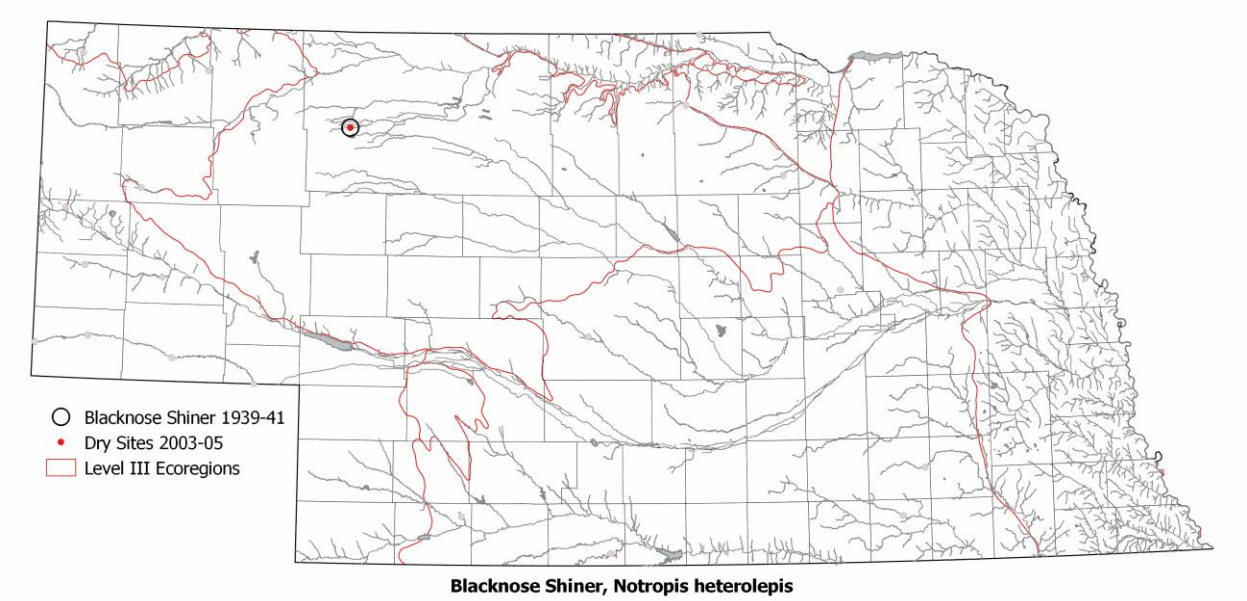
Looking at the results by ecoregion, Smith et.al. (2014) noted no change in any individual ecoregion but an overall increase of 300%.

The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Blacknose Dace was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Blacknose Dace was collected during the 2003-05 stream survey. Since only four collections were made, the table below shows the actual recorded values.

Blacknose Dace	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Site 39	21	8.04	572	12	1.5	2.3	13
Site 290	21.4	7.95	389	3.7	1.6	2.5	14
Site 293	20	9.84	830	16.6	8.5	6.3	10
Site 294	30.4	9.42	796	56.8	69.0	30.7	15

Blacknose Shiner, *Notropis heterolepis*



Blacknose Shiner, Notropis heterolepis

The Blacknose Shiner prefers low gradient perennial prairie streams with cool, clear vegetated waters. They do not tolerate turbidity and will disappear if the waters become dirty or the vegetation disappears. The Blacknose Shiner is native to the northern US and southern Canada from North Dakota to Maine and from Missouri to Hudson's Bay. It's global status is G4 which means it is "Apparently secure". In Nebraska, they are a Tier I at-risk species (S1).

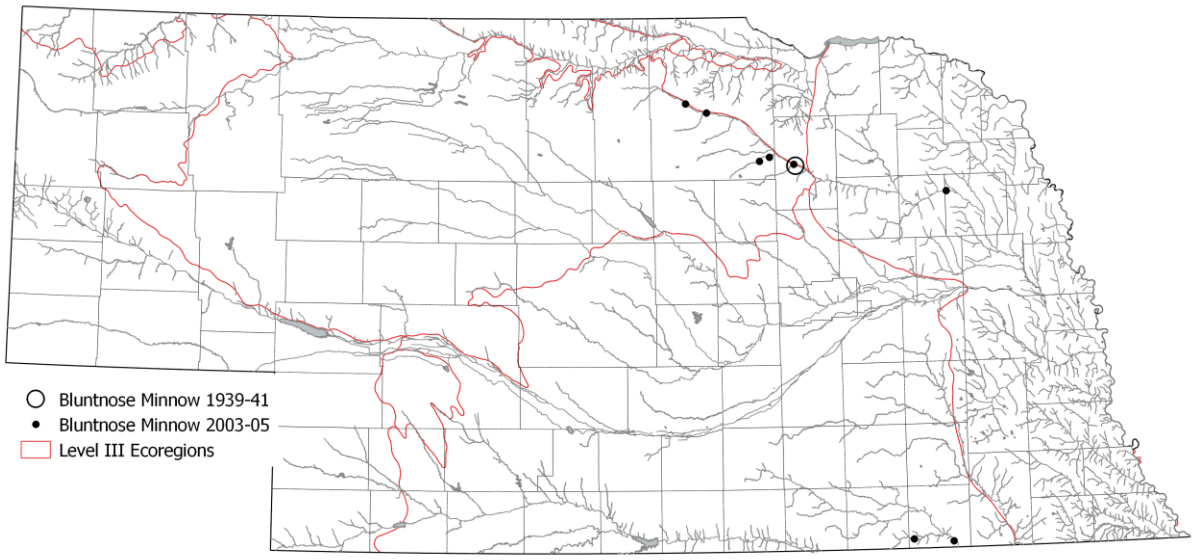
1939-41	1
2003-05	0
Matches	0
Missing	1
New sites	0
Dry sites	0

The Blacknose Shiner was collected at one site in the 1939-41 and none in 2003-05. There have been two periods for the collection of the Blacknose Shiner in Nebraska. In the 1890's, it was collected from numerous sites in north-central Nebraska. In more recent years, it has been increasingly difficult to find these. When we do collect Blacknose Shiner, it is typically a single specimen. A rare species like this that appears to maintain small populations so the chances of missing them in any given survey are high.

The Blacknose Shiner was collected once in 1939-41 but not at all in the 2003-05 survey so an ecoregion evaluation (Smith et.al. 2014) could not be done. Assume a 100% decline.

Since none were collected in the 2003-05 survey, there is no data with which to construct the stream size or water quality table.

Bluntnose Minnow, *Pimephales notatus*



Bluntnose Minnow, Pimephales notatus

1939-41	1
2003-05	8
Matches	1
Missing	0
New sites	7
Dry sites	0

The Bluntnose Minnow can be found in all types of water though it does best in streams of moderate size which drain lands with a lot of organic matter and with high phytoplankton. It often does best in waters that lack it's close relative, the Fathead Minnow. The Bluntnose Minnow is native to the much of the eastern US except for the Atlantic Coast. It's global status is G5 as it is a common and widespread species.

The Bluntnose Minnow was collected at one site in the 1939-41 survey (11 fish) and eight sites in 2003-2005 (668 fish). The map and the numbers collected suggest that it's range has increased since the 1939-1941 survey. It is possible that it was present in the same streams in both surveys, but was much less common and was missed in 1939-1941.

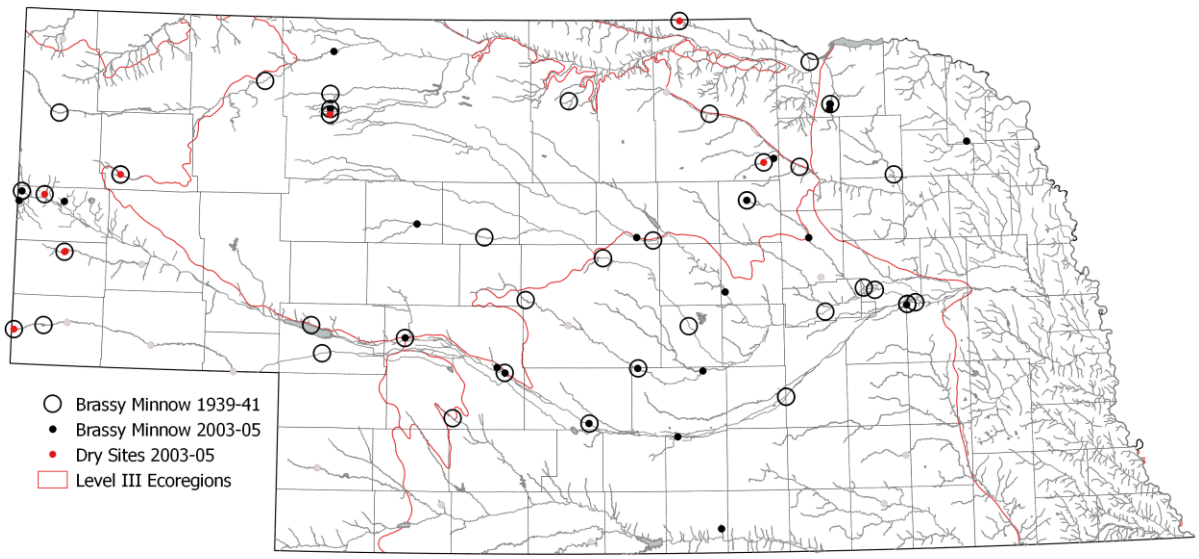
Looking at the results by ecoregion, Smith et.al.(2014) noted that it had increased by 300% in the Nebraska Sand Hills. It was found in the Central Great Plains region in the 2003-05 survey but not in the earlier 1939-41 survey. The overall change was +600%.

The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Bluntnose Minnow was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Bluntnose Minnow was collected during the 2003-05 stream survey. Since fewer than ten collections were made which is too few for computing exceedance, only minimum, maximum and median values are shown.

Bluntnose Minnow	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	16.3	1.61	262.5	0.9	0.3	3.0	5
Maximum	33.9	9.41	675	157	483	91.0	32
Median	26.2	7.12	290	23.2	20.2	11.1	17

Brassy Minnow, *Hybognathus hankinsoni*



Brassy Minnow, Hybognathus hankinsoni

1939-41	39
2003-05	24
Matches	10
Missing	22
New sites	14
Dry sites	7

The Brassy Minnow prefers cool, clear water and are most often found in spring areas in small to medium sized streams. The Brassy Minnow is native to the northern US and southern Canada from Montana to New York then south as far as Kansas. It's global status is G5 and it's Nebraska status is S4.

The Brassy Minnow was collected at 38 sites in the 1939-41 (1,474 fish) and 22 sites in 2003-2005 (411 fish). There were only nine matches while it was missing from 22 sites. Seven sites were dry and they were found at 14 new sites. The missing sites and new sites are interspersed on the map which is somewhat confusing. So what can we make of this?

Our experience is that, if the species is present in a stream, they are present in numbers high enough to be easily collected. We are pretty sure that the total catch for the 1939-41 survey are underreported while those for the 2003-05 survey are correct. The decline in numbers collected from 1,474 to 411 along with the decline in the number of sites coupled with the sites where they were missing indicates a major decline. The Brassy minnow's preference for cool, clear waters and the number of open circles in the map above suggest that this species bears watching.

Looking at the results by ecoregion, Smith et.al.(2014) noted that the Brassy Minnow had declined in four regions and increased in one. The declines were in the Central Great Plains (-27%), Western High Plains (-33%), Nebraska Sand Hills (-50%) and Northwestern Glaciated Plains (-100%). They increased in the Western Corn Belt Plains (+100%) for an overall change of -29%.

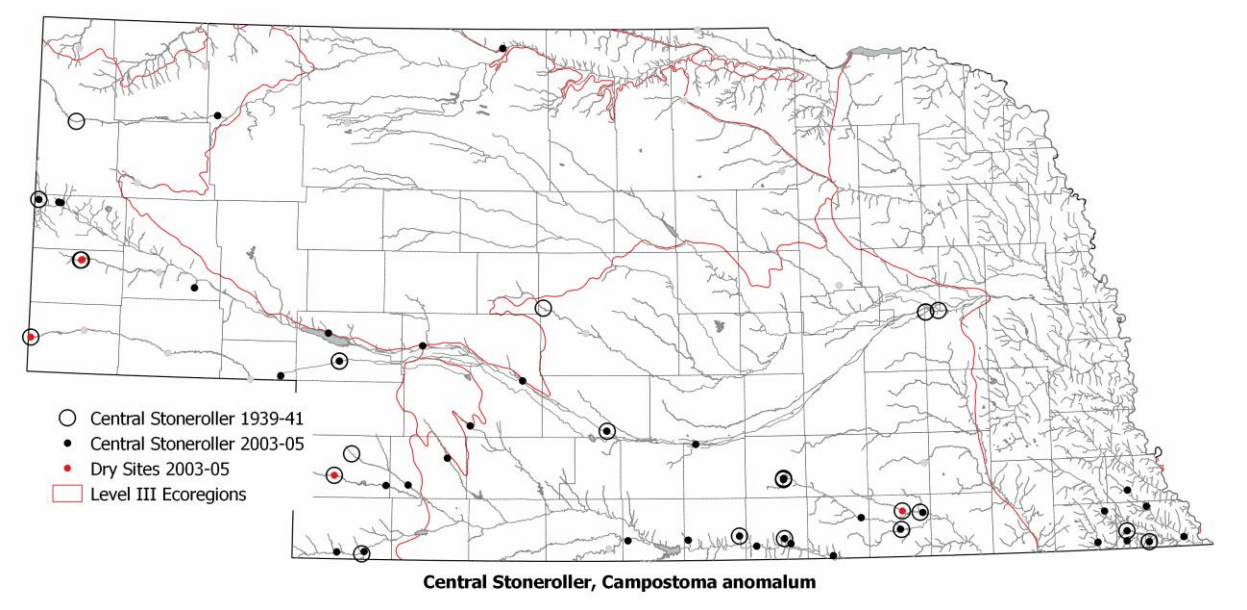
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Brassy Minnow was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Brassy Minnow was collected during the 2003-05 stream survey.

Brassy Minnow	Water Temperature (C)	Dissolved Oxygen (mg/L)	Specific Conductance (umhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	16.1	1.6	120.3	0.19	0.3	2.0	8
Maximum	29.1	9.97	1098	863	591.5	154.8	34
Median	21.7	7.325	491	16.75	29.6	15.4	17
80% Exceedance	19.6	4.96	230.1	2.51	0.7	3.6	11
20% Exceedance	24.7	7.73	814	28	165.8	52.2	29

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **80% Exceedance** means 80% of recorded values were higher than this value while **20% Exceedance** means 20% of recorded values were higher.

Central Stoneroller, *Campostoma anomalum*



Central Stoneroller, Campostoma anomalum

The Central Stoneroller prefers clear, cool small to medium streams having moderate to fast current with gravel bottoms and plenty of pools and riffles. It is tolerant of turbidity and silt. The Central Stoneroller is native to much of the US east of the Continental Divide exclusive of the Gulf and Atlantic Coast streams. It's global status is G5 and its Nebraska status is S5 (widespread, abundant, secure).

1939-41	23
2003-05	39
Matches	11
Missing	8
New sites	28
Dry sites	4

The Central Stoneroller was collected 26 times in 1939-1941 and 40 times in 2003-2005. There were 11 sites where they were collected in both surveys while they were missing from six sites. The 2003-2005 survey found them at 25 new sites and three 1939-1941 sites were dry. There is considerable overlap between the two surveys except for two sites in the lower Platte and one in the South Loup where they were not found. Despite the increase in the number of collections in 2003-2005, it would not appear that there have been any significant changes in distribution with the possible exception of the Niobrara River. In the Niobrara, they are something of an anomaly in that they were only found three times. There was a single headwaters site in 1939-1941 and there were two sites downstream in the 2003-05 survey. This later might represent a downstream range extension.

One oddity is their absence from the Big Blue River basin. They are present the Republican and Little Blue to the west and the Nemaha to the east but not the Big Blue for some reason.

Looking at the results by ecoregion, Smith et.al.(2014) noted that they were found in only three ecoregions and that they had increased in all three. These included: the Central Great Plains (+64%), the Western High Plains (+100%) and the Western Corn Belt Plains (+250%). Overall, the increase was 105%.

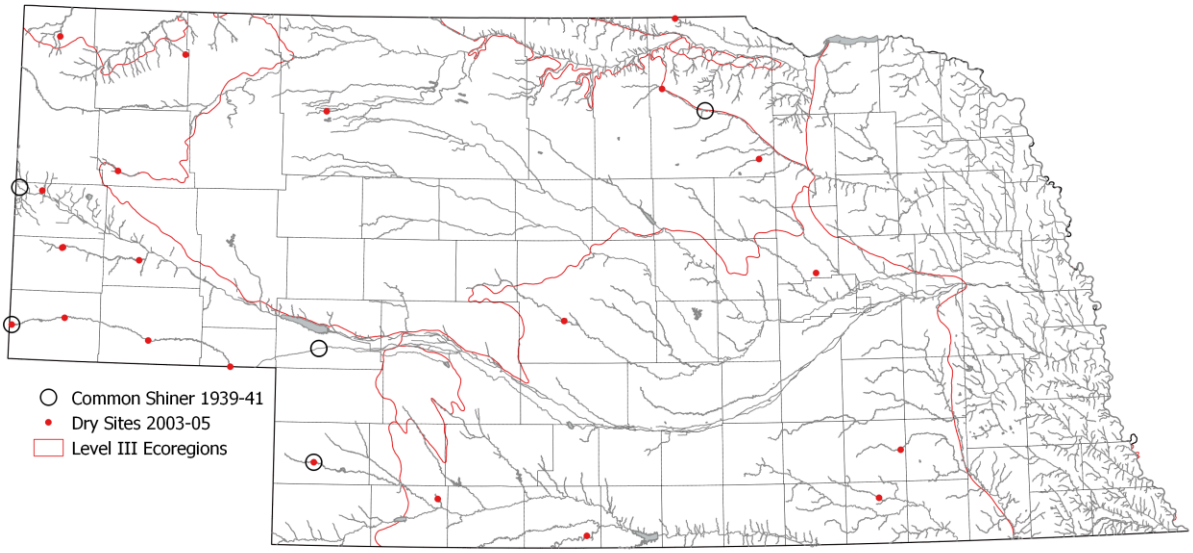
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Central Stoneroller was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Central Stoneroller was collected during the 2003-05 stream survey.

Central Stoneroller	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	13	1.4	200.4	0.5	0	2.2	4.4
Maximum	32.8	13.7	2210	863	494	154.8	37
Median	22.1	7.6	626.5	8.9	7.2	7.8	13
80% Exceedance	18.4	2.5	428.4	2.3	2.3	4.0	8
20% Exceedance	25	9.74	826	30.4	25.9	23.8	27

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **80% Exceedance** means 80% of recorded values were higher than this value while **20% Exceedance** means 20% of recorded values were higher.

Common Shiner, *Luxilus cornutus*



Common Shiner, Luxilus cornutus

The Common Shiner prefers small to medium streams and rivers with clear water and sand/gravel substrates. They do not tolerate siltation and turbidity. The Common Shiner is native to the northern US and extreme southern Canada from the Great Plains to the Atlantic. It's global status is G5 and its Nebraska status is S2 (imperiled).

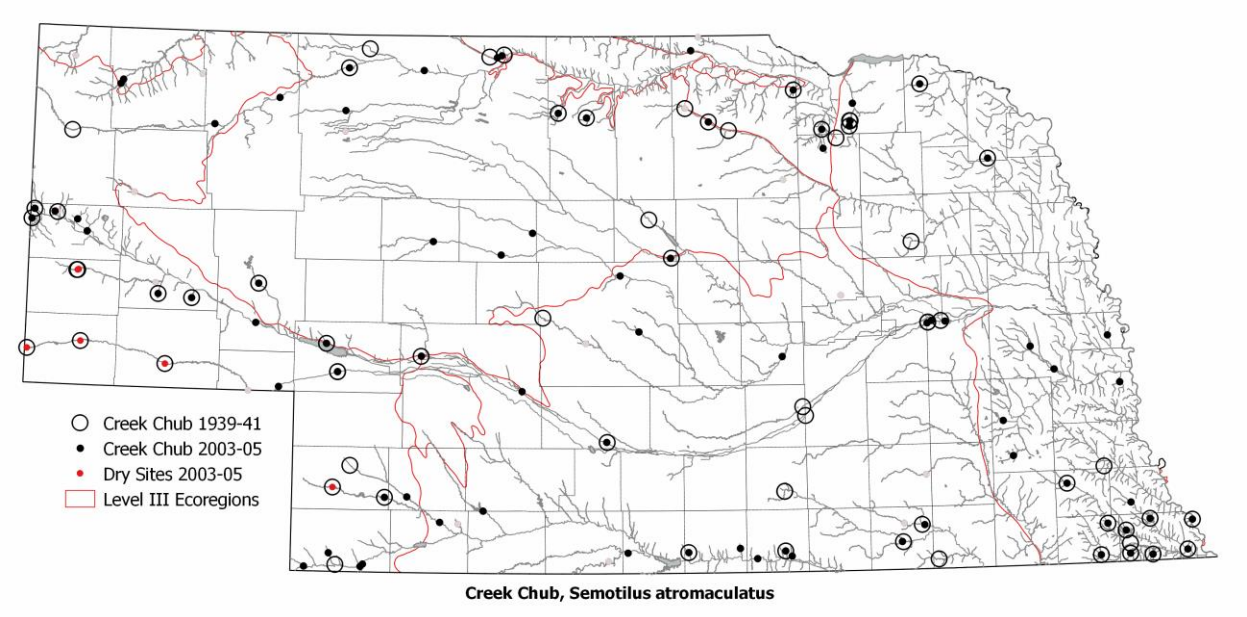
1939-41	5
2003-05	0
Matches	0
Missing	4
New sites	0
Dry sites	1

The Common Shiner was collected from five sites in 1939-1941 (68 fish) and none in 2003-2005. Even where it is found, it is an uncommon species so it is easy to miss. The Lodgepole Creek site was dry in the 2003-2005 survey. Much of Lodgepole Creek was dry in the fall of 2014 so this population may be in hurt city. Both the South Platte River and the Frenchman have been extensively dewatered so these populations may also be in trouble which is supported by the map below. The upper North Platte River has had quite a few collections since 2000 and the 1939-41site on the border was visited in the fall of 2014 and the Common Shiner was found at that time. So the 2003-2005 survey missed them. They have not been recently found at the Elkhorn River site but have been found downstream so that population may be persisting at a very low level. The results of the two surveys suggest that species appears to be in trouble in Nebraska and other data supports this.

Looking at the results by ecoregion, Smith et.al.(2014) noted that it could only be rated in two regions, the Western High Plains and the Nebraska Sand Hills. It declined 100% in both and the overall decline was 100%.

No table of water quality or stream dimensions could be constructed since no Common Shiners were collected in the 2003-05 survey.

Creek Chub, *Semotilus atromaculatus*



Creek Chub, Semotilus atromaculatus

1939-41	61
2003-05	80
Matches	39
Missing	15
New sites	41
Dry sites	7

As its name implies, the Creek Chub prefers creeks and small rivers with clear water and sand/gravel beds. The Creek Chub is native to most of the US and extreme southern Canada east of the Rockies. It's global status is G5 and its Nebraska status is S5 (widespread, abundant, secure).

The Creek Chub was collected 66 times in 1939-1941 and 80 times in the 2003-2005 survey. It was the 4th most commonly found species in 1939-1941 and the 6th most common in 2003-2005. The overall distribution has changed little except, possibly for their appearance in the White and Middle Loup Rivers and the new collections in the lower Platte River basin. But these might be due to the randomness of sampling fishes. There were some sites where they were not found in 2003-2005 that might represent real changes. The upper ends of the Frenchman and Spring Creeks in the Republican River basin have been dewatered by groundwater pumping. The upper ends of the Little Blue and South Loup Rivers have gone dry as has the middle Platte River which could explain the absence of the Creek chub at these sites. The upper Niobrara River site at Agate was invaded by Northern Pike (*Esox Lucius*) from the reservoir downstream which virtually wiped out all small fishes at that site. Two streams in the southern Panhandle, Pumpkin and Lodgepole Creek s have been almost totally dewatered by groundwater pumping which has led to the loss of these populations. Outside of these instances, the species is doing fine statewide.

Looking at the results by ecoregion, Smith et.al. (2014) noted that the Creek Chub had increased in all ecoregions. These include the Central Great Plains (+36%), the Western High Plains (+73%), the Nebraska Sand Hills (+33%), the Northwest Glaciated Plains (+33%), the Northwest Great Plains (+100%) and the Western Corn Belt Plains (+18%) for an overall increase of 39%.

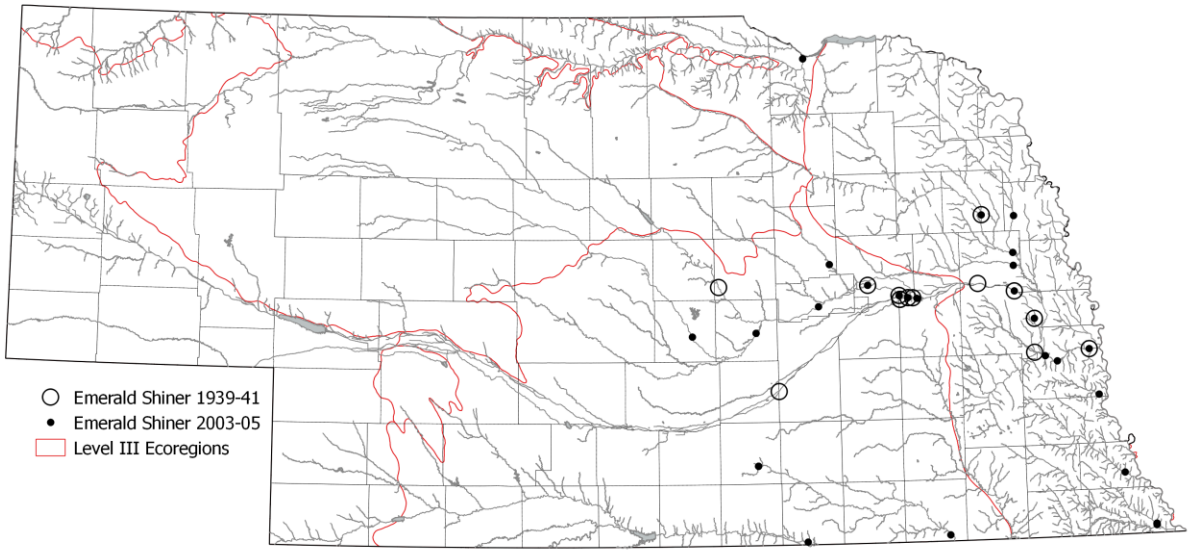
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Creek Chub was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Creek Chub was collected during the 2003-05 stream survey.

Creek Chub	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	13	1.4	151.5	0.48	0	1.0	4
Maximum	34.9	13.7	2210	863	1160	169.2	51
Median	21.4	7.6	538.0	11.4	10.7	7.1	15
90% Exceedance	16.3	2.4	187.7	1.0	0.7	2.9	8
10% Exceedance	27.6	10.03	868	65.1	106.8	50.6	34

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). 90**% Exceedance** means 90% of recorded values were higher than this value while 10**% Exceedance** means 10% of recorded values were higher

Emerald Shiner, *Notropis atherinoides*



Emerald Shiner, Notropis atherinoides

1939-41	13
2003-05	25
Matches	8
Missing	5
New sites	17
Dry sites	0

The Emerald Shiner prefers large rivers and lakes where it lives in large schools in open water. The Emerald Shiner is native to most of the US and Canada from the Gulf Coast northward beyond Hudson's Bay and from the Rockies to Maine. It's global status is G5 and its Nebraska status is S5 (widespread, abundant, secure).

In 1939-1941 it was found in the lower portions of the Platte River, the Loup River and the Elkhorn River where it was the 22nd most commonly collected fish. In 2003-2005 it was still found in the same river reaches but was also found in tributaries to the Missouri. It's relative abundance was about the same at 21st overall. The collections in the Little Blue and Republican Rivers may represent range extensions due to releases of bait fish in the large reservoirs in Nebraska and Kansas on those systems. In the Loup basin the new collections in 2003-2005 might suggest range extensions, but this species is migratory so these collections would not be at all surprising.

Looking at the results by ecoregion, Smith et.al.(2014) noted that they were found in only two regions and had increased in both. These were the Central Great Plains (+38%) and the Western Corn Belt Plains (+117%) with an overall increase of +79%.

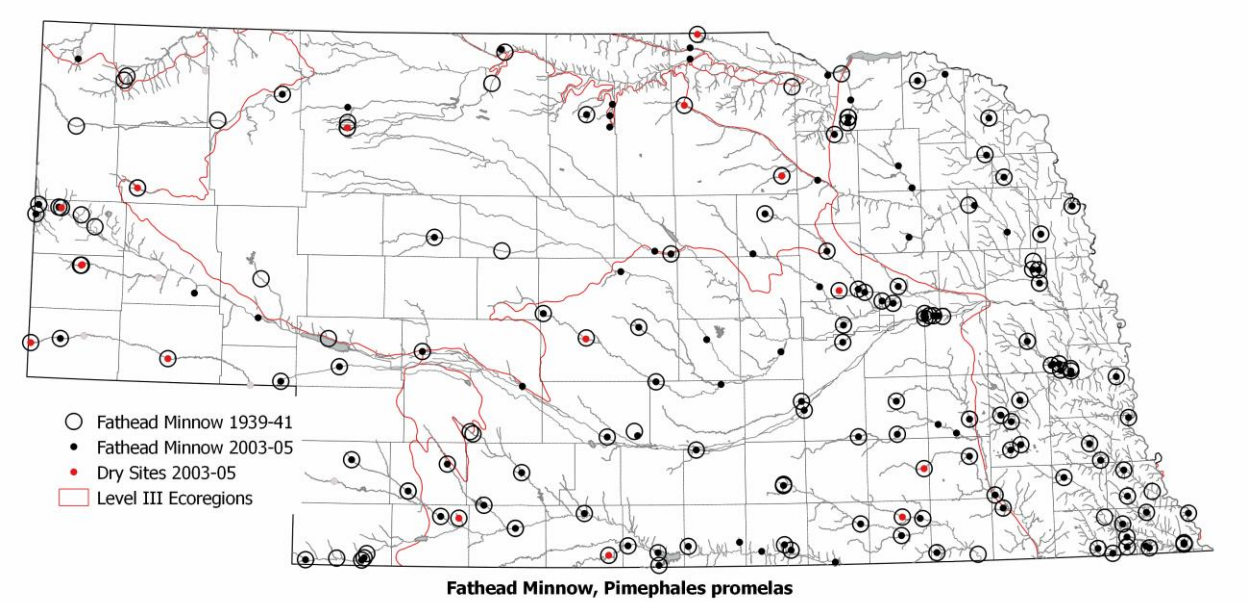
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Emerald Shiner was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Emerald Shiner was collected during the 2003-05 stream survey.

Emerald Shiner	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	14.6	1.37	244.1	9.7	0.5	9.6	2
Maximum	34.9	10.88	994	1063	4210	500.8	58
Median	25.0	5.1	434.0	83.2	215.5	79.2	20.6
80% Exceedance	19.5	1.7	309.7	30.8	23.9	18.6	13
20% Exceedance	27.9	8.51	658	182	1410.0	360.0	28

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **80% Exceedance** means 80% of recorded values were higher than this value while 2**0% Exceedance** means 20% of recorded values were higher.

Fathead Minnow, *Pimephales promelas*



Fathead Minnow, Pimephales promelas

The Fathead Minnow prefers water. That's pretty general and that is what they are, a generalist. Small streams, large rivers, ponds, and lakes are all suitable habitats. Turbid water and mud bottoms are just fine. The Fathead Minnow is native to most of the US and Canada from the Gulf Coast northward beyond Hudson's Bay and from the Rockies to Maine. It's global status is G5 and its Nebraska status is S5 (widespread, abundant, secure).

1939-41	146
2003-05	136
Matches	104
Missing	27
New sites	32
Dry sites	15

This is one species that was collected at more sites in 1939-1941 than in 2003-05. It was the most common fish collected in 1939-1941 and the second most common in 2003-2005. From available records, we can tally 4,085 caught in 1939-1941 which may not include fish that were identified and released. In 2003-2005 a total of 9,582 were sampled.

Looking at the results by ecoregion, Smith et.al. (2014) noted that Fathead Minnows had increased in three ecoregions; the Central Great Plains (+21%), the Northwestern Great Plains (+33%) and the Western Corn Belt Plains (+8%). They noted declines in two regions: the Western High Plains (-18%) and the Nebraska Sand Hills (-10%). There was no change in the Northwestern Glaciated Plains. Overall, the species increased by 8%.

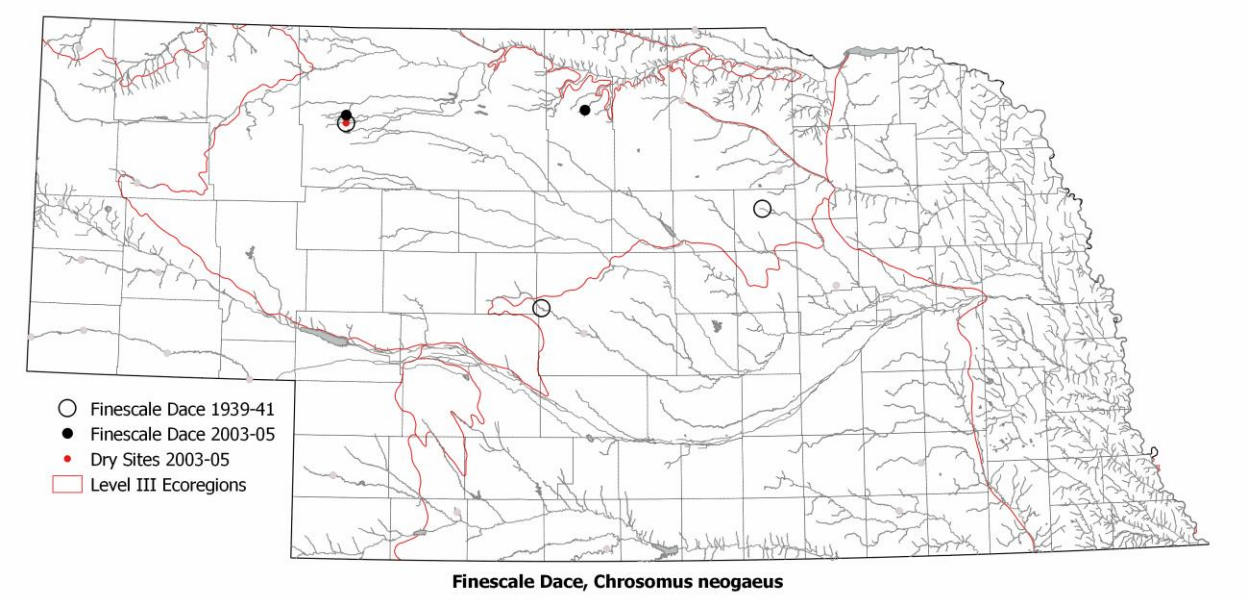
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Fathead Minnow was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Fathead Minnow was collected during the 2003-05 stream survey.

Fathead Minnow	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	14.6	0.78	14.06	0.19	0.00	1.0	2
Maximum	34.9	13.7	4672	1063	1715	372.7	68
Median	22.9	6.7	580.5	23.0	16.0	10.4	17
90% Exceedance	16.8	1.7	249.3	2.5	0.6	3.4	8
10% Exceedance	29.1	9.47	908	148	305.1	91.0	34

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). 90**% Exceedance** means 90% of recorded values were higher than this value while 10**% Exceedance** means 10% of recorded values were higher.

Finescale Dace, *Chrosomus neogaeus*



Finescale Dace, Chrosomus neogaeus

The Finescale Dace prefers cool, clear vegetated streams but will also use marshes, sloughs and beaver ponds if they are clear and cool. The Finescale dace is native along the US/ Canada border from Minnesota to Maine with isolated populations in Canada. It's global status is G5 and its Nebraska status is S1 (critically imperiled).

1939-41	3
2003-05	2
Matches	0
Missing	2
New sites	2
Dry sites	1

This is one of the rarer species in Nebraska. Note that one of the 2003-2005 new sites is obscured by the dry site. The Finescale Dace is present in Nebraska as a relict of the last glaciation and survives in the cool headwater streams. Most of these are in the Sandhills but, wherever they occur, these habitats are at risk due to groundwater development leading to declining streamflows. The upper South Loup River went dry a few years ago and none have been seen there since.

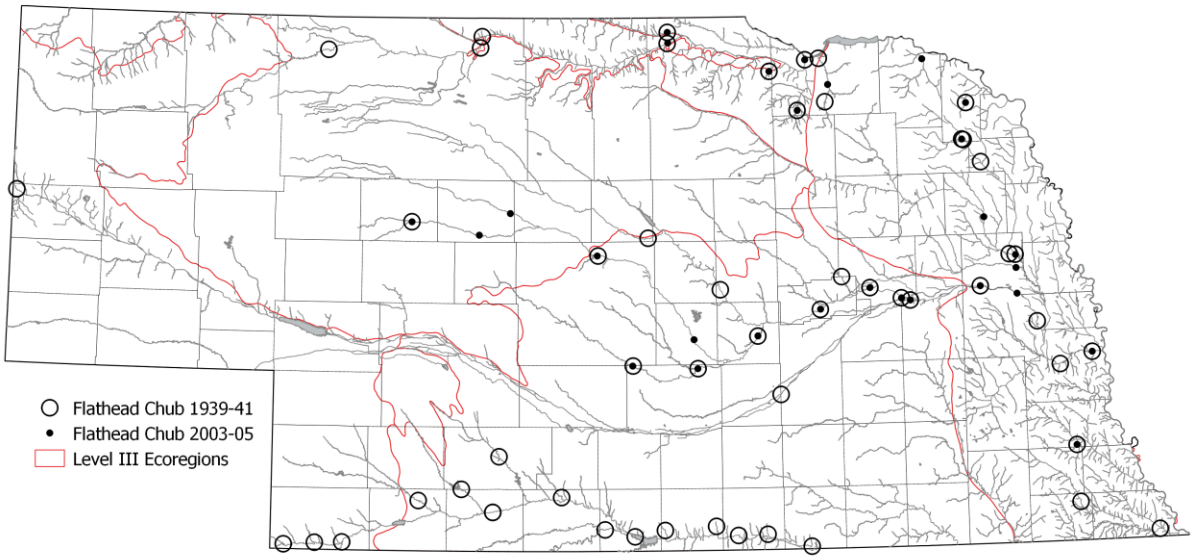
Looking at the results by ecoregion, Smith et.al.(2014) noted that there was a 100% increase in the Nebraska Sand Hills and a 100% decrease in the Central Great Plains for a net change of zero.

The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Finescale Dace was collected during the 2003-05 stream survey. Since there were only two collections, only the actual recorded values are listed.

Habitat conditions of water quality, discharge and stream dimensions where the Finescale Dace was collected during the 2003-05 stream survey. The table shows the actual recorded values.

Finescale Dace	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Site 52	19.5	5.32	187.7	1.9	1.0	3.8	25
Site 136	16.8	4.96	120.3	50	0.3	3.6	16

Flathead Chub, *Platygobio gracilis*



Flathead Chub, Platygobio gracilis

The Flathead Chub prefers large rivers and their tributaries where they use swift channels over sand and gravel bottoms. They are adapted for turbidity and the fluctuating flows typical of Great Plains streams. The Flathead Chub is primarily native to the Missouri River system with populations in the Rio Grande in New Mexico and Canadian River in Oklahoma as well as sites in Canada. It's global status is G5 and its Nebraska status is S5.

1939-41	51
2003-05	28
Matches	21
Missing	30
New sites	7
Dry sites	0

The Flathead Chub has declined markedly since the 1939-1941 survey. It was collected at 52 sites in 1939-1941 and was the 8th most common species found at that time. In 2003-2005 it was found at 28 sites and had dropped to the 21st most commonly collected species. The total number collected in 1939-1941 was 962 compared to 217 in 2003-2005. The map shows that they have completely disappeared from the Republican River basin. Since 1941 several dams built in the basin along with extensive irrigation development have reduced flows and changed the timing of flows to where this species could no longer survive. Some comments in Johnson's field notes are telling. Site 258, Muddy Creek, 17 July 1940: "Platygobio gracilis – Great numbers of young." Site 254, Republican River, 16 July 1940: "Platygobio gracilis – Very abundant in stream, hugging bottom in current." Site 261, Red Willow Creek, 18 July 1940: "Platygobio gracilis – Very abundant, especially in narrow eroded channels in the stream bottom where current is swift."

The Nebraska species conservation status is S5 (widespread, abundant and secure). It should be S4 (not rare and apparently secure) or, perhaps, S3 (rare or uncommon but not imperiled).

Looking at the results by ecoregion, Smith et.al. (2014) noted that the species had declined in five ecoregions; the Central Great Plains (-63%), the Western High Plains (-100%), the Northwest Glaciated Plains (-20%), the Northwest Great Plains (-67%) and the Western Corn Belt Plains (-15%). The Nebraska Sand Hills had an increase of 50% but overall there was a 45% decline.

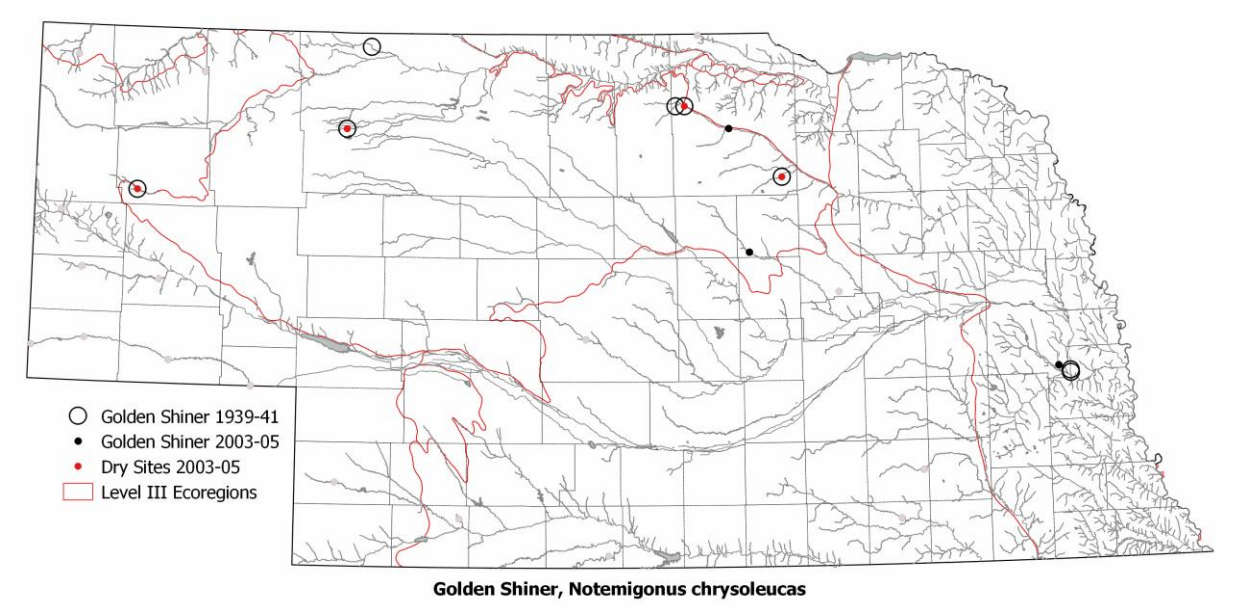
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Flathead Chub was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Flathead Chub was collected during the 2003-05 stream survey.

Flathead Chub	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	14.6	1.37	168.2	9.35	8.8	4.8	2
Maximum	34.9	10.08	1098	1063	4210	398.8	51
Median	23.7	6.6	361.6	56.1	192.3	59.1	21
80% Exceedance	19.1	2.0	253.9	17.4	51.1	15.1	12
20% Exceedance	27.9	8.51	565	119	1160.0	240.5	29

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). 8**0% Exceedance** means 80% of recorded values were higher than this value while 2**0% Exceedance** means 20% of recorded values were higher.

Golden Shiner, *Notemigonus chrysoleucas*



Golden Shiner, Notemigonus chrysoleucas

1939-41	8
2003-05	3
Matches	0
Missing	4
New sites	3
Dry sites	4

The Golden Shiner prefers the quieter waters such as lakes, oxbows, and sloughs or quiet water areas in rivers. They like clearer waters and lots of vegetation. It is often sold as a bait fish. The Golden Shiner is native to much of North America from the Great Plains to the Atlantic and Mexico to Canada. It's global status is G5 and its Nebraska status is S5.

The Golden Shiner was collected at eight sites in 1939-41 of which half were dry in 2003-05. There was an almost-match down in the lower Platte basin. Other than that, these data don't provide much insight into the status of the species. The species is predominately found in the north-central part of the state with additional populations in the southeast. Since the Golden Shiner is often sold as bait, some of these populations could be the result of the release of bait fish.

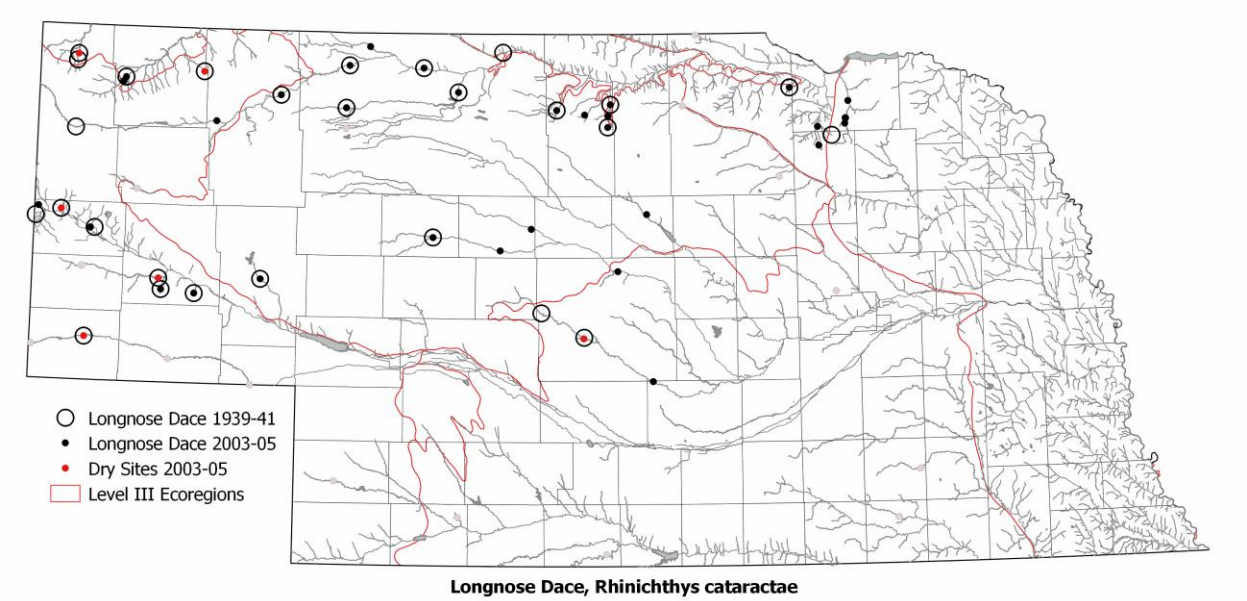
Looking at the results by ecoregion, Smith et.al. noted that the Golden Shiner had only been found in two regions and that they had declined in both. These were the Nebraska Sand Hills (-33%) and the Western Corn Belt Plains (-50%). The overall change was -40%.

The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Golden Shiner was collected during the 2003-05 stream survey. With only three collections, the table simply lists the actual recorded values.

Habitat conditions of water quality, discharge and stream dimensions where the Golden Shiner was collected during the 2003-05 stream survey. The table shows the actual recorded values.

Golden Shiner	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Site 60	18	4.5	163	14.2	156.4	24.5	33
Site 288	30.3	7.62	276.1	15.3	35.1	15.0	16
Site 20/209	17.1	10.31	747	10.63	11.3	7.8	45

Longnose dace, *Rhinichthys cataractae*



Longnose Dace, Rhinichthys cataractae

1939-41	27
2003-05	32
Matches	16
Missing	5
New sites	16
Dry sites	6

The Longnose Dace prefers cool water streams with moderate to high gradient and sand or gravel beds. The Longnose Dace is found in the cool waters of the northern US from the Pacific to the Atlantic as well as much of Canada. The US range of this species extends down the Rocky Mountains into Mexico and down the Appalachians to Georgia. It's global status is G5 and its Nebraska status is S4.

The Longnose Dace was collected at 27 sites in 1939-41 and 32 sites in 2003-05 with quite a few matches (16). As a rule, this species, where found, forms large schools and is fairly easy to collect. Hence, if they are there, we find them. Of the 1939-41sites where the species was not found, six were dry in 2003-2005. Of the five sites where it was missing, one, the upper Niobrara River, had been invaded by a predator, the Northern Pike, and virtually all small fishes have disappeared in that stretch of river. Many of the streams in the Hat Creek watershed (extreme northwest corner of state) have suffered severe dewatering by irrigation withdrawals. The upper South Loup has also experienced some extreme low flows in recent years. Aside from this, the Longnose Dace has been doing ok.

Looking at the results by ecoregion, Smith et.al. (2014) noted increases in three, the Central Great Plains (+100%), the Nebraska Sand Hills (+56%) and the Northwest Glaciated Plains (+50%). There was no change in the remainder of the ecoregions. Overall, there was a 52% increase. The Longnose Dace, in our experience, is fairly easy to find if present, irrespective of the sampling method. Therefore the increase is probably real.

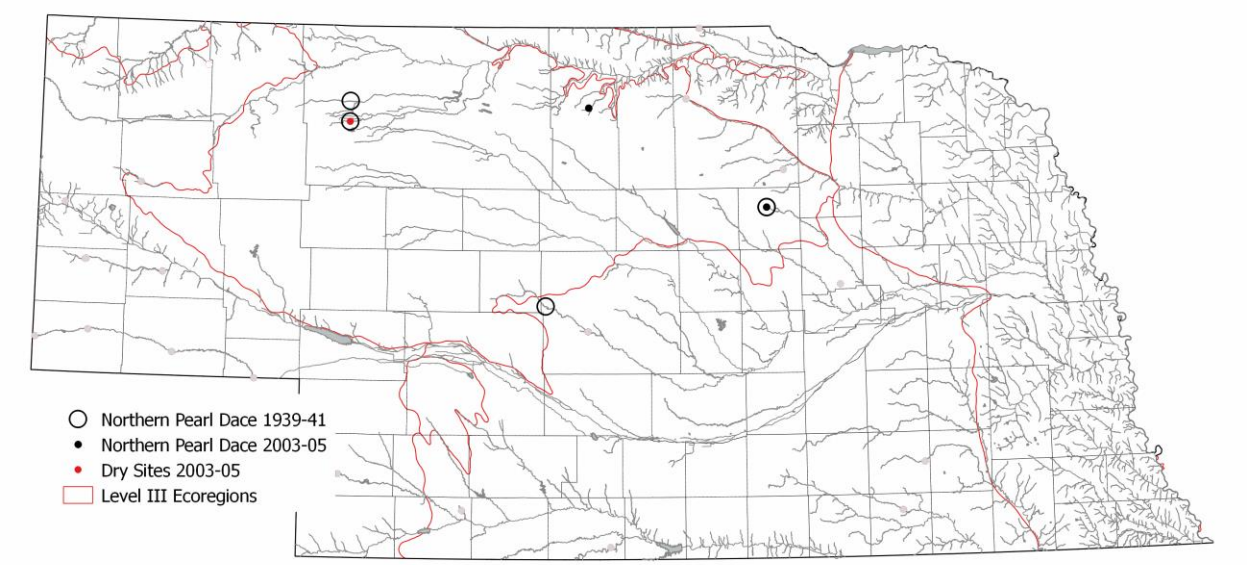
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Longnose Dace was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Longnose Dace was collected during the 2003-05 stream survey.

Longnose Dace	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	14.5	3.28	105.9	0.8	1.0	2.3	8
Maximum	29.6	13.48	919	863	429	122.7	51
Median	22.0	7.7	243.1	9.5	46.5	6.6	26
80% Exceedance	18.8	5.8	157.1	3.3	5.0	3.8	13
20% Exceedance	25.4	8.92	449.9	28	151.0	23.0	35

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). 8**0% Exceedance** means 80% of recorded values were higher than this value while **20% Exceedance** means 20% of recorded values were higher.

Northern Pearl Dace, *Margariscus nachtriebi*



Northern Pearl Dace, Margariscus nachtriebi

The Northern Pearl Dace prefers the cool, clear waters of spring areas of small to medium streams. They are often found in beaver ponds and marshes. The range of the Northern Pearl Dace is Canada and the northern US from Montana to Maine. The Nebraska populations are glacial relicts. It's global status is G5 and its Nebraska status is S1.

1939-41	4
2003-05	2
Matches	1
Missing	2
New sites	1
Dry sites	1

The Northern Pearl Dace was collected four times in the 1939-41 survey (59 fish) and twice in the 2003-05 survey (89 fish). Of these, there was one site where they were collected both times and one site that was dry in 2003-05. The locations shown on the map outline the range of the species which is the north-central part of the state in the central Niobrara and upper reaches of the Loup basin. The South Loup River populations may have been extirpated as a result of stream dewatering.

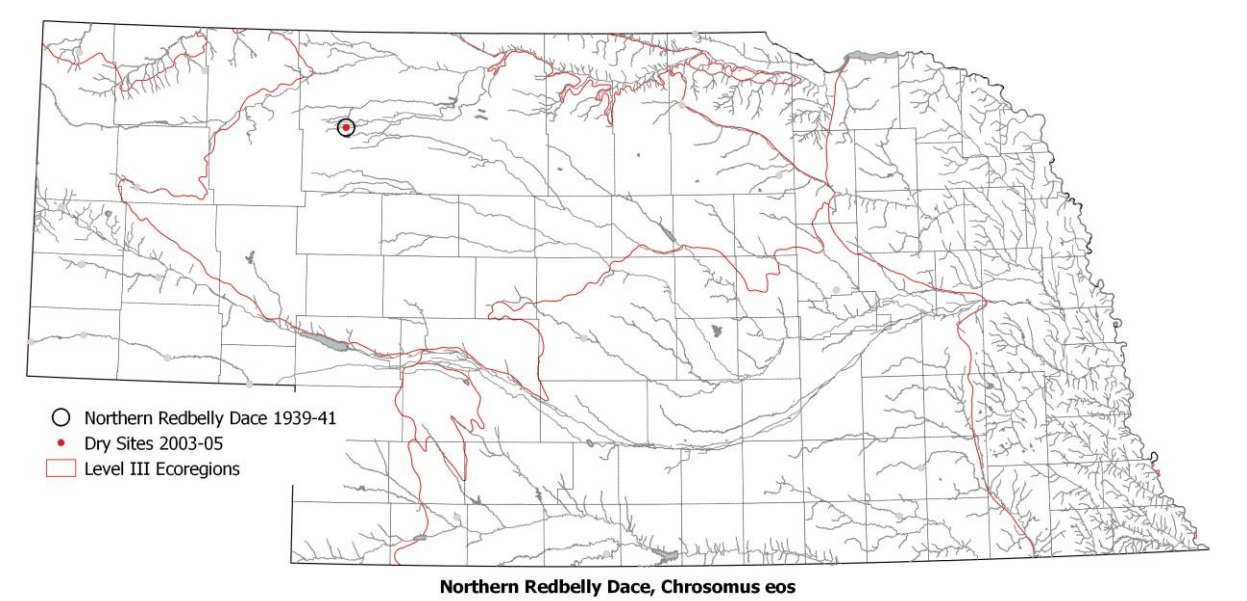
Looking at the results by ecoregion, Smith et.al.(2014) did not rate four regions because of no historical collections. They noted a decline in the Central Great Plains (-100%) and no change in the Nebraska Sand Hills. The overall change was -33%.

The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Northern Pearl Dace was collected during the 2003-05 stream survey. Since only three collections were made, the table lists the actual recorded values.

Habitat conditions of water quality, discharge and stream dimensions where the Northern Pearl Dace was collected during the 2003-05 stream survey. The table shows the actual recorded values.

Northern Pearl Dace	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Site 39	21	8.04	572	12	1.5	2.3	13
Site 52	19.5	5.32	187.7	1.9	1.0	3.8	25
Site 289/314	22.8	5.37	230.1	16.2	0.7	2.9	33

Northern Redbelly Dace, *Chrosomus eos*



Northern Redbelly Dace, Chrosomus eos

1939-41	1
2003-05	0
Matches	0
Missing	0
New sites	0
Dry sites	1

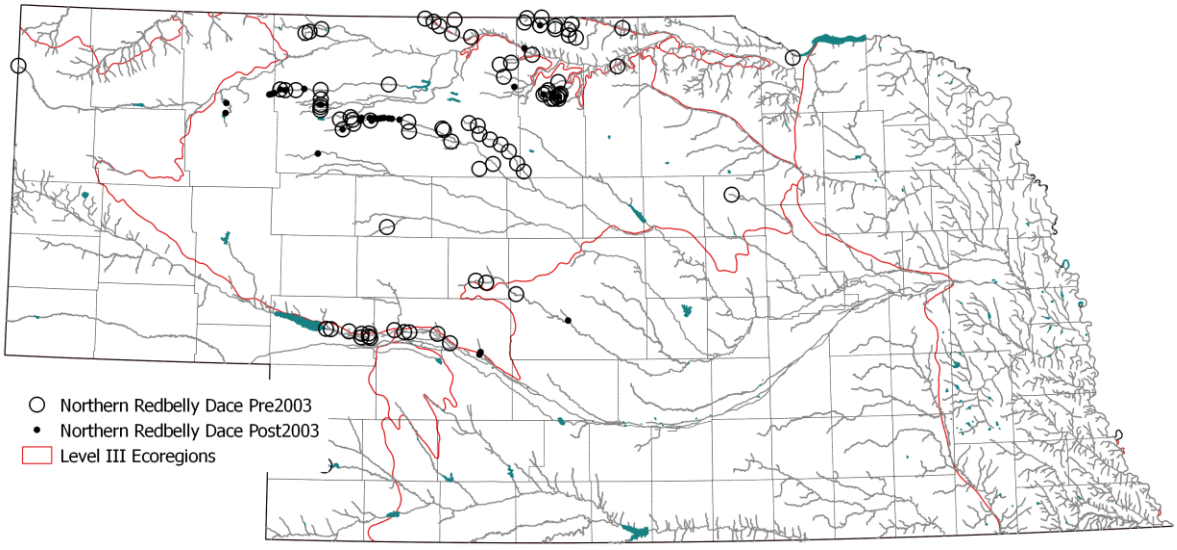
The Northern Redbelly Dace prefers cool, clear vegetated streams but will also use marshes, sloughs and beaver ponds if they are clear and cool. The range of the Northern Redbelly Dace is from New England through the Great Lakes to Montana and southern Canada. In Nebraska, it is a glacial relict species. It's global status is G5 and its Nebraska status is S2.

The Northern Redbelly Dace was collected once in the 1939-1941 survey at a site that was dry in the 2003-2005 survey. This single site doesn't say much about their distribution or status in Nebraska. The map below illustrates all collections (1893-2013) and shows that their range is the north-central part of the state.

Because no Northern Redbelly Dace were collected in the 2003-05 survey, Smith et.al.(2014) did not do any ecoregion comparisons for this species.

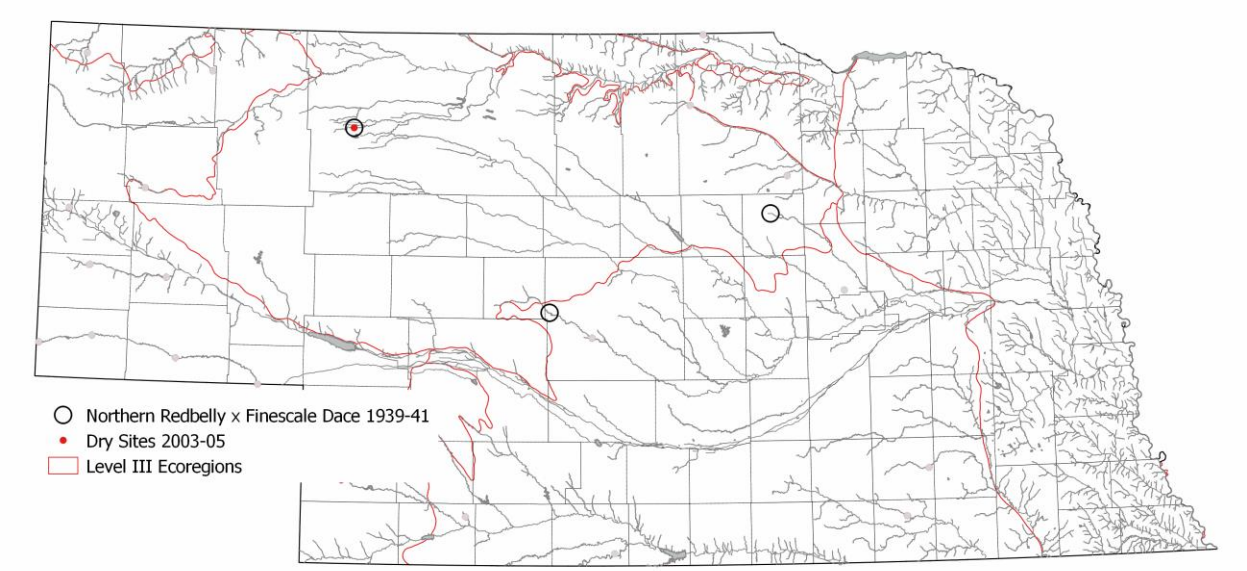
Also, because no Northern Redbelly Dace were collected in the 2003-05 survey, no habitat data could be collected nor tables constructed.

As an alternative, a map illustrating all collections of the Northern Redbelly Dace (pre and post-2003) is presented below. This does several things. It shows the overall range of the species. It shows the number of sites where the species has not been found since 2003, indicating a significant decline. It also indicates the problems with redoing a historical survey. By it's very nature, the random selection of sample sites, it missed a lot of the historical sites where this (or any) species with limited distribution, might be found.



Northern Redbelly Dace, Chrosomus eos

Northern Redbelly x Finescale Dace, *Chrosomus eos-neogaeus*



Northern Redbelly Dace x Finescale Dace Hybrid, Chrosomus eos x neogaeus

1939-41	3
2003-05	0
Matches	0
Missing	2
New sites	0
Dry sites	1

The hybrid of the Northern Redbelly Dace and Finescale Dace uses the same habitats as it's parent species. It prefers cool, clear vegetated streams but will also use marshes, sloughs and beaver ponds if they are clear and cool. The range of the hybrid is the same as it's parent species. It's global status is G5 and its Nebraska status is S2.

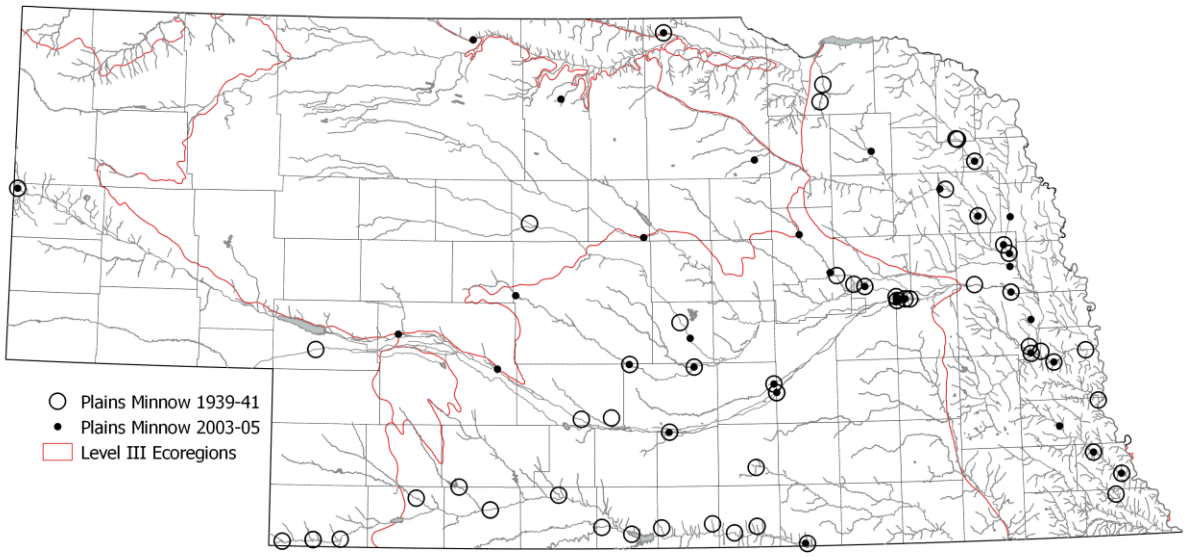
First a few words about this hybrid. An internet search on this will reveal that there have been a number of papers published on hybridization of these two species. Normally, hybrids are non-fertile. However, the *Chrosomus eos-neogaeus* hybrid is fertile and all are female. Some populations have only one parent species along with the hybrid. That is because they are able to reproduce via "gynogenesis" . Normally, females produce haploid eggs and add the genetic material from the male to become diploid so the eggs can develop. In gynogenesis, the hybrid produces diploid eggs. The eggs are laid and fertilized by a related species but the fertilization only stimulates the egg to develop, but does not add any genetic material. The result is that the progeny are actually clones of the parent female.

This hybrid was recognized from three sites in the 1939-1941 survey. It was not found in the 2003-2005 survey though that could be because the hybrid is quite difficult to identify. It's overall range is similar to that of the parent species, the Northern Redbelly Dace and the Finescale Dace.

Because no Northern Redbelly Dace were collected in the 2003-05 survey, Smith et.al.(2014) did not do any ecoregion comparisons for this species.

Also, because none were collected in the 2003-05 survey, no habitat data could be collected nor charts constructed.

Plains Minnow, *Hybognathus placitus*



Plains Minnow, Hybognathus placitus

The Plains Minnow prefers the broad, shallow, open braided river channels with sand bottoms characteristics of Great Plains streams. Seldom found in small, intermittent creeks or streams with muddy or rocky bottoms. The range of the Plains Minnow is the central Great Plains from Montana to Texas and down the Missouri River into the Mississippi River. It's global status is G4 and its Nebraska status is S4.

1939-41	54
2003-05	38
Matches	23
Missing	31
New sites	15
Dry sites	0

In marked contrast to most of the species wherein the 2003-2005 survey collected more fish at more sites, this was the reverse. The 1939-41 survey found Plains Minnows at 54 sites (1,660 fish) while the 2003-05 survey found them at only 38 sites (731 fish). Of these, there were only 23 matches (44%) and 30 sites where they were missing. These are indications of a significant decline in the Plains Minnow in Nebraska. The most noticeable decline was in the Republican River basin where the species has virtually disappeared. This is due to the altered hydrology where significant portions of the streams have been dewatered and have been changed to, what amounts to, intermittent creeks. There are also declines in the South Platte River (dewatering), the Middle Loup River (barriers), Bazile Creek (?) and tributaries to the Missouri River (channelization of Missouri). It seems to be holding on in the Niobrara, Elkhorn, South Loup and Little Nemaha Rivers. The situation in the Platte is mixed.

Looking at the results by ecoregion, Smith et.al.(2014) noted declines in three regions: the Central Great Plains (-37%), the Western High Plains (-60%) and the Western Corn Belt Plains (-21%). There was no change in the Nebraska Sand Hills or Northwestern Glaciated Plains. The Northwestern Great Plains was not rated.

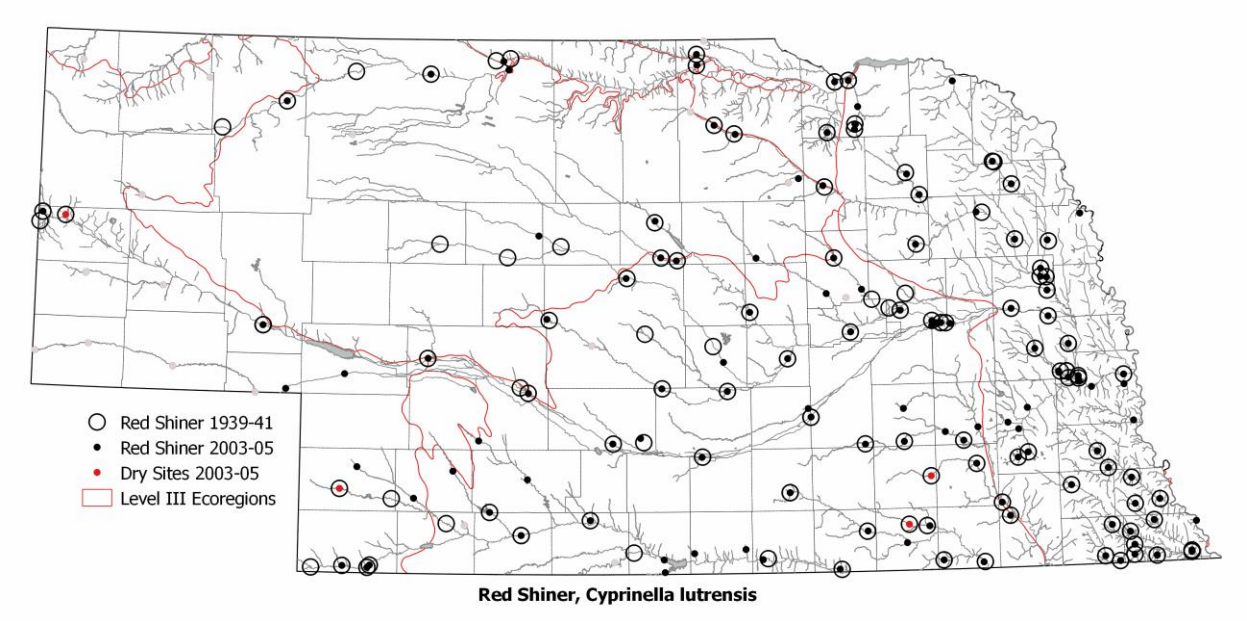
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Plains Minnow was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Plains Minnow was collected during the 2003-05 stream survey.

Plains Minnow	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	14.6	0.78	187.7	0.65	0.5	2.5	5
Maximum	34.9	8.95	1143	1063	3900	500.8	44
Median	23.8	4.3	456.0	44.2	102.7	28.5	24
80% Exceedance	20	1.67	282.8	8.9	17.4	11.1	10
20% Exceedance	27.9	7.34	826	119	559.0	154.8	30

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **80% Exceedance** means 80% of recorded values were higher than this value while **20% Exceedance** means 20% of recorded values were higher.

Red Shiner, *Cyprinella lutrensis*



Red Shiner, Cyprinella lutrensis

1939-41	117
2003-05	133
Matches	97
Missing	17
New sites	36
Dry sites	3

The Red Shiner is a habitat generalist found in large rivers and small streams, perennial or intermittent, turbid or clear. The Red Shiner's historical range extends from Mexico though New Mexico and Colorado to South Dakota then east to Illinois and back down to Louisiana. It's global status is G5 and its Nebraska status is S5

The Red Shiner is one of the most ubiquitous species in Nebraska. It was collected at 123 sites in 1939-41 which ranked it 3rd in frequency of occurrence. It was collected at 137 sites in the 2003-05 survey where it still ranked 3rd overall. Numbers were quite different between the years with 3,004 collected in 1939-41 and 35,164 in the 2003-05 survey (which supports the idea that Raymond Johnson was vouchering only a portion of those caught, at least with abundant species). There are few differences between the distributions though there appear to have been some local declines such as in the Dismal River and Frenchman Creek.

Looking at the results by ecoregion, Smith et.al.(2014) noted that the Red Shiner increased in two; the Central Great Plains (+21%) and Western Corn Belt Plains (+28%). They noted a decrease of 10% in the Nebraska Sand Hills and no changes in the remaining three ecoregions. There was an overall increase of 18%.

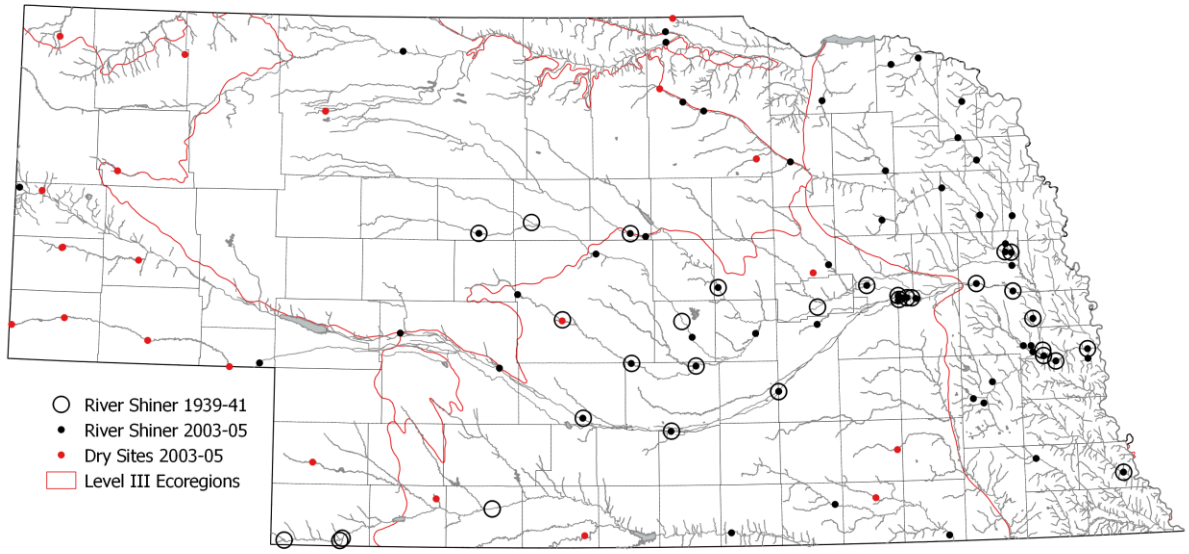
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Red Shiner was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Red Shiner was collected during the 2003-05 stream survey.

Red Shiner	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	14.6	0.78	14.06	0.1	0	1.0	2
Maximum	34.9	13.7	4672	1063	4210	500.8	68
Median	23.3	6.9	541.0	30.6	30.2	14.6	20
90% Exceedance	17.4	1.67	253.9	4.0	1.5	4.6	8
10% Exceedance	29.1	9.37	908	204	591.5	154.8	35

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **90% Exceedance** means 90% of recorded values were higher than this value while **10% Exceedance** means 10% of recorded values were higher.

River Shiner, *Notropis blennius*



River Shiner, Notropis blennius

1939-41	30
2003-05	65
Matches	23
Missing	6
New sites	42
Dry sites	1

The River Shiner prefers larger streams with wide, shallow channels and sand beds. They are found in the Mississippi River basin as far north as Minnesota and Nebraska and the Hudson River drainage in Canada. It's global status is G5 and its Nebraska status is S4

The River Shiner was found at 30 sites in 1939-1941 (387 fish) and 65 sites in 2003-2005 (2,512 fish). Overall frequency of occurrence improved from 15th in 1939-1941 to 11th in 2003-2005. The species appears to have declined in the Republican River upstream of Harlan County Reservoir. Otherwise the number of sites where it was found and the numbers collected say the species has increased, particularly in the northeast. Either that or they were in such low numbers in the 1939-1941 survey that they were missed.

Looking at the results by ecoregion, Smith et.al.(2014) noted that the River Shiner had increased in three regions; the Central Great Plains (+60%), the Nebraska Sand Hills (+150%) and the Western Corn Belt Plains (+200%). There was no change in the Western High Plains. Overall they had a +113% increase.

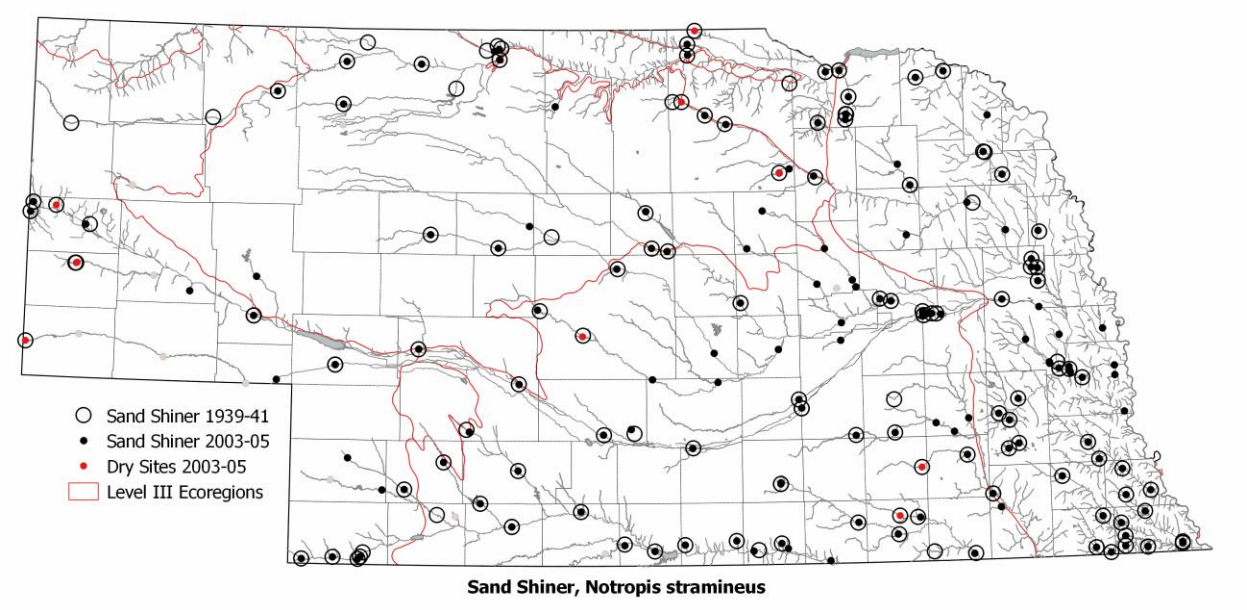
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the River Shiner was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the River Shiner was collected during the 2003-05 stream survey.

River Shiner	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	14.6	1.37	14.06	0.19	0.3	3.0	5
Maximum	34.9	13.7	4672	1063	4210	500.8	51
Median	22.7	6.7	496.6	44.4	106.8	29.4	21
90% Exceedance	17	1,61	244.1	4.0	4.3	5.6	10
10% Exceedance	30.3	9.47	959	237	1160.0	360.0	36

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **90% Exceedance** means 90% of recorded values were higher than this value while **10% Exceedance** means 10% of recorded values were higher.

Sand Shiner, *Notropis stramineus*



Sand Shiner, Notropis stramineus

The Sand Shiner can be found in all streams from small clear streams to large turbid rivers as long as they have sand beds. They are native to North America from the Rocky Mountains to the Appalachians and the Canadian border to Oklahoma. It's global status is G5 and its Nebraska status is S5

1939-41	132
2003-05	151
Matches	109
Missing	14
New sites	42
Dry sites	9

The Sand Shiner was collected from 13 sites in the 1939-41 survey (5,662 fish) and 15 times in the 2003-05 survey (37,343 fish). It ranked 2nd in the 1939-41 survey and 1st in the 2003-05 survey. The overall distribution has remained the same. As a general rule, the Sand Shiner's preference for shallow, open sandy channels and their abundance makes them easy to catch. So seeing the "new sites" such as those in the Loup River basin, makes one wonder it their range has increased, if only to occupy additional streams. The ecoregion analysis in the next paragraph says they have.

Looking at the results by ecoregion, Smith et.al.(2014) noted that the Sand Shiner had increased in four regions: the Central Great Plains (+34%), the Western High Plains (+14%), the Nebraska Sand Hills (+7%) and the Western Corn Belt Plains (+31%). They had actually declined in one, the Northwestern Glaciated Plains (-20%) and one, the Northwestern Great Plains had no change. The overall change was +24%.

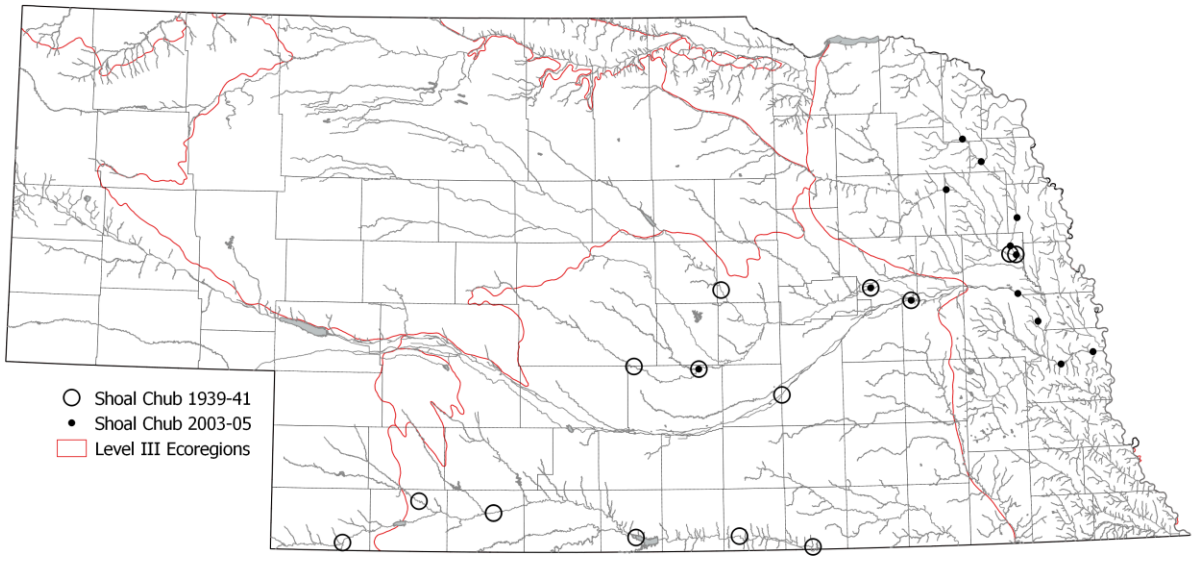
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Sand Shiner was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Sand Shiner was collected during the 2003-05 stream survey.

Sand Shiner	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	13	0.78	14.06	0.1	0	2.2	2
Maximum	34.9	13.7	4672	1063	4210	500.8	68
Median	22.7	6.9	541.0	23.5	23.9	12.4	20
90% Exceedance	16.4	1.69	229.4	2.5	1.5	4.3	8
10% Exceedance	28.6	9.47	919	190	559.0	139.3	36

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **90% Exceedance** means 90% of recorded values were higher than this value while **10% Exceedance** means 10% of recorded values were higher.

Shoal Chub, *Macrhybopsis hyostoma*



Shoal hub, Macrhybopsis hyostoma

1939-41	14
2003-05	13
Matches	4
Missing	10
New sites	9
Dry sites	0

The Shoal Chub prefers shallow channels with good current in large, perennial sand-bed streams. They are native to southern and central US streams from the Rio Grande eastward to the Apalachicola then north to Ohio and west through Minnesota and Nebraska. It's global status is G5 and its Nebraska status is S4

The Shoal Chub was collected 14 times in the 1939-41 survey (276 fish) and 13 times in the 2003-05 survey (69 fish). While the number of collection sites was almost equal, the distribution of those sites was quite different. The species has disappeared from the Republican River basin because the streams here are no longer large and turbid but are now tiny and dry. They may be in trouble in the Middle Platte River and are of some concern in the Loup. Finding them in the Lower Platte is probably a case of better detection. The new collections in the Elkhorn basin may be range expansions but may also be better detection ability.

Looking at the results by ecoregion, Smith et.al.(2014) noted declines in the Central Great Plains (-73%) and the Western High Plains (-100%). There was an increase in the Western Corn Belt Plains (+400%) for an overall change of -7%.

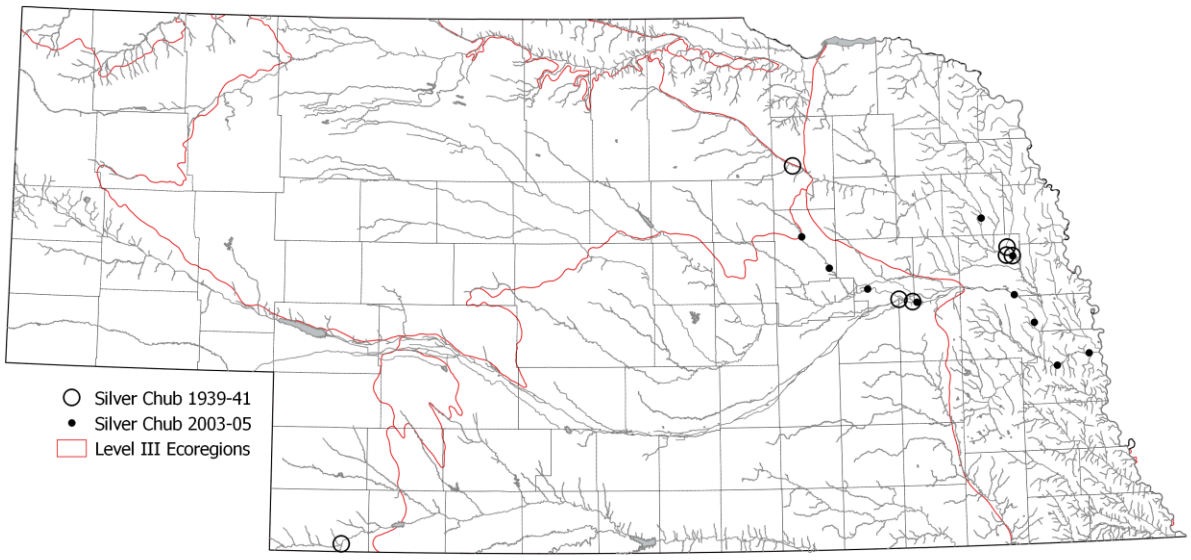
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Shoal Chub was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Shoal Chub was collected during the 2003-05 stream survey.

Shoal Chub	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	19.5	1.46	281.3	41.1	101.2	22.6	10
Maximum	32.9	10.08	1098	1063	4210	500.8	44
Median	25.3	5.99	440.2	109.9	483	91	26
75% Exceedance	20.8	1.61	372.9	62.1	180.6	24.0	20
25% Exceedance	26.9	7.4	919	182	1770.0	372.7	32

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **75% Exceedance** means 75% of recorded values were higher than this value while **25% Exceedance** means 25% of recorded values were higher.

Silver Chub, *Macrhybopsis storeriana*



Silver Chub, Macrhybopsis storeriana

1939-41	7
2003-05	10
Matches	2
Missing	5
New sites	8
Dry sites	0

The Silver Chub prefers medium to large rivers where it uses areas with slow currents and deep pools. The primary range of the Silver Chub is the Mississippi River basin. It's global status is G5 and its Nebraska status is S4

It was collected seven times in the 1939-41 survey and ten times in the 2003-05 survey. The numbers were not high with only 12 being collected in 1939-41 and 36 in 2003-05. It is interesting to note the two clusters of collections, one at the confluence of the Elkhorn River and Logan Creek, the other on the Platte at the confluence of some small tributaries. The single collection in the extreme southwest corner of the state was made in 1939. The site was revisited in 1940 and was dry. As the species is never common where found, the map suggests that the range has not changed.

Looking at the results by ecoregion, Smith et.al.(2014) noted that two ecoregions had increases, two had decreases and two were neutral. The increases were in the Central Great Plains (+100%) and Western Corn Belt Plains (+100%). The decreases were in the Western High Plains (-100%) and Nebraska Sand Hills (-100%) (there was only one historical collection in each of these two). The overall change was +43%.

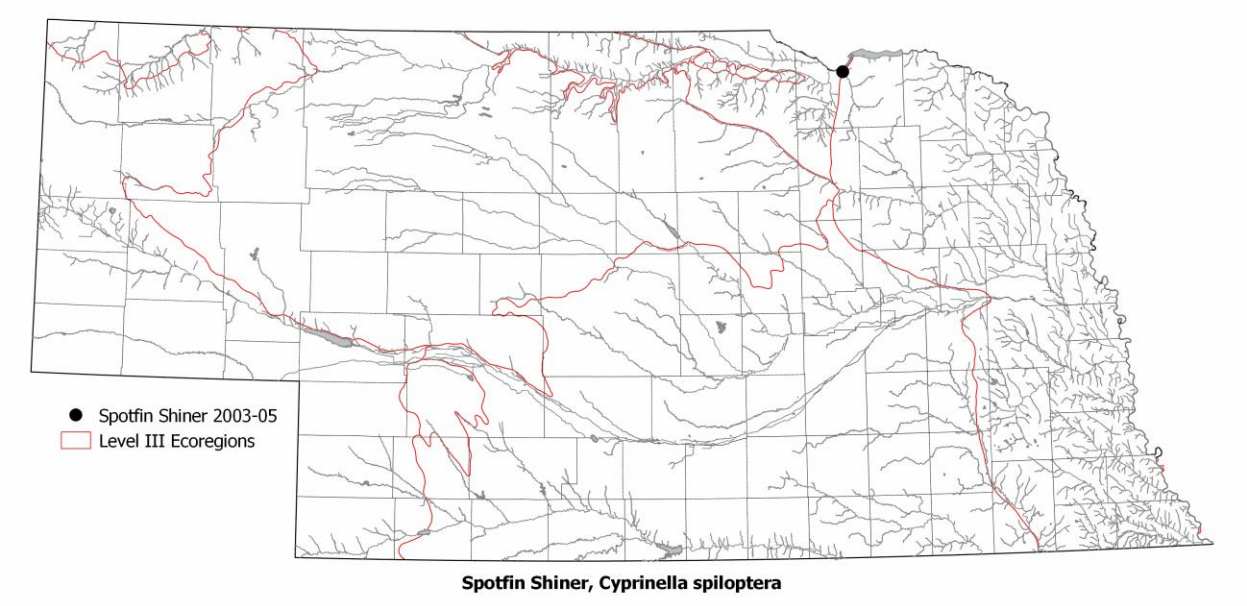
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Silver Chub was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Silver Chub was collected during the 2003-05 stream survey.

Silver Chub	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	18.6	1.37	282.7	14.9	16.1	10.5	10
Maximum	28.2	10.08	678	1040	4210.0	500.8	35
Median	25.4	5.06	378.4	85.4	576.6	104.7	23
75% Exceedance	20.8	1.61	370.5	41.1	74.2	18.8	20
25% Exceedance	27.9	7.4	541	2090	398.8	398.8	26

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **75% Exceedance** means 75% of recorded values were higher than this value while **25% Exceedance** means 25% of recorded values were higher.

Spotfin Shiner, *Cyprinella spiloptera*



Spotfin Shiner, Cyprinella spiloptera

1939-41	0
2003-05	1
Matches	0
Missing	0
New sites	1
Dry sites	0

The Spotfin Shiner is not native to Nebraska waters but appeared in the 1970's. It prefers medium-sized perennial rivers with clear water and a sand/gravel bed. The primary range of the Spotfin Shiner is from the Hudson River to Minnesota then south through Iowa and Missouri to Mississippi. It's global status is G5 and its Nebraska status is S2S3.

This species was not collected in the 1939-1941 survey and only once in the 2003-2005 survey. It is possible that the species migrated here from populations in central Iowa sometime in the 1970's. It is also possible that it came here via a bait shipment. In any case, they were first collected in 1983 from the Missouri River in Burt County. Then, in 1985, they were collected from the Missouri River upstream in Cedar and Knox Counties. The Knox County site is above Gavins Point Dam which supports a bait bucket introduction. Since then it has expanded its range southward and into some the Missouri's tributaries.

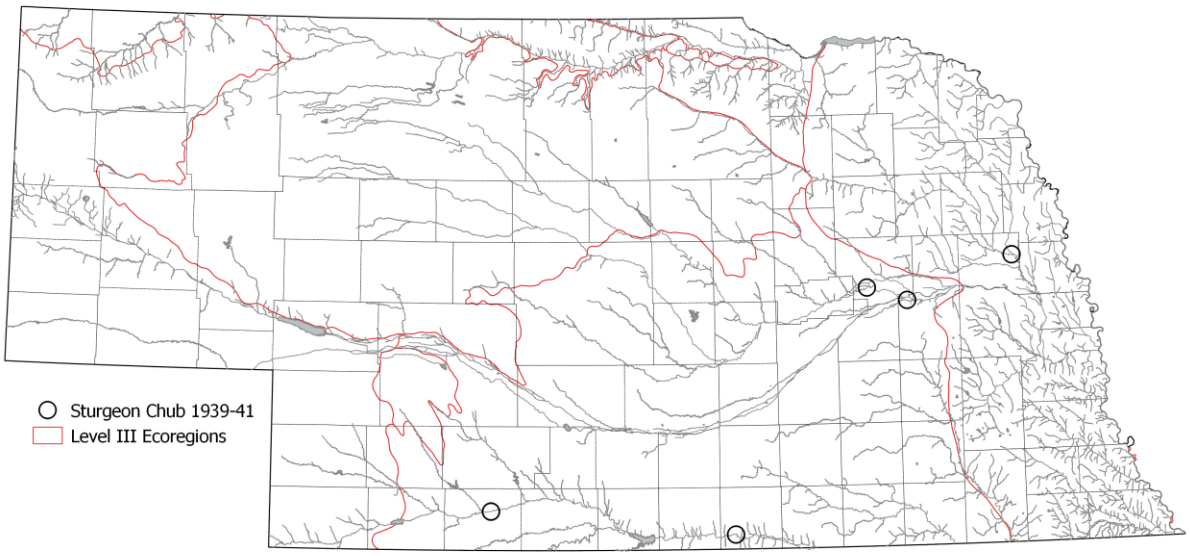
Looking at the results by ecoregion cannot be done because there are no historical collections with which to compare.

The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Spotfin Shiner was collected during the 2003-05 stream survey. Since only one collection was made, the table lists the actual recorded values.

Habitat conditions of water quality, discharge and stream dimensions where the Spotfin Shiner was collected during the 2003-05 stream survey. The table lists only the actual recorded values for the single collection site.

Spotfin Shiner	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Site 42	28.4	6.8	710	190	153.9	22.6	22

Sturgeon Chub, *Macrhybopsis gelida*



Sturgeon Chub, Macrhybopsis gelida

1939-41	5
2003-05	0
Matches	0
Missing	5
New sites	0
Dry sites	0

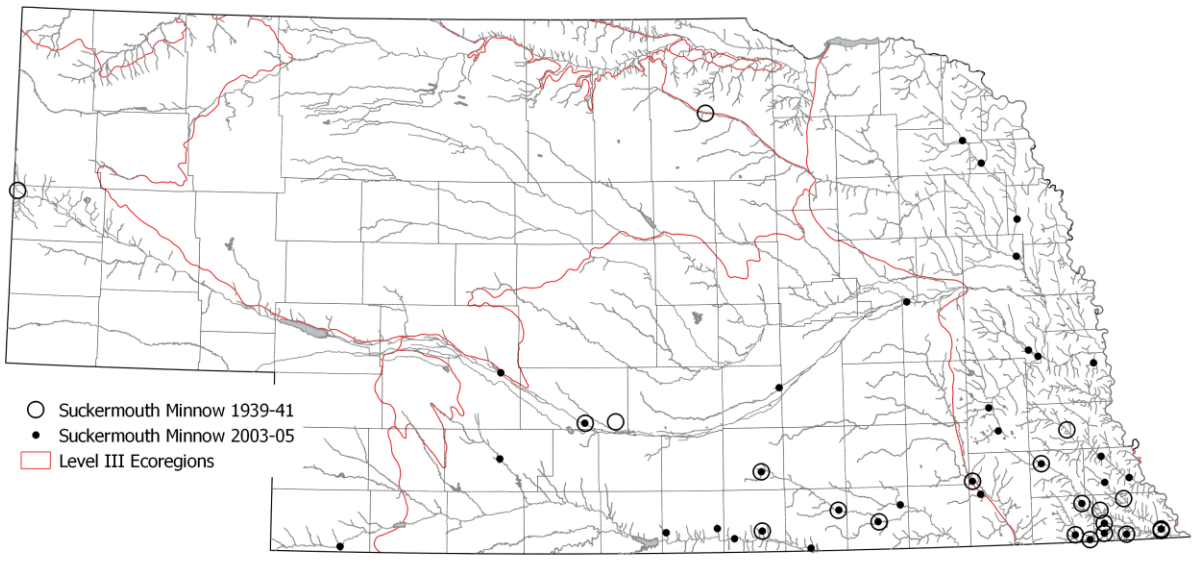
Sturgeon Chub prefer big turbid rivers where they use areas with swift current and shifting sand/gravel shoals. The primary range of the Sturgeon Chub is the Missouri River and its major tributaries plus a little of the Mississippi River. Its global status is G3 and its Nebraska status is S1.

Sturgeon Chub were collected five times in the 1939-41 survey. In those five collections, 107 fish were caught which averages to just over 21 fish per site, a fairly high number. No Sturgeon Chub were collected in the 2003-2005 survey, but other studies have collected specimens from the lower Platte River and the Missouri River where it appears to be in decline. It has been extirpated from the Republican River and it has not been recently collected from the Loup or Elkhorn Rivers or the Platte upstream of the mouth of the Loup.

Looking at the results by ecoregion, Smith et.al.(2014) noted a decline in two regions, the Central Great Plains and the Western Corn Belt Plains. Both declines were 100% and the overall change was also 100%.

Since none were collected in the 2003-05 survey, no table could be constructed.

Suckermouth Minnow, *Phenacobius mirabilis*



Suckermouth Minnow, Phenacobius mirabilis

The Suckermouth Minnow prefers the faster water of riffles in perennial streams with sand/gravel beds. They are somewhat tolerant of turbidity and low flows. The primary range of the Suckermouth Minnow is from Wyoming through Minnesota to Ohio then southward to Tennessee, Texas and New Mexico. It's global status is G5 and its Nebraska status is S4.

1939-41	21
2003-05	37
Matches	13
Missing	8
New sites	23
Dry sites	0

The Suckermouth Minnow was collected 21 times (150 fish) in the 1939-41 survey and 37 times (675 fish) in the 2003-05 survey. Its frequency of occurrence changed little from 19th in the 1939-41 survey to 17th in the 2003-05 survey. There was a great deal of overlap in the collections from the two surveys. There are two outliers in the 1939-41 survey, one in the upper Elkhorn River and a second in the North Platte River at the Wyoming border. The Suckermouth Minnow was not found at these sites in the 2003-05 survey. The species may have declined at these areas or may just be uncommon. The increase in collections in the Republican basin may be an increase in distribution. Or it could be a reflection of the difference in collection methods. The same can be said for the collections in the Platte and Logan Creek in the northeast (though this would seem to be unlikely).

Looking at the results by ecoregion, Smith et.al.(2014) noted that the Suckermouth Minnow had increases in the Central Great Plains (+150%) and the Western Corn Belt Plains (+54%). It had decreased in the Nebraska Sand Hills (-100%) and had no change in the Western High Plains. Overall they had increased (+71%).

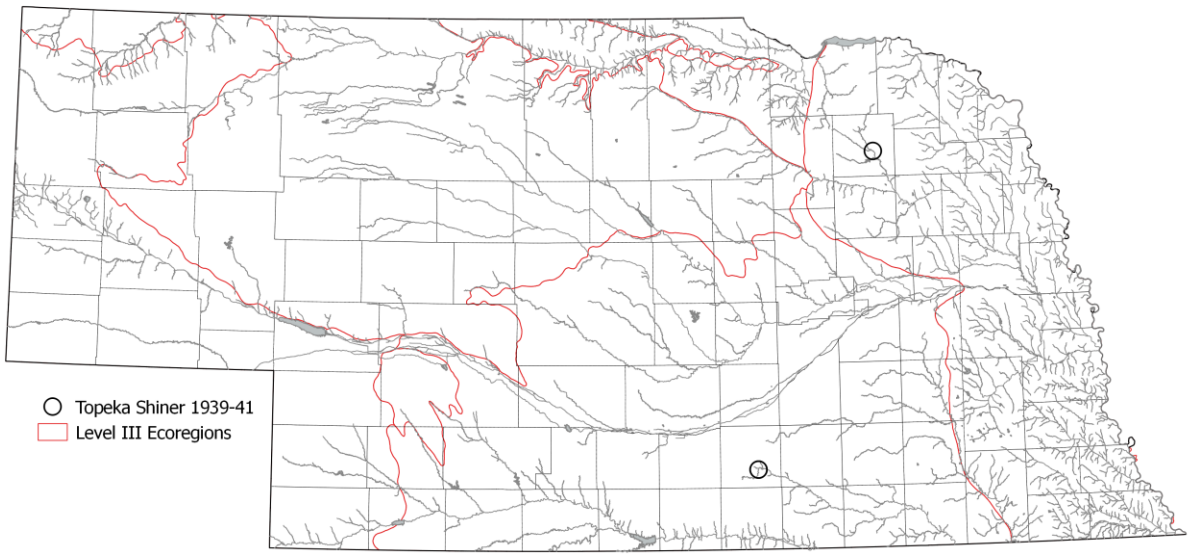
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Suckermouth Minnow was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Suckermouth Minnow was collected during the 2003-05 stream survey.

Suckermouth Minnow	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	14.6	1.46	314.5	1.03	0	3.8	4
Maximum	32.8	10.88	4672	721	594.3	116.3	37
Median	23.9	7.1	607.0	30.0	12.8	10.9	15
80% Exceedance	20	2.02	472	4.05	2.8	6.0	11
20% Exceedance	26	8.77	825	80	101.2	27.0	29

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **80% Exceedance** means 80% of recorded values were higher than this value while **20% Exceedance** means 20% of recorded values were higher.

Topeka Shiner, *Notropis topeka*



Topeka Shiner, Notrois topeka

1939-41	3
2003-05	0
Matches	0
Missing	3
New sites	0
Dry sites	0

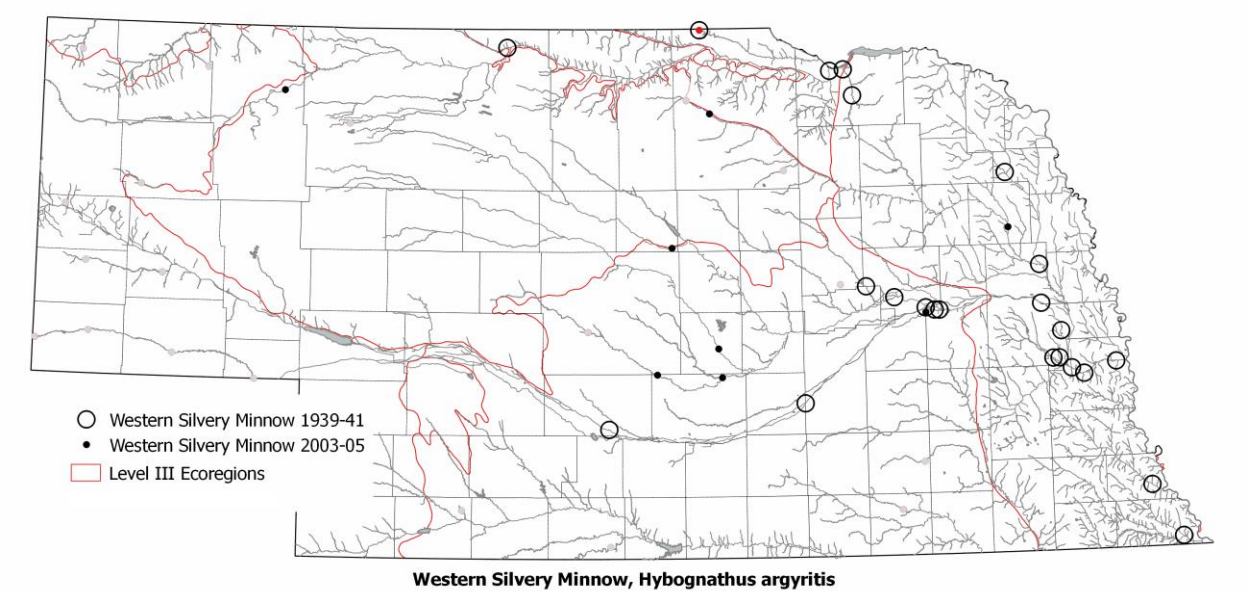
The Topeka Shiner prefers the quiet waters of pools, oxbows and off-channel areas of perennial streams. They are intolerant of pollution, turbidity and stream alteration. The range of the Topeka Shiner is Missouri, Kansas, Nebraska, South Dakota, Minnesota and Iowa. It's global status is G3 and its Nebraska status is S1.

The Topeka Shiner was collected three times (four fish) in the 1939-41 survey (the site on the Little Blue River sampled twice). It was not found in the 2003-05 survey. The species has been extirpated from both streams where it was originally collected due to the habitat changes that went along with agricultural development. Since then it has been found in three other streams, only one of which shares a watershed (the Elkhorn) with a historical collection. The status of the species in these other streams is, in a nutshell, precarious.

Looking at the results by ecoregion, Smith et.al.(2014) noted 100% declines in the two regions were the species occurred, the Western Corn Belt Plains and the Central Great Plains. The overall decrease was 100%.

Since none were collected in the 2003-05 survey, no stream size or water quality table could be constructed.

Western Silvery Minnow, *Hybognathus argyritis*



Western Silvery Minnow, Hybognathus argyritis

1939-41	23
2003-05	8
Matches	0
Missing	22
New sites	8
Dry sites	1

The Western Silvery Minnow prefers streams with deep slow water and mud bottom but can be found in faster water. The range of the Western Silvery Minnow is the Missouri River and its tributaries. It's global status is G4 and its Nebraska status is S5.

The Western Silvery Minnow was collected at 23 sites (819 fish) in the 1939-1941 survey. It was collected at eight sites (93 fish) in the 2003-2005 survey. This species was unique in that there were no matches between the two surveys. There was only one place where the two surveys collected this fish, on the Platte River near the mouth of the Loup River. This map and the numbers collected indicate that it has disappeared or seriously declined in much of its historic range in the state. The only places it was found are quite a distance upstream of where it should be found, based on its historic range and habitat preference.

Looking at the results by ecoregion, Smith et.al.(2014) noted that there were declines in three regions and no change in one. The declines were in the Northwestern Glaciated Plains (-100%), Northwestern Great Plains (-100%) and Western Corn Belt Plains (-92%). There was no change in the Central Corn Belt Plains. The overall change was -60%. These numbers and the map above show a serious decline for this species.

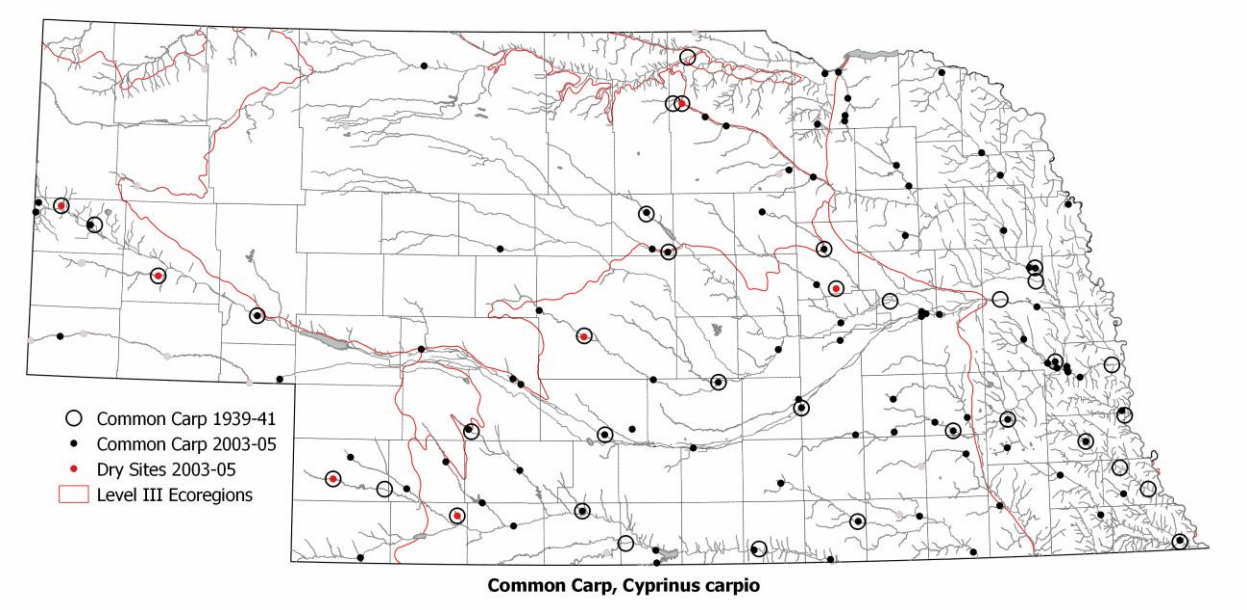
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Western Silvery Minnow was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Western Silvery Minnow was collected during the 2003-05 stream survey. Since only eight collections were made, the table below lists the actual recorded values along with the minimum, maximum and median values.

Western silvery minnow	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Site 32	28	1.37	375.5	65.1	559.0	93.0	28
Site 66	14.6	3.7	244.1	9.98	560.4	162.7	14
Site 77	26.4	1.99	440.2	107.2	198.4	33.3	32
Site 140	16.3	9.41	262.5	0.9	0.3	4.1	5
Site 280	29.6	6.8	256.8	5.1	52.5	30.0	12
Site 306	20.1	7.34	382.7	47.3	151.0	23.6	28
Site 307	21.5	5.7	198.6	7.93	197.3	61.3	25
Site 205B	19.9	7.48	427.5	11.3	0.5		
Minimum	14.6	1.37	198.6	0.65	0.26734	2.2	5
Maximum	29.6	9.84	2210	1063	1160.0	372.7	68
Median	20.8	6.3	632.5	11.3	16.2	18.2	15

CYPRINIDAE
Old World Minnows

Common Carp, *Cyprinus carpio*



Common Carp, Cyprinus carpio

The Common Carp is an exotic species which the U.S. Fish Commission imported and widely stocked all over the US in the late 1800's. It was assumed that the native fishes were of little value while the Common Carp would do well and feed the people. It does well in warm water rivers, streams, lakes, reservoirs, and sloughs. They tolerate clear and turbid waters and all kinds of substrates. They do not do well in cold, clear waters. The Common Carp is now found in much of the US and is considered by most to be a nuisance. It's global status is G5 and its Nebraska status is S5 (widespread, abundant, secure).

1939-41	36
2003-05	94
Matches	16
Missing	13
New sites	78
Dry sites	7

The data and the map shows that the Common Carp has increased it's presence in Nebraska streams since the 1939-41 survey. In the6 1939-41 survey, 152 Common Carp were collected. In the 2003-05 survey, 1,127 were collected. The distribution has not changed much, just the number of sites where they were found. For instance, in the Big Blue River basin, they were found at one site in 1939-41 and eight sites in 2003-05. In the Elkhorn River basin they were found at four sites in 1939-41 and 12 sites in 2003-05. With a few exceptions, this pattern holds for most of the basins in the state.

Looking at the results by ecoregion, Smith et.al.(2014) noted that the Common Carp had increased in four regions: the Central Great Plains (+258%), the Western High Plains (+233%), the Nebraska Sand Hills (+300%) and the Western Corn Belt Plains (+164%). They had decreased in one region, the Northwestern Great Plains (-100%). Overall the change was an increase of +221%.

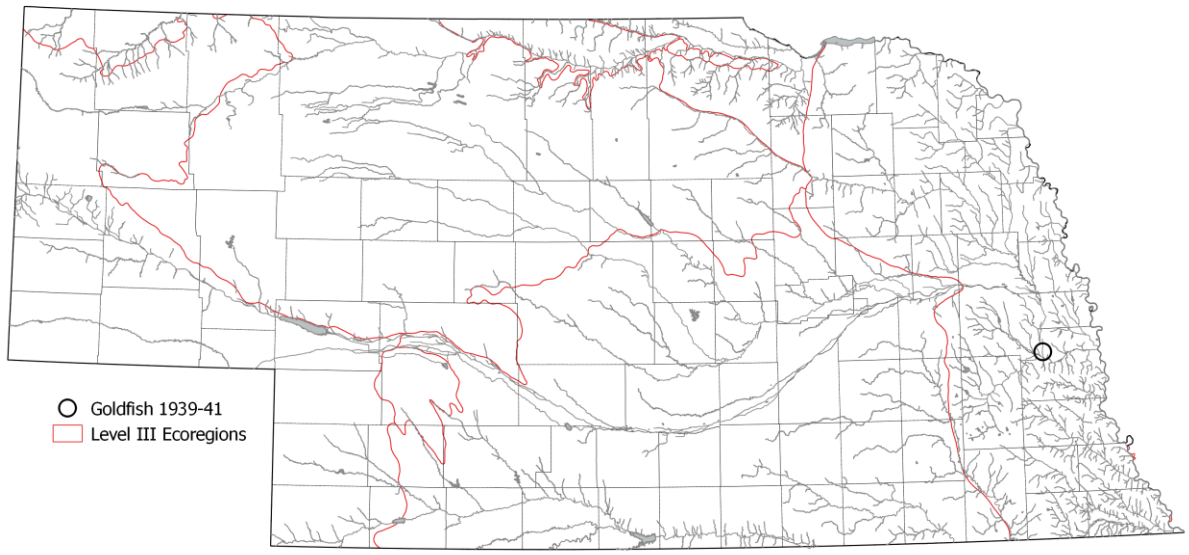
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Common Carp was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Common Carp was collected during the 2003-05 stream survey.

Common Carp	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	15.4	0.78	149.5	0.148	0	2.2	2
Maximum	32.8	13.7	4672	863	3900	500.8	68
Median	23.2	6.5	567.5	28.0	30.2	12.4	23
90% Exceedance	17.3	1.67	270.3	3.8	0.7	4.5	10
10% Exceedance	28.1	8.88	954	182	494.0	116.3	37

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **90% Exceedance** means 90% of recorded values were higher than this value while 1**0% Exceedance** means 10% of recorded values were higher.

Goldfish, *Carassius auratus*



Goldfish, Carassius auratus

1939-41	1
2003-05	0
Matches	0
Missing	1
New sites	0
Dry sites	0

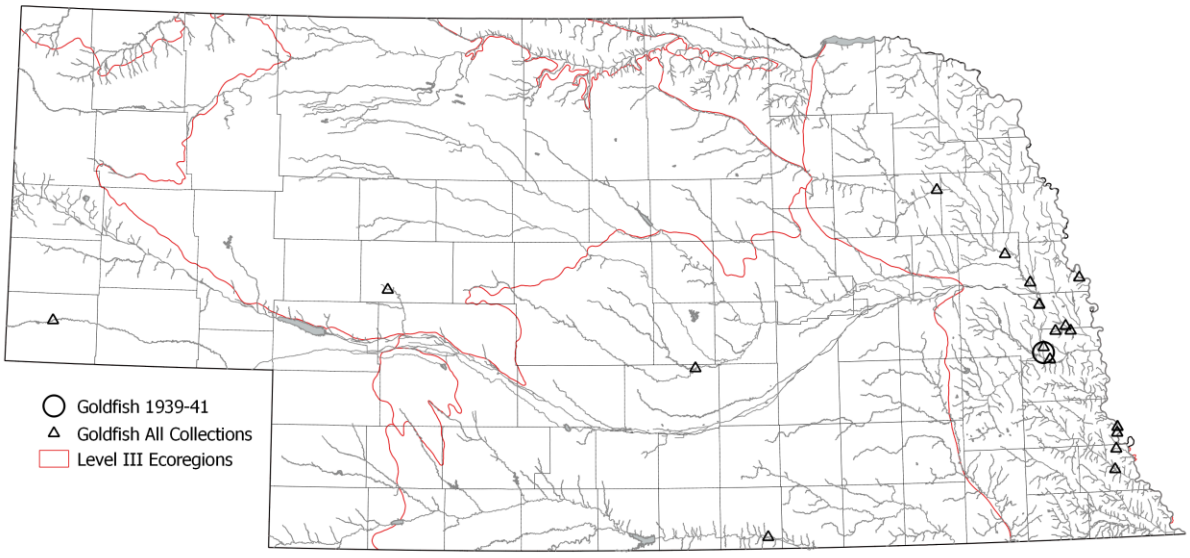
The Goldfish prefers quiet waters like lakes and ponds with abundant vegetation. They can be found in the quiet areas of streams. The Goldfish is native to Asia but was imported to North America in the 1880's. Widely available as an aquarium fish, they are often dumped into city park ponds and similar areas when they are no longer wanted. It's global status is G5 and its Nebraska status is S5.

Talk about meager data to work with. There was one collection of a Goldfish in the 1939-41 survey and none in the 2003-05 survey. They are present in the streams in eastern part of the state but are seldom seen. As an indication of this, over the past 46 years and in hundreds of stream fish samplings, they have been collected a total 21 times.

Because of the paucity of data, the map on the next page was generated to illustrate all collections of the fish from Nebraska waters. The pattern of collections suggests that they could be breeding in the eastern portion of the state. Aside from aquarium releases, the Goldfish is also a legal bait fish in Nebraska there may be some that get into the wild that way. The western collections-who knows? The farthest west, on Lodgepole Creek is in the vicinity of Oliver Reservoir so that could also be a bait release.

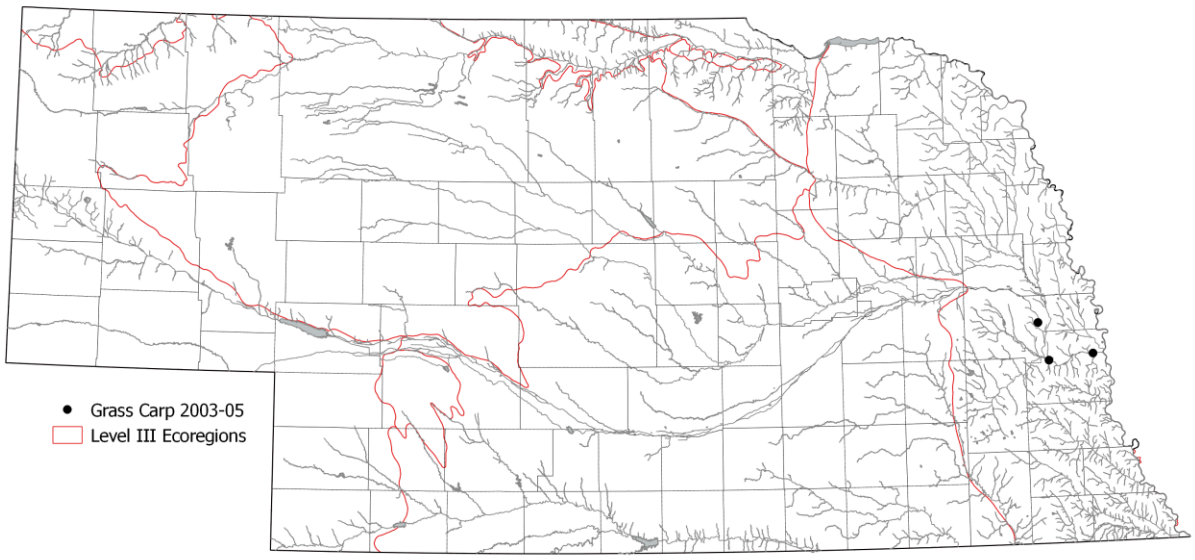
Looking at the results by ecoregion, Smith et.al.(2014) noted a 100% decline in the Western Corn Belt Plains and a 100% decline overall.

No charts could be constructed as none were collected in the 2003-05 survey.



Goldfish, Carassius auratus

Grass Carp, *Ctenopharyngodon idella*



Grass Carp, Ctenopharyngodon idella

The Grass Carp is an exotic species which first appeared in Nebraska in the 1970's when it began appearing in Missouri River commercial fisherman's nets. They are now commonly collected in the Missouri River and from the lower ends of it's tributaries. They are considered to be a nuisance species. It's global status is G5 and its Nebraska status is SNR (not ranked exotic).

1939-41	0
2003-05	3
Matches	0
Missing	0
New sites	3
Dry sites	0

The Grass Carp was not present in North America, let alone Nebraska, at the time of the 1939-41 survey. They were collected three times from the lower Platte River in the 2003-05 survey.

Changes in status by ecoregion (Smith et.al. 2014) could not be assessed since the Grass Carp was not collected in the 1939-41 survey.

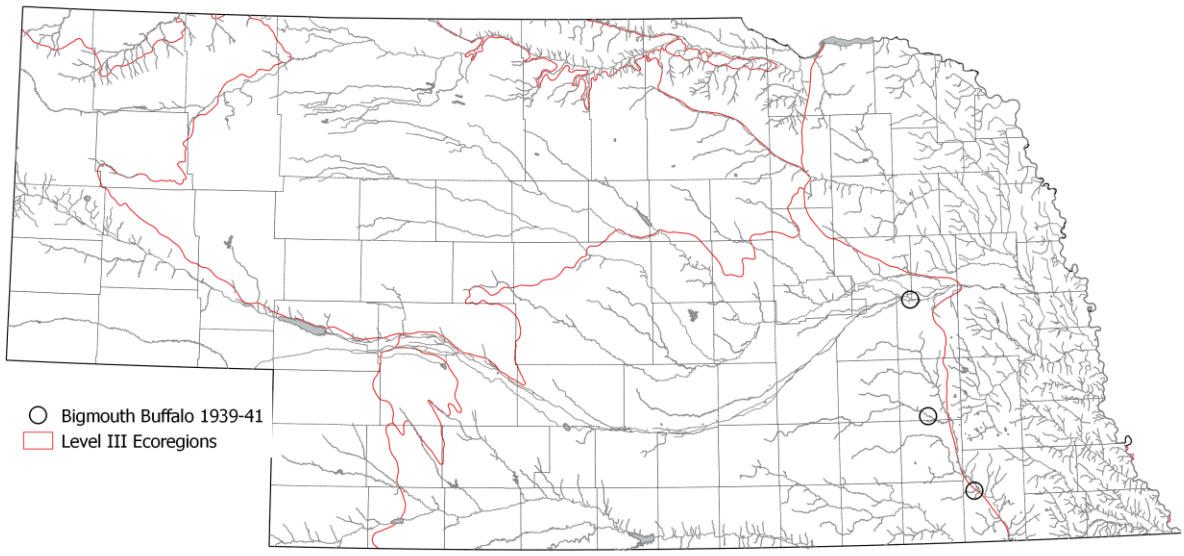
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Grass Carp was collected during the 2003-05 stream survey. Since only three were collected, the actual recorded values are shown in the table.

Habitat conditions of water quality, discharge and stream dimensions where the Grass Carp was collected during the 2003-05 stream survey. The table shows the actual recorded values.

Grass Carp	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Site 3	17.8	9.47	689	44.4	13.3	35.2	19
Site 24	26.9	7.4	411.1	237	1770.0	439.2	25
Site 214	20.8	10.08	678	1040	4210.0	360.0	20

CATOSTOMIDAE
Sucker Family

Bigmouth Buffalo, *Ictiobus cyprinellus*



Bigmouth Buffalo, Ictiobus cyprinellus

The Bigmouth Buffalo prefers the quiet waters found in oxbows and off-channel areas of larger rivers. The Bigmouth Buffalo is native to the entire Mississippi River basin from Louisiana to Montana and east to Ohio. It's global status is G5 which means that it is "Common, widespread, and abundant (although it may be rare in parts of its range). Not vulnerable in most of its range".

1939-41	3
2003-05	0
Matches	0
Missing	3
New sites	0
Dry sites	0

The Bigmouth Buffalo was collected at three sites in the 1939-41. Two of these are from tributaries to the Big Blue River and one is from Clear Creek, a tributary of the Platte River. It was not found in the 2003-05 survey.

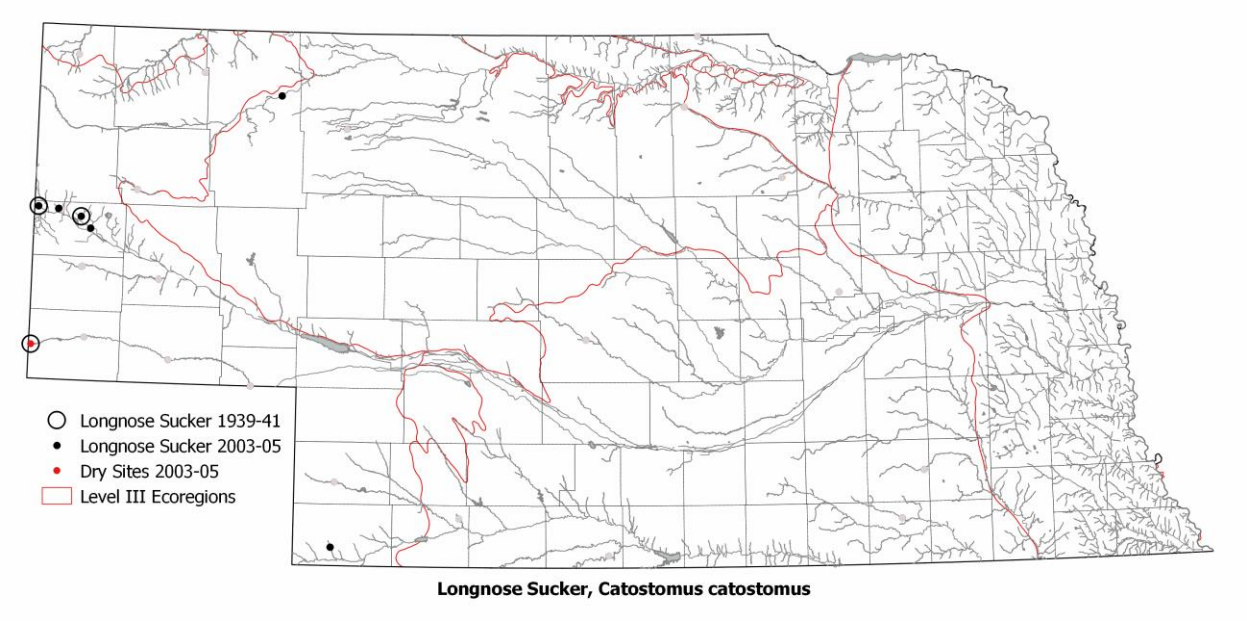
It is difficult to make any generalizations from these meagre data but we do have other collections data to help put these into context. The Bigmouth Buffalo is mainly found in the Missouri River though we do have a few collections from the Elkhorn River, the lower Loup River, the Nemaha River and the Platte River. The collections data says that the Bigmouth Buffalo is uncommon in these interior streams. The Platte River basin site was actually on a small stream south of Columbus. That the species was not found at this site in 2003-05 is due to luck.

The two collections from the Big Blue River basin is another matter. These are the only collections of this species that have ever been made from this river. The Big Blue River had numerous mill dams built in the late 1800's. In the early 1900's, many of these mill dams were converted to electric power generation and their dams were enlarged. As a result the river was broken into very short segments which cut off the spawning (and other) migrations of many fish species. The collections of this species from that basin in 1939-41 may have represented the remnants of a population that has long since died out.

Looking at the results by ecoregion, Smith et.al.(2014) noted decreases in two regions; the Central Great Plains (-100%) and the Western Corn Belt Plains (-100%) and an overall decline of -100%.

No charts could be constructed as none were collected in the 2003-05 survey.

Longnose Sucker, *Catostomus catostomus*



Longnose Sucker, Catostomus catostomus

1939-41	3
2003-05	6
Matches	2
Missing	0
New sites	4
Dry sites	1

The Longnose Sucker prefers streams and lakes with clear, cold waters. They are found in the Rocky Mountains from Colorado northward, the Great Lakes area and Canada. It's global status is G5 and its Nebraska status is S4.

The Longnose Sucker was found three times in 1939-41 and six times in 2003-05. As meager as this data appears to be, it does describe the range of the Longnose Sucker in Nebraska as most are found in the North Platte River near the Wyoming border. They appear to be stable as they are regularly collected in this section of river. Occasional collections have been made in the western end of the Republican River basin but the population here appears to be quite small and quite vulnerable. The Lodgepole Creek population is extirpated as most of that stream is now dry. The single collection location on the Niobrara River is the only time this species has been collected from that river and is somewhat of a mystery.

Looking at the results by ecoregion, Smith et.al.(2014) noted a +150% increase in the Western High Plains. They could not be rated in the Nebraska Sand Hills or Central Great Plains as they were not collected there in the 1939-41 survey.

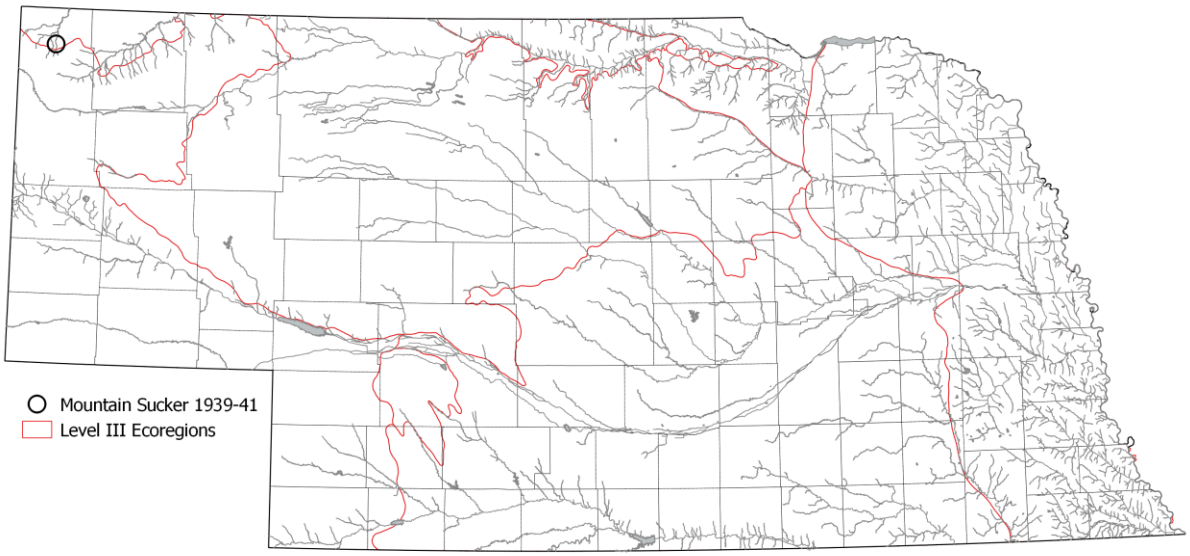
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Longnose Sucker was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Longnose Sucker was collected during the 2003-05 stream survey.

Longnose Sucker	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	16.1	5.76	256.8	1.18	0.3	2.0	8
Maximum	29.6	8.04	919	863	52.5	50.6	28
Median	22.2	6.675	820	18.1	10.5	5.3	12

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower).

Mountain Sucker, *Catostomus platyrhynchus*



Mountain Sucker, Catostomus platyrhynchus

The Mountain Sucker prefers streams with clear, cold waters. They are found in the Rocky Mountains and Sierra Nevada from California and Utah into Canada. It's global status is G5 and its Nebraska status is S1.

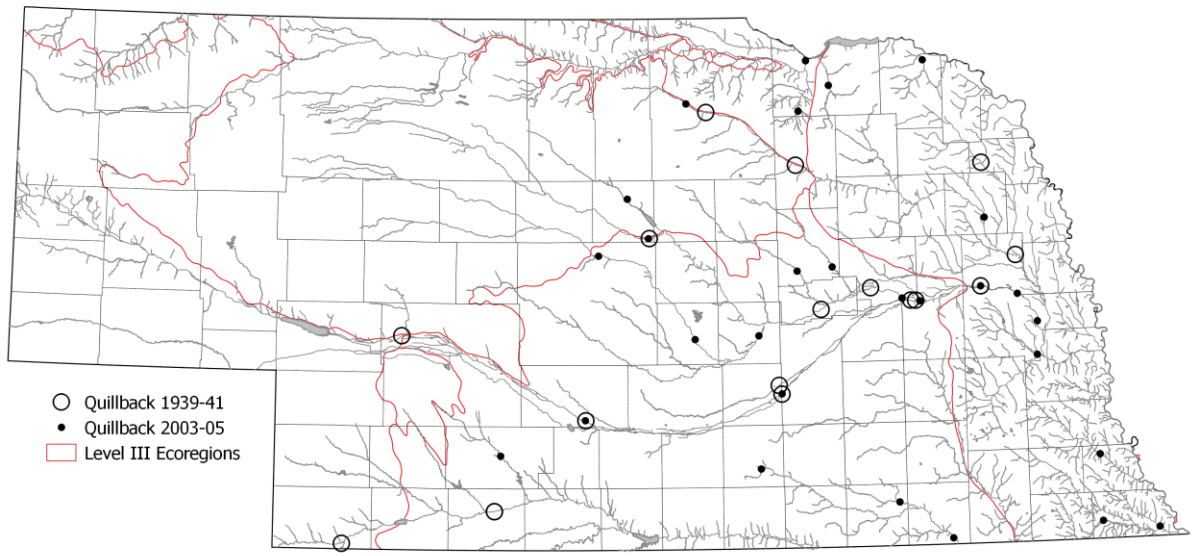
1939-41	1
2003-05	0
Matches	0
Missing	1
New sites	0
Dry sites	0

The species was collected once in the 1939-41 survey from Hat Creek in Sioux County in the extreme northwest corner of the state. Hat Creek drains into the Cheyenne River and is part of the watershed that includes the Black Hills streams in South Dakota where Mountain Suckers are still found. Whether this collection was part of a viable population or a waif is not known. It has not been seen in Nebraska water since the 1939-41 survey.

Looking at the results by ecoregion, Smith et.al.(2014) noted a -100% decline in the Northwestern Great Plains and a 100% decline overall.

No charts could be constructed since the Mountain Sucker was not collected in the 2003-05 survey.

Quillback, *Carpiodes cyprinus*



Quillback, Carpiodes cyprinus

1939-41	16
2003-05	28
Matches	6
Missing	10
New sites	22
Dry sites	0

The Quillback prefers the lower portions of large and medium streams with sandy silt bottoms. The center of the Quillback's range is from Nebraska to Ohio and extends west as far as Wyoming, north into Canada, south to the Gulf and east to the Atlantic . It's global status is G5 and its Nebraska status is S4.

The Quillback was collected 16 times in the 1939-41 survey and 28 times in the 2003-05 survey. The numbers collected were equivalent at 72 in the 1939-41 survey (4.2 per site) and 138 in the 2003-05 survey (4.7 per site). In the frequency of occurrence it was 20th in both surveys. There were only six sites where the Quillback was collected both times. The distribution in the state would appear to be decreasing in the Republican River basin but increasing in the Little Blue River as well as the southeast and northeast. In the Elkhorn River basin, there were four "missing" sites and two "new" sites which may be indicative of the randomness of sampling a large mobile species like the Quillback.

Looking at the results by ecoregion, Smith et.al.(2014) noted that the Quillback had increased in two regions: the Central Great Plains (+75%) and the Western Corn Belt Plains (+200%). They had decreased in the Western High Plains (-100%). The overall change was +80%.

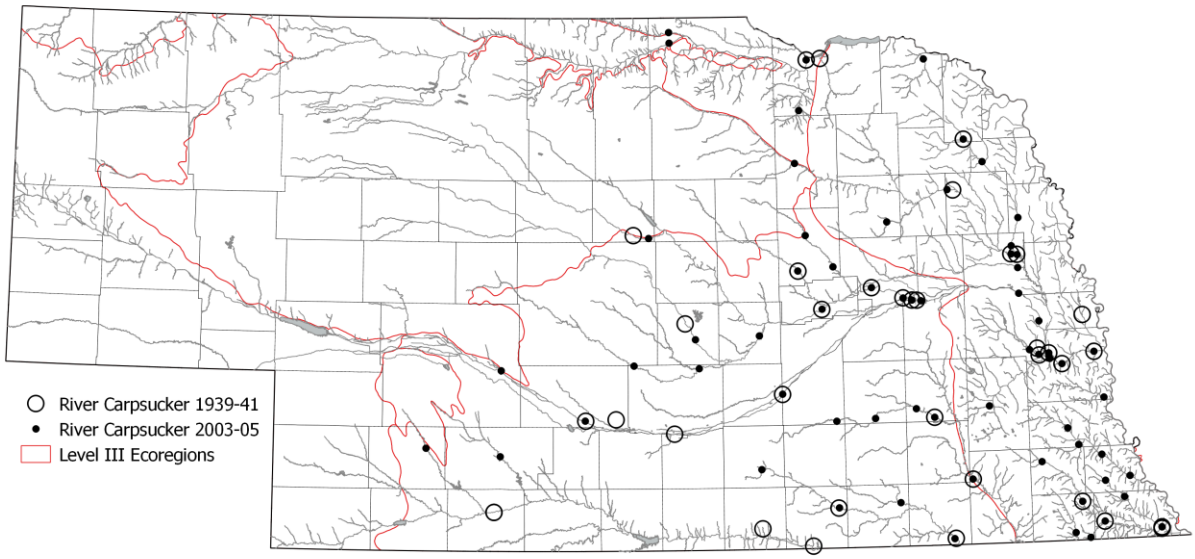
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Quillback was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Quillback was collected during the 2003-05 stream survey.

Quillback	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	14.6	1.37	149.5	0.9	0.3	4.1	2
Maximum	31.4	10.88	1143	470	2090.0	439.2	37
Median	24.95	5.845	396.2	52.65	102.9	36.3	20
80% Exceedence	21	2.1	285.8	10.0	23.4	10.5	13
20% Exceedence	27.9	7.67	640	119	560.4	169.2	28

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **80% Exceedance** means 80% of recorded values were higher than this value while **20% Exceedance** means 20% of recorded values were higher.

River Carpsucker, *Carpiodes carpiodes*



River Carpsucker, Carpiodes carpio

1939-41	35
2003-05	66
Matches	25
Missing	10
New sites	41
Dry sites	0

The preferred habitat of the River Carpsucker is silt-bottomed pools of low to moderate gradient streams as well as reservoirs. The range of the River Carpsucker is the Mississippi River and Rio Grande drainages as well as the Gulf Coast drainages between them. It's global status is G5 and its Nebraska status is S5

The River Carpsucker was collected 36 times in the 1939-41 survey (133 fish) and 67 times in the 2003-05 survey (1,047 fish). In spite of the increase in sample sites and in numbers collected, it dropped from 14th to 20th in frequency of occurrence. While its incidence appears to have increased in some drainages (e.g. Nemaha, Big Blue), the overall distribution appears to be the much the same.

Looking at the results by ecoregion, Smith et.al.(2014) noted that the River Carpsucker had increased in three regions and decreased in none. The increases were in the Central Great Plains (+37%), Northwestern Glaciated Plains (+50%) and the Western Corn Belt Plains (+133%). The overall increase was +83%.

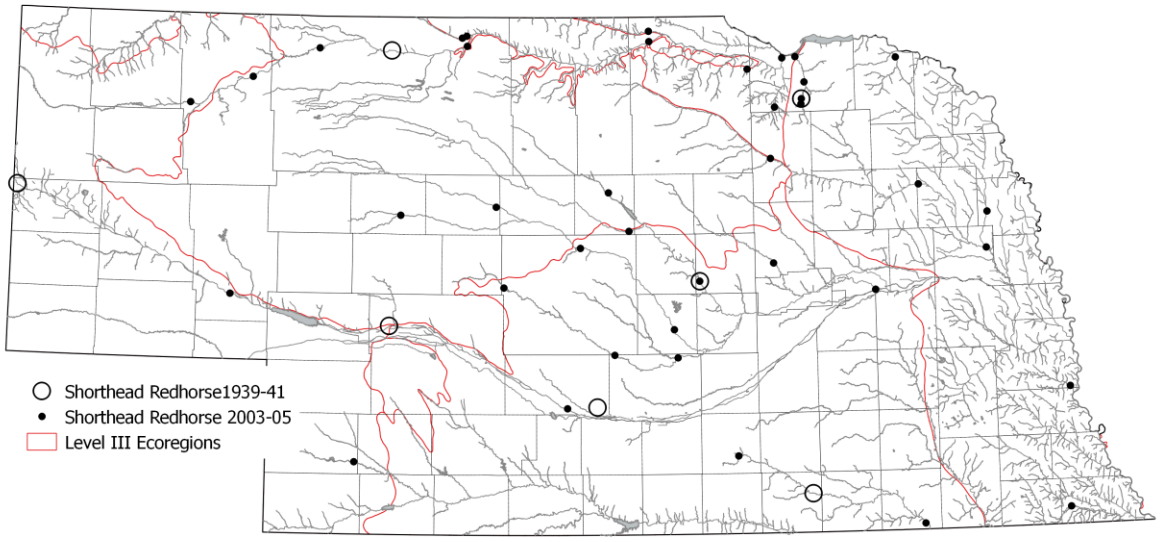
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the River Carpsucker was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the River Carpsucker was collected during the 2003-05 stream survey.

River Carpsucker	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	14.6	1.46	198.6	2.51	0.5	2.2	2
Maximum	34.9	10.88	4672	1063	4210	500.8	58
Median	23.7	6.85	530	62.1	74.2	23.6	23
90% Exceedence	17.7	1.6	282.7	9.7	3.8	7.5	11
10% Exceedence	29.1	8.74	954	253	1160.0	344.8	35

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **90% Exceedance** means 90% of recorded values were higher than this value while **10% Exceedance** means 10% of recorded values were higher.

Shorthead Redhorse, *Moxostoma macrolepidotum*



Shorthead Redhorse, Moxostoma macrolepidotum

1939-41	7
2003-05	38
Matches	2
Missing	5
New sites	36
Dry sites	0

The Shorthead Redhorse prefers small to large rivers where they occupy areas with moderate to strong currents. They are native to much of North America from the Rocky Mountains to the Hudson River and from Hudson's Bay south to Illinois. It's global status is G5 and its Nebraska status is S5.

The Shorthead Redhorse was collected at seven sites in the 1939-141 survey (8 fish)and at 39 sites in the 2003-05 survey (190 fish). The frequency of occurrence ranking changed dramatically from 44th in 1939-41 to 29th in 2003-05. In the 2003-05 survey it was not collected at five of the historic sites though they were collected from all of these same streams, it just wasn't found at these five sites. This is another example of the randomness of sampling fishes in streams. What the map above shows is that the Shorthead Redhorse has increased its presence in Nebraska's streams. But has it? In his thesis, Raymond Johnson states that the species may have been more common before he did his survey. His evidence came from earlier surveys in the 1890's and (perhaps less than reliable?) angler comments.

Looking at the results by ecoregion, Smith et.al.(2014) noted that the Shorthead Redhorse had been collected in four regions in the 1939-41 survey and it had increased in all four. These included the Central Great Plains (+300%), the Western High Plains (+50%), the Nebraska Sand Hills (+500%) and the Western Corn Belt Plains (+800%). The overall change was +443%. That is a rather dramatic change.

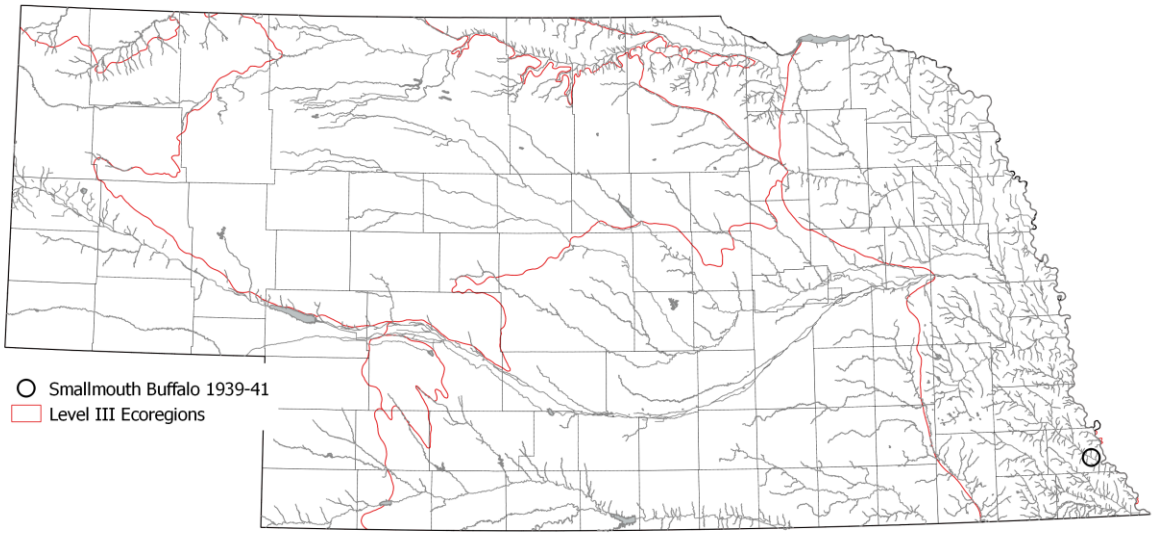
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Shorthead Redhorse was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Shorthead Redhorse was collected during the 2003-05 stream survey.

Shorthead Redhorse	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	14.6	1.46	149.5	1.5	0.5	4.8	2
Maximum	34.9	10.88	994	233	1410	364.7	58
Median	24.1	6.8	321.1	25.1	107.8	28.1	21
80% Exceedence	21	2.2	244.1	9.4	17.5	8.0	13
20% Exceedence	28.1	8.13	602	80	389.6	96.8	31

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **80% Exceedance** means 80% of recorded values were higher than this value while **20% Exceedance** means 20% of recorded values were higher.

Smallmouth Buffalo, *Ictiobus bubalus*



Smallmouth Buffalo, Ictiobus bubalus

1939-41	1
2003-05	0
Matches	0
Missing	1
New sites	0
Dry sites	0

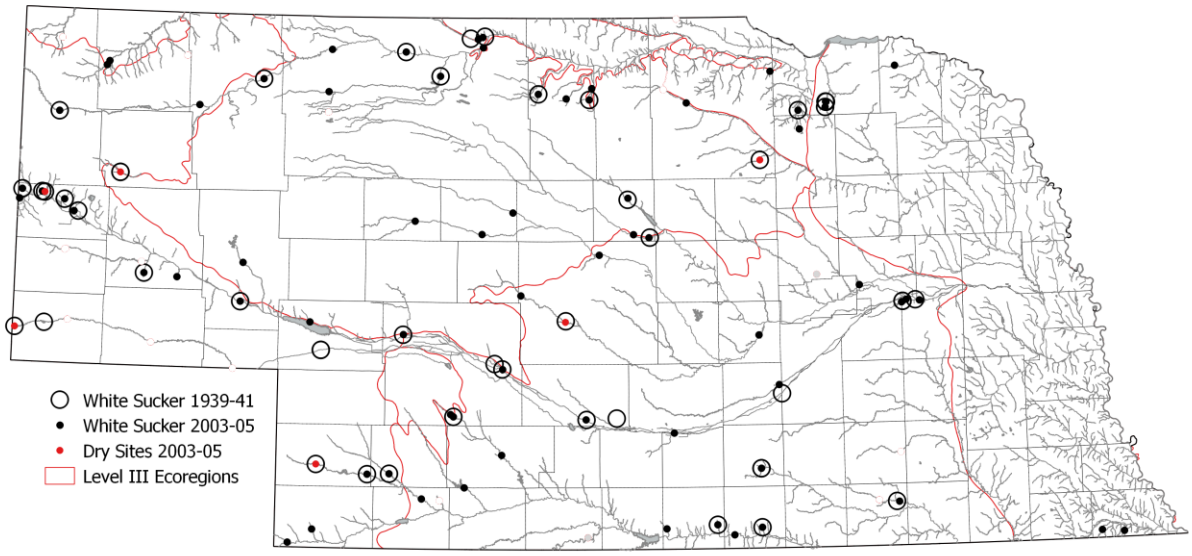
The Smallmouth Buffalo prefers medium to large rivers where it uses areas with moderate turbidity and slower currents. It also does well in reservoirs. The primary range of the Smallmouth buffalo is the Mississippi River basin. It's global status is G5 and its Nebraska status is S3.

The Smallmouth Buffalo was collected once in the 1939-41 survey and not at all in the 2003-05 survey. The species is common in the Missouri River and it is occasionally collected from the river's tributaries which probably explain the single collection in the 1939-41 survey. They can travel long distances into Nebraska's interior rivers as there is a record from the forks of the North and South Platte Rivers as well as collections in the Elkhorn and Loup basins. But these are rare events.

Looking at the results by ecoregion, Smith et.al.(2014) did not evaluate the Smallmouth Buffalo because they were not collected in the 2003-05 survey and only once in the 1939-41 survey.

No charts were constructed since none were collected in the 2003-05 survey.

White Sucker, *Catostomus commersonii*



White Sucker, Catostomus commersonii

The White Sucker prefers small clear streams. The literature indicates that they also prefer rocky streams or rocky areas of streams. Very few Nebraska streams are rocky. The range of the White Sucker is one of the more widespread species being found in most of Canada and the northern US east of the Rocky Mountains. It's global status is G5 and its Nebraska status is S5.

1939-41	44
2003-05	69
Matches	32
Missing	7
New sites	37
Dry sites	5

The White Sucker was collected from 47 sites (590 fish) in the 1939-41 survey and at 70 sites (2,585 fish) in the 2003-05 survey. As a rule, the White Sucker is relatively easy to find when sampling a stream site. Therefore, its presence at new sites indicates expansion into new watersheds or increases in populations within streams/watersheds. It is also interesting to note, in contrast to most other species, that they are almost absent from eastern Nebraska.

Looking at the results by ecoregion, Smith et.al.(2014) noted that the White Sucker had increased in all five regions. These include: the Central Great Plains (+71%), the Western High Plains (+15%), the Nebraska Sand Hills (+133%), the Northwestern Glaciated Plains (+300%), the Northwestern Great Plains (+133%) and the Western Corn Belt Plains (+67%). The overall increase was +73%.

The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the White Sucker was collected during the 2003-05 stream survey.

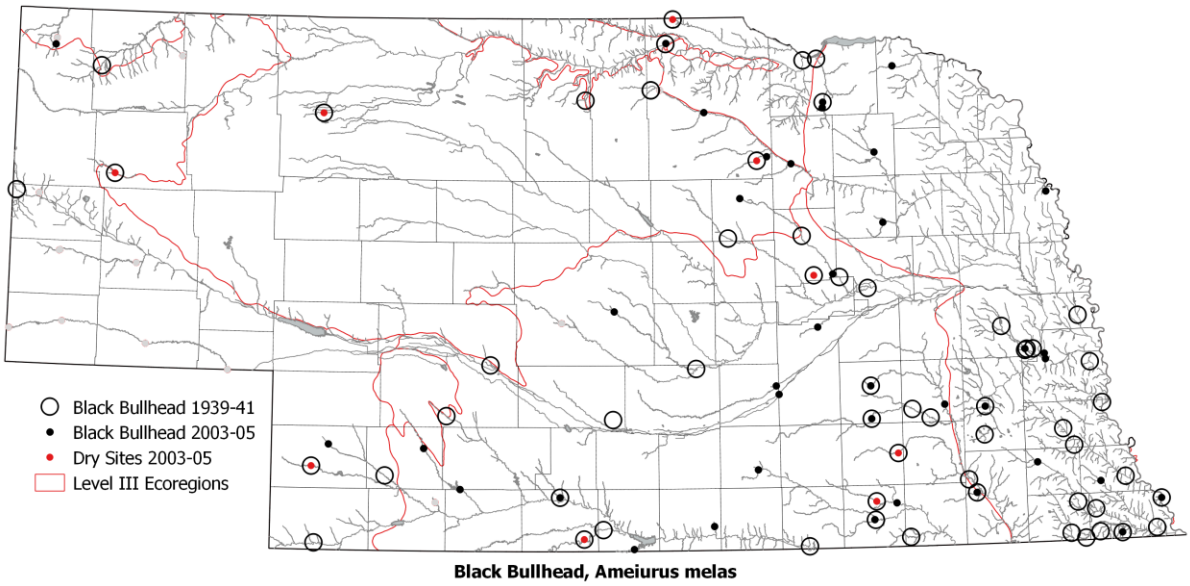
Habitat conditions of water quality, discharge and stream dimensions where the White Sucker was collected during the 2003-05 stream survey.

White Sucker	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	14.5	1.58	134.7	0.148	0	2.0	5
Maximum	29.6	13.48	1076	863	1160	169.2	51
Median	21.6	7.34	427.95	9.52	16.2	7.1	22
90% Exceedence	16.3	2.2	180.9	0.9	1.0	2.9	11
10% Exceedence	25.6	10.16	825	31.6	199.2	73.7	37

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **90% Exceedance** means 90% of recorded values were higher than this value while **10% Exceedance** means 10% of recorded values were higher.

ICTALURIDAE
Catfish Family

Black Bullhead, *Ameiurus melas*



Black Bullhead, Ameiurus melas

The Black Bullhead prefers quiet waters so is generally found in backwaters and oxbows as well as pools of smaller streams. These areas usually have soft bottoms and can be quite turbid. It has been stocked in farm ponds which could impact it's overall distribution in the state.

1939-41	58
2003-05	38
Matches	10
Missing	40
New sites	28
Dry sites	8

The Black Bullhead was collected at 57 sites in 1939-41 (360 fish) and at 40 sites in 2003-05 (427 fish) of which 11 matched the 1939-41 collection sites. It was missing from 37 (65%) of the historic sites but was found at 26 new sites. Eight of the historic sites were dry in 2003-2005.

In the 1939-41 survey, it ranked 18th overall in frequency of occurrence in samples while in the 2003-05 survey, it dropped to 24th. The overall trend is confusing. It was missing from 37 sites but this was balanced by being found at 26 new sites. As a rule, the species is collected in low numbers unless you happen to catch a school of small ones. However, if it is present, it is relatively easy to collect. It's absence from 37 sites suggests either a decline of the species or it's preferred habitat.

Looking at the results by ecoregion, Smith et.al. (2014) noted and increase in one region, the Nebraska Sand Hills (+33%). In one ecoregion, the Central Great Plains there was no change. The remaining four ecoregions including the Western High Plains (-67%), Northwestern Glaciated Plains (-100%), Northwest Great Plains (-33%) and Western Corn Belt Plains (-36%) all showed declines. Overall, there was a 24% decline in the number of sites where the species was found.

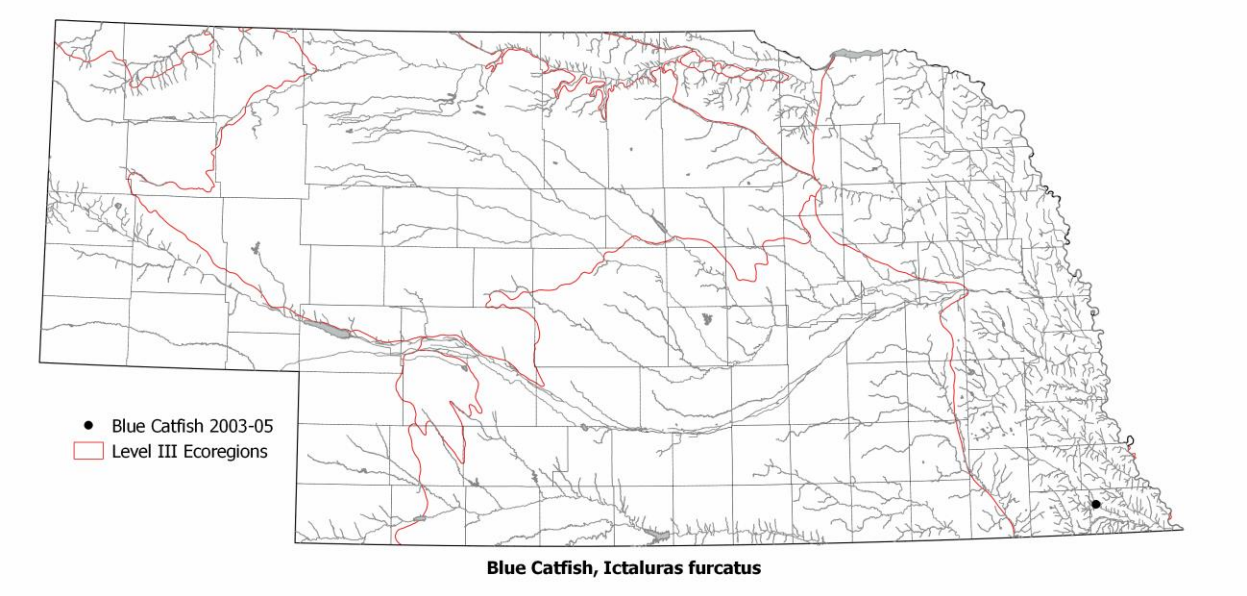
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Black Bullhead was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Black Bullhead was collected during the 2003-05 stream survey.

Black Bullhead	Water Temperature (C)	Dissolved Oxygen (mg/L)	Specific Conductance (umhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	15.5	0.8	230.1	0.93	0	1.0	5.8
Maximum	34.4	12.2	4672	700	1062	344.8	36.9
Median	24.0	5.6	597	22.2	3.8	7.2	16.3
80% Exceedance	19.6	1.85	421.6	13.2	0.7	4.2	11
20% Exceedance	27.3	7.73	755	75.6	23.2	11.8	31

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **80% Exceedance** means 80% of recorded values were higher than this value while **20% Exceedance** means 20% of recorded values were higher.

Blue Catfish, *Ictaluras furcatus*



Blue Catfish, Ictaluras furcatus

The Blue Catfish is a big river fish that tolerates turbid waters. It is native to the Missouri River and has been collected in the main tributaries to the Missouri. The Blue Catfish is native to the Gulf Coast streams from Texas to Alabama then northward through the Mississippi, Ohio and Missouri Rivers. It's global status is G5 which means it is "Common, widespread and abundant (although it may be rare in parts of it's range)".

1939-41	0
2003-05	1
Matches	0
Missing	0
New sites	1
Dry sites	0

The Blue Catfish was not collected in 1939-41 and was found once in 2003-05. There isn't too much one can say about this species. It is a big river fish that is occasionally found in the Missouri's tributaries. A professor of biology at the University of Nebraska at Omaha (Dr. Richard Stasiak) has regularly collected juvenile Blue Catfish from the lower Elkhorn River. These collections indicate that the species may be using the tributaries for spawning.

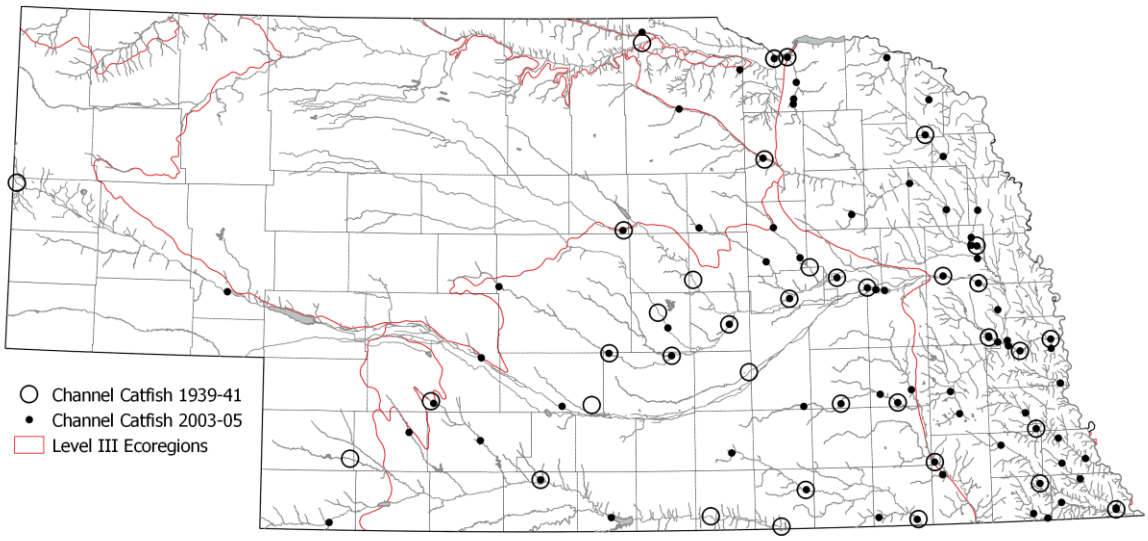
Looking at the results by ecoregion, Smith et.al. (2014) reported that the species could not be evaluated with only one collection in the two surveys.

The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Blue Sucker was collected during the 2003-05 stream survey. Since only one was collected, the table shows the actual recorded values.

Habitat conditions of water quality, discharge and stream dimensions where the Blue Catfish was collected during the 2003-05 stream survey. The table shows the actual recorded values.

Blue Sucker	Water Temperature (C)	Dissolved Oxygen (mg/L)	Specific Conductance (umhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Site 231	33.9	10.65	391.1	6.6	1.7	9.3	4

Channel Catfish, *Ictaluras punctatus*



Channel Catfish, Ictaluras punctatus

The Channel Catfish prefers the larger streams with moderate currents and clean bottoms of sand and gravel. They are a migratory species, moving upstream in the spring for spawning and feeding and returning downstream in the fall to overwinter in deeper waters. The Channel Catfish is native to much of the US and southern Canada east of the Continental Divide exclusive of the Atlantic Coast streams. It's global status is G5 and its Nebraska status is S5 (widespread, abundant, secure).

1939-41	37
2003-05	83
Matches	28
Missing	9
New sites	55
Dry sites	0

There is quite a difference in the number of collections in the two surveys (37 in 1939-41 versus 83 in 2003-05). However, looking at the map, the range didn't really change but they were found at more sites. It is possible that the 2003-05 survey was more successful at collecting juvenile fish which will use smaller streams. That is not to say that there haven't been any changes in distribution since 1941. We can look to a couple of instances of change. The Channel Catfish was collected from the North Platte River at the Wyoming/Nebraska border in the early survey. After that survey, several irrigation diversion dams were built on the North Platte River which blocked their migrations that far upriver. In another instance, the species was not found in the lower portions of the Republican River near the Kansas border in the 2003-05 survey. After the 1939-41 survey, Harlan County Reservoir and several irrigation diversion dams were built on the lower Republican River. As a result, migrations were cut off and, as the river periodically went dry, the Channel Catfish was virtually eliminated.

Looking at the results by ecoregion, Smith et.al.(2014) noted increases in four regions: the Central Great Plains (+55%), the Nebraska Sand Hills (+200%), the Northwestern Glaciated Plains (+100%), and the Western Corn Belt Plains (+291%). The noted a decrease in the Northwestern Great Plains (-100%) and no change in the Western High Plains. Overall the change was an increase of +124%.

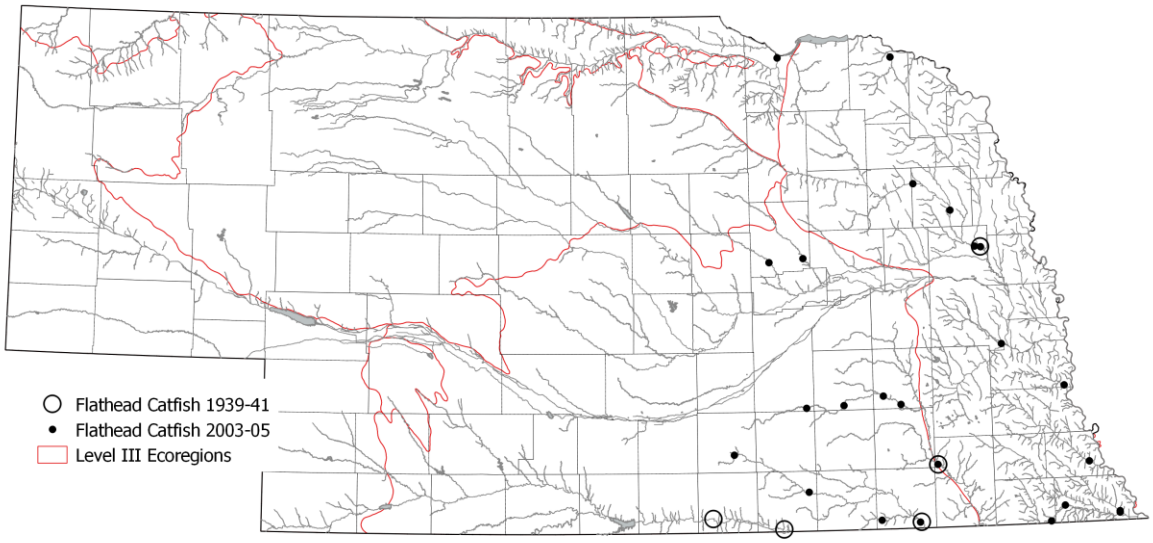
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Channel Catfish was collected during the 2003-05 stream survey

Habitat conditions of water quality, discharge and stream dimensions where the Channel Catfish was collected during the 2003-05 stream survey.

Channel Catfish	Water Temperature (C)	Dissolved Oxygen (mg/L)	Specific Conductance (umhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	14.6	1.37	163	2.2	0.1	2.2	2
Maximum	34.9	10.88	4672	1063	4210	398.8	58
Median	22.9	7.0	526.0	56.4	37.2	18.2	21
90% Exceedance	16.4	1.61	274.3	9.35	3.7	5.4	10
10% Exceedance	28.4	8.81	796	204	560.4	139.3	33

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **90% Exceedance** means 90% of recorded values were higher than this value while 1**0% Exceedance** means 10% of recorded values were higher.

Flathead Catfish, *Pylodictis olivaris*



Flathead Catfish, Pylodictis olivaris

1939-41	5
2003-05	24
Matches	3
Missing	2
New sites	21
Dry sites	0

The Flathead Catfish prefers pools and quiet areas of large rivers though they can be found in smaller rivers in quite shallow water. The Flathead Catfish is native to a large portion of the North America from Mexico to North Dakota then east to Pennsylvania and down to Alabama on the Gulf Coast. It's global status is G5 and its Nebraska status is S5.

The Flathead Catfish was collected at five locations in 1939-41 and 24 in 2003-05. They have disappeared from the Republican River, probably due to low flows. The range has enlarged elsewhere partially due to the channelization of the Missouri River beginning in the 1940's. Much of the river's banks were lined with rock riprap which provided abundant habitat for Flathead Catfish. Many of the collections along the eastern border may come from the Missouri River. The reason for the increases in the Little Blue, Big Blue and Loup basins is not known because the species has not been stocked there by Nebraska Game and Parks. We cannot rule out private stockings followed by natural reproduction.

Looking at the results by ecoregion, Smith et.al.(2014) noted that they were found in two regions and had increased in both. These were the Central Great Plains (+233%) and the Western Corn Belt Plains (+550%). The overall change was an increase of +380%.

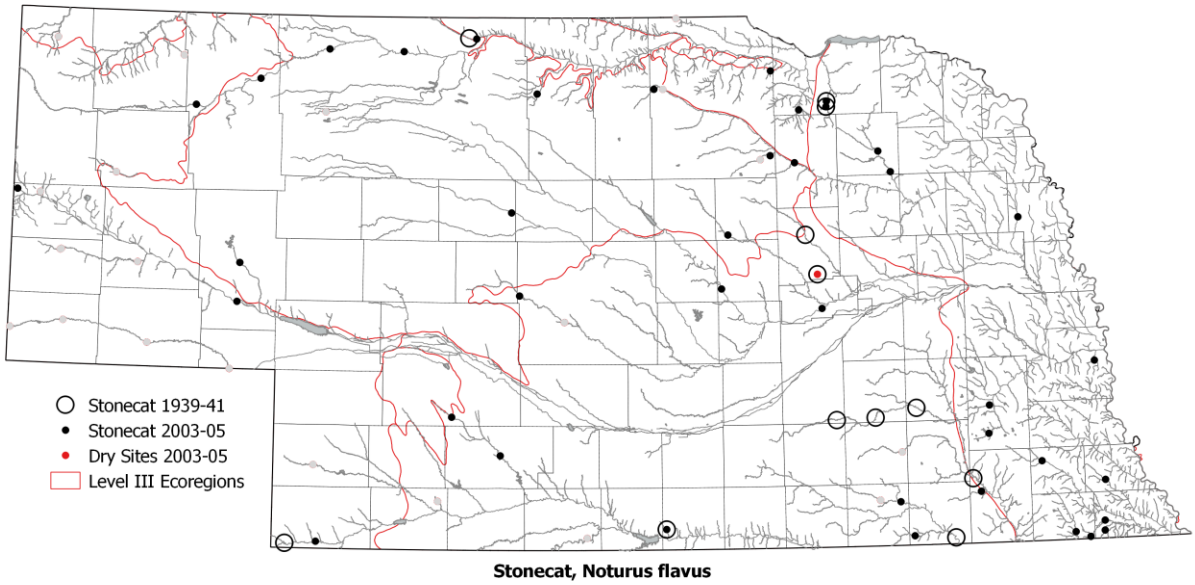
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Flathead Catfish was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Flathead Catfish was collected during the 2003-05 stream survey.

Flathead Catfish	Water Temperature (C)	Dissolved Oxygen (mg/L)	Specific Conductance (umhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	15.4	1.37	285.8	4.05	0.5	5.4	2
Maximum	34.9	10.88	1143	721	594.3	264.3	58
Median	25.1	4.3	507.5	76.9	55.6	18.3	24
80% Exceedance	22.2	1.61	367.5	40	11.1	10.3	13
20% Exceedance	29.1	8.53	620	204	239.2	62.8	32

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **80% Exceedance** means 80% of recorded values were higher than this value while **20% Exceedance** means 20% of recorded values were higher.

Stonecat, *Noturus flavus*



Stonecat, Noturus flavus

1939-41	12
2003-05	40
Matches	5
Missing	6
New sites	35
Dry sites	1

The Stonecat prefers clear perennial streams where it hides in and under whatever cover is available. The primary range of the Stonecat is from the upper Mississippi River basin above the mouth of the Arkansas and the Great Lakes watershed. It's global status is G5 and its Nebraska status is S5.

The Stonecat was collected 12 times in the 1939-41 survey (13 fish) and 41 times in the 2003-05 survey (107 fish). The map suggests that the Stonecat has greatly expanded its range in the state. However, the Stonecat lives on the bottom of a stream, hiding under stones or any other cover that is available and they are not abundant wherever found. Note that the early survey averaged barely over one fish per site and the later survey was just 2.6 fish per site. That would mean that they could be missed by seining but, at the same time, they are not terribly hard to find, even with dip net sampling. So the increases could be real. They do appear to have declined in the West Fork Big Blue River.

Looking at the results by ecoregion, Smith et.al.(2014) noted that collections had increased in three regions; the Central Great Plains (+50%), the Western High Plains (+300%) and the Western Corn Belt Plains (+367%). There was no change in the Northwestern Glaciated Plains. The overall change was +264%.

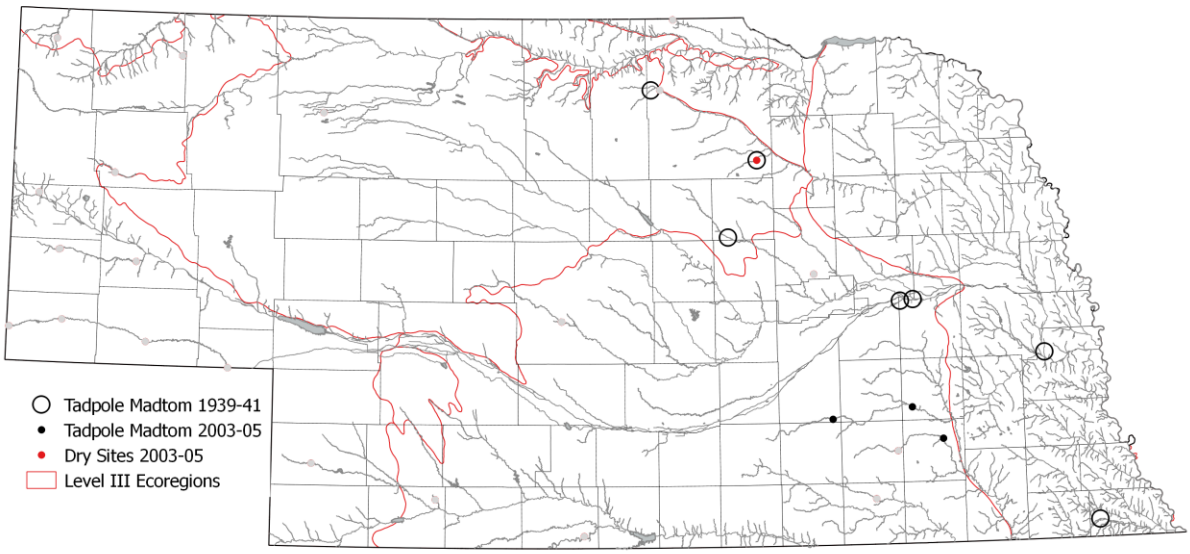
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Stonecat was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Stonecat was collected during the 2003-05 stream survey.

Stonecat	Water Temperature (C)	Dissolved Oxygen (mg/L)	Specific Conductance (umhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	14.5	0.78	134.7	0.8	0	2.2	4
Maximum	31.4	10.35	4672	863	1715	240.5	44
Median	22.6	7.5	470.1	21.9	17.4	7.8	22
80% Exceedance	18	3.84	245.9	6.68	5.2	5.2	12
20% Exceedance	26	8.68	642	59.6	72.7	24.5	30

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **80% Exceedance** means 80% of recorded values were higher than this value while **20% Exceedance** means 20% of recorded values were higher.

Tadpole Madtom, *Noturus gyrinus*



Tadpole Madtom, Noturus gyrinus

The Tadpole Madtom prefers moderately clear to turbid slow-moving perennial streams. They are typically found in the heavy cover provided by vegetation or detritus. The range of the Tadpole Madtom is Texas to Canada then eastward through the Great Lakes to the Hudson River then south to Florida. They are not found in the Appalachians. It's global status is G3 and its Nebraska status is S3.

1939-41	7
2003-05	3
Matches	0
Missing	7
New sites	3
Dry sites	1

The Tadpole Madtom was collected seven times (14 fish) in the 1939-41 survey and three times in the 2003-05 (four fish). Currently it is most commonly found in the Big Blue River basin. The map suggests a decline with their disappearance from more northerly sites.

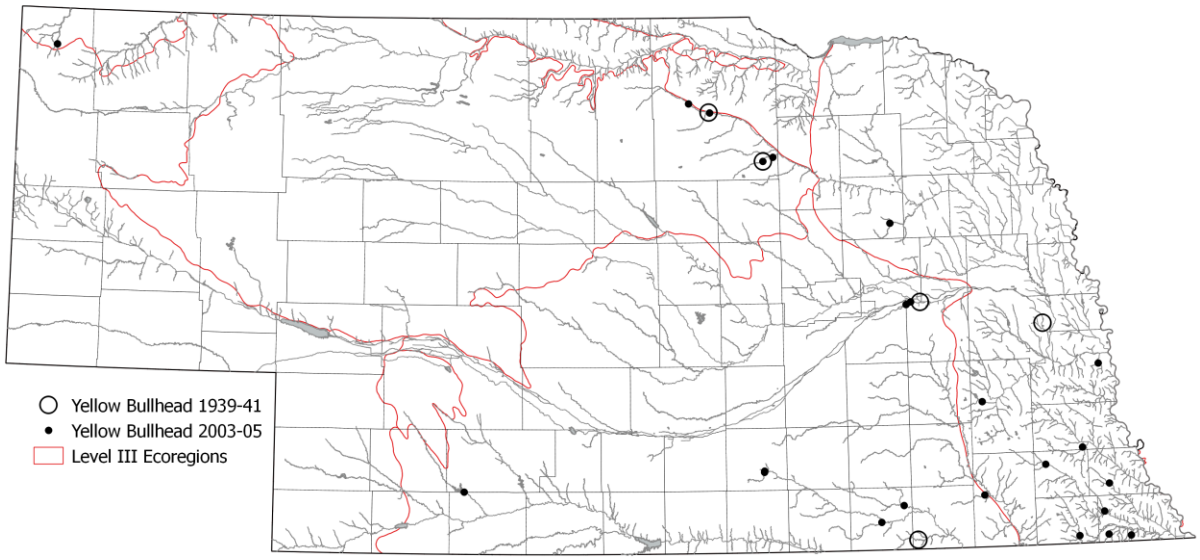
Looking at the results by ecoregion, Smith et.al.(2014) noted that the Tadpole Madtom had increased in one region, the Central Great Plains (+50%). They had decreased in two regions; the Nebraska Sand Hills (-100%) and the Western Corn Belt Plains (-100%). The overall change was a -57%.

The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Tadpole Madtom was collected during the 2003-05 stream survey. Since only three collections were made, the table shows the actual recorded values.

Habitat conditions of water quality, discharge and stream dimensions where the Tadpole Madtom was collected during the 2003-05 stream survey. The table shows the actual recorded values.

Tadpole Madtom	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Site 149	15.4	8.53	580	204	67.1	13.9	38
Site 240	19.8	7.32	595	21.8	7.9	9.8	36
Site 298	23.8	2.05	505	556	11.1	5.8	24

Yellow Bullhead, *Ameiurus natalis*



Yellow Bullhead, Ameiurus natalis

1939-41	5
2003-05	21
Matches	2
Missing	3
New sites	19
Dry sites	0

The Yellow Bullhead prefers clear, perennial streams with rocky beds (though they tolerate other substrates) as well as ponds and lakes. The range of the Yellow Bullhead is most of the US from the Great Plains to the Atlantic and the Great Lakes to the Gulf Coast. It's global status is G5 and its Nebraska status is S4

The Yellow Bullhead was collected five times in the 1939-41 survey (14 fish) and 26 times in the 2003-05 survey (140 fish). The overall range hasn't changed much except for the sample in the extreme northwest in the Hat Creek watershed which really stands out from the rest. The collection in the Republican basin is below an irrigation reservoir which implies a bait bucket or other introduction. The number of new sites in the southeast suggests a range expansion or an improved ability to sample them.

Looking at the results by ecoregion, Smith et.al.(2014) noted that had increased in three regions including the Central Great Plains (+167%), the Nebraska Sand Hills (+50%) and the Western Corn Belt Plains (+800%). The overall change was +250%.

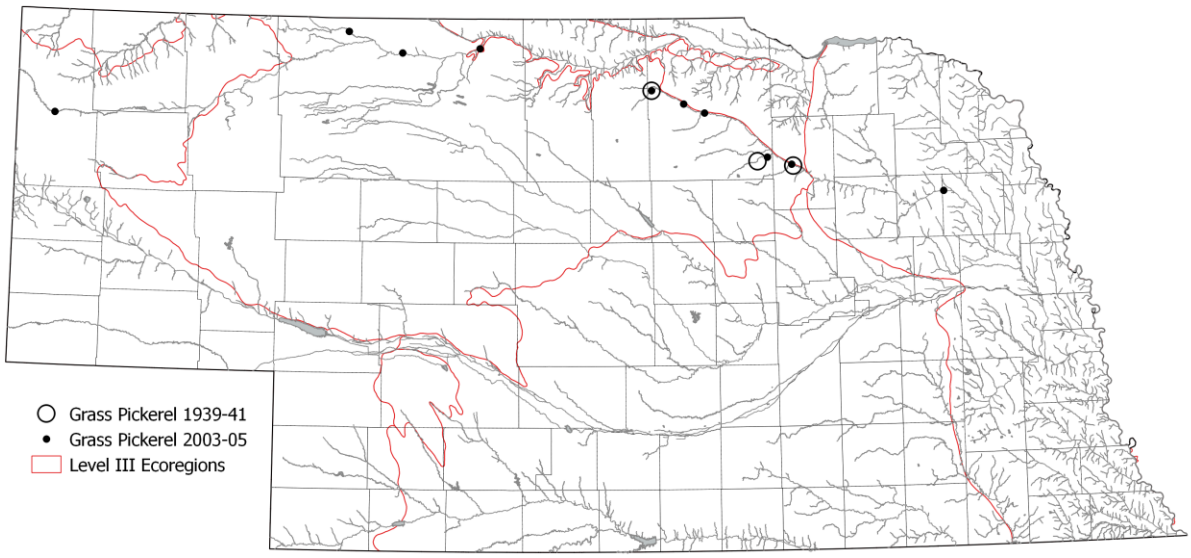
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Yellow Bullhead was collected during the 2003-05 stream survey. Since only three were collected, the table shows the actual recorded values.

Habitat conditions of water quality, discharge and stream dimensions where the Yellow Bullhead was collected during the 2003-05 stream survey. The table shows the actual recorded values.

Yellow Bullhead	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Site 229	21.6	6.85	541	112	3.3	10.2	31
Site 231	33.9	10.65	391.1	6.6	1.7	9.3	4
Site 17/203/204	20	2.56	635	3.98	16.2	17.0	30

ESOCIDAE
Pike Family

Grass Pickerel, *Esox americanus vermiculatus*



Grass (Redfin) Pickerel, Esox americanus vermiculatus

1939-41	3
2003-05	10
Matches	3
Missing	0
New sites	7
Dry sites	0

The Grass Pickerel prefers clear, vegetated waters. These can be streams, oxbows, marshes, or sloughs. They are native to the central US in a band from Texas to the Great Lakes. It's global status is G5 and its Nebraska status is S5.

The Grass Pickerel was collected three times in the 1939-1941 survey, all in the Elkhorn River basin. It was found ten times in the 2003-2005 survey. The primary range of the species in Nebraska is the upper Elkhorn River basin and the middle Niobrara basin. The populations in these two basins appear to be stable. The Grass Pickerel is a glacial relict in Nebraska with it's main range far to the east. It is known that the Niobrara River basin is the youngest river basin in the state, formed some 10,000 years ago at the end of the Pleistocene. It is also known that the developing Niobrara captured some of the southeasterly trending streams that were in the Elkhorn and Loup basins. One can wonder if the presence of this fish in the middle Niobrara basin is a result of the capture of streams from older watersheds that had populations of Grass Pickerel. [Or, on the other hand, maybe someone stocked them up there.]

Looking at the results by ecoregion, Smith et.al.(2014) noted that there was an increase in one region, the Nebraska Sand Hills (+133%). Overall the change was an increase of +233%.

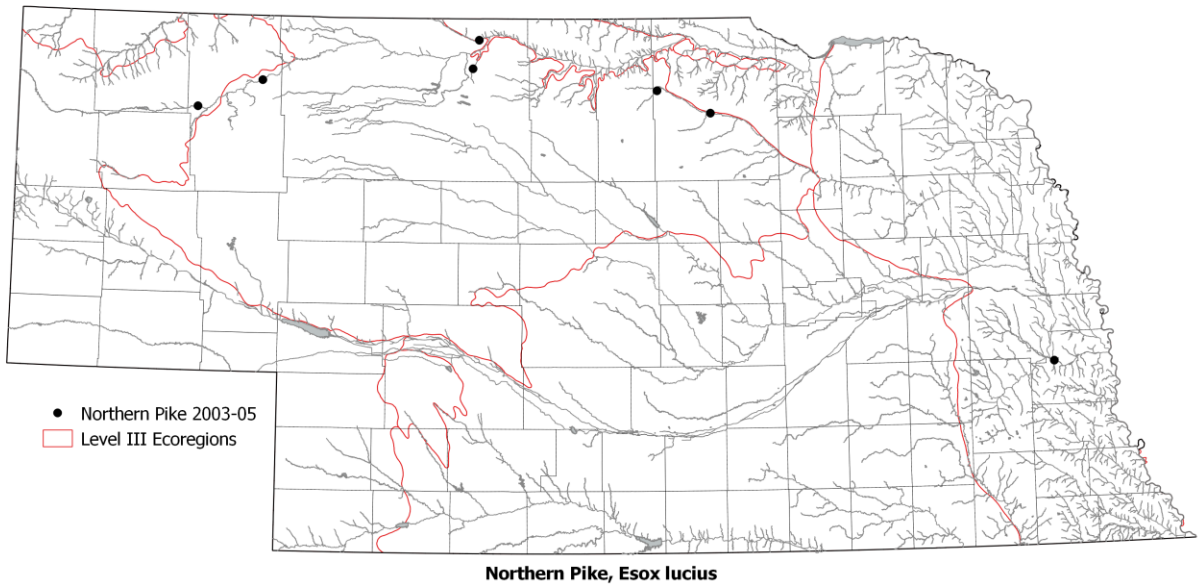
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Grass Pickerel was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Grass Pickerel was collected during the 2003-05 stream survey.

Grass Pickerel	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	16.3	1.61	134.7	0.9	0.3	3.8	5
Maximum	32.9	10.11	442.5	62.1	483	139.5	44
Median	24.9	7.73	266.4	5.255	21.0	11.1	17
90% Exceedence	22.6	7.5	214.5	3.6	3.4	4.1	12
10% Exceedence	27.7	8.88	297.2	15.3	294.1	43.7	33

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **75% Exceedance** means 75% of recorded values were higher than this value while **25% Exceedance** means 25% of recorded values were higher.

Northern Pike, *Esox lucius*



Northern Pike, Esox lucius

The Northern Pike prefers the cool, clear vegetated waters of lakes and streams. The range of the Northern Pike is described as circumboreal meaning it is found all around the planet in the northern latitudes. In North America,it is found throughout Canada and then ranges down into the US through the Great Lakes states to Montana and extending south as far as Missouri. It's global status is G5 and its Nebraska status is S5.

1939-41	0
2003-05	7
Matches	0
Missing	0
New sites	7
Dry sites	0

No Northern Pike were collected in the 1939-41 survey though Raymond Johnson does discuss numerous records that pre-dated his survey. They were collected seven times in the 2003-05 survey. The archeological record shows that this species is native to the state with records in the Loup basin and the lower Platte River. They were evidently very rare at the time of the earlier surveys but widespread stockings have increased their presence in Nebraska streams. For instance, they have been stocked into the upper Elkhorn River as well as two large reservoirs in the Niobrara River basin which may have contributed to their presence in those two rivers. However, the Northern Pike has also been stocked into numerous other reservoirs around the state and it doesn't appear any stream populations have developed from those.

They could not be evaluated by ecoregions (Smith et.al.) because none were collected in the 1939-41 survey so there was nothing to compare to.

The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Northern Pike was collected during the 2003-05 stream survey.

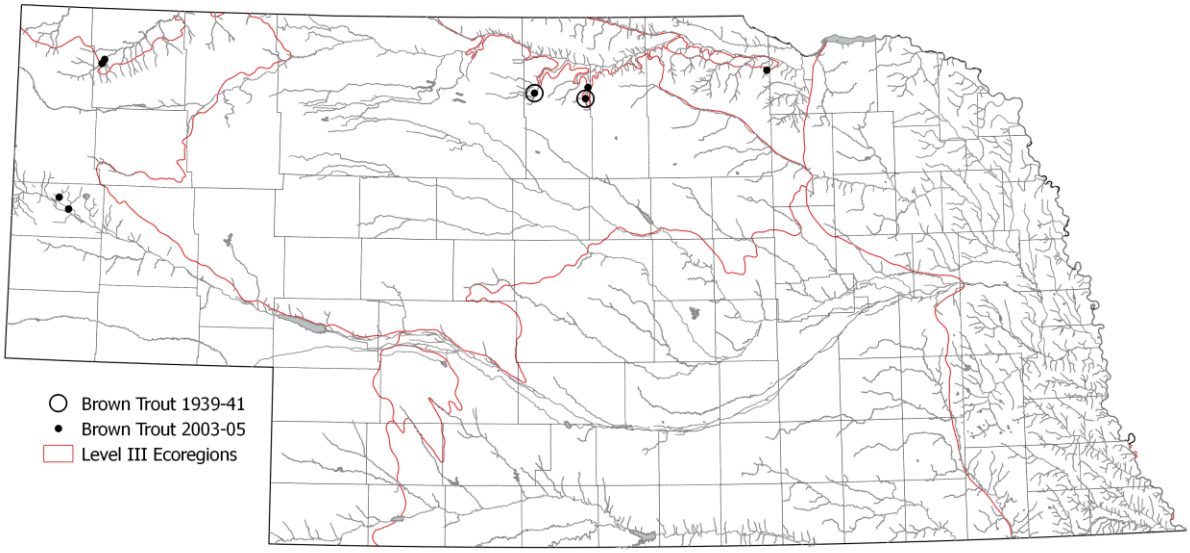
Habitat conditions of water quality, discharge and stream dimensions where the Northern Pike was collected during the 2003-05 stream survey.

Northern Pike	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	17.8	5.02	134.7	3.3	0.1	2.8	12
Maximum	30.3	10.11	689	44.4	52.5	35.2	33
Median	23.2	7.78	276.1	9.35	13.3	8	18

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower).

SALMONIDAE
Salmon Family

Brown Trout, *Salmo trutta*



Brown Trout, Salmo trutta

1939-41	2
2003-05	8
Matches	2
Missing	0
New sites	6
Dry sites	0

The Brown Trout prefers cold, clean streams, ponds and lakes. While it can tolerate warmer waters than other trouts, it still needs cold (or cool) waters to survive Nebraska's hot summers. The Brown Trout is native to Europe and western Asia. In North America, it is an exotic fish and was introduced beginning in the 1800's. It's global status is G5 and its Nebraska status is S5 (widespread, abundant, secure).

The Brown Trout has been stocked into a number of streams in the North Platte, Niobrara and White/Hat basins. The locations on the map simply indicate where they have been stocked. Only a few of these are self-sustaining. A "natural" extension of their range (unassisted by humans) is not possible.

Looking at the results by ecoregion, Smith et.al.(2014) noted that there was no change in the Nebraska Sand Hills. There was an increase of +300% in the Northwestern Great Plains. Overall the increase was +300%.

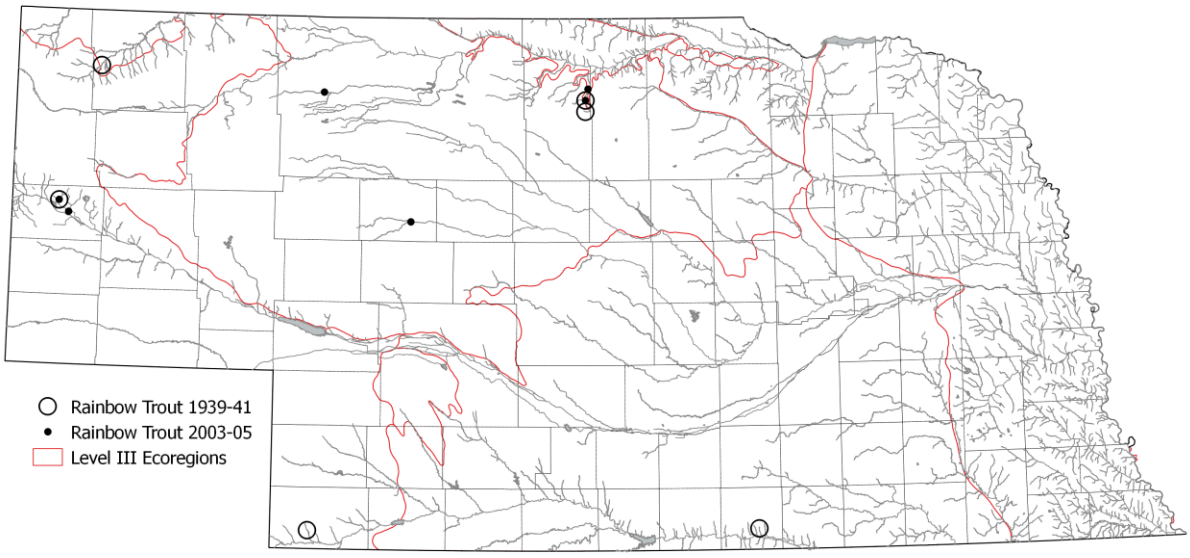
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Brown Trout was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Brown Trout was collected during the 2003-05 stream survey.

Brown Trout	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	14.5	5.76	134.7	0.8	0.7	2.0	11
Maximum	24.5	13.48	919	30.1	74.0	9.6	35
Median	18.2	8.125	325.0	6.9	12.5	5.1	22

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower).

Rainbow Trout, *Oncorhynchus mykiss*



Rainbow Trout, Oncorhynchus mykiss

The Rainbow Trout prefers cold water streams and lakes and introductions into Nebraska waters began in the 1880's. The historical range of the Rainbow Trout is the Pacific Coast from Mexico to Alaska. It has been widely stocked all over the world. It's global status is G5 and its Nebraska status is SNA.

1939-41	6
2003-05	6
Matches	2
Missing	4
New sites	4
Dry sites	0

The Rainbow Trout was collected six times in each survey. It has been and continues to be widely stocked as a sport fish. So, as a non-native species, it is found where it has been stocked and the collections reflect this.

Looking at the results by ecoregion, Smith et.al.(2014) noted a decline in one region, the Central Great Plains (-100%), and an increase in another, the Nebraska Sand Hills (+100%). There was no change in the Western Great Plains and the Northwestern Great Plains. The overall change was zero.

The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Rainbow Trout was collected during the 2003-05 stream survey.

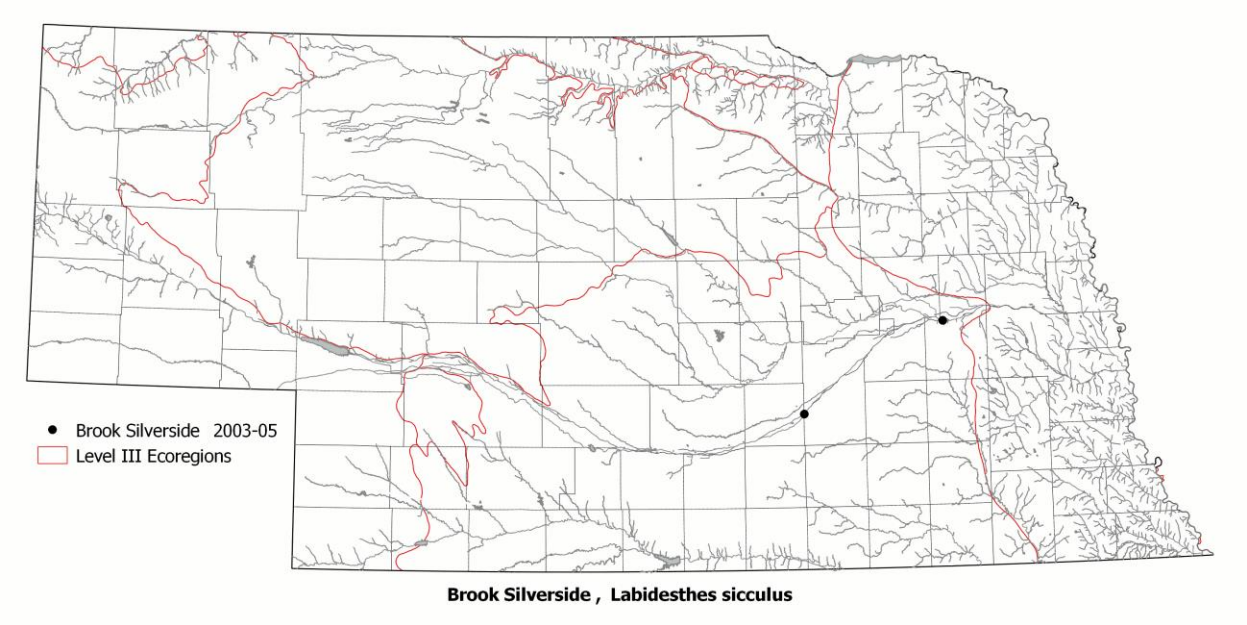
Habitat conditions of water quality, discharge and stream dimensions where the Rainbow Trout was collected during the 2003-05 stream survey.

Rainbow Trout	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	15.9	5.73	134.7	0.9	0.7	2.0	12
Maximum	25.4	13.48	919	30.1	94.7	16.7	35
Median	20.4	7.11	174.7	9.9	55.5	8.3	26

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower).

ATHERINIDAE
Silversides Family

Brook Silverside, *Labidesthes sicculus*



Brook Silverside , Labidesthes sicculus

The Brook Silverside prefers calm, clear water and is usually found in ponds and sandpit lakes though is occasionally found in streams. The Brook Silverside is native to the northern US and southern Canada from Montana to New York then south as far as Kansas. It's global status is G5 and it's Nebraska status is SNA (species not assessed).

1939-41	0
2003-05	2
Matches	0
Missing	0
New sites	2
Dry sites	0

The Brook Silverside is not native to Nebraska but entered the state in the early 1980's along with shipments of Threadfin Shad (*Dorosoma petenense*) from Illinois. At that time experimental stockings of Threadfin Shad were being made to see if they could improve the growth of sport fishes. They did not, the experimental stockings ceased, and the Threadfin Shad died out. However, the Brook Silverside survived and persists in some sandpit lakes along the Platte River where it is of some value as a prey fish. The collections in 2003-05 in the Platte River are of fish that probably entered the river when the lakes flooded. It has spread though the Platte River and is occasionally sampled but, at this time, does not appear to be much of a threat as an invasive.

No ecoregion evaluation could be done (Smith et.al. 2014) since the Brook Silverside was not collected in the 1939-41 survey.

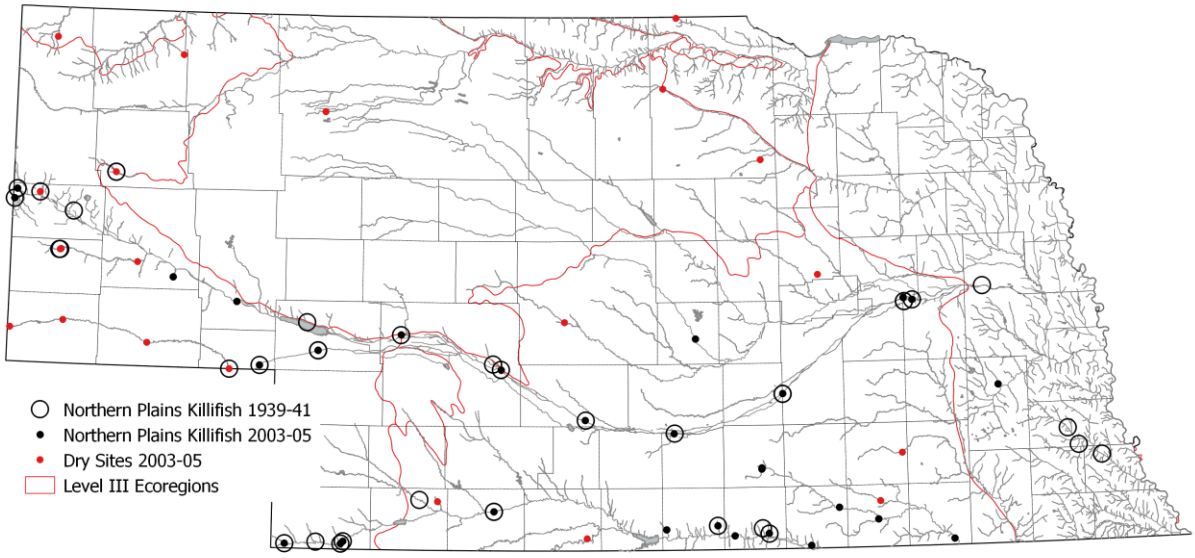
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Brook Silverside was collected during the 2003-05 stream survey. Since only two collections were made, the table shows the actual recorded values.

Habitat conditions of water quality, discharge and stream dimensions where the Brook Silverside was collected during the 2003-05 stream survey. The table shows the actual recorded values.

Brook Silverside	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Site 202	22.7	1.58	658	14.9	16.1	18.8	23
Site 79/275	21.5	2.44	883	7.25	756.0	305.8	16

FUNDULIDAE
Killifish Family

Northern Plains Killifish, *Fundulus kansae*



Northern Plains Killifish, Fundulus kansae

1939-41	35
2003-05	30
Matches	17
Missing	12
New sites	13
Dry sites	6

The Northern Plains Killifish prefers alkaline/saline shallow streams with sand bottoms. They are seldom collected from waters that are more than 150 cm deep. Their range is the central Great Plains from Montana to Oklahoma. It's global status is G5 and its Nebraska status is S4.

The Northern Plains Killifish was collected 37 times in the 1939-1941 survey and 30 times in the 2003-2005 survey. In his 1939-1941 survey, Raymond Johnson found that the Northern Plains Killifish was restricted to the Platte River and the watersheds south of the Platte. The species has been extirpated from Pumpkin, Lodgepole, and Snake Creeks in the Panhandle due to dewatering of the streams by groundwater pumping. They have apparently been extirpated from the Little Nemaha River in the southeastern corner of the state for unknown reasons. On the other hand, they appear to have extended their range into the Little Blue River. There was one collection from the Middle Loup River which represents it's presence in a new watershed though the source is unknown. Other than that, there is still a great deal of overlap between the two surveys suggesting that the species is still doing ok. The Northern Plains Killifish is sometimes sold for bait as "Tiger minnows". This could explain some of the range extensions.

Looking at the results by ecoregion, Smith et.al.(2014) noted that they had increased in one region, the Central Great Plains (+38%). They also noted that they had decreased in two regions, the Nebraska Sand Hills (-100%) and Western Corn Belt Plains (-75%). The Northern Plains Killifish had no change in the Western High Plains. Overall there was a minor increase of +3%.

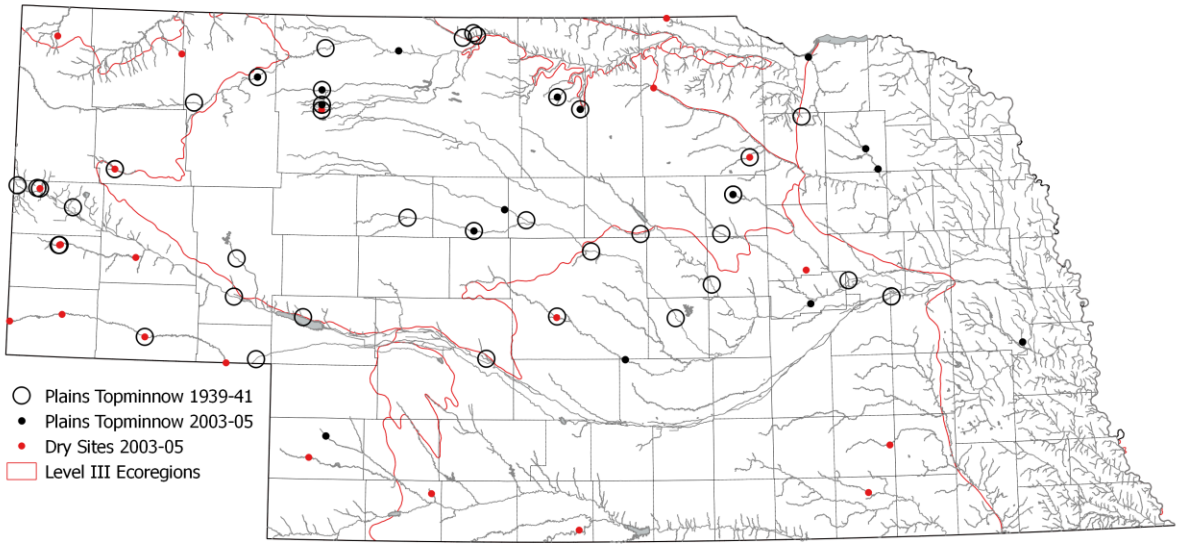
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Northern Plains Killifish was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Northern Plains Killifish was collected during the 2003-05 stream survey.

Northern Plains Killifish	Water Temperature (C)	Dissolved Oxygen (mg/L)	Specific Conductance (umhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	13	1.6	14.06	0.48	0.0	2.2	5
Maximum	32.8	13.7	2210	1063	1410	372.7	28
Median	23.0	7.5	692.0	7.4	11.7	12.8	12
80% Exceedance	16.1	2.12	452	2.29	4.6	5.5	8
20% Exceedance	25.1	9.74	908	26.1	123.1	75.6	15

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **80% Exceedance** means 80% of recorded values were higher than this value while **20% Exceedance** means 20% of recorded values were higher.

Plains Topminnow, *Fundulus sciadicus*



Plains Topminnow, Fundulus sciadicus

The Plains Topminnow prefers the quiet, well-vegetated waters of channel margins, off-channel areas and spring-fed streams, marshes and sloughs. The Plains Topminnow has two population centers. The primary is the state of Nebraska with extensions into the neighboring states. The second is south central Missouri. It's global status is G4 and its Nebraska status is S1.

1939-41	38
2003-05	15
Matches	8
Missing	22
New sites	7
Dry sites	8

The Plains Topminnow showed a significant decline from 42 sites in the 1939-41 survey (522 fish)to 16 sites in the 2003-05 survey (183 fish). Their preferred habitat is often obvious in the field and, as a rule, these fish are easy to find and collect. The decline noted between these two surveys then indicates a major drop in the specie's status. In the 1939-41 survey, Raymond Johnson did not find any Plains Topminnow south of the Platte River. The collection in the Republican basin is presumed to be a bait bucket introduction from the Platte River since the site is immediately below Enders Reservoir. The decline in the Platte River is presumed to be due to competition with the introduced Western mosquitofish, *Gambusia affinis*. The declines in the Loup and Niobrara River basins are not so easy to explain.

Looking at the results by ecoregion, Smith et.al. (2014) noted decreases in all five regions where it was found. These include: the Central Great Plains (-75%), the Western High Plains (-80%), the Nebraska Sand Hills (-36%), the Northwestern Glaciated Plains (-100%) and Northwest Great Plains (-100%). The overall change was a decline of -50%.

The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Plains Topminnow was collected during the 2003-05 stream survey.

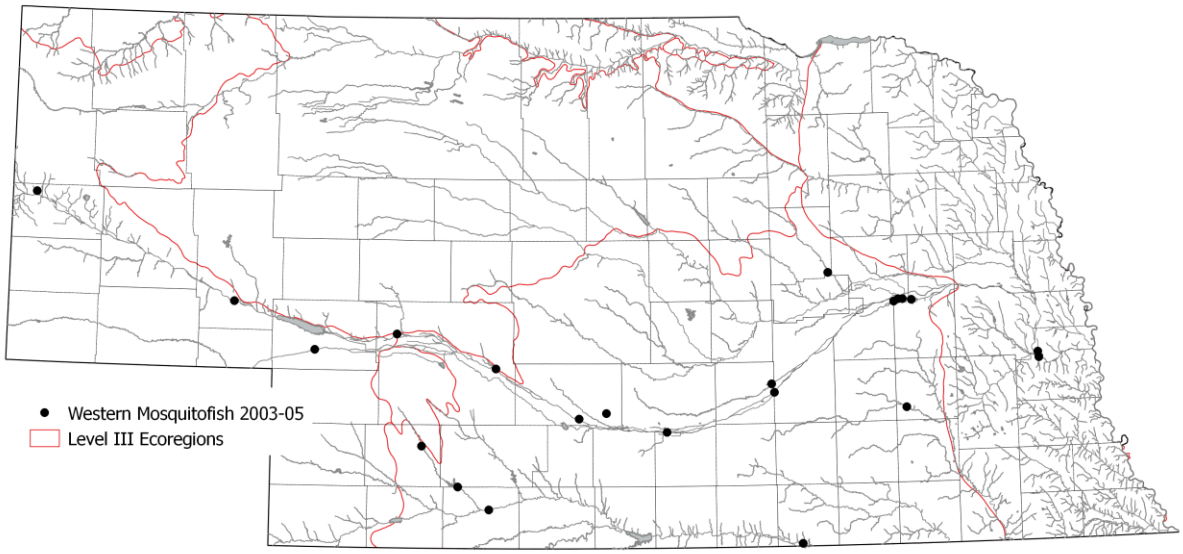
Habitat conditions of water quality, discharge and stream dimensions where the Plains Topminnow was collected during the 2003-05 stream survey.

Plains Topminnow	Water Temperature (C)	Dissolved Oxygen (mg/L)	Specific Conductance (umhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	16.8	0.78	105.9	1.9	0	2.6	8
Maximum	29.6	10.31	850	222	1715	240.5	51
Median	23.3	5.9	243.5	19.9	56.3	16.7	27
75% Exceedance	19.7	2.2	168.2	5.6	1.0	3.8	17
25% Exceedance	25.4	6.8	414.8	53.5	151.0	23.6	34

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **75% Exceedance** means 75% of recorded values were higher than this value while **25% Exceedance** means 25% of recorded values were higher.

POECILIIDAE
Livebearer Family

Western Mosquitofish, *Gambusa affinis*



Western Mosquitofish, Gambusia affinis

The Western Mosquitofish prefers the quiet vegetated waters of sloughs, marshes, oxbows, and off-channel areas. The range of the Western Mosquitofish is southern North America from Mexico to New Mexico up to Florida and north to southern Illinois It's global status is G5 and its Nebraska status is SNA.

1939-41	0
2003-05	23
Matches	0
Missing	0
New sites	23
Dry sites	0

The Western Mosquitofish was introduced into Nebraska waters in the 1960's in the mistaken belief that they would eat and control mosquitos. It was collected 23 times (719 fish) in the 2003-2005 survey. It is common in the Platte and Republican River systems.

The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Western Mosquitofish was collected during the 2003-05 stream survey.

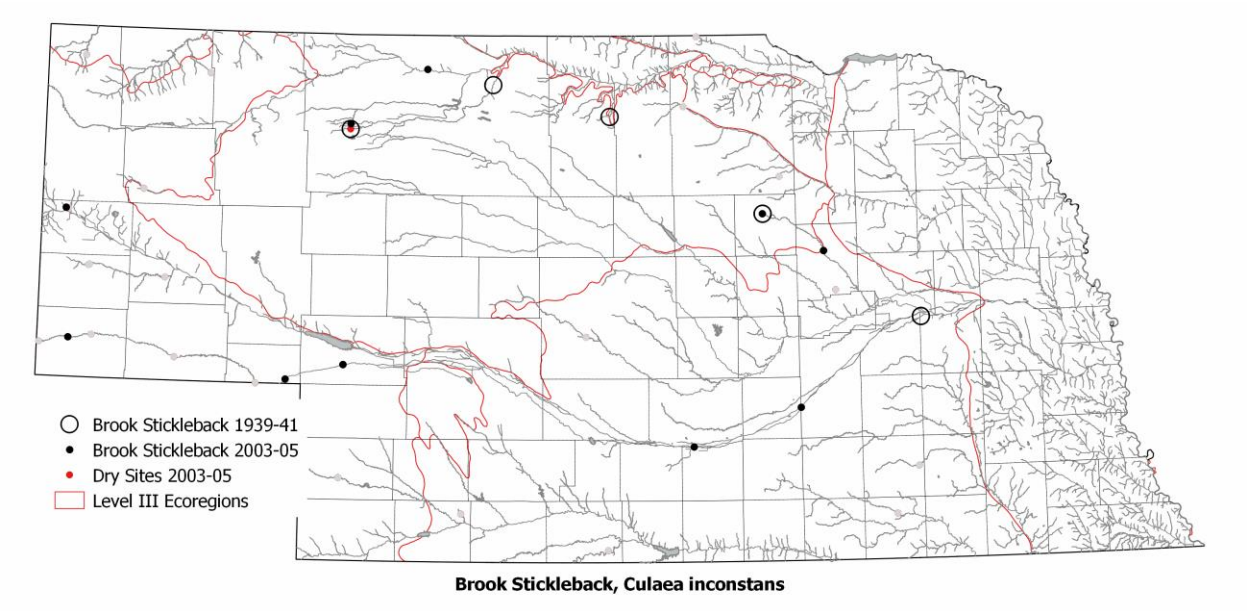
Habitat conditions of water quality, discharge and stream dimensions where the Western Mosquitofish was collected during the 2003-05 stream survey.

Western Mosquitofish	Water Temperature (C)	Dissolved Oxygen (mg/L)	Specific Conductance (umhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	13	1.58	281.3	0.65	0.3	2.2	7
Maximum	32.8	9.74	2210	1063	1160	372.7	68
Median	21.3	4.8	673.5	10.6	14.7	17.0	16
75% Exceedance	17.7	2.44	592	3.99	3.8	8.8	10
25% Exceedance	24.3	8.51	828	21	67.8	75.6	31

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **75% Exceedance** means 75% of recorded values were higher than this value while **25% Exceedance** means 25% of recorded values were higher.

GASTEROSTEIDAE
Stickleback Family

Brook Stickleback, *Culaea inconstans*



Brook Stickleback, Culaea inconstans

1939-41	5
2003-05	11
Matches	1
Missing	3
New sites	10
Dry sites	1

The Brook Stickleback prefers cool, clear, weedy spring-fed streams and ponds but is not tolerant of turbidity. It is an aggressive little fish so it generally does well when introduced into suitable waters. The Brook Stickleback is native to the US from Nebraska to Vermont and then well into northern Canada. It's global status is G5 and its Nebraska status is S3 (rare and uncommon).

The Brook Stickleback is a native of Nebraska but it's original distribution is not known. It was collected once in 1893 in Long Pine Creek (Niobrara basin) at the same place where it was found in 1939. So the 1939-1941 collections may partially describe the native range. The problem is that the species is often included in shipments of baitfish from out of state so, as a result, its range has probably expanded via the bait bucket. The map below illustrates all collections of Brook Stickleback over the years to put the map above into perspective. Some of these populations may be due to the release of baitfish.

Looking at the results by ecoregion, Smith et.al. (2014) noted that they had increased in two regions: the Central Great Plains (+50%) and the Nebraska Sand Hills (+200%). They had decreased in one region, the Northwestern Great Plains (-100%). They were not evaluated in the remaining three regions and, overall, had increased by +175%.

The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Brook Stickleback was collected during the 2003-05 stream survey.

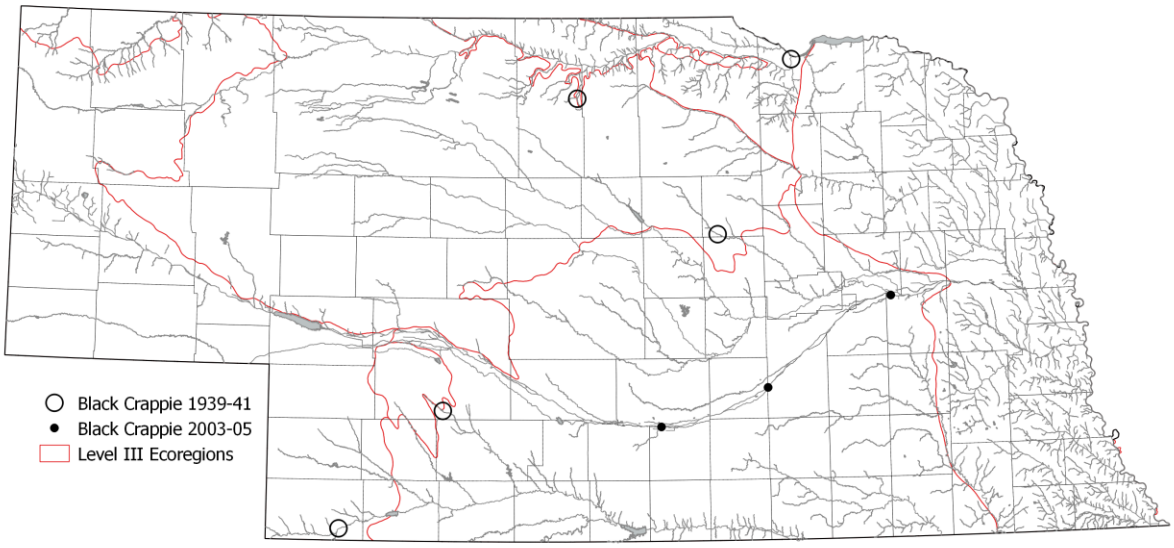
Habitat conditions of water quality, discharge and stream dimensions where the Brook Stickleback was collected during the 2003-05 stream survey.

Brook Stickleback	Water Temperature (C)	Dissolved Oxygen (mg/L)	Specific Conductance (umhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	13	1.6	120.3	0.48	0.3	2.8	8
Maximum	29.3	13.7	2210	50	756	305.8	44
Median	19.2	5.2	726.5	11.7	10.5	9.3	16
75% Exceedance	16.8	2.09	230.1	0.9	0.3	3.6	11
25% Exceedance	24.7	9.74	2132	74.2	294.1	23.0	21

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **75% Exceedance** means 75% of recorded values were higher than this value while **25% Exceedance** means 25% of recorded values were higher.

CENTRARCHIDAE
Sunfish Family

Black Crappie, *Pomoxis nigromaculatus*



Black Crappis, Pomoxiz nigromaculatus

The Black Crappie prefers clear, vegetated lake habitats and is uncommon in streams. Available evidence is that it may have been native to the oxbows and off-channel habitats of the historical Missouri River. It has been widely stocked in lakes and ponds throughout the state.

1939-41	5
2003-05	3
Matches	0
Missing	5
New sites	3
Dry sites	1

The Black Crappie was collected at six sites in 1939-41 and at three sites in 2003-05 of which none matched the 1939-41 collection sites. It was missing from all of the historic sites but was found at three new sites. One of the historic sites was dry in 2003-2005.

Looking at the results by ecoregion, Smith et.al. (2014) noted an increase in one, the Central Great Plains and decreases in the others. Overall, they reported a 25% decline in the number of sites were the species was found.

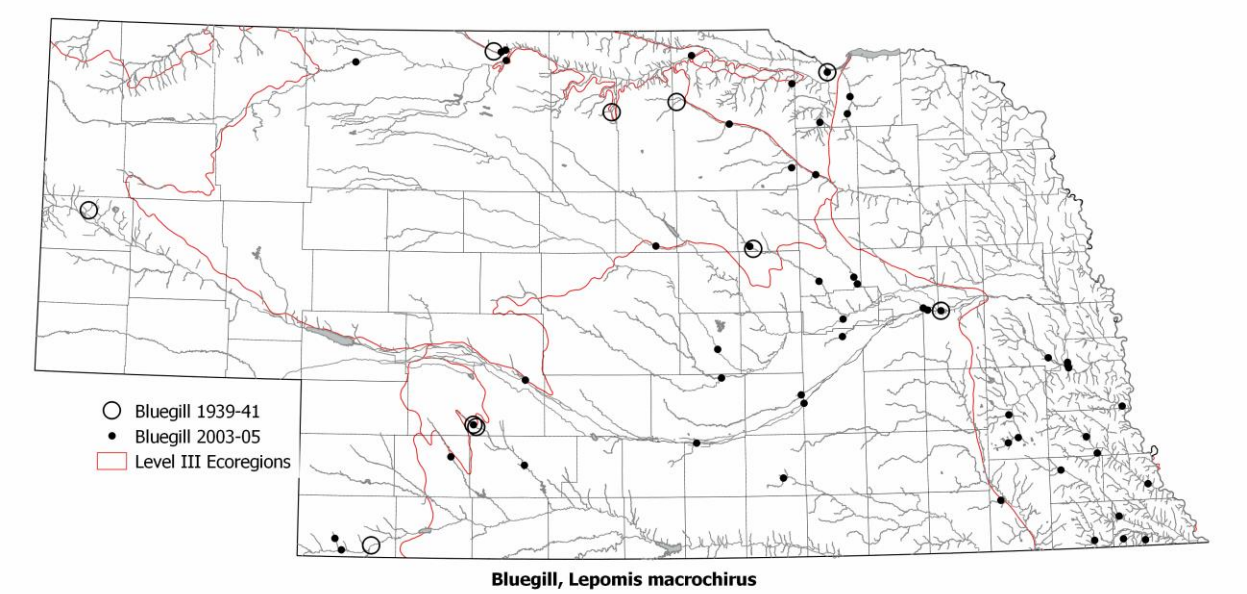
The Black Crappie is a widely stocked sport fish beginning in the 1880's. Whether it is native to the interior streams of Nebraska is not known. There may even be some question as to whether it is native to the Missouri River. We just don't know. In any case, the presence in the 1939-41 and 2003-05 collections is the result of escapees from lake and pond stockings.

The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Black Crappie was collected during the 2003-05 stream survey. Since only three collections were made, the table shows the actual recorded values.

Habitat conditions of water quality, discharge and stream dimensions where the Black Crappie was collected during the 2003-05 stream survey. The table shows the actual recorded values.

Black Crappie	Water Temperature (C)	Dissolved Oxygen (mg/L)	Specific Conductance (umhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Site 85	24.7	1.6	908	19.8	494.0	154.8	17
Site 17/203/204	20	2.56	635	3.98	16.2	17.0	30
Site 79/275	21.5	2.44	883	7.25	756.0	305.8	16

Bluegill, *Lepomis macrochirus*



Bluegill, Lepomis macrochirus

The Bluegill prefers lakes and ponds with clear vegetated waters. In streams, it is found in backwaters, pools and off-channel areas. The Bluegill is a common sport fish and has been widely stocked all over the state. Bluegill collected from streams tend to be small. The Bluegill is native to the much of the eastern US. It's global status is G5 as it is a common and widespread species.

1939-41	11
2003-05	51
Matches	6
Missing	5
New sites	45
Dry sites	0

The Bluegill was collected at 11 sites in the 1939-41 and 51 in 2003-05. The map suggests that it's range has increased since the 1939-41 survey. This is probably true as the species has been widely stocked as a sport fish in lakes and ponds throughout the state. Archeological records show the species is native to the state with specimens identified from a site near the mouth of the North Loup River.

Looking at the results by ecoregion, Smith et.al. (2014) noted increases in the Central Great Plains (+567%), Western High Plains (+100%), Nebraska Sand Hills (+67%), Northwestern Glaciated Plains (+200%) and Northwestern Great Plains (+100%). The overall change was +410%. (They were not rated in the Western Corn Belt Plains as there were no collections there in 1939-41.)

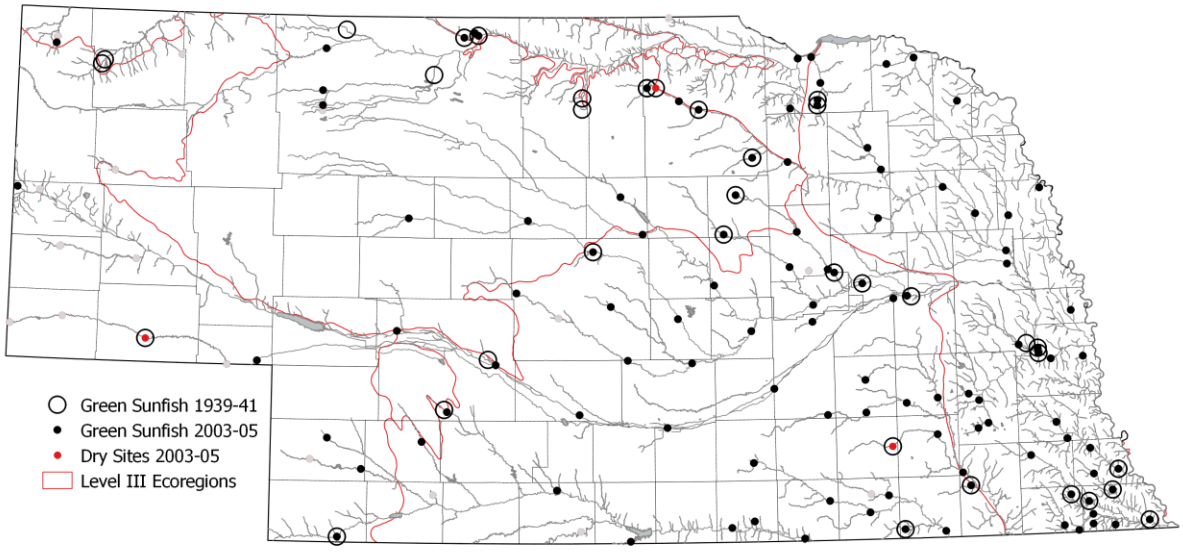
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Bluegill was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Bluegill was collected during the 2003-05 stream survey.

Bluegill	Water Temperature (C)	Dissolved Oxygen (mg/L)	Specific Conductance (umhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	14.6	1.58	163	0.19	0	2.2	2
Maximum	34.4	10.88	4672	721	1715	364.7	58
Median	22.8	6.98	490.85	20.3	16.8	11.1	17
80% Exceedance	17.7	2.2	285.8	8.8	3.8	5.6	13
20% Exceedance	25.6	8.51	689	68.4	198.4	43.7	31

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **80% Exceedance** means 80% of recorded values were higher than this value while **20% Exceedance** means 20% of recorded values were higher.

Green Sunfish, *Lepomis cyanellus*



Green Sunfish, Lepomis cyanellus

The Green Sunfish prefers moderate to low gradient streams as well as their vegetated oxbows, marshes, and sloughs. They do not prefer larger rivers or areas with fast currents. They are tolerant of turbidity. The Green Sunfish is native to much of the central US from the Great Plains to the Appalachians and Mexico to the Great Lakes. It's global status is G5 and its Nebraska status is S5.

1939-41	35
2003-05	110
Matches	22
Missing	10
New sites	88
Dry sites	3

The Green Sunfish was collected 35 times in the 1939-41 survey (88 fish) and ranked 12th in its frequency of collection. It was collected 110 times in the 2003-05 survey (1,729 fish) and ranked 4th. It is clear that the Green Sunfish has increased its range in Nebraska. It could be by people seining them for bait and releasing them in new waters. But that doesn't really make sense for a number of sites as they don't have fishable water. But we can only speculate on the mechanism of this dramatic increase because we just don't know how they did it.

Looking at the results by ecoregion, Smith et.al. (2014) noted that the Green Sunfish had shown increases in four regions: the Central Great Plains (+438%), the Western High Plains (+500%), the Nebraska Sand Hills (+63%) and the Western Corn Belt Plains (+310%). They had declined in the Northwestern Great Plains (-40%) and were not rated in the Northwestern Glaciated Plains. Overall there was an increase of +241%).

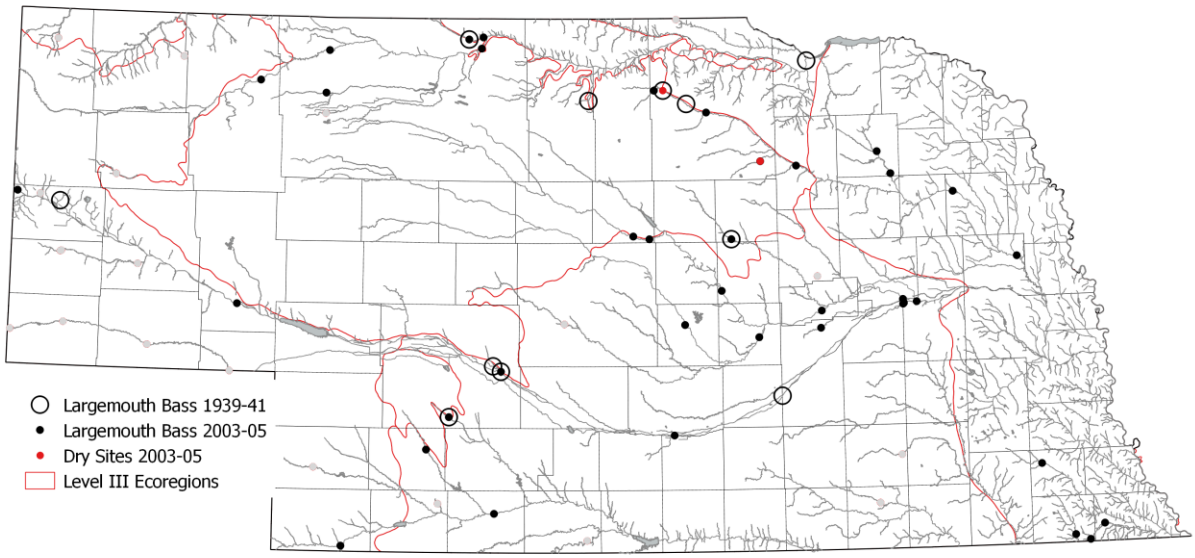
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Green Sunfish was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Green Sunfish was collected during the 2003-05 stream survey.

Green Sunfish	Water Temperature (C)	Dissolved Oxygen (mg/L)	Specific Conductance (umhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	14.6	0.78	120.3	0.148	0	2.2	2
Maximum	33.9	13.7	4672	863	3900	500.8	38
Median	22.85	6.695	534.5	28	22.6	11.5	20
90% Exceedance	16.8	1.69	229.4	4.05	0.5	4.2	8
10% Exceedance	28.2	8.92	850	33.5	389.6	93.0	34

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **90% Exceedance** means 90% of recorded values were higher than this value while **10% Exceedance** means 10% of recorded values were higher.

Largemouth Bass, *Micropterus salmoides*



Largemouth Bass, Micropterus salmoides

1939-41	12
2003-05	38
Matches	5
Missing	6
New sites	32
Dry sites	1

The Largemouth Bass prefers lakes, reservoirs, ponds, oxbows and off-channel areas with clear water and aquatic vegetation. They can maintain populations in streams but these fish are often small and depend on the presence of quiet water such as pools, sloughs and oxbows. The Largemouth Bass is a sport fish that has been widely stocked all over the country since the late 1900's so defining it's native range is almost impossible. It was probably from central Mexico to Florida then north to the Canadian border from the eastern edge of the Great Plains to the Appalachians. It's global status is G5 and its Nebraska status is S5.

The stocking of Largemouth Bass (as "Black bass") into Nebraska waters began in 1885 and continued through the years. Early Nebraska Fish Commission Reports and archeological records show that the species is native to Nebraska waters but how widely distributed will never be known. It was collected 13 times in 1939-1941 and 39 times in the 2003-2005 surveys. The incidence of this species in streams has increased due to the hundreds of ponds and reservoirs that were built in the interim. Most, if not all, have been stocked with Largemouth bass, many of which have travelled upstream into feeder streams or were washed over the outlet into the stream below.

Looking at the results by ecoregion, Smith et.al. (2014) noted that there were increases in four regions: the Central Great Plains (+300%), the Western High Plains (+200%), the Nebraska Sand Hills (+167%) and Northwestern Great Plains (+50%). There was a decrease in the Northwestern Glaciated Plains (-100%) while the Western Corn Belt Plains was not rated.

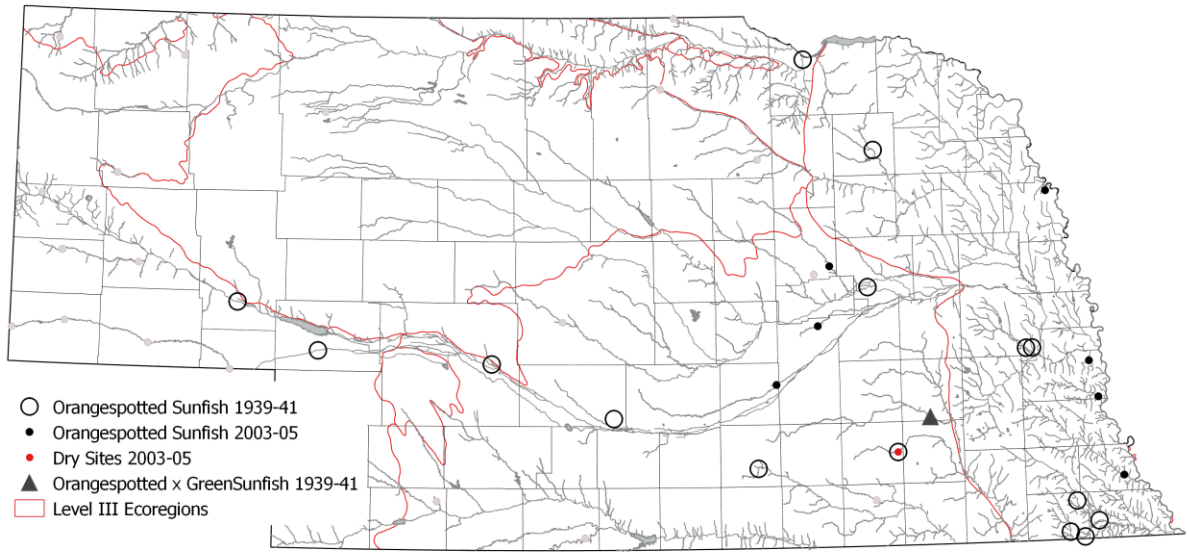
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Largemouth Bass was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Largemouth Bass was collected during the 2003-05 stream survey.

Largemouth Bass	Water Temperature (C)	Dissolved Oxygen (mg/L)	Specific Conductance (umhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	14.6	0.8	134.7	0.19	0.5	2.7	4
Maximum	32.9	10.6	994	863	1715	364.7	37
Median	24.45	6.1	389.7	13.9	45.9	18.8	17
80% Exceedance	20	1.85	244.1	5.6	6.5	8.7	12
20% Exceedance	27.7	7.92	642	54.3	483.0	116.3	30

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **80% Exceedance** means 80% of recorded values were higher than this value while **20% Exceedance** means 20% of recorded values were higher.

Orangespotted Sunfish, *Lepomis humilis*



Orangespotted Sunfish, Lepomis humilis

1939-41	14
2003-05	7
Matches	0
Missing	13
New sites	7
Dry sites	1

The Orangespotted Sunfish prefers pools in small low-gradient streams. They tolerate turbidity and seem to have little preference for substrate. The range of the Orangespotted Sunfish is the central US from South Dakota to Ohio and south to Texas. It's global status is G5 and its Nebraska status is S5.

They were collected 15 times in the 1939-41 survey and seven times in the 2003-05 survey. The results of these two surveys were somewhat unique in that there was no location where they were collected in both surveys. The locations shown on the map describe the overall range of the species in Nebraska which is the southeastern half of the state. They may not compete well with other sunfishes as they are almost always collected in streams, often along with Green Sunfish. The map may indicate a constriction in the range of the species in Nebraska with the disappearance of the more western and northern populations. It is odd that none were found in the southeast corner of the state as they used to be common down there. The Orangespotted Sunfish will hybridize with the Green Sunfish and one was collected in the 1939-41 survey as indicated on the map. The Orangespotted Sunfish seldom grows large enough to be of interest to the angler so has not been stocked in other waters so the map may be representative of it's native range.

Looking at the results by ecoregion, Smith et.al. (2014) noted that the Orangespotted Sunfish had decreased in all four of the regions where it had been found. These were the Central Great Plains (-25%), the Western High Plains (-100%), the Northwestern Glaciated Plains (-100%) and the Western Corn Belt Plains (-43%) with an overall decrease of -46%.

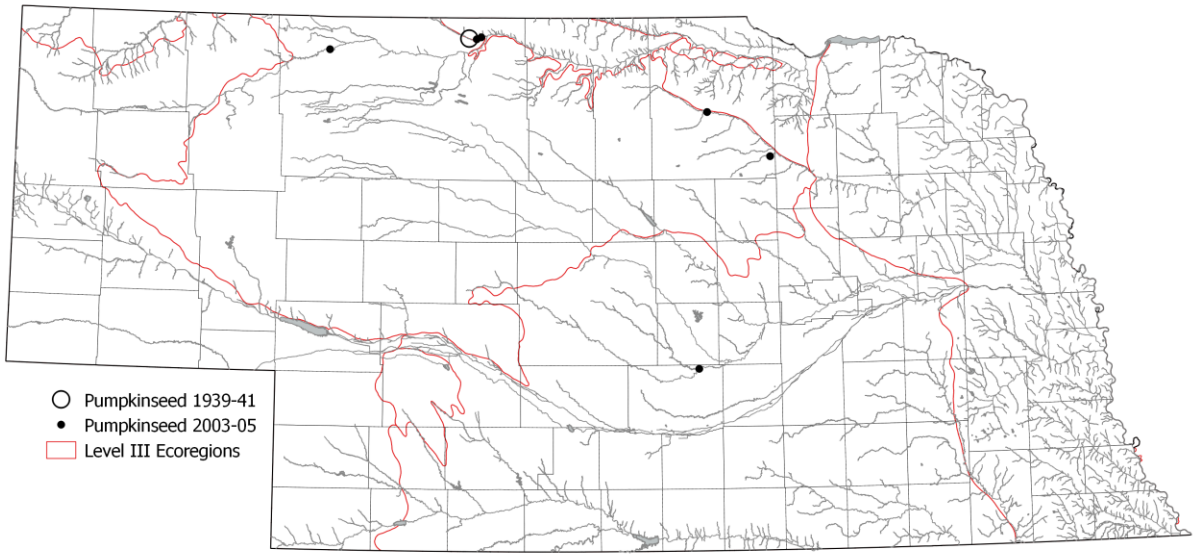
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Orangespotted Sunfish was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Orangespotted Sunfish was collected during the 2003-05 stream survey.

Orangespotted Sunfish	Water Temperature (C)	Dissolved Oxygen (mg/L)	Specific Conductance (umhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	17.7	1.67	362.2	9.86	0.9	4.6	10
Maximum	28	8.77	825	721	239.2	36.8	58
Median	24.3	7.3	531	30	6.8	8.6	24

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower).

Pumpkinseed, *Lepomis gibbosus*



Pumpkinseed, Lepomis gibbosus

The Pumpkinseed prefers cool, quiet, clear waters with abundant aquatic vegetation. Their range is from Missouri north into Canada, then east through the Great Lakes to New England then down the Atlantic Coast to Georgia . It's global status is G5 and its Nebraska status is SNR.

1939-41	1
2003-05	6
Matches	1
Missing	0
New sites	5
Dry sites	0

The Pumpkinseed is assumed to be an introduced species as the first time they were found was the single collection of one fish near Valentine in the 1939-41 survey. It was collected six times in the 2003-05 survey. The map above provides little information on the Pumpkinseed in Nebraska. All collections of this fish show that the center of distribution is the middle Niobrara River basin with a second concentration in the upper Elkhorn basin with a few additional collections outside of these areas. Either this is an expansion from a stocking in the Valentine area in the late 1900's or the species was present but undiscovered until 1940. If the latter, the population was isolated from the rest of the range to the east and, if so, a genetic analysis might tell us whether they really are native.

Looking at the results by ecoregion, Smith et.al. (2014) noted that increased in the Northwestern Great Plains (+100%). They were not rated in any other region since they had been collected in only the one. The overall change was +500%.

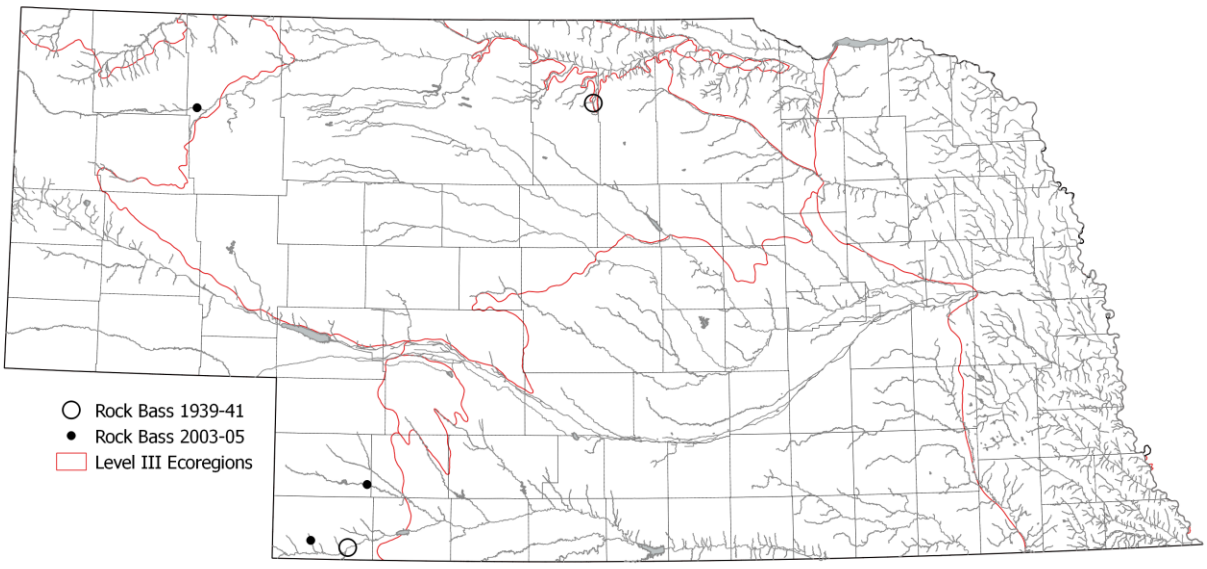
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Pumpkinseed was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Pumpkinseed was collected during the 2003-05 stream survey.

Pumpkinseed	Water Temperature (C)	Dissolved Oxygen (mg/L)	Specific Conductance (umhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	22.1	1.99	229.4	1.5	5.3	7.2	8
Maximum	30.3	9.97	440.2	107.2	198.4	33.3	34
Median	24.55	7.675	289.5	10.5	26.2	11.6	15

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower).

Rock Bass, *Ambloplites rupestris*



Rock Bass, Ambloplites rupestris

The Rock Bass prefers clear, moderate-sized streams with rocky bottoms. The Rock Bass is native to North America from Minnesota to New England and south to Alabama. It's global status is G5 and its Nebraska status is SNA.

1939-41	2
2003-05	3
Matches	0
Missing	2
New sites	3
Dry sites	0

The Rock Bass was collected two times (three fish) in the 1939-41 survey and three times (36 fish) in the 2003-05 survey. Note that the Rock Bass was collected from the mouth of the Big Sioux River (South Dakota/Iowa/Nebraska border) in 1893. Other than that, there is no evidence that it is native to the state. It was stocked in a number of waters prior to the earlier survey which might explain its collection in the 1939-41 survey. Stockings have continued and there are isolated populations but the species is not common. All of the collections in 2003-05 were in the vicinity of reservoirs or fish hatcheries. For instance, the collection from the upper Niobrara River is downstream of Box Butte Reservoir. The collections in the southwest corner are near the Rock Creek Fish Hatchery and downstream of Enders Reservoir.

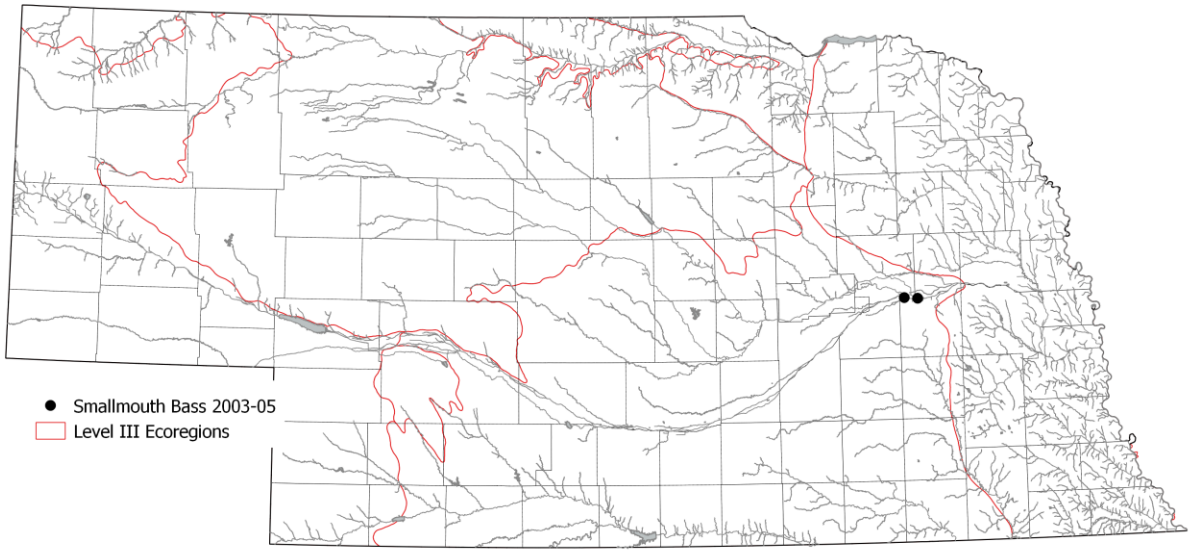
Looking at the results by ecoregion, Smith et.al. (2014) noted that there had been a decrease in one region: the Northwestern Great Plains (-100%) with an overall statewide increase of +200%.

The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Rock Bass was collected during the 2003-05 stream survey. Since only three collections were made, the table shows the actual recorded values.

Habitat conditions of water quality, discharge and stream dimensions where the Rock Bass was collected during the 2003-05 stream survey. The table shows the actual recorded values.

Rock Bass	Water Temperature (C)	Dissolved Oxygen (mg/L)	Specific Conductance (umhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Site 97	21.6	6.91	321.1	81.9	18.4	7.0	17
Site 102	16.1	6.56	350.8	1.18	4.7	5.2	28
Site 133	27.6	7.78	449.9	3.3	6.2	5.2	26

Smallmouth Bass, *Micropterus dolomieu*



Smallmouth Bass, Micropterus dolomieu

The Smallmouth Bass is not native to Nebraska. It prefers cool, clear streams that have fast currents and pools with gravel bottoms. The primary range of the Smallmouth Bass is from Minnesota through the Great Lakes to the Hudson River then south to Georgia and over to Arkansas. It's global status is G5 and its Nebraska status is SNA.

1939-41	0
2003-05	2
Matches	0
Missing	0
New sites	2
Dry sites	0

The Smallmouth Bass was not found in the 1939-41 survey and twice in the 2003-05 survey in the Middle Platte River. These were probably escapees from sandpits that had been stocked.

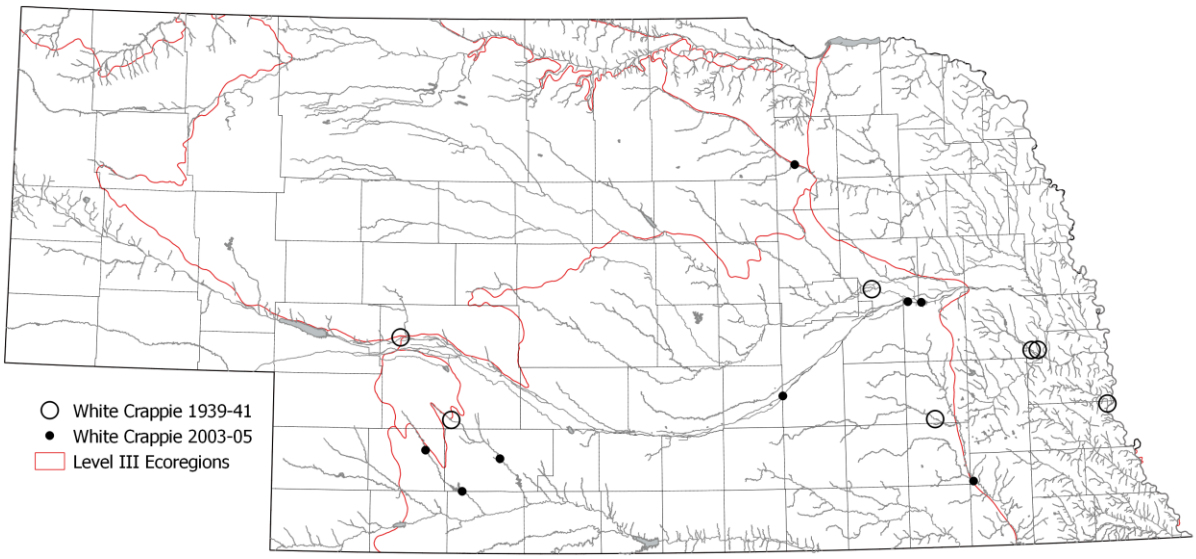
The Smallmouth Bass could not be evaluated by ecoregion.

The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Smallmouth Bass was collected during the 2003-05 stream survey. Since only two collections were made, the table shows the actual recorded values.

Habitat conditions of water quality, discharge and stream dimensions where the Smallmouth Bass was collected during the 2003-05 stream survey. The table shows the actual recorded values.

Smallmouth Bass	Water Temperature (C)	Dissolved Oxygen (mg/L)	Specific Conductance (umhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Site 202	22.7	1.58	658	14.9	16.1	18.8	23
Site 17/203/204	20	2.56	635	3.98	16.2	17.0	30

White Crappie, *Pomoxis annularis*



White Crappie, Pomoxis annularis

The White Crappie prefers the quiet waters of lakes, pools, oxbows and off-channel areas. The range of the White Crappie is from the Great Plains to the Appalachians and Mexico to the Great Lakes. It's global status is G5 and its Nebraska status is S5.

1939-41	7
2003-05	8
Matches	0
Missing	7
New sites	8
Dry sites	0

The White Crappie was collected at seven sites in the 1939-41 survey (12 fish) and eight sites in the 2003-05 survey (18 fish). It is believed to be native to the Missouri River habitats on the eastern border. Stockings began in the 1880's and have continued statewide blurring the history of this fish.

Looking at the results by ecoregion, Smith et.al. (2014) noted that the White Crappie had increased in one region: the Central Great Plains (+100%) and decreased in two: the Western High Plains (-100%) and the Western Corn Belt Plains (-67%). The overall change was a +14% increase.

The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the White Crappie was collected during the 2003-05 stream survey.

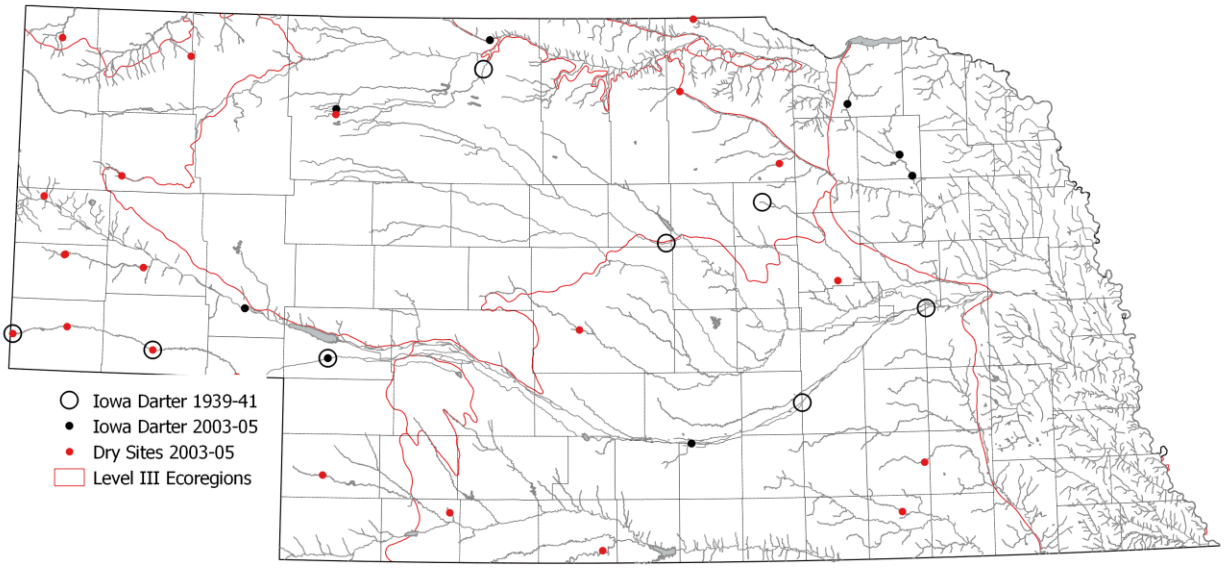
Habitat conditions of water quality, discharge and stream dimensions where the White Crappie was collected during the 2003-05 stream survey.

White Crappie	Water Temperature (C)	Dissolved Oxygen (mg/L)	Specific Conductance (umhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	16.4	1.57	270.3	0.93	1.9	7.5	11
Maximum	27.7	8.88	883	303	756	305.8	37
Median	22.2	2.5	606.0	22.8	19.8	16.1	26

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower).

PERCIDAE
Perch Family

Iowa Darter, *Etheostoma exile*



Iowa Darter, Etheostoma exile

The Iowa Darter prefers streams, sloughs, marshes and lakes with cool, clear water and organic substrates and aquatic vegetation. The Iowa Darter is native to much of the northern US and southern Canada from the Rockies to New England, particularly around the Great Lakes. The Nebraska populations are somewhat disjunct from the rest and may be glacial relicts. It's global status is G5 and its Nebraska status is S4.

1939-41	8
2003-05	8
Matches	0
Missing	6
New sites	8
Dry sites	2

The Iowa Darter was collected eight times in the 1939-41 survey and eight times in the 2003-05 survey, but the species was found at only one of the sites in both surveys. The data from the two surveys are pretty meager with little overlap in collections so one wonders what this is telling us. The Iowa darter is never abundant wherever we do find it and it lives right on the bottom of streams in riffles so it can be easy to miss. It's presence in the now-turbid North Fork Elkhorn River is a little surprising considering their preference for clear waters. The population in Lodgepole Creek is at risk because the stream has been substantially dried up due to groundwater pumping.

Looking at the results by ecoregion, Smith et.al. (2014) noted that they had increased in one region: the Western High Plains (+100%), decreased in one: the Central Great Plains (-67%) and showed no change in one: the Nebraska Sand Hills. The overall change was +60%.

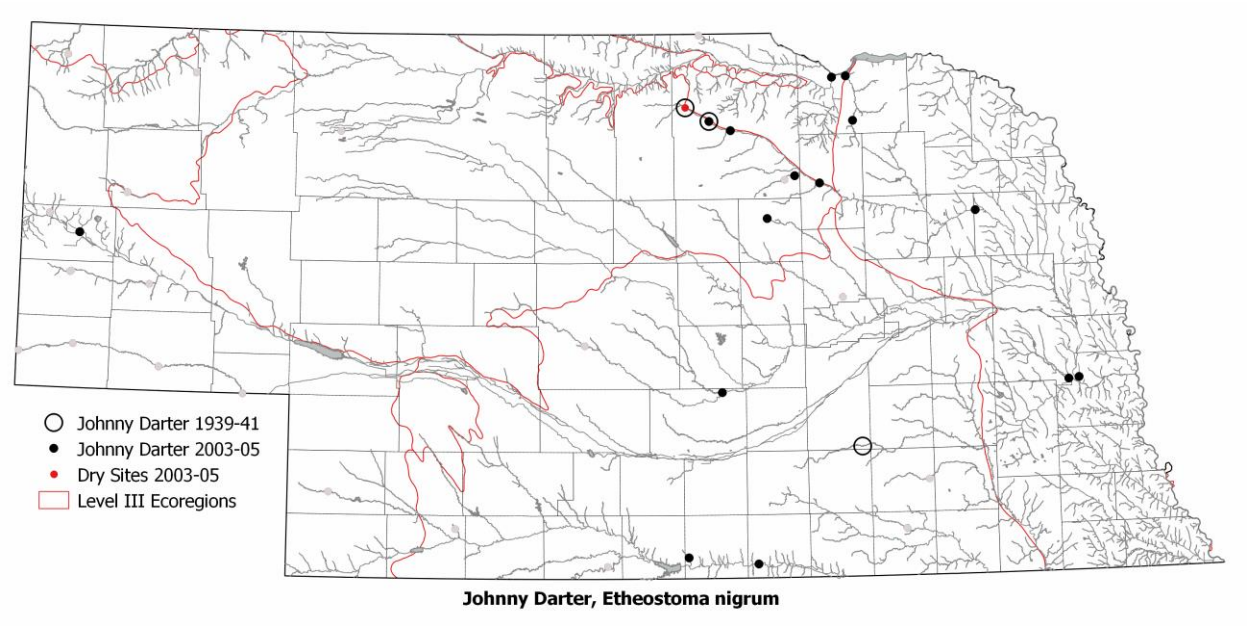
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Iowa Darter was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Iowa Darter was collected during the 2003-05 stream survey.

Iowa Darter	Water Temperature (C)	Dissolved Oxygen (mg/L)	Specific Conductance (umhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	16.8	0.78	120.3	0.48	0.3	2.3	8
Maximum	28.1	12.56	2132	75.6	494	154.8	27
Median	23.95	4.4	768	16.7	28.4	9.9	14

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower).

Johnny Darter, *Etheostoma nigrum*



Johnny Darter, Etheostoma nigrum

1939-41	3
2003-05	15
Matches	1
Missing	1
New sites	14
Dry sites	1

The Johnny Darter prefers streams, sloughs, marshes and lakes with cool, clear water, organic substrates and aquatic vegetation. The Johnny Darter has a wide distribution from Alabama to Hudson's Bay and the Great Plains to the Appalachians. It's global status is G5 and its Nebraska status is S3.

The Johnny Darter was collected three times in 1939-41 and 15 times in 2003-05 with only one match. They are usually collected one or two at a time whenever they are sampled so it may be that the difference between the two surveys represents a difference in catchability rather than any changes in populations. One difference was the collection of a Johnny darter in the West Fork Big Blue in the 1939-41 survey. That is the only time the species has been found in the Big Blue River watershed.

Looking at the results by ecoregion, Smith et.al. (2014) noted that they had increased in two regions: the Central Great Plains (+200%) and the Nebraska Sand Hills (+400%). They were not evaluated in the other regions which had no collections in 1939-41. Overall the increase was +650%.

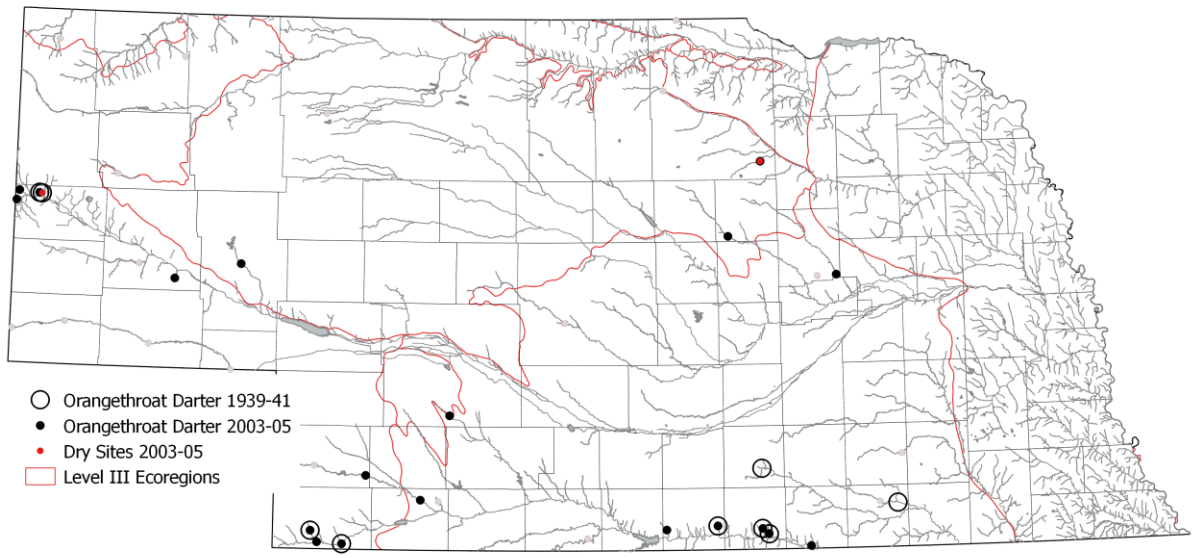
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Johnny Darter was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Johnny Darter was collected during the 2003-05 stream survey.

Johnny Darter	Water Temperature (C)	Dissolved Oxygen (mg/L)	Specific Conductance (umhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	16.3	1.61	230.1	0.9	0.3	2.2	2
Maximum	32.9	10.35	1143	190	483	264.3	33
Median	23.8	6.8	440.2	30.1	35.1	11.1	20
75% Exceedance	21	2.12	276.1	12	3.8	4.1	12
25% Exceedance	28.4	8.74	710	73.8	153.9	40.5	25

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **75% Exceedance** means 75% of recorded values were higher than this value while **25% Exceedance** means 25% of recorded values were higher.

Orangethroat Darter, *Etheostoma spectabile*



Orangethroat Darter, Etheostoma spectabile

1939-41	9
2003-05	19
Matches	6
Missing	2
New sites	13
Dry sites	1

The Orangethroat Darter prefers riffle areas in small streams having gravel or sand/gravel bottoms. They tolerate turbidity and can survive in pools of intermittent streams. The range of the Orangethroat Darter is the central US from Nebraska to Ohio and then south to Texas. It's global status is G5 and its Nebraska status is S3.

Orangethroat Darters were collected nine times in the 1939-41 survey and 19 times in the 2003-05 survey. This small fish lives on the bottom of the stream and can be missed. For this reason, it is unlikely that the new sites in the 2003-05 survey represent range extensions (with the exception of the Loup basin). It appears Orangethroat Darters may have disappeared from the Little Blue River. The two collections in the Loup basin represent the first time that Orangethroat Darters have been collected here so these may be range extensions. Overall, the two surveys complement each other in describing the range of the species as being the Little Blue, Republican and North Platte basins.

Looking at the results by ecoregion, Smith et.al. (2014) noted that they had increased in two regions: the Central Great Plains (+60%) and the Nebraska Sand Hills (+167%). They were not evaluated in the other four regions as they were not collected there in the 1939-41 survey. Overall there was an increase of +125%.

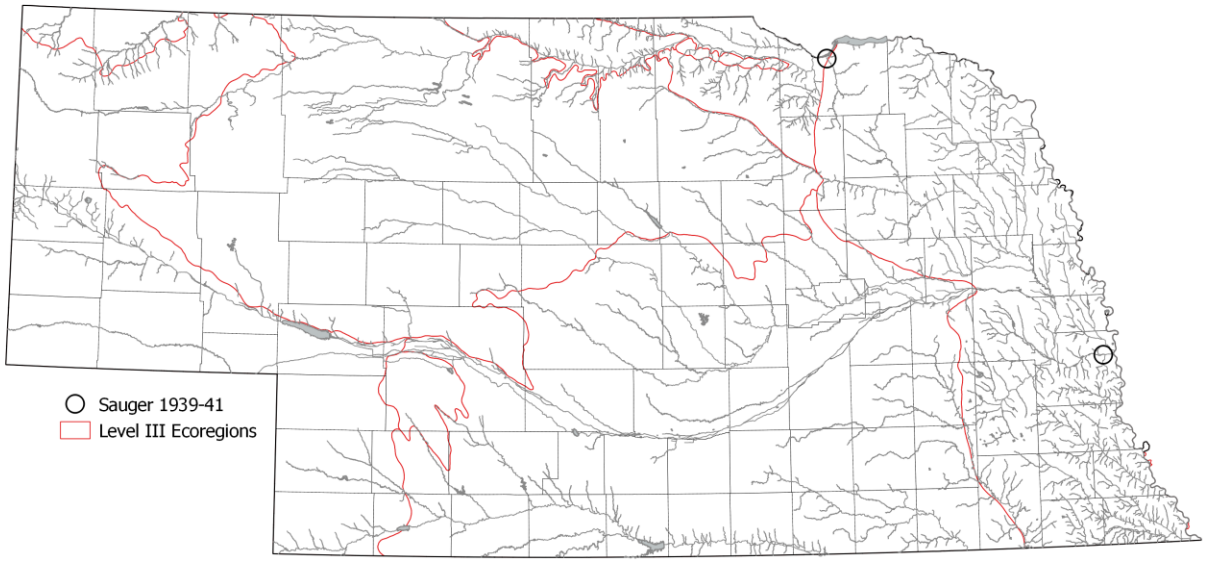
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Orangethroat Darter was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Orangethroat Darter was collected during the 2003-05 stream survey.

Orangethroat Darter	Water Temperature (C)	Dissolved Oxygen (mg/L)	Specific Conductance (umhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	15.3	1.77	157.9	1.03	0.3	2.2	5
Maximum	33.9	10.6	1076	863	156.4	50.6	34
Median	21.7	7.37	562	8.22	7.6	5.0	15
75% Exceedance	18	5.79	350.8	5.72	4.4	2.9	11
25% Exceedance	24.6	10.03	727	17.3	18.4	9.1	31

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **75% Exceedance** means 75% of recorded values were higher than this value while **25% Exceedance** means 25% of recorded values were higher.

Sauger, *Sander canadensis*



Sauger, Sander canadensis

1939-41	2
2003-05	0
Matches	0
Missing	2
New sites	0
Dry sites	0

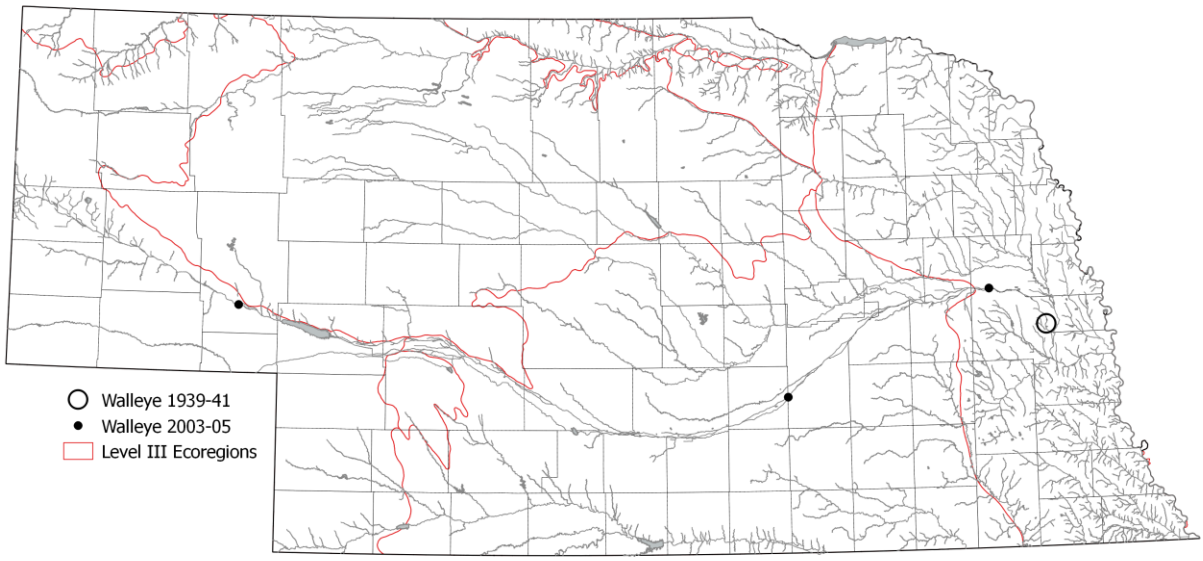
The Sauger prefers large, turbid rivers. They are native to North America from Quebec through the Great Lakes to Arkansas then northwest through Montana into Canada. It's global status is G5 and its Nebraska status is S5

The Sauger is native to the Missouri River. Archeological data also shows that either the Walleye (*Sander vitreus*) or the Sauger was found in interior streams before European settlement. The two collections in the 1939-41 survey are from the Platte River and Bazile Creek near their confluence with the Missouri. It was not found in the 2003-05 survey which may be related to the decline of the Missouri River populations due to habitat degradation.

Looking at the results by ecoregion, Smith et.al. (2014) noted declines in the Northwestern Glaciated Plains (-100%) and the Western Corn Belt Plains (-100%). Overall the was a decline of -100%.

No tables could be constructed for the Sauger as none were collected during the 2003-05 stream survey.

Walleye, *Sander vitreus*



Walleye, Sander vitreus

1939-41	1
2003-05	3
Matches	0
Missing	1
New sites	3
Dry sites	0

The Walleye prefers lakes but will also inhabit large, clear rivers. The range of the Walleye is a cool water fish with a widespread range that extends from northern Canada to Arkansas and from the Rocky Mountains to the Appalachians. It's global status is G5 and its Nebraska status is S5.

The Walleye was collected once (one fish) in the 1939-1941 survey and twice (four fish) in the 2003-2005 survey. The species has been widely stocked as a sport fish so its presence in a river would not be unexpected. The 1883 Nebraska Fish Commission Report states, "This fish (i.e. wall-eyed pike) is already found in some of the waters of the state and is a food fish and affords a large degree of sport to the angler. This fish though occasionally met with, is not abundant. Indeed, they are found in but few streams in the state, but wherever they have been found they are not inferior to the best fish known, indigenous to our waters, in both size and quality." So, given its preference for large, clear rivers, it would not be unexpected that, though native, it would be fairly uncommon as we have only a few rivers that would qualify as "large" though historical evidence is that our interior streams were often described as clear.

Looking at the results by ecoregion, Smith et.al. (2014) noted that there was no change in the one region where they were found in the 1939-41 survey (the Western Corn Belt Plains). There was an overall increase of +200%.

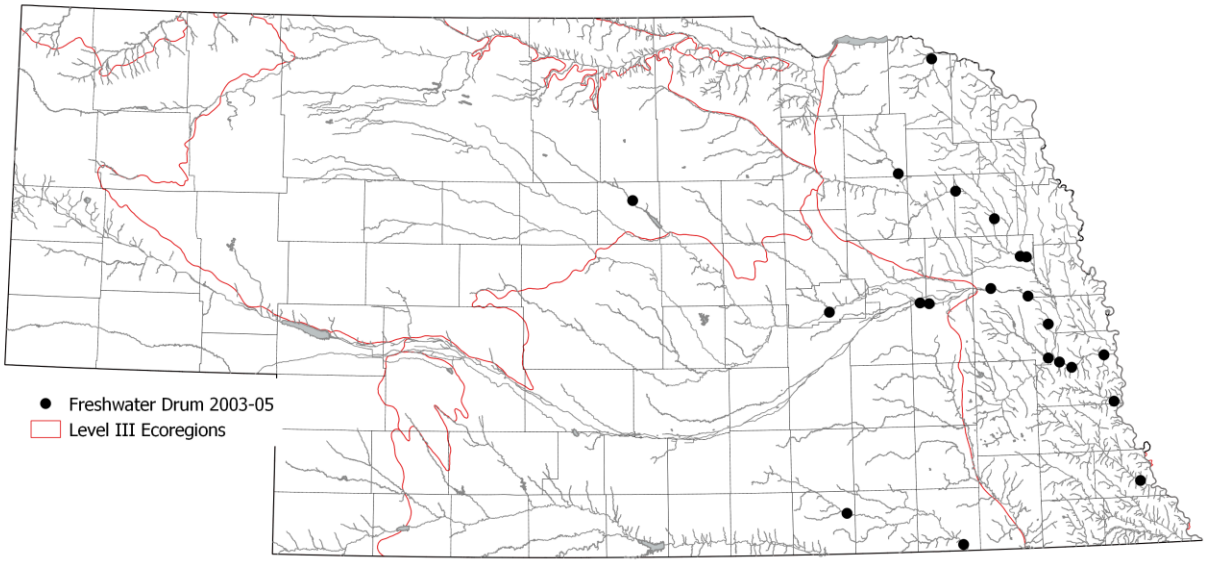
The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Walleye was collected during the 2003-05 stream survey. Since only three collections were made, the table shows the actual recorded values.

Habitat conditions of water quality, discharge and stream dimensions where the Walleye was collected during the 2003-05 stream survey. The table shows the actual recorded values.

Walleye	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Site 107	28.1	3.84	828	13.6	62.2	139.3	8
Site 247	24.9	7.11	455.1	470	1830.0	180.5	21
Site 79/275	21.5	2.44	883	7.25	756.0	305.8	16

SCIAENIDAE
Drum Family

Freshwater Drum, *Aplodinotus grunniens*



Freshwater Drum, Aplodinotus grunniens

1939-41	0
2003-05	22
Matches	0
Missing	0
New sites	22
Dry sites	0

The Freshwater Drum prefers lakes and pools in rivers with clear water and a clean bottom. They are native to much of the US from the Great Plains to the Appalachians and the Gulf Coast to Canada. It's global status is G5 and its Nebraska status is S5.

The Freshwater Drum actually was collected twice by Raymond Johnson in his 1939-41 survey. But these were collections from lakes (Memphis Lake and Lake Quinnebaugh) which were not sampled in the 2003-05 survey. In any case, the 2003-05 survey shows that the species has increased it's range within Nebraska. The Freshwater Drum is native to the Missouri River so collections from tributaries to that river would not be unexpected. The Freshwater Drum in the Little Blue River may have come from Tuttle Creek Reservoir on the Blue River in Kansas. The collection from the Calamus River (center of state on map) is upstream of Calamus Reservoir.

The Freshwater Drum was not evaluated at the ecoregion by Smith et.al. (2014) due to the lack of samples in the 1939-41 survey.

The table on the next page describes the habitat conditions of water quality, discharge and stream dimensions where the Freshwater Drum was collected during the 2003-05 stream survey.

Habitat conditions of water quality, discharge and stream dimensions where the Brassy Minnow was collected during the 2003-05 stream survey.

Freshwater Drum	Water Temperature (ºC)	Dissolved Oxygen (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (ntu)	Discharge (cfs)	Mean Width (m)	Mean Depth (cm)
Minimum	17.8	1.37	149.5	4.05	13.3	10.1	10
Maximum	32.9	10.08	1143	1063	4210	500.8	58
Median	25.6	3.9	411.1	73.8	483.0	73.7	25
80% Exceedance	22.7	1.6	362.2	53.5	69.0	22.7	20
20% Exceedance	28.2	8.13	678	237	1770.0	360.0	33

The **Minimum** is the lowest value recorded while the **Maximum** is the highest. The **Median** is the 50% exceedance value (half were higher, half were lower). **80% Exceedance** means 80% of recorded values were higher than this value while **20% Exceedance** means 20% of recorded values were higher.

RIVER BASIN DESCRIPTIONS

BIG BLUE RIVER BASIN

The Big Blue River exits Nebraska and flows into Kansas south of Barneston in the southeastern part of the state. Its two main branches drain a large portion of the area south of the Platte River in eastern Nebraska from just southeast of Grand Island east to Seward and then south to Crete and Beatrice. Its drainage encompasses much of the eastern portion of what is known as the Rainwater Basin where many of the former wetland areas have been drained and are now intensively farmed for corn and soybeans.

Basin Area: 4,563 mi2

Basin Relief and Topography: flat plains in the upper basin (the West Fork begins at 1980 ft above sea level), rolling hills and dissected plains in lower basin (1150 ft above sea level at the Kansas state line)

Total Stream Length: 1,371 miles

River Order: 4

Mean Annual Discharge: at Barneston 872cfs

Land Use: >80% cultivated

Special Features: Runoff is significant during heavy storms. Drainage patterns poorly defined in upper basin with many internal drainage wetlands

Major Tributaries: West Fork Big Blue River, Lincoln Creek, Beaver Creek, Turkey Creek

Lakes, Reservoirs and Obstructions to Fish movements: Historically there were more than 30 dams on the Big Blue and its main tributaries. These were originally built to operate flour mills, but several were converted to hydroelectric power production. Currently five dams, at Barneston, Holmesville, Beatrice, Seward, and Surprise, are still intact but none are operational.

Basin Connections: The Big Blue River basin is part of the Kansas (Kaw) River system, which includes the Little Blue River basin and the Republican River Basin in Nebraska.

LITTLE BLUE RIVER BASIN

The Little Blue River basin lies to the south and west of the Big Blue River basin. It flows generally southeasterly from its headwaters southwest of Hastings toward Fairbury and continues on into northern Kansas where it joins the Big Blue River. This river drains the southern rainwater basin area between the Big Blue River and Republican River basins.

Basin Area: 2,691 mi2

Basin Relief and Topography: Flat plains and rolling hills with numerous wetlands in the upper basin (begins at 2010 ft above sea level) to steep hills in the lower basin (1180ft above sea level).

Total Stream Length: 398 mi

River Order: 3

Mean Annual Discharge: at Hollenburg , Kansas 537cfs

Land Use: > 70% cultivated

Special Features: Base flow low, runoff significant during storms, variable stream flows.

Major Tributaries: Rose Creek, Big Sandy Creek

Lakes, Reservoirs and Obstructions to Fish movements: There is a single major dam on the Little Blue River at Fairbury which provides cooling water for an electric power plant.

Basin Connections: The Little Blue River basin is part of the Kansas (Kaw) River system, which includes the Big Blue River basin and the Republican River Basin in Nebraska.

REPUBLICAN RIVER BASIN

The Republican River drains a large area in the south-central and southwestern portion of Nebraska south of the Platte River and to the west of the Little Blue River. Its headwaters lie in the Western High Plains ecoregion in eastern Colorado and northwestern Kansas through the rolling plains and breaks of the Central Great Plains ecoregion. The main trend of the flow of the Republican River is easterly through the southern tier of Nebraska counties before exiting the state southeast of Red Cloud, Nebraska where it joins the Kansas River in north central Kansas. The flow of the Republican River has been altered by a series of large reservoirs which were built for flood control and irrigation. In the northern part of the basin tributary flows have been augmented by groundwater mounding from irrigation in the Platte River basin. The northern boundary of the Republican River basin, adjoining the Platte River basin, includes the western portion of the wetland complex known as the Rainwater Basin.

Basin Area (in Nebraska): 9,712 mi2

Basin Relief and Topography: Enters Nebraska from Colorado at an elevation of 3340 ft above sea level and exits into Kansas at an elevation of 1520ft above sea level. Well developed drainage patterns except in the sandhills area in the northwestern part of the basin.

Total Stream Length (in Nebraska): 653mi

River Order: 4

Mean Annual Discharge: near Hardy 350cfs (1958 – 2001), 882cfs (1933-1952)

Land Use: 50% cultivated cropland, 45% rangeland and pasture

Special Features: Upstream from Harlan County Reservoir the Republican River is dewatered for much of the summer due to groundwater and surface water withdrawals. Conversely, downstream the river channel is used to deliver water to the Superior and Courtland Canals near Guide Rock, Nebraska and then dewatered in the fall, winter and spring while the reservoir is refilling.

Major Tributaries: Frenchman River, Beaver Creek, Medicine Creek

Lakes, Reservoirs and Obstructions to Fish movements: No natural lakes. Large reservoirs include: Harlan County Reservoir, Enders Reservoir, Swanson Reservoir, Hugh Butler Reservoir, and Harry Strunk Reservoir. In addition, several irrigation diversions impede fish movements and dewater sections of the Republican River.

Basin Connections: The Republican River basin is part of the Kansas (Kaw) River system, which includes the Little Blue River basin and the Big Blue River Basin in Nebraska.

NEMAHA RIVER BASINS

The area of Nebraska south of the Platte River basin and east of the Big Blue River basin is drained by several streams and rivers which are direct tributaries to the Missouri River. This area is in the loess and glacial drift hills of the Western Corn Belt Plains ecoregion. This area is not a discreet river basin, but rather includes all the tributaries that feed directly into the Missouri River south of the Platte River to the Kansas state line. The area is named for the two largest of these tributaries. These streams head east and south of Lincoln and flow generally easterly and southeasterly to the Missouri River. In pre-European settlement times the downstream portions of these streams meandered through well-developed flood plains, but they have been extensively channelized for flood control.

Basin Area (in Nebraska): 2,771mi2

Basin Relief and Topography: Dissected with rolling hills and well developed floodplains.

Total Stream Length (in Nebraska): 1,744mi (1,643 without the Missouri). Both the Big Nemaha and Little Nemaha rivers rise at about 1410ft above sea level. The Little Nemaha River joins the Missouri River at about 880 ft above sea level while the Big Nemaha River joins the Missouri river at an elevation of about 840 ft above sea level.

River Order: 4 (Big Nemaha), 4 (Little Nemaha)

Mean Annual Discharge: Little Nemaha River at Auburn, 323cfs, Big Nemaha River at Falls City, 635cfs

Land Use: > 70% cultivated, 20% rangeland or pasture

Major Tributaries: Big Nemaha River, Little Nemaha River, Weeping Water Creek.

Lakes, Reservoirs and Obstructions to Fish movements: Numerous small reservoirs and farm ponds on tributary streams.

Special Features: The Nemaha River channels were among the first in Nebraska to be ditched as part of a plan to "improve" runoff and prevent flooding in the early part of the 20th century. Subsequent head cutting and increased erosion visible as bed degradation and channel widening are evident throughout the basin. We can only speculate on the impact on the fish fauna of this area.

Basin Connections: Direct tributaries of the Missouri River.

PLATTE RIVER BASIN (Lower and Middle Platte)

The Platte River extends from the confluence of the North Platte River and the South Platte River near North Platte, Nebraska east to the Missouri River. The middle Platte lies in the Platte River valley portion of the Central Great Plains ecoregion. The lower Platte River runs through the lower Platte alluvial plains and the Nebraska/Kansas loess hills portions of the Western Corn Belt Plains ecoregion. Although its major tributaries are treated as separate units in this discussion, they do indeed form a single continuous system which drains the majority of Nebraska. This system allowed many large Missouri River species to travel west as far as Wyoming and Colorado since there were virtually no obstructions, except during times of drought. This broad shallow river with its many shifting sand bars was important to fishes adapted to turbid water conditions and today provides one of the last refuges for this characteristically Great Plains fauna.

Basin Area (in Nebraska): 8,240 mi2

Basin Relief and Topography: Over most of its length, from its origin at an elevation of 2760ft above sea level the Platte River flows in a broad valley bounded by the sand hills on the north and loess hills on the south into a relatively narrow valley near its mouth before draining into the Missouri River at an elevation of about 940 ft above sea level.

Total Stream Length: 1,816 mi

River Order: 5

Mean Annual Discharge: 203m3/s (7,159cfs) at Louisville.

Land Use: Extensive irrigated agriculture, urban concentrations along the length of the river, but most concentrated in the east.

Major Tributaries: Salt Creek, Elkhorn River, Shell Creek, Loup River, Prairie Creek, Wood River, Buffalo Creek, North Platte River, South Platte River.

Lakes, Reservoirs and Obstructions to Fish movements: There are no natural lakes in the immediate drainage basin of the Platte River. Major reservoirs have been constructed in the Salt Creek and its tributaries (i.e. Branched Oak, Pawnee, etc.), and associated with hydro-power and irrigation facilities along the Platte River (i.e. Lake Babcock, Johnson County Reservoir,

etc.). Irrigation and power generation diversions have been constructed at several points along the middle Platte, but there are none along the lower Platte.

Special Features: A broad shallow river with extensive shifting sand bars.

Basin Connections: Missouri River, Elkhorn River, Loup River, North Platte River, South Platte River

NORTH PLATTE RIVER BASIN

The North Platte River heads in the southern Rocky Mountains of northern Colorado and drains north into Wyoming before turning east and entering the Nebraska panhandle near Scotts Bluff. In Nebraska it flows generally southeasterly to its confluence with the South Platte River near North Platte. The North Platte River lies entirely within the Western High Plains ecoregion. Its floodplain is bounded on the south by bluffs and rock outcrops and on the north by the Sandhills. Most tributaries of the North Platte River enter from the north with water from the Sandhills aquifer.

Basin Area (in Nebraska): 7,140 mi2

Basin Relief and Topography: The North Platte River enters Nebraska at an elevation of 4040ft above sea level, flows southeastward before joining the South Platte River at an elevation of 2760ft above sea level. Through most of its length in Nebraska it is bounded by bluffs and escarpments of Miocene and Oligocene sandstones and silt stones.

Total Stream Length (in Nebraska): 942mi

River Order: 5

Mean Annual Discharge: (1896-1942 at North Platte) 2,618cfs, (1943-present) 775cfs.

Land Use: 75% rangeland or pasture, 20% irrigated cropland

Major Tributaries: Birdwood Creek, Blue Creek, Pumpkin Creek.

Lakes, Reservoirs and Obstructions to Fish movements: There are no natural lakes in the North Platte drainage. Lake McConaughy and Lake Ogallala are the only mainstem reservoirs in the Nebraska section of the North Platte. However, Lake Minatare and Lake Alice are associated with irrigation projects in the North Platte valley.

Special Features: Return flows from irrigation and the stocking of rainbow trout in Lake McConaughy enabled the establishment of a naturally reproducing migratory trout fishery within the North Platte drainage from the early 1940's until about 1980. Eutrophication of Lake McConaughy and reduced flows in the North Platte River has since extirpated this fishery.

Basin Connections: Platte River system

SOUTH PLATTE RIVER BASIN

The South Platte River heads in the mountains of central Colorado and flows generally northeasterly, entering Nebraska in the southeastern panhandle. From here it flows east in a broad valley to its confluence with the North Platte River at North Platte. In Nebraska the South Platte River lies entirely within the Western High Plains ecoregion.

Basin Area: (in Nebraska) 3,150 mi2

Basin Relief and Topography: The South Platte River enters Nebraska from Colorado at an elevation of 3430ft above sea level and flows northeasterly across alluvial plains to its confluence with the North Platte River at an elevation of 2760ft above sea level.

Total Stream Length: 368 mi

River Order: 4

Mean Annual Discharge: 561cfs at Roscoe, Nebraska

Land Use: 65% cropland, 30% rangeland

Major Tributaries: Lodgepole Creek

Lakes, Reservoirs and Obstructions to Fish movements: irrigation diversions and dewatering.

Special Features: Discharge in the South Platte River is greatly influenced by diversions for Denver, Colorado and front range cities.

Basin Connections: Platte River system

ELKHORN RIVER BASIN

The Elkhorn River begins in the eastern portion of the Sandhills and flows generally southeast and south until it joins the Platte River west of Omaha. The western portion of the Elkhorn River lies on the boundary between the Sandhills and Northwestern Glaciated Plains ecoregions and flows eastward into the northeastern Nebraska loess hills portion of the Western Corn Belt Plains ecoregion.

Basin Area: 6,953 mi2

Basin Relief and Topography: The Elkhorn River rises in Sandhills wetlands at an elevation of 2310ft above sea level, flows east and south through loess hills until it joins the Platte River at an elevation of 1070ft above sea level.

Total Stream Length: 762 mi

River Order: 4

Mean Annual Discharge: 1,364cfs at Waterloo, Nebraska

Land Use: > 50% cultivated, livestock production, native hay grasslands

Major Tributaries: Maple Creek, Logan Creek, Pebble Creek, Plum Creek, North Fork of the Elkhorn River, Union Creek.

Lakes, Reservoirs and Obstructions to Fish movements: The only dams on the Elkhorn River are at Atkinson, Nebraska and on the North Fork of the Elkhorn at Norfolk. There are numerous farm ponds on tributaries.

Special Features: Upper basin flows are uniform because of groundwater discharge fromSandhills aquifers but these flows have been declining in recent years due to groundwater pumping.

Basin Connections: The Elkhorn River system is connected directly to the Platte River and from there to the Missouri River drainage.

LOUP RIVER BASIN

The Loup River basin begins within the Nebraska Sand Hills ecoregion and flows into the Central Nebraska Loess Plains area of the Central Great Plains ecoregion before flowing into the Platte River near Columbus, Nebraska.

Basin Area: 15,230 mi2

Basin Relief and Topography: Rolling stabilized sand dunes in the west to dissected loess plains in the lower and eastern parts of the basin. The Loup River system rises at an elevation of 3680ft above sea level at the headwaters of the Middle Loup River and flows mainly southeastwardly to its confluence with the Platte River at an elevation of 1410ft above sea level.

Total Stream Length: 1,083 mi.

River Order: 4

Mean Annual Discharge: 2,362cfs (729 from the Loup River plus 1,633 from the Loup Power Canal.

Land Use: Ranching with increasing amounts of cultivated agriculture especially in the eastern parts of the drainage.

Major Tributaries: Beaver Creek, Cedar River, North Loup River, Calamus River, Middle Loup River, Oak Creek, Dismal River, Couth Loup River, Mud Creek.

Lakes, Reservoirs and Obstructions to Fish movements: Irrigation diversions along most major tributaries. Many natural lakes are found in the western and central portions of the basin. Several large reservoirs (Calamus and Sherman Reservoirs) store water for irrigation.

Special Features: Large areas of wetlands (fens) are found in the central portion of the basin and the western portion of the basin contains highly alkaline lakes. Two of the main tributaries, the Middle Loup River and the Dismal River, are predominantly fed by groundwater and have remarkably uniform flows.

Basin Connections: Part of the Platte River system in Nebraska. Provides a major portion of the flow in the lower Platte River, especially during low flow periods and most summers.

NIOBRARA RIVER BASIN

The Niobrara River begins in eastern Wyoming within the Western High Plains ecoregion and then flows through the northern part of the Nebraska Sand Hills ecoregion, the southern part of the Northwestern Great Plains ecoregion and the Northwestern Glaciated Plains ecoregion before flowing into the Missouri River.

Basin Area: 32,600km2

Basin Relief and Topography: The Niobrara River enters Nebraska from Wyoming at an elevation of 4690ft above sea level through rolling high plains and dissected canyons before its confluence with the Missouri River at an elevation of 1210ft above sea level.

Total Stream Length: 747mi

River Order: 4

Mean Annual Discharge: 493m/s (1,724cfs)

Land Use: > 75% rangeland and pasture, 20% cropland

Major Tributaries: Verdigre Creek, Keya Paha River, Long Pine Creek, Plum Creek, Gordon Creek Minnechaduza Creek, Snake River, Bear Creek.

Lakes, Reservoirs and Obstructions to Fish movements: Spencer Dam, Cornell Dam, Merritt Reservoir, Box Butte Reservoir.

Special Features: The Niobrara River basin lies at the eastern edge of the Rocky mountain forest, the western edge of the eastern deciduous forest and the southern edge of the northern forest species and the northern extent of many southern prairie species.

Basin Connections: Direct tributary to the Missouri River.

MISSOURI RIVER TRIBUTARIES

The Missouri Tributaries basin lies completely within the Western Corn Belt Plains ecoregion and includes all of the smaller tributaries that feed directly into the Missouri River between the mouth of the Niobrara River and the mouth of the Platte River.

Basin Area: 2,950 mi2

Basin Relief and Topography: Steeply sloping headwaters to low gradient on the Missouri River floodplain.

Total Stream Length: 880mi in 28 individual drainages.

River Order: NA

Mean Annual Discharge: NA

Land Use: 60% cropland, 20% pasture, urbanization increasing

Major Tributaries: Bazile Creek, Bow Creek, Aowa Creek, Papillion Creek.

Lakes, Reservoirs and Obstructions to Fish movements: Channelization of the Missouri River and near the mouths of tributaries and localized pollution on some tributaries may limit the movement of some fish species. In addition there are numerous farm ponds on these tributaries.

Special Features: This area includes over 28 distinct tributaries which range from agricultural to urban watersheds.

Basin Connections: All these tributaries connect directly to the Missouri River.

Comments:

WHITE RIVER AND HAT CREEK BASINS

The White River and Hat Creek basins lie in the far northwestern corner of Nebraska, mostly in the Northwestern Great Plains ecoregion. The White River flows northeastward until it joins the Missouri River in South Dakota. Hat Creek is a tributary of the Cheyenne River which also joins the Missouri River in South Dakota. The tributaries rise in the bluffs and pine forests which appear similar to the Black Hills of South Dakota.

Basin Area (combined in Nebraska): 2,130mi2

Basin Relief and Topography: Streams are entrenched in the Pine Ridge area and flow northeast across rolling hills and badlands in Cretaceous and Tertiary aged deposits of sandstone and silt stone. The White River rises at an elevation of 4810ft above sea level and flows into South Dakota at an elevation of 3040ft above sea level. Hat Creek rises at an elevation of 4760ft above sea level and flows into South Dakota at an elevation of 3520ft above sea level.

Total Stream Length: 634 miles

River Order: 3

Mean Annual Discharge: (1932-1943 near Chadron) 26cfs

Land Use: 15% cropland, 55% rangelands and pastures, 30% forest

Major Tributaries:

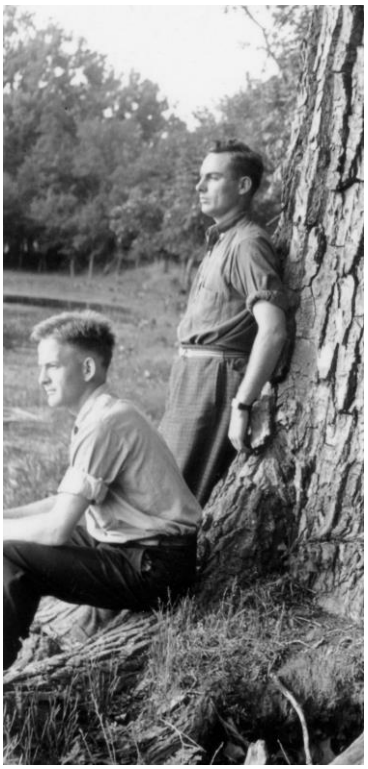
Lakes, Reservoirs and Obstructions to Fish movements: No mainstream reservoirs in Nebraska, but many small stock watering ponds on tributaries.

Special Features: Headwater tributaries are spring fed but many streams become intermittent downstream. These basins are susceptible to intense runoff events due to the combination of heavy rains falling on impermeable clay soils.

Basin Connections: These basins are part of the White River and Cheyenne River systems in South Dakota which flow into the Missouri River.

APPENDICES

1939 Field Sampling Outfit



In 1939, during his stream sampling trip to Nebraska, Raymond Johnson took photographs of various things of interest. Johnson, a native of Peru, Nebraska, was a graduate student at the University of Michigan. The survey was his graduate project and, during the summer, he was assisted by a fellow student, Russell Wallace (in photo at right; Johnson is sitting, Wallace is standing). They traveled around the state in this sedan, a 1936 Ford five window coupe, provided by the University of Nebraska, and they camped out every night. Note that this was still the tailend of the Great Depression so they were probably on a shoe-string budget. [There are numerous photos showing this same vehicle and various camps that they had set up.]

All of their camping gear, personal gear and sampling gear as well as specimen storage were carried in and on this car. Here we see one of their camps consisting of two Army cots set out on the ground (it must have been nice weather). Note the rolled up seine on the front fender and the tent tied to the back bumper. Another photo shows at least two more seines tied to the front bumper. There is no way that they could have carried all of their fish samples with them for the full summer. Since they had a UNL car, perhaps they had an arrangement with UNL to store specimens temporarily.

2005 Field Sampling Outfit

2005 stream survey crew. Left to right: Landon Pierce, Tony Barada, Bill Garvey and Ayhan Yilidrim. Kelly Corman is taking the photograph. Not shown is Tara Anderson.

The photo above shows a typical field sampling trip in 2005. A six person crew with a tote barge electrofisher. There was no camping. When within an hour or two of Lincoln the crews would return to the University and everyone slept in their own beds. Further out, they stayed in motels. A crew this size would need two pickups to haul the personnel and the sampling gear. Aside from these obvious differences with the 1939 survey, the crew are still wading in the stream and collecting fishes. The fishes are stored in a water-filled container and the crew will be picking fish up, identifying them and recording what they found. Whether 1939 or 2005, they are still sampling fishes and any one of either crew, if transported to the other timeline (aside from the usual disorientation due to time travel), would know exactly what to do. We look at the 1939 photo and are amazed at the 'primitive' conditions in which they worked. Would a fish sampling crew in 2077 look at the photo above and be equally amazed?

Appendix Table 1. Species of fish that have been collected from Nebraska streams during the stream surveys of 1939-1941 and 2003-2005. The 1941 Scientific names and common names are those used by Raymond Johnson in his thesis or were in current use at that time. Cells with asterisks were species not collected in the 1939-41 survey. Cells with a diagonal fill indicate species that were not present in Nebraska during the 1939-41 survey. Multiple names in the same box indicate where species have been combined since the 1941 survey.

Family	Common name 2016	Scientific name 2016	Common name 1941	Scientific Name 1941
Lampreys	Chestnut Lamprey	*Ichthyomyzon castaneus*	Western Lamprey	*Ichthyomyzon castaneus*
	Silver Lamprey	*Ichthyomyzon unicuspis*	****	*Ichthyomyzon concolor*
Sturgeons	Lake Sturgeon	*Acipenser fulvescens*	Rock Sturgeon	*Acipenser fulvescens*
	Pallid Sturgeon	*Scaphirhynchus albus*	****	*Scaphirhynchus albus*
	Shovelnose Sturgeon	*Scaphirhynchus platorynchus*	Shovelnose sturgeon	*Scaphirhynchus platorynchus*
Paddlefish	Paddlefish	*Polyodon spathula*	Paddlefish	*Polyodon spathula*
Gars	Longnose Gar	*Lepisosteus osseus*	Northern Longnose Gar	*Lepisosteus osseus oxyurus*
	Shortnose Gar	*Lepisosteus platostomus*	Shortnose gar	*Lepisosteus platostomus*
Bowfins	Bowfin	*Amia calva*	Bowfin	*Amia calva*
Mooneyes	Goldeye	*Hiodon alosoides*	Goldeye	*Amphiodon alosoides*
	Mooneye	*Hiodon tergisus*	Mooneye	*Hiodon tergisus*
Eels	American Eel	*Anguilla rostrata*	American Eel	*Anguilla bostoniensis*
Herrings	Skipjack Herring	*Alosa chrysochloris*	****	*Pomolobus chrysochloris*
	Gizzard Shad	*Dorosoma cepedianum*	Gizzard Shad	*Dorosoma cepedianum*
Minnows	Bigmouth Shiner	*Notropis dorsalis*	Central Bigmouth Shiner Western Bigmouth Shiner	*Notropis dorsalis dorsalis* *Notropis dorsalis piptolepis*
	Blacknose Shiner	*Notropis heterolepis*	****	*Notropis heterolepis*

	Bluntnose Minnow	*Pimephales notatus*	Bluntnose Minnow	*Hyborhynchus notatus*
	Brassy Minnow	*Hybognathus hankinsoni*	Brassy Minnow	*Hybognathus hankinsoni*
	Central Stoneroller	*Campostoma anomalum*	Plains Stoneroller	*Campostoma anomalum plumbeum*
	Common shiner	*Luxilus cornutus*	Northern Common shiner	*Notropis cornutus frontalis*
	Creek Chub	*Semotilus atromaculatus*	Northern Creek Chub	*Semotilus atromaculatus atromaculatus*
	Emerald Shiner	*Notropis atherinoides*	Emerald Shiner Plains Shiner	*Notropis atherinoides atherinoides* *Notropis percobromus*
	Fathead Minnow	*Pimephales promelas*	Northern Fathead Minnow	*Pimephales promelas promelas*
	Finescale Dace	*Chrosomus neogaeus*	Finescale Dace	*Pfrille neogaea*
	Flathead Chub	*Platygobio gracilis*	Plains Flathead Chub Creek Flathead Chub	*Platygobio gracilis communis* *Platygobio gracilis gulonellus*
	Golden Shiner	*Notemigonus crysoleucas*	Western Golden Shiner	*Notemigonus crysoleucas auratus*
	Hornyhead Chub	*Nocomis biguttatus*	Hornyhead Chub	*Nocomis biguttatus*
	Lake Chub	*Couesius plumbeus*	Northern Creek Chub	*Couesius plumbeus dissimilis*
	Longnose Dace	*Rhinichthys cataractae*	Plains Longnose Dace	*Rhinichthys cataractae ocella*
	Northern Redbelly Dace	*Chrosomus eos*	Northern Redbelly Dace	*Chrosomus eos*
	Northern Pearl Dace	*Margariscus nachtreibi*	Northern Pearl Dace	*Margariscus margarita nachtriebi*
	Plains Minnow	*Hybognathus placitus*	Northern Plains Silvery Minnow	*Hybognathus placitus placitus*
	Red Shiner	*Cyprinella lutrensis*	Plains Redfin Shiner	*Notropis lutrensis lutrensis*
	River Shiner	*Notropis blennius*	River Shiner	*Notropis blennius*
	Sand Shiner	*Notropis stramineus*	Plains Sand Shiner	*Notropis deliciosus missurinesis*
	Shoal Chub	*Macrhybopsis hyostoma*	Plains Speckled Chub	*Extrarius aestivalis sescuialis*
	Sicklefin Chub	*Macrhybopsis meeki*	Sicklefin Dace	*Macrhybopsis meeki*
	Silver Chub	*Macrhybopsis storeriana*	Silver Chub	*Hybopsis storerianus*
	Silverband Shiner	*Notropis shumardi*	Silverband Shiner	*Notropis illecobrosus*

	Spotfin Shiner	*Cyprinella spiloptera*		
	Spottail Shiner	*Notropis hudsonius*		
	Sturgeon Chub	*Macrhybopsis gelida*	Sturgeon Dace	*Macrhybopsis gelidus*
	Suckermouth Minnow	*Phenacobius mirabilis*	Suckermouth Minnow	*Phenacobius mirabilis*
	Topeka Shiner	*Notropis topeka*	Topeka Shiner	*Notropis topeka*
	Western Blacknose Dace	*Rhinichthys obtusus*	Western Blacknose Dace	*Rhinichthys atratulus meleagris*
	Western Silvery Minnow	*Hybognathus argyritis*	Western Silvery Minnow	*Hybognathus nuchalis nuchalis*
Old World Minnows	Grass Carp	*Ctenopharyngodon idella*		
	Goldfish	*Carassius auratus*	Gold Fish	*Carassius auratus*
	Common Carp	*Cyprinus carpio*	Carp	*Cyprinus carpio*
	Bighead Carp	*Hypophthalmichthyes nobilis*		
	Silver Carp	*Hypophthamichthyes molitrix*		
	Rudd	*Scardineus erythophthalmus*		
Suckers	River Carpsucker	*Carpiodes carpio*	River Carpsucker Northern Carpsucker	*Carpiodes forbesi Carpiodes carpio carpio*
	Quillback	*Carpiodes cyprinus*	Bluntnose Carpsucker	*Carpiodes velifer*
	Longnose Sucker	*Catostomus catostomus*	Western Longnose Sucker	*Catostomus catostomus griseus*
	White Sucker	*Catostomus commersonii*	Western White Sucker	*Catostomus commersonii sucklii*
	Mountain Sucker	*Catostomus platyrhynchus*	Mountain Sucker	*Pantosteus jordani*
	Blue Sucker	*Cycleptus elongatus*	****	*Cycleptus elongatus*
	Lake Chubsucker	*Erimyzon sucetta*		
	Smallmouth Buffalo	*Ictiobus bubalus*	Smallmouth Buffalofish	*Ictiobus bubalus*
	Bigmouth Buffalo	*Ictiobus cyprinellus*	Bigmouth Buffalofish	*Megastomatobus cyprinella*
	Black Buffalo	*Ictiobus niger*	Black Buffalofish	*Ictiobus niger*
	Shorthead Redhorse	*Moxostoma macrolepidotum*	Northern Redhorse	*Moxostoma aureolum*

Catfishes	Black Bullhead	*Ameiurus melas*	Northern Black Bullhead	*Ameiurus melas melas*
	Yellow Bullhead	*Ameiurus natalis*	Northern Yellow Bullhead	*Ameiurus natalis natalis*
	Brown Bullhead	*Ameiurus nebulosus*		
	Blue Catfish	*Ictalurus furcatus*	Northern Blue Catfish	*Ictalurus furcatus furcatus*
	Channel Catfish	*Ictalurus punctatus*	Northern Channel Catfish	*Ictalurus lacustris punctatus*
	Stonecat	*Noturus flavus*	Stonecat	*Noturus flavus*
	Tadpole Madtom	*Noturus gyrinus*	Tadpole Madtom	*Schibeodes gyrinus*
	Flathead Catfish	*Pylodictus olivaris*	Shovelhead Catfish	*Pilodictis olivaris*
Pikes	Grass Pickerel	*Esox americanus*	Mud Pickerel	*Esox vermiculatus*
	Northern Pike	*Esox lucius*	Northern Pike	*Esox lucius*
Trouts	Cutthroat Trout	*Oncorhynchus clarki*	Yellowstone Cutthroat	*Salmo clarkii lewisi*
	Rainbow Trout	*Oncorhynchus mykiss*	Coast Rainbow Trout	*Salmo gairdnerii irideus*
	Brown Trout	*Salmo trutta*	Brown Trout	*Salmo trutta fario*
	Brook Trout	*Salvelinus fontinalis*	Common Brook Trout	*Salvelinus fontinalis fontinalis*
Cods	Burbot	*Lota lota*	Eastern Burbot	*Lota lota maculosa*
Silversides	Brook Silverside	*Labidesthes sicculus*		
Killifishes	Plains Topminnow	*Fundulus sciadicus*	Plains Killifish	*Fundulus sciadicus*
	Northern Plains Killifish	*Fundulus kansae*	Plains Topminnow	*Plancterus kansae*
Livebearers	Western Mosquitofish	*Gambusia affinis*		
Sticklebacks	Brook Stickleback	*Culaea inconstans*	Brook Stickleback	*Eucalia inconstans*
Temperate basses	White Perch	*Morone americana*		
	White Bass	*Morone chrysops*		
	Yellow Bass	*Morone*		

		mississippiensis		
	Striped Bass	*Morone saxatilis*		
Sunfishes	Rock Bass	*Ambloplites rupestris*	Northern Rock Bass	*Ambloplites rupestris rupestris*
	Sacramento Perch	*Archoplites interruptus*		
	Green Sunfish	*Lepomis cyanellus*	Green Sunfish	*Lepomis cyanellus*
	Pumpkinseed	*Lepomis gibbosus*	Pumpkinseed	*Lepomis gibbosus*
	Orangespotted Sunfish	*Lepomis humilis*	Orangespotted Sunfish	*Lepomis humilis*
	Bluegill	*Lepomis macrochirus*	Common Bluegill	*Lepomis macrochirus macrochirus*
	Redear Sunfish	*Lepomis microlophus*		
	Smallmouth Bass	*Micropterus dolomieu*	Northern Smallmouth Bass	*Micropterus dolomieu dolomieu*
	Largemouth Bass	*Micropterus salmoides*	Largemouth Bass	*Huro salmoides*
	White Crappie	*Pomoxis annularis*	White Crappie	*Pomoxis annularis*
	Black Crappie	*Pomoxis nigromaculatus*	Black Crappie	*Pomoxis nigro-maculatus*
Perches	Iowa Darter	*Etheostoma exile*	Iowa Darter	*Poecilichthys exilis*
	Johnny Darter	*Etheostoma nigrum*	Central Johnny Darter	*Boleosoma nigrum nigrum*
	Orangethroat Darter	*Etheostoma spectabile*	Plains Orangethroat Darter	*Poecilichthys spectabilis gulchelius*
	Yellow Perch	*Perca flavescens*	Yellow Perch	*Perca flavescens*
	Blackside Darter	*Percina maculata*	Blackside Darter	*Hadropterus maculatus*
	Sauger	*Sander canadensis*	Eastern Sauger	*Stizostedion canadense canadense*
	Walleye	*Sander vitreus*	Walleye	*Stizostedion vitreum vitreum*
Drums	Freshwater Drum	*Aplodinotus grunniens*	Freshwater Sheepshead	*Aplodinotus grunniens*

Appendix Table 2. Listing of 1939-41 stream fishery survey sample sites that were revisited during the 2003-05 survey.

SITE	STREAM	BASIN	COUNTY	LOCATION
Site (no number)	Republican River	Republican	Nuckolls	just below dam at Superior
Site 1	Western Sarpy Drainage Ditch	Lower Platte	Sarpy	2se Linoma Beach
Site 3	Western Sarpy Drainage Ditch	Lower Platte	Sarpy	3se Linoma Beach
Site 4	Platte River	Lower Platte	Sarpy	2e South Bend on Cass/Sarpy County line
Site 5	Papillion Creek	Missouri Tribs	Douglas	1s Fort Crook
Site 6	Logan Creek	Elkhorn	Burt	1s Oakland
Site 7	Combination Ditch	Missouri Tribs	Burt	3s Decatur on Hwy 73e
Sites 12/317	Logan Creek	Elkhorn	Dixon	1n Wakefield
Site 14	Union Creek	Elkhorn	Madison	.25w Madison
Site 15	Platte River	Middle Platte	Platte	1s Columbus
Sites 17/203/204	Clear Creek	Middle Platte	Butler	4s Columbus
Site 18	Wahoo Creek	Lower Platte	Saunders	1n Ashland
Sites 20/209	Clear Creek	Lower Platte	Saunders	3n 1w Ashland
Site 21	Wahoo Creek	Lower Platte	Saunders	3n 3w Ashland
Site 24	Platte River	Lower Platte	Douglas	.25w Venice
Site 25	Platte River	Lower Platte	Saunders	2s Fremont
Site 27	Maple Creek	Elkhorn	Dodge	6.5n Fremont
Site 28	Elkhorn River	Elkhorn	Dodge	1n Hooper
Site 29	Logan Creek	Elkhorn	Dodge	4n 1e Hooper
Site 32	Elkhorn River	Elkhorn	Cuming	.5w West Point
Site 34	Elkhorn River	Elkhorn	Cuming	4nw Wisner
Site 35	North Fork Elkhorn River	Elkhorn	Pierce	.5e Hadar
Site 36	North Fork Elkhorn River	Elkhorn	Pierce	3n Pierce
Site 37	Bazile Creek	Missouri Tribs	Knox	1n Creighton
Site 38	Bazile Creek	Missouri Tribs	Knox	Bazile Mills

Site 39	Spring Creek	Missouri Tribs	Knox	.5e Bazile Mills
Site 40	Bazile Creek	Missouri Tribs	Knox	Center
Site 41B	Verdigre Creek	Niobrara	Knox	10n Royal
Site 42	Bazile Creek	Missouri Tribs	Knox	6e Niobrara
Sites 43/291	Niobrara River	Niobrara	Knox	Niobrara State Park
Site 45	Steel Creek	Niobrara	Holt	1ne Dorsey
Site 47	Keya Paha River	Niobrara	Keya Paha	3s Naper
Site 48	Niobrara River	Niobrara	Boyd	6s Naper
Sites 49/286	South Fork Elkhorn River	Elkhorn	Holt	5w Stuart
Site 50	Long Pine Creek	Niobrara	Brown	7s Long Pine
Site 51	Long Pine Creek	Niobrara	Brown	above power dam at Long Pine
Site 52	Bone Creek	Niobrara	Brown	1w Ainsworth
Site 54	Schlagel Creek	Niobrara	Cherry	14ssw Valentine
Site 55	Snake River	Niobrara	Cherry	w Simeon
Site 56	Plum Creek	Niobrara	Brown	3w Johnstown
Site 57	Long Pine Creek	Niobrara	Brown	4n Long Pine
Site 58	Calamus River	Loup	Loup	2nw Harrop
Site 59	North Loup River	Loup	Loup	1n Taylor
Site 60	Cedar River	Loup	Wheeler	1se Ericson
Site 61	Beaver Creek	Loup	Boone	.5n Loretto
Site 62	Shell Creek	Lower Platte	Platte	4nw Platte Center
Site 64	Wood River	Middle Platte	Hall	2e Grand Island
Site 65	Middle Loup River	Loup	Howard	1s St.Paul
Site 66	Middle Loup River	Loup	Sherman	1.5w Loup City
Site 68	Mud Creek	Loup	Custer	.5w Berwyn
Site 69	Middle Loup River	Loup	Custer	2n Gates
Site 70	Middle Loup River	Loup	Blaine	2nw Dunning
Site 71	Dismal River	Loup	Thomas	13s Thedford
Site 72	Dismal River	Loup	Hooker	14s Mullen
Site 74	South Loup River	Loup	Custer	1w Arnold

Site 77	South Loup River	Loup	Buffalo	1e Ravenna
Site 78	Lincoln Creek	Big Blue	York	2.5n York
Sites 81/241	Little Blue River	Little Blue	Adams	1n .5w Ayr
Site 83	Spring Creek	Little Blue	Adams	1n .5w Ayr
Site 85	Platte River	Middle Platte	Buffalo	s Kearney
Site 86	Buffalo Creek	Middle Platte	Dawson	1n 2w Overton
Site 87	Platte River	Middle Platte	Lincoln	s Brady
Site 88	Irrigation ditch	Middle Platte	Lincoln	4nw Brady along Hwy 30
Site 89	North Platte River	North Platte	Lincoln	3.5n Sutherland
Site 92	Medicine Creek	Republican	Lincoln	above Wellfleet lake
Site 93	Medicine Creek	Republican	Lincoln	below Wellfleet lake
Site 94	Red Willow Creek	Republican	Hayes	7.5ne Hayes Center
Site 96	Stinking Water Creek	Republican	Hayes	n Hamlet
Site 97	Frenchman River	Republican	Chase	.5nw Wauneta
Site 98	Republican River	Republican	Dundy	1.25e Benkelman
Site 100	Rock Creek	Republican	Dundy	Parks
Site 102	Rock Creek	Republican	Dundy	Rock Creek Hatchery
Site 104	Spring Creek	Republican	Chase	5n Imperial
Site 105	South Platte River	South Platte	Keith	.5w Ogallala
Site 106	Lonergan Creek	North Platte	Keith	1.25e Lemoyne
Site 107	North Platte River	North Platte	Garden	1s Oshkosh
Site 109	Blue Creek	North Platte	Garden	13n Oshkosh
Site 111	Cedar Creek	North Platte	Morrill	6s 1.5e Broadwater
Site 113	Greenwood Creek	North Platte	Morrill	s Bridgeport
Site 116	Lodgepole Creek	South Platte	Kimball	below Oliver Reservoir
Site 118	Tub Springs	North Platte	Scottsbluff	7nw Scottsbluff
Site 119	Akers Draw	North Platte	Scottsbluff	2nw Mitchell
Site 121	Horse Creek	North Platte	Scottsbluff	Lyman
Site 122	Winters Creek	North Platte	Scottsbluff	3.5e Scottsbluff
Site 124	Niobrara River	Niobrara	Sioux	1.5e Agate
Site 126	Sowbelly Creek	White/Hat	Sioux	ne Harrison

Site 127	White River	White/Hat	Sioux	2ne Crawford
Site 128	White River	White/Hat	Sioux	at hatchery in Crawford
Site 133	Niobrara River	Niobrara	Sheridan	Hwy 87 s Hay Springs
Site 136	Arkansas Flats Creek	Niobrara	Cherry	32n Hyannis
Site 137	Snake River	Niobrara	Cherry	24s 6e Merriman
Site 138	Niobrara River	Niobrara	Cherry	s Merriman
Site 140	Elkhorn River	Elkhorn	Holt	1s Atkinson
Site 142	Haines Branch	Lower Platte	Lancaster	s Pioneers Park
Site 144	Middle Creek	Lower Platte	Lancaster	1e Emerald
Site 147	Little Salt Creek	Lower Platte	Lancaster	4n Lincoln
Site 149	West Fork Big Blue River	Big Blue	Seward	sw Beaver Crossing at Indian Creek
Site 201	Platte River	Middle Platte	Butler	overflow pool, 3n 3w Bellwood
Site 202	Clear Creek	Middle Platte	Butler	2.5n 3w Bellwood
Site 205a	Clear Creek	Middle Platte	Butler	3n 6w Bellwood
Site 205b	Clear Creek	Middle Platte	Butler	3n 6w Bellwood
Site 206	West Sarpy Drainage Ditch	Lower Platte	Sarpy	1se Linoma Beach
Site 208	Silver Creek	Lower Platte	Saunders	1s Memphis
Site 212	Weeping Water Creek	Nemaha	Cass	5se Union, .75m above Missouri
Site 213	Fourmile Creek	Lower Platte	Cass	11e Louisville
Site 214	Platte River	Lower Platte	Sarpy	nw Plattsmouth
Site 217	Little Nemaha River	Nemaha	Otoe	1s Syracuse
Site 218	South Fork Little Nemaha River	Nemaha	Otoe	5w Talmage
Site 219	Little Nemaha River	Nemaha	Nemaha	1se Brock
Site 220	Little Nemaha River	Nemaha	Nemaha	.5e Stein
Site 221	Wine Branch	Nemaha	Richardson	5e Barada
Site 223	Big Nemaha River	Nemaha	Richardson	.5n Preston
Site 224	Big Muddy Creek	Nemaha	Richardson	1.25n Preston
Site 225	Rock Creek	Nemaha	Richardson	3s 3w Salem
Site 226	Fourmile Creek	Nemaha	Richardson	5e 1n DuBois

Site 227	South Fork Big Nemaha River	Nemaha	Richardson	1e 4s Humboldt
Site 228	North Fork Big Nemaha River	Nemaha	Johnson	.5s Sterling
Site 229	Big Muddy Creek	Nemaha	Nemaha	5w 5s Auburn
Site 230	Big Muddy Creek	Nemaha	Richardson	.5w Stella
Site 231	Long Branch	Nemaha	Richardson	1n 2w Humboldt
Site 232	North Fork Big Nemaha River	Nemaha	Pawnee	3n Table Rock
Site 233	South Fork Big Nemaha River	Nemaha	Pawnee	2s .5e DuBois
Site 234	Turkey Creek	Nemaha	Pawnee	4s Pawnee City
Site 235	Cub Creek	Big Blue	Gage	3w Beatrice
Site 236	Turkey Creek	Big Blue	Gage	3se DeWitt
Site 238	Salt Creek	Lower Platte	Lancaster	1w 1s Sprague
Site 239	Salt Creek	Lower Platte	Lancaster	4ne Sprague
Site 240	Turkey Creek	Big Blue	Saline	1e Pleasant Hill
Site 242	Little Blue River	Little Blue	Nuckolls	1se Oak
Site 243	Spring Creek	Little Blue	Thayer	1se Hebron
Site 244	Big Sandy Creek	Little Blue	Thayer	3w Alexandria
Site 245	Rose Creek	Little Blue	Jefferson	.5s Reynolds
Site 246	Little Blue River	Little Blue	Jefferson	.5w Steele City
Site 247	Platte River	Lower Platte	Dodge	1se North Bend
Site 249	Willow Creek	Republican	Webster	2w Guide Rock
Site 250	Elm Creek	Republican	Webster	4n Lester
Site 251	Republican River	Republican	Webster	2e Inavale
Site 252	Thompson Creek	Republican	Franklin	6n Riverton
Site 253	Turkey Creek	Republican	Franklin	3n .75w Naponee
Site 254	Republican River	Republican	Harlan	1sw Alma
Site 255	Prairie Dog Creek	Republican	Harlan	6s Alma
Site 256	Sappa Creek	Republican	Harlan	.25s Stamford
Site 258	Muddy Creek	Republican	Furnas	1w Arapahoe
Site 259	Republican River	Republican	Red Willow	1s Indianola
Site 260	Medicine Creek	Republican	Frontier	1e Stockville

Site 261	Red Willow Creek	Republican	Red Willow	10n McCook
Site 263	Frenchman River	Republican	Hitchcock	.5ne Beverly
Site 264	North Fork Republican River	Republican	Dundy	1sw Benkelman
Site 265	North Fork Republican River	Republican	Dundy	1nw Haigler
Site 266	South Platte River	South Platte	Deuel	2ne Colorado line
Site 267	South Platte River	South Platte	Keith	1s 1w Brule
Site 273	North Platte River	North Platte	Scottsbluff	1se Henry
Site 274	Big Blue River	Big Blue	Seward	1n 1e Milford
Site 275	Platte River	Middle Platte	Merrick	Hwy 34 bridge, se Grand Island
Site 277	Platte River	Middle Platte	Dawson	3s Lexington
Site 280	Niobrara River	Niobrara	Sheridan	Hwy 27 s Gordon
Site 281	Bear Creek	Niobrara	Cherry	8e Merriman
Site 283	Niobrara River	Niobrara	Cherry	3se Valentine at Bryan bridge
Site 284	Minnechaduza Creek	Niobrara	Cherry	1e Valentine
Site 285	Minnechaduza Creek	Niobrara	Cherry	3w Valentine
Site 288	Elkhorn River	Elkhorn	Holt	1s Emmet
Sites 289/314	Beaver Creek	Loup	Wheeler	6n Bartlett
Site 290	Merriman Creek	Niobrara	Antelope	6e 6n Royal
Site 293	West Bow Creek	Missouri Tribs	Cedar	.5n Fordyce
Site 294	Bow Creek	Missouri Tribs	Cedar	1.5e Wynot
Sites 295/299	Sand Creek	Lower Platte	Saunders	.25n Wahoo
Site 296	West Fork Big Blue River	Big Blue	Seward	3s 5w Milford
Site 297	West Fork Big Blue River	Big Blue	York	.25s McCool Junction
Site 298	West Fork Big Blue River	Big Blue	Hamilton	3e Stockham
Site 301	Loup River	Loup	Platte	1s Monroe
Site 302	Looking Glass Creek	Loup	Platte	at Monroe and 5w Monroe
Site 303	Loup River	Loup	Nance	1s Fullerton
Site 304	Prairie Creek	Middle Platte	Merrick	7s Fullerton
Site 306	South Loup River	Loup	Buffalo	8n Miller

Site 307	North Loup River	Loup	Loup	6e Taylor
Site 308	North Loup River	Loup	Greeley	1.5w Scotia
Site 309	Cedar River	Loup	Boone	.25n Cedar Rapids
Site 310	Bogus Creek	Loup	Boone	2s St.Edward
Site 311	Beaver Creek	Loup	Boone	3s 2e St.Edward
Site 312	Elkhorn River	Elkhorn	Antelope	2e Clearwater
Site 313a	Cache Creek	Elkhorn	Holt	18sw Ewing
Site 313c	Cache Creek	Elkhorn	Holt	18sw Ewing
Site 315	Elkhorn River	Elkhorn	Dodge	1n Winslow
Site 316	Logan Creek	Elkhorn	Thurston	2.5n .5w Pender
Site 319	South Creek	Missouri Tribs	Dixon	2s .5w Martinsburg

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