

FISHES OF THE NIOBRARA RIVER AT AGATE FOSSIL BEDS NATONAL MONUMENT
2011 SURVEY

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By

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ABSTRACT

In June 2011, a fish inventory was conducted in the Niobrara River at Agate Fossil Beds National Monument (AGFO). Collecting techniques and locations were similar to those used in previous surveys conducted in 1979 and 1989. Results of the 2011 survey indicated a major change in the fish community had occurred during this time period. Although absent in the 1979 and 1989 surveys, Northern pike (*Esox lucius*) were the dominant fish species at AGFO in 2011. White sucker (*Catostomus commersoni*) was the single remaining species from the fish community identified in the 1979 and 1989 inventories, and another new species, Green sunfish (*Lepomis cyanellus*) was added. Except for the addition of the sunfish, these findings basically confirmed the results of an electrofishing inventory conducted in 2008. Compared to the 1979-1989 surveys, the number of fish species decreased from 9 to 3 in 2011, and the total numbers of individual specimens declined from over 600 to fewer than 70. Additional fish collections in 2011 at the Nature Conservancy's Cherry Ranch upstream from the monument indicated that a basically intact fish community comprised of 10 species still exists in good numbers. This is west of a control structure on the Nunn property that presumably restricts the upstream migration of pike.

INTRODUCTION

This report documents the 2011 survey of the fish population in the Niobrara River at Agate Fossil Beds National Monument (AGFO) and at several sites both upstream and downstream from the monument boundaries. It updates a recent assessment conducted in 2008 (Pegg and Pope 2008) and records substantial changes from surveys carried out in 1979 and 1989 (Stasiak 1990). The 2008 survey listed only 12 specimens of 2 fish species, compared to several hundred specimens representing 9 different fish species in the 1979 and 1989 surveys.

Fishes in the 2008 inventory were collected with electrofishing gear (as opposed to the nets used in the 1979 and 1989 studies). Thus a question was raised about whether the low numbers of specimens taken in 2008 reflected the true changes in the fish community, or if they were an artifact of the collection technique. To help answer this question and to update information about the present state of the fish community, this current survey was conducted using techniques and locations similar to the 1979 and 1989 inventories.

MATERIAL AND METHODS

This survey took place from 26-28 June, 2011, approximately the same time of year as the previous assessments. Two nets were used, a 2.5m straight seine, and a 4m bag seine; both had 6mm bar mesh and were 1.5m deep. Two long-handled Erickson nets (1m X .5m frames) with the same mesh size were also used to sample in heavy vegetation. Sampling was conducted at eight locations (sites 2-9) within the monument boundaries, at locations that approximately corresponded to those used in previous fish surveys (1979, 1989, and 2008) (**Table 1 and Figure 1**). In addition, one location (site 1) was sampled east of the monument on private property, and three locations (sites 10-12) were sampled west of AGFO on the Agate Springs Ranch (also private land, **Figure 1**). Finally, four sites were sampled upstream of a control structure located on the Nunn Ranch. These included three sites at TNC's Cherry Ranch, and one at the Guadalcanal Memorial Prairie Preserve (**Figure 2**). Although there was variance, about 100m were sampled at each location. In addition to straight seining, crew members flushed fishes into the nets by disturbing the thick channel-side vegetation. Collecting continued at each location until at least 5 successive hauls did not reveal new species. The clear water also allowed easy positive identification of observed fish. Fishes were counted, photographed, and released unharmed. Physical characteristics for each site were recorded: these included GPS location, elevation, water temperature, current velocity, dissolved oxygen (DO), pH, and total dissolved solids (TDS). Stream depth and width were estimated. In some areas, water depth was over 2 meters and the nets could not reach the bottom. Temperature, pH and TDS were measured using Hana Instruments Dist 1 meters. DO was measured using a Yellow Springs Instruments #55 oxygen meter. Current velocity was measured with a Global Water FP101 Global Flow velocity meter, and a Trimble GeoExplorer2008 series GPS unit was used to determine GPS location and elevation. Turbidity was not measured, but the water clarity was excellent at all sites, with fish and vegetation easily observed at all depths. The water quality data for each site are listed in **Table 2**.

This study was conducted in accordance with protocol #11-041-05-EP issued by the UNMC IACUC (institutional animal care and use committee). Dr. Stasiak had a Nebraska scientific and educational collecting permit (master permit #61) issued by the Nebraska Game and Parks Commission.

RESULTS AND DISCUSSION

Fishes

The numbers of fishes collected and observed at each site are summarized in **Table 3**. A total of 68 fish specimens were collected and released at the 8 locations within the monument boundaries. These represented only 3 species: *Esox lucius* (Northern pike), *Catostomus commersoni* (White sucker), and *Lepomis cyanellus* (Green sunfish). Fish specimens were collected at all sites except station 6 (Lone Tree) and station 8 (oxbow, **Figure 3**). Collections just east of the monument boundaries and on the Agate Springs Ranch immediately to the west totaled over 80 fish specimens; these represented the same 3 species. Further upstream on the TNC Cherry Ranch and the Guadalcanal Memorial Prairie Preserve, hundreds of specimens were collected or observed, including 10 different species (**Table 4**). **Table 5** compares the fish species and numbers collected at AGFO in the four studies conducted since 1979.

Northern Pike: Pike were distributed throughout the monument and west into Agate Springs Ranch. They dominated the fish community at AGFO, and were especially abundant in the western sites (2-6), where several large individuals could be readily observed in the clear water. At least four size classes were collected or observed, ranging from young of the year (yoy) at about 75mm; age class 1 at approximately 200mm; age class 2 at about 320mm (**Photo A**); and age class 3 at about 400mm. Several much larger individuals were observed (these big pike are hard to capture with nets in clear water), indicating adults of spawning age and size are present and have been reproducing successfully for at least 5-6 successive years. A total of 8 pike (mostly yoy) were also collected at site 10 and 11 west of the monument in the marshy area of the Agate Springs Ranch.

Although pike are native to the Niobrara River (Schainost 2008), they probably were restricted to the lower portion of the river near the confluence with the Missouri River and would not have inhabited the upper section of the river basin prior to European settlement. They were not found in AGFO in the 1979 or the 1989 surveys. Apparently high water flows in the early 1990's (or even earlier) have allowed the pike to move upstream from the large population in Box Butte Reservoir. Once pike became established at AGFO, they had a very negative impact on the native fishes (Stasiak and Cunningham 2006). At this time it appears that this highly predatory species has effectively eliminated all but one native fish (white sucker) from the river within the monument boundaries. It might be expected that the present lack of fish would limit the size of the pike population, but this is not the case due to the abundant supply of crayfish in the river.

White suckers: Suckers were rare at most locations in the monument except at the extreme western site (9) where the river enters into the monument through a culvert under highway 29. Here several 125mm individuals (probably age class 2, **Photo B**) were taken along with a large number of yoy of about 25mm. Two large adult suckers were observed at site 1 in the deep pool below a culvert under the roadway east of the monument. This sucker appears to be the lone native fish that has managed to persist despite the pike invasion, but sucker numbers seem to be inverse to the pike population. Where pike are abundant, the sucker numbers are low or absent.

Green sunfish: This species was collected in the monument (site 9) and Agate Springs Ranch (sites 10 and 11) for the first time. Most individuals were approximately 125mm (**Photo C**) and were likely age 2-3. Green sunfish are native to the Niobrara system, but are not a natural component of the headwaters community (Schainost 2008). Once established, they are very tolerant of diverse habitat conditions and can thrive under degraded water quality situations. Since they are most common at the Agate Springs Ranch and the western end of AGFO, they likely were stocked (possibly with or mistaken for bluegill) as sport fish on the ranch. Both bluegill (*Lepomis macrochirus*) and largemouth bass (*Micropterus salmoides*) were collected previously on the ranch (Stasiak 1990). Green sunfish do not grow to very large size in headwater streams (maximum size is about 180mm), and thus they constitute only a minor threat to the native fishes compared to the large fish-eating pike.

Fish collections upstream from the control structure

Fishes were collected at three locations on the Nature Conservancy Cherry Ranch and at the Guadalcanal Memorial Prairie Preserve (**Table 4**). These sites are upstream from the Agate Springs Ranch and west of a control structure (**Figure 2**) on the Nunn Ranch that most likely serves to prevent fish migration into the headwaters of the Niobrara River. The 10 species observed represent the typical fish community of native fishes that probably inhabited the Niobrara River within the AGFO prior to human disturbance.

Salamanders

Although no fishes were found in the oxbow (site 8), a large population of Barred salamander (*Ambystoma mavortium*) larvae was present (**Photo D**). These may represent neotenic individuals (ability to reproduce without metamorphosis into the adult form). These aquatic vertebrates are associated with marginal aquatic habitats that exclude fishes, especially large predatory species. While these bodies of water may be permanent or semi-permanent (existing for many years), they are cut off from the river and water quality and/or chemistry is too extreme for most fishes. Often the water is so shallow as to “winter kill” by freezing solid

and/or eliminating oxygen. The oxbow in the monument had a high amount of dissolved material (TDS of 1300 ppm) and a low oxygen level of 3.6 mg/l (this despite a large surface area).

Aquatic vegetation

The sides of the river channel at most locations throughout the monument are dominated by dense stands of cattail (*Typha* sp.) and an introduced yellow iris (*Iris pseudoacorus*). The iris should probably be considered an invasive species in the monument. In many of the collecting sites in AGFO, the river has been confined to a narrow channel of 1-2 meters in width and 1-2 meters in depth. The water velocity here is just under 1 m/sec, which is significantly greater than areas where the channel is not constrained by the plants and is much wider and shallower. Where these emergent plants shade the water, the temperature remains cold and the in-stream productivity is low; combined with the decay of all of the organic material produced by the large plant biomass, the result is relatively low DO levels (around 3.5 ppm) at a few stations. While this was not tested, the DO levels likely peak in the late afternoon and drop to their lowest levels late at night. At sites where cattails and iris did not constrict the channel (sites 2, 9, 10, 11 and 12) DO levels were significantly higher. While the low DO fluctuations may contribute to fish stress at times, for the most part the native fishes are adapted to these conditions (Pegg and Pope 2008). Thus the disappearance of most of the expected fish species cannot be explained by water quality changes alone over the past 20 years.

Water Quality

The water quality parameters measured in this survey are very similar to those reported by Pegg and Pope (2008), indicating that the aquatic habitat has changed very little in the past three years. With the exception of some rather low DO levels at a few of the stations, all of the data were in the normal, expected range. The water was very clear and conditions should have been suitable to support the native fish community.

Comparison of Fish Surveys Since 1979

The fish inventory surveys of 1979 and 1989 (Stasiak 1990) listed a total of 9 species, representing 5 fish families (see figure 5 for a comparison of fish species collected 1979-2011). If the bass and bluegill that were collected at Agate Springs Ranch were included, then we would have 11 species representing 6 families. Not only was the diversity good in 1989, but

619 individual specimens were reported. The fish community at AGFO in 1989 was representative of the expected fish community as reflected by the current surveys conducted at relatively undisturbed sites upstream from Agate Springs Ranch. Although never collected in any of these surveys, Finescale dace and Northern pearl dace were most likely native to the AGFO reach of the Niobrara River, based on their continued presence on the TNC Cherry Ranch. They are very intolerant of large predator fishes (He and Kitchell 1990; Stasiak and Cunningham 2006). They were probably eliminated by the heavy trout stocking that occurred beginning as early as 1929 (Anonymous, 1993). The rest of the fish community apparently survived intact until the early 1990's even under the heavy trout stocking taking place nearly annually. When the pike became established in the early 1990's, a predator was introduced into the system that would feed heavily on all sizes and age classes of the other fishes (Stasiak and Cunningham 2006). The fishes of the Niobrara headwaters fish community are not adapted to living with large pike, so it is not surprising that white sucker is the only remnant of the previous community. The 2008 inventory only reported 12 specimens of two species, so both numbers and diversity were much diminished by that time. This 2011 survey collected more specimens and a new introduced species (Green sunfish), but likely reflects on the efficiencies of the collecting techniques rather than on any changes in the fish composition.

IBI

The Index of Biotic Integrity (IBI) has been useful as a measure of disturbance or stream quality, using 12 factors (called metrics) of species diversity, richness, and trophic structure (Karr et al, 1986). The scale ranges from a high of 60 (pristine) to a low score of 12 (extremely disturbed). IBI data for streams in western Nebraska are generally unavailable, so direct comparisons between rivers cannot be made. A Large fluctuation in the IBI score within the same river stretch, however, is a good indication of disturbance. The IBI score for the fishes taken at AGFO during the 1989 survey was 38, which indicated a fair to good quality stream. Due to the low diversity and numbers of species, the score for this 2011 survey would be 16, which indicates a highly impacted fish community (Miller et. al 1988). The 2011 fish collection received the lowest possible rating (1) for 11 of the 12 metrics; only the metric measuring the general health of the fishes received a high score of 5. In contrast, the IBI score for the fishes collected on the TNC Cherry Ranch would be in the range of 42-44.

Future Conservation and Management Considerations.

The native fish community is nearly absent from the Niobrara River flowing through Agate Fossil Beds National Monument (AGFO). The present survey has demonstrated that nearly all the native fish species, except White Sucker (*Catostomus commersonii*) and Green Sunfish (*Lepomis cyanellus*), historically present in this portion of the river are now extirpated. Moreover, the immediate upstream and downstream private properties exhibit the same loss of native fish diversity. The most obvious explanation for the loss of this native fish diversity is the long history of nonnative fish stocking in this segment of the Niobrara River (Anonymous 1993). Specifically, the river segment as we define it is bounded by Box Butte Reservoir downstream of AGFO to just upstream to the historic Cook Ranch. Prior to the construction of Box Butte Reservoir, the Nebraska Game and Parks Commission (NGPC) was involved in a multiple decades long process of trying to establish a trout fishery in the upper segment of the Niobrara River. This effort consisted of many different species of salmonids having been stocked in this portion of the river. Beginning as early as 1929, thousands of trout were stocked almost annually. Later, the establishment of Box Butte Reservoir led to further nonnative fish stocking via game fish introductions for a reservoir sport fishery, particular the establishment of Northern Pike (*Esox lucius*). It is this establishment of a viable pike fishery with an extensive flood effect in the early 1990's that has led to the existing depauperate fish condition at AGFO. He and Kitchell (1990) demonstrated the direct and indirect effects of introducing northern pike into a fish community comprised of many of the same minnow species originally found in the Niobrara River at AGFO. Just one month after pike were experimentally introduced, finescale dace, northern redbelly dace, brassy minnows, and fathead minnows decreased in density to the point that they were rarely found in the lake.

Conversations with staff members at AGFO, the surrounding landowners, and ranch hands at these properties indicate that in either 1991 or 1992, a larger flood event occurred in early spring of one of these years producing extreme bank overflow conditions that essentially filled the floodplain valley. This is an ideal condition for Northern Pike to move long distances upstream to spawn. These same people we spoke with described the fishing in this segment of Niobrara River, including to the Nunn Property, as a somewhat decent place to catch trout (albeit they also mentioned the trout fishing was much better in the late 1960's and 1970's). However, after the flood event in the early 1990's, the trout disappeared and were replaced with pike. Indeed, the pike are mentioned by these same individuals as being present all the way from the Nunn property to the west and downstream to the Skavdahl property. Our sampling gives credence to these statements. Northern Pike made up the bulk of the fish collected and observed during our recent survey, followed by White Suckers. Moreover, sight observation along sites within this segment of river revealed no schools of minnow species associated with any habitat type. This is highly unusual since nearly any stream will have

schools of minnow species easily observed from bridge crossings or culverts. The exception to this phenomenon is in streams where nonnative sight feeding predators have been established. We have observed this condition at trout streams in Nebraska, as well as streams with well-established centrarchid (bass, sunfish) populations.

Fortunately, the depauperate fish assemblage found in the AGFO is not indicative of the extreme upper portion of the Niobrara River further upstream. The native fishes of this segment of river, including several Tier I and Tier II fish species classified by the Nature Heritage Program of the NGPC, are still present at The Nature Conservancy's (TNC) Cherry Creek Ranch; moreover, evidence of Northern Pike were not observed at this site nor at Prairie Plains Resources Institute's Guadalcanal Memorial Prairie Preserve. Interestingly, between the TNC's property and AGFO there exists a water control structure that may be acting as a barrier to Northern Pike movement. This structure is located on the Nunn Ranch approximately 10 miles upstream from AGFO (**Figure 4**). Examination of various aerial imagery sets for this location indicates the structure is associated with a berm system on either side of the structure that acts as a water control device. This temporarily floods the stream valley upstream of the structure so the water can be delivered via an earthen canal used to irrigate meadows downstream of the structure. Apparently, the structure and associated berms are of sufficient size to prevent Northern Pike movement further upstream. To fully evaluate this assumption, field sampling needs to be conducted from the uppermost portion of the Cook Ranch to TNC's property, with particular attention paid to the control structure on the Nunn Ranch.

Given our hypothesis that Northern Pike have decimated the native fish assemblage from the Nunn Ranch to Box Butte Reservoir, is a restoration scenario possible for this segment of river? Although challenging, we believe a viable option exists for restoring and maintaining the native fish assemblage in the Niobrara River within AGFO. However, for any restoration strategy to be successful, the private landowners upstream and downstream of AGFO must be brought into the discussion and have buy-in for the restoration project to succeed. Moreover, multiple state and federal agencies, as well as NGOs, will need to develop a partnership for this to succeed. Our conceptual restoration vision for this segment of the river involves the construction of a water control device on the extreme eastern portion of the river in AGFO. Most likely berms would have to be built as part of this engineering. This system would have to be built to engineering standards that take into account the historic flood flows in this area, particularly the event in the early 1990's. This control structure would act as a barrier to any Northern Pike, or any other sight feeding nonnative piscivores, emanating downstream of AGFO.

Once this structure is in place, piscicide treatment (e.g. application of rotenone) of some 20 to 25 stream miles will be necessary to eliminate Northern Pike from the Nunn Ranch control structure west of AGFO through the Skavdahl property east of AGFO. Part of the treatment

process would be to ensure that the canals used by the private property owners are dry, i.e. shut off, or those canals to the west will need to be treated as well. Secondly, all water entering the Skavdahl property should be sent down their existing canal system, effectively stopping flow to that part of the Niobrara River on this property. Ideally, this shunting of water through Skavdahl's existing control structure would take place a week or so before actual river treatment to lessen the amount of water flowing into the marshy areas adjacent to the Niobrara River on the Skavdahl property. Thus at the time of treatment, the canal would effectively act as a conduit making treatment a more effective process. At some point on the downstream end of the Skavdahl property, a chemical reagent would be released into both the canal and the river to neutralize the rotenone used in the fish kill. After the construction and treatment in this segment of the river are complete, restocking of native fish will probably be necessary given the complete lack of any cyprinid species present in this segment of river. We believe ample numbers of individuals of various native fish species, including the Tier I & II species, exist upstream of the Nunn Ranch for restocking efforts. Existing population levels should be sufficient to allow for capture for restocking purposes, yet not affect the long-term viability of these species in the upper portion of the Niobrara River.

Concomitant with this restoration work will be the need to address the dense stands of emergent vegetation along the Niobrara River in AGFO. The Yellow Iris (*Iris pseudacorus*) and Cattails (*Typha* spp.) are severely disrupting both the instream habitat and chemical processes in this reach of the Niobrara River. These dense stands of this vegetation create a condition where the microbial decomposition of this organic material is affecting the dissolved oxygen (DO) availability in the river. This condition creates sufficient levels of DO very early in the diel cycle; however, DO levels drop significantly by mid-day, and are extremely low by mid-afternoon and early evening hours. This extreme daily fluctuation in DO levels creates a harsh environmental condition for gill breathing organisms. For the stream restoration in this reach of the Niobrara River to be successful, developing and implementing a management strategy that address this ecologically stressful condition is imperative. We believe the most cost effective and long-term feasible management option to control the emergent vegetation along the Niobrara River in AGFO is to establish a grazing management program. We understand that potential regulatory and institutional hurdles may exist within the National Park Service for establishing grazing at AGFO, including the use of chemical treatment of the emergent vegetation. However, the introduction of a grazing system to control the density of emergent vegetation along the river would be a powerful symbol to the surrounding private landowners, greatly increasing their buy-in and partnership participation in the restoration of this national riverine treasure.

ACKNOWLEDGEMENTS

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Tables

Table 1. Locations of the fish collecting sites along the Niobrara River in June 2011.

Site	Location	Latitude	Longitude	Elevation (m)
1	Ranch east of AGFO	42.42921	103.71545	1341.50
2	East side of AGFO	42.42831	103.72576	1339.69
3	South of cabins	42.42749	103.72972	1338.84
4	Visitor Center bridge	42.42467	103.72972	1341.53
5	near Hoffman House	42.42167	103.74612	1342.20
6	Fishing Access	42.42093	103.75540	1344.78
7	Lone Tree	42.41713	103.75869	1345.50
8	Oxbow near west entrance	42.42443	103.78679	1348.78
9	Highway 29 at entrance	42.42326	103.79116	1350.00
10	Agate Springs Ranch #1	42.42737	103.80298	1354.35
11	Agate Springs Ranch #2	42.45125	103.83430	1360.64
12	Agate Springs Ranch #3	42.45467	103.83510	1365.05
13	TNC Cherry Ranch	42.52701	103.92201	-----
14	Guadalupe Memorial Prairie	42.61094	103.96522	-----
*	Nunn Ranch Control Structure	42.49825	103.89833	-----

* No fish were collected at the control structure

Table 2. Water quality measurements taken at fish collecting sites in 2011.

Site	Temperature (Celsius)	pH	DO (mg/l)	TDS (ppm)	Velocity (m/s)
1	21.4	7.57	4.79	174	0.6
2	24.3	7.82	6.78	225	0
3	20.3	7.61	3.37	198	0.39
4	19.8	7.66	3.63	194	0.16
5	19.7	7.50	3.11	192	0.34
6	24.4	7.90	4.88	204	0.65
7	19.9	7.85	5.58	187	0.28
8	21.0	8.40	3.61	1300	0
9	18.3	8.12	6.80	190	0.28
10	27.0	8.31	7.95	196	0.45
11	25.8	8.30	8.13	209	0.31
12	26.0	8.50	7.36	203	0.26

* Water quality data were not taken at sites 13 and 14.

Table 3. Fish numbers collected in the Niobrara River at AGFO and in the ranches immediately to the east and west of the monument.

Site	<i>Esox lucius</i>	<i>Catostomus commersoni</i>	<i>Lepomis cyanellus</i>
	(Northern pike)	(White sucker)	(Green sunfish)
1	0	2	0
2	6	0	0
3	15	2	0
4	3	0	0
5	2	0	0
6	3	2	0
7	0	0	0
8	0	0	0
9	0	33+*	2
10	7	0	11
11	1	30+*	1
12	0	30+*	0

* YOY (young of the year). These very small fish were present in large numbers.

Table 4. Fishes collected upstream from Agate Fossil Beds National Monument, west of control structure (sites 13 and 14).

Niobrara River TNC Cherry Ranch, Sioux County Nebraska, 27 June 2011

Lat/Long: 42.527006, -103.922006

Fish Collected Throughout the Property

Scientific name	Common name
<i>Semotilus atromaculatus</i>	Creek Chub
<i>Pimephales promelas</i>	Fathead Minnow
<i>Chrosomus neogaeus</i>	Finescale Dace
<i>Margariscus nachtriebi</i>	Northern Pearl Dace
<i>C. neogaeus x C. eos</i>	<i>Chrosomus</i> hybrid
<i>Campostoma anomalum</i>	Central Stoneroller
<i>Rhinichthys cataractae</i>	Longnose Dace
<i>Hybognathus hankinsoni</i>	Brassy Minnow
<i>Catostomus commersonii</i>	White Sucker
<i>Fundulus sciadicus</i>	Plains Topminnow

Niobrara River Guadalcanal Memorial Prairie Preserve

Prairie Plains Resources Institute, Sioux County Nebraska, 27 June 2011

Lat/Long: 42.610941, -103.965221

Scientific name	Common name
<i>Semotilus atromaculatus</i>	Creek Chub
<i>Chrosomus neogaeus</i>	Finescale Dace *
<i>Catostomus commersonii</i>	White Sucker

* YOY only

Table 5. Summary of fish collections and percent composition in the Niobrara River within the AGFO boundary.

Species	1979*	1989	2008	2011
Brassy Minnow (<i>Hybognathus hankinsoni</i>)	44 (37%)	29 (4.7%)	0	0
Central stoneroller (<i>Campostoma anomalum</i>)	6 (5.5%)	25 (4.0%)	0	0
Creek Chub (<i>Semotilus atromaculatus</i>)	36 (33.3%)	273 (44.2%)	0	0
Fathead Minnow (<i>Pimephales promelas</i>)	10 (9.3%)	128 (20.7%)	0	0
Longnose Dace (<i>Rhinichthys cataractae</i>)	0	4 (.6%)	0	0
White Sucker (<i>Catostomus commersoni</i>)	9 (8.3%)	153 (24.8%)	6 (50%)	37 (54.4%)
Iowa Darter (<i>Etheostoma exile</i>)	1 (.9%)	0	0	0
Plains Topminnow (<i>Fundulus sciadicus</i>)	0	3 (.4%)	0	0
Brown Trout (<i>Salmo trutta</i>)	2 (1.8%)	4 (.6%)	0	0
Northern Pike (<i>Esox lucius</i>)	0	0	6 (50%)	29 (42.6%)
Green Sunfish (<i>Lepomis cyanellus</i>)	0	0	0	2 (2.9%)

* Only two sites were collected in 1979

Figures

Site Locations for 2011 Fish Survey

Site Locations

● Site Locations

▲ Hoffman House

Agate Fossil Beds National Monument

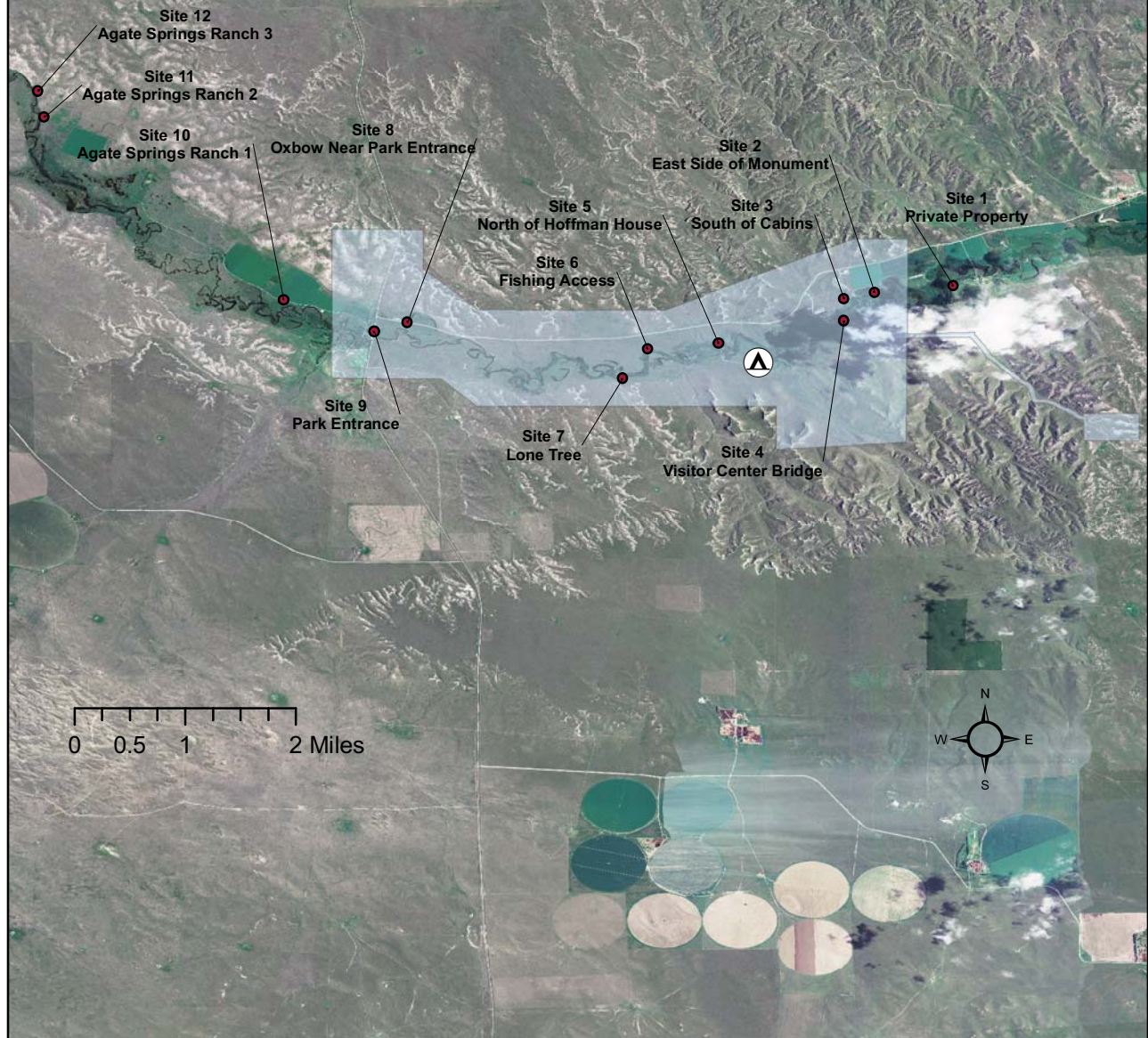


Figure 1.

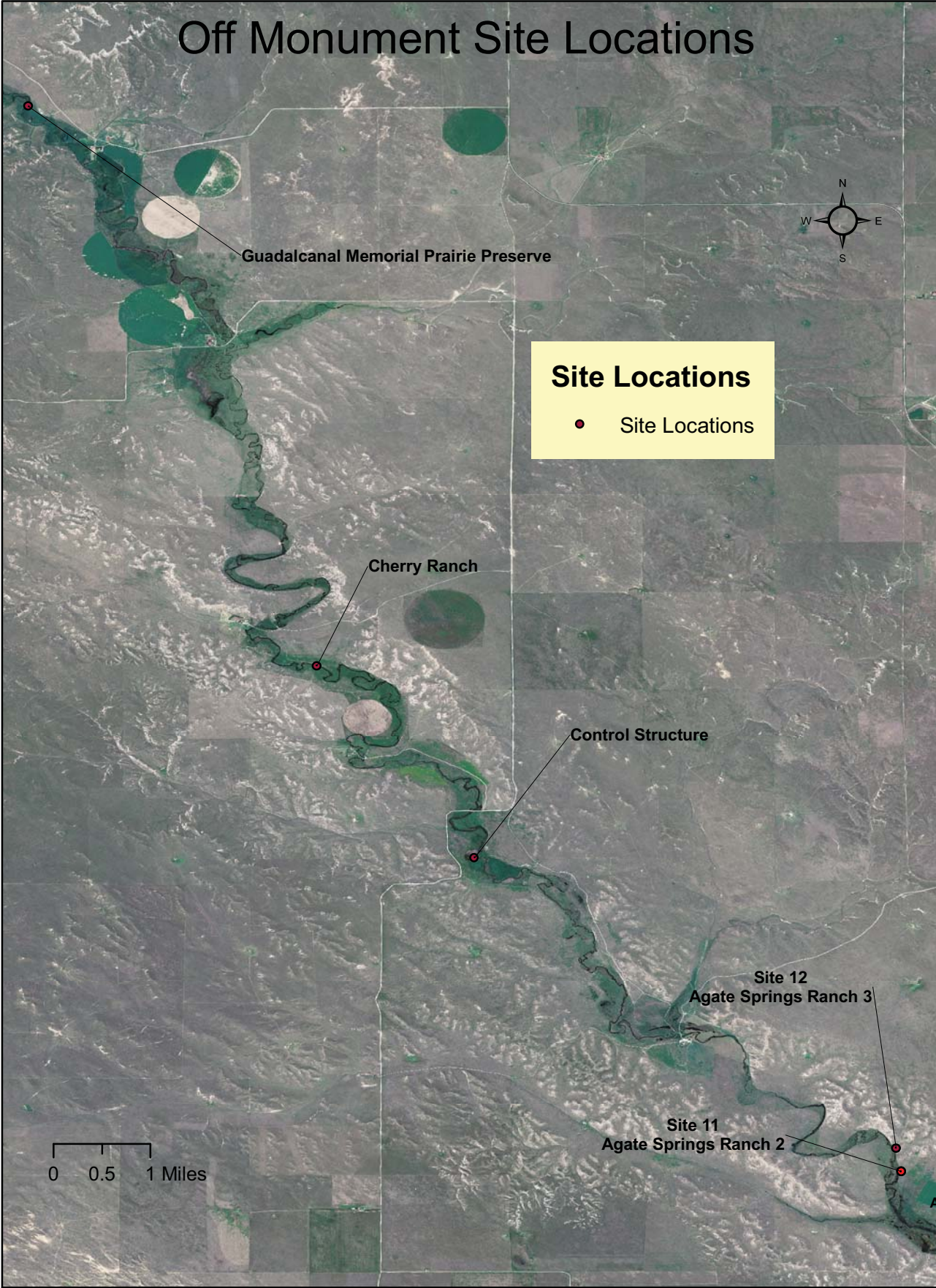


Figure 2.

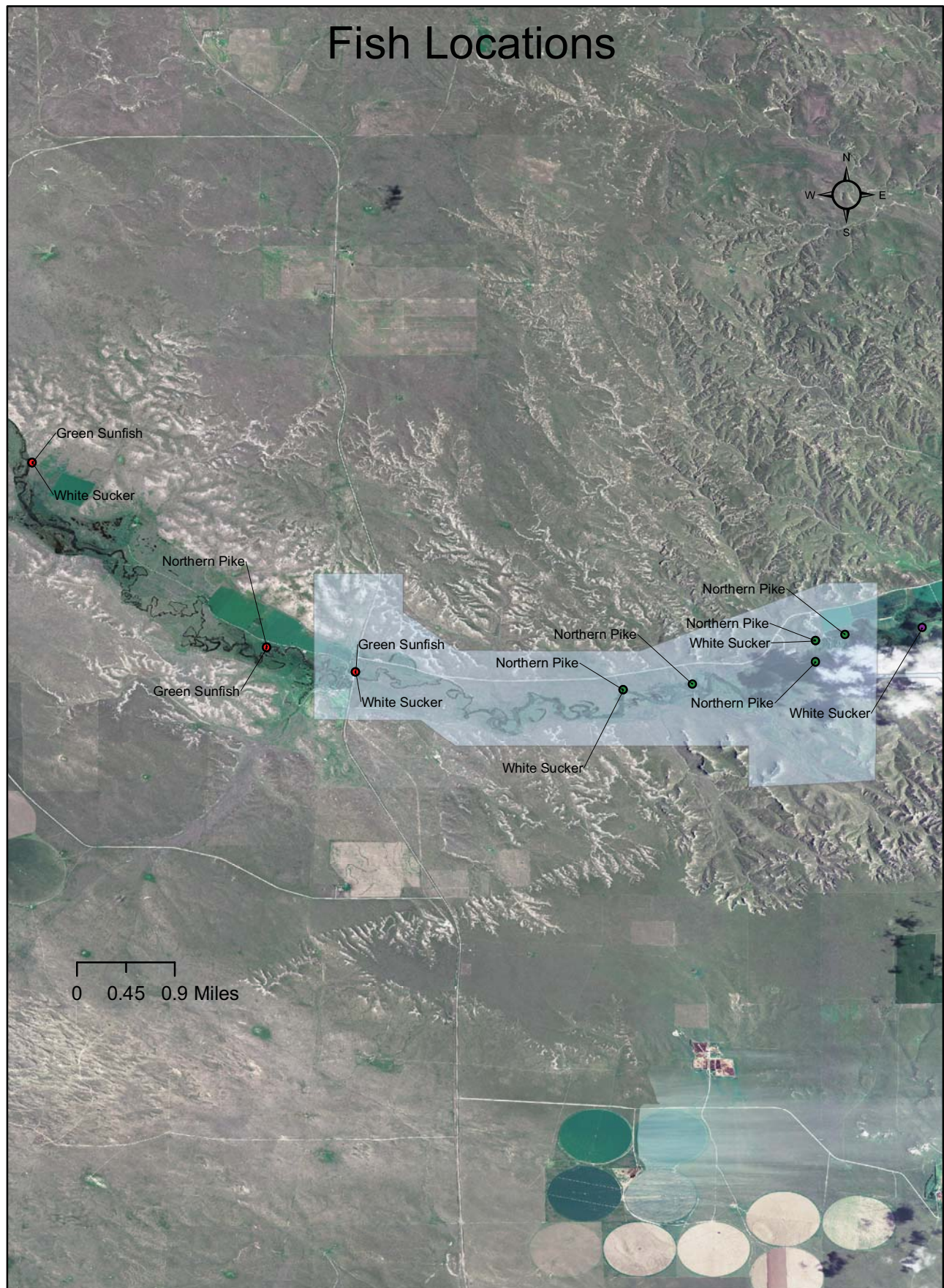


Figure 3.



Figure 4. Location of control structure on Nunn Ranch in proximity to AGFO.

Photographs. Fishes and an amphibian taken in the Niobrara River inside AGFO in June 2011 A. *Esox lucius*, Northern Pike; B. *Catostomus commersoni*, White Sucker ; C. *Lepomis cyanellus*, Green sunfish; and D. *Ambystoma mavortium*, Barred Salamander .



A. Northern pike



B. White sucker



C. Green sunfish



D. Barred salamander (*Ambystoma mavortium*) larva, from site 8 oxbow.