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Section of Fisheries**

Stream Survey Report

**Snake River
2001**

By

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Summary

The Snake River is a designated trout stream with a headwater located 8 miles north of the town of Becker in Sherburne County, Minnesota. The stream flows approximately 14 miles to its confluence with the Elk River, near Big Lake. During 2001, a survey including temperature monitoring, electrofishing and mapping using geographic information systems layers was completed to update fisheries and physical feature information. Overall, the entire length of the Snake River had a sinuosity of 1.4, and a gradient of 5.6 feet/mile. This low gradient and relatively low sinuosity offer little opportunity for cold water fish survival. Due to previous ditching and continual erosion, the substrates consists primarily of sand and silt. These substrates can support trout survival from stocking if temperatures are favorable, but generally, do not allow for adequate spawning. The lack of shading may influence the water temperature, allowing cold water to warm to a point at which trout survival would not be possible. However, there were favorable temperatures within the middle portion of the Snake River, and mottled sculpin, pearl dace and northern redbelly dace were sampled, which suggests potential for cold water species survival. Overhanging vegetation although present in some reaches sampled, was not abundant throughout the majority of the river.

The Snake River watershed encompasses more than 20,000 acres, of which 37% was forested land. Agricultural land was 27% of the land use, while grassland/pasture represented more than 25%. While a relatively large percentage of the land was in non-agricultural use, the extensive ditching in the past has left the stream channel straightened with little habitat that would support trout. Results from electrofishing showed a population associated with large watershed size and a history of ditching. Nineteen species of fish were sampled at three stations in nearly one hour of electrofishing on-time. Cold water species such as pearl dace, mottled sculpin, and northern red-belly dace were moderately abundant in one station, with catch rates of 2.9, 102.1 and 43.8 per hour, respectively. The remaining 16 species were common to warm water populations. The Snake River may offer an opportunity for river restoration; however, limitations by private property ownership may prevent such actions. Ideally, the channel would be reconstructed to provide considerably higher sinuosity and an abundance of bank stabilizing vegetation, including trees to offer shading.

STUDY AREA

The Snake River is a designated trout stream with a headwater located 8 miles north of the town of Becker in Sherburne County, Minnesota. It flows approximately 14 miles to the confluence with the Elk River (Figure 1). The stream has a watershed of 21,554 acres (Figure 2) with estimated land use of 37% forested, 29% grassland/shrub/pasture, 27% agricultural and 4% wetland (Table 1). Extensive ditching has taken place within the last 100 years, yet the stream was designated as a trout stream in 1974. The stream was stocked with both rainbow and brown trout from 1972 through 1979 with reasonable success as records of a recreational fishery are documented in those years. The Snake River is still designated as a trout stream despite a cessation of stocking and the absence of trout in recent surveys.

METHODS

An initial survey of The Snake River was conducted in 1977, and follow up surveys were done in 1985 and 1986. These surveys compiled information on fish communities, physical and chemical characteristics and invertebrate species composition and abundance. During 2001, a re-survey including temperature monitoring, electrofishing and mapping using geographic information systems (GIS) layers was completed to update fisheries and physical feature information.

The Snake River was mapped using a Corvallis Micro Technologies (CMT) GPS unit to mark locations of temperature monitors and electrofishing start and end points. Analysis of land use and map production was performed using Arcview® 3.1, and the 1991 international land use/land cover layer. Stowaway Tidbit® remote temperature monitors were placed in three locations (pools) in the stream where flow was expected to be constant (Figure 3). Monitors were programmed to record temperature each hour and anchored to the streambed to evaluate minimum, maximum and daily fluctuation, and assess the response to air temperatures, between May and October.

Fish were sampled using a Smith Root BP-15D back pack electrofisher, with pulsed direct current during October. Three stations were sampled and all fish were counted and identified. Catch per hour of electrofishing (CPUE) was calculated for all stations. Overall comparisons were made to the 1985 survey to assess changes in species richness and size structure.

RESULTS and DISCUSSION

Overall, the entire length (14 miles) of the Snake River had a sinuosity of 1.4, and a gradient of 5.6 feet/mile. This low gradient and relatively low sinuosity offer little opportunity for cold water fish survival; though, sculpin and northern redbelly dace were caught in one area (EF2). This suggests that some favorable conditions currently exist in some areas that may allow trout to survive. The area represented by EF 2 had two tributaries that entered from both east and west sides of the river. These tributaries had cooler temperatures, which may provide refuge for cold water species during periods of thermal stress. Due to previous ditching and continual erosion, the substrates consisted primarily of sand and silt. These substrates can support trout survival, but generally do not allow for adequate spawning. Overhanging vegetation, although present in some reaches sampled, was not abundant throughout the majority of the river. This may increase the temperature profile for the Snake River by not allowing for adequate shading.

The Snake River watershed is very large (21,551 acres) and reasonably forested (37%). While a relatively large percentage of the land within the watershed was in non-agricultural use, the extensive ditching of the past has left the stream channel straightened with little habitat that would support trout. Other trout streams (Thiel Creek, Fairhaven Creek) with favorable land uses (76% and 49% non-agricultural, respectively) and shorter stream length (1.5 and 3.6 miles, respectively), are generally less affected by slight modifications in the stream channel, due to their smaller watershed drainage areas, and higher quality land use. Increased watershed drainage area has an impact on the forces that influence channel dimensions and stability. The Snake River is longer and has a considerably larger watershed than the remainder of cold water streams found in the Montrose Fisheries Management Area. The combination of a longer stream and the larger watershed may put additional stress on the impacted stream health by preventing adequate recovery time from major events (floods or ditching) that affect morphology.

Temperature monitor data suggests that in both the upper and lower stations (Figure 3), air temperature and sun exposure may have influenced water temperature (Figure 4). However, both the upper and middle stations had maximum water temperatures that could potentially support brown trout, with readings of 24.9 and 22.8 °C, respectively (Table 2). The middle station had a favorable temperature profile for trout, with minimum, average, and maximum temperatures low enough for adequate survival. The lower

station had a profile that resembles a warm to cool water stream rather than a cold water stream.

Results from electrofishing showed a fishery associated with large watershed size and a history of ditching. Nineteen species of fish were sampled at three stations in nearly one hour of electrofishing on-time (Table 3). Cold water species such as pearl dace, mottled sculpin, and northern redbelly dace were caught in one station (EF 2) with moderate abundance, 2.9, 102.1 and 43.8 per hour, respectively (Figure 3). The remaining 16 species are more common to warm water populations. Species such as johnny darter, fathead minnow, creek chub, central mud minnow, and white sucker were most abundant in the electrofishing overall (Table 3). Although 10 northern pike were sampled, no adults were caught, and all were between 152 and 218 mm. The presence of young-of-the-year northern pike suggests that adults may be migrating up from the Elk River to spawn during spring high flow conditions.

Species composition has changed since the 1985 survey and species richness has increased to 19. The occurrence of blunt nose minnow, black-side darter, pearl dace and yellow bullhead were new to the 2001 electrofishing survey. In contrast, black crappie and golden shiner were observed during the 1985 survey, but were not found in 2001. Additionally, the 1985 survey captured nine northern pike larger than 275 mm, and the largest being 575 mm. The absence of larger northern pike in 2001, may be due to the limited resting and pool habitat favored by pike in lotic systems. Some of the changes in species presence or absence may be due to mis-identification, since some of the minnow species are difficult to distinguish.

Management Implications

The Snake River has had a history of successful trout stocking in the early to mid 1970's; however, annual put-and-take trout stocking is no longer an option without public access for anglers. The Snake River may offer an opportunity for river restoration; however, limitations by private property ownership may prevent such action. Ideally, the channel would be reconstructed to provide considerably higher sinuosity and an abundance of bank stabilizing vegetation, including some trees to offer shading. Although Rosgen classification was not performed during 2001, a rough estimate of stream type can give insight into what morphological characteristics the stream may have (Rosgen 1996). Based on the low sinuosity and lack of relief over the stream length, the stream may be best characterized by the E , D or F stream type. If stream restoration becomes a possibility, an effort to restore the channel to a C or E channel with a sinuosity

higher than 1.5 may provide for considerable improvement in stream health. Improvements in canopy cover and bank stabilization would reduce silt loads within the channel. Additionally, returning appropriate sinuosity would also induce scouring of deeper areas and expose gravel substrate. Restorative efforts may potentially improve trout survival if stable water temperatures are achieved.

The Snake River represents a resource that was previously modified to allow for better drainage of surrounding crop land. Undoing these modifications would be costly and time consuming. However, cold water resources within central Minnesota are of extreme value; and are viewed as potential indicators of overall ecosystem health and integrity. Restorative efforts would also increase spawning and resting habitat for a myriad of species that need cool water to survive. The potential restoration of cold water resources such as the Snake River, would be beneficial to the local ecosystem and provide additional recreation opportunities.

Table 1. The Snake River (M-65-7) major watershed estimated land use by acres and percent (1991 data).

Land use category	Acres	Percent
Forest	8,041.1	37.3%
Agricultural	5,836.4	27.1%
Grassland/pasture	5,403.1	25.1%
Wetland	909.7	4.2%
Grassland/shrub	820.4	3.8%
Residential	332.0	1.5%
Lakes	199.3	0.9%
Unclassified	9.4	0.0%
Total	21,551.4	

Table 2. The Snake River temperature monitor average, minimum, and maximum hourly values (°C) recorded from three locations between May and October 2001.

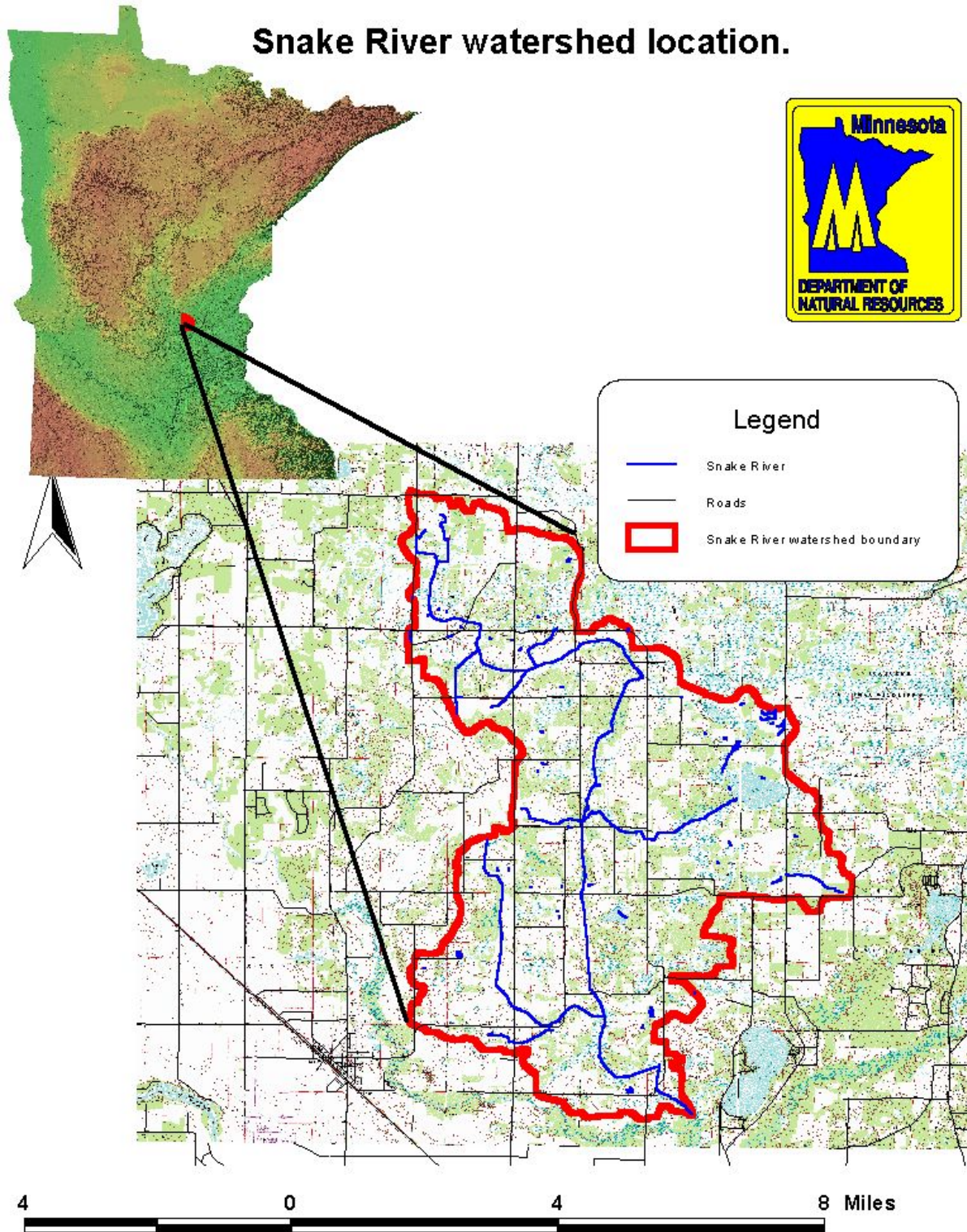
Monitor	N readings	Minimum °C	Average °C	Maximum °C	% >20 °C	% >24 °C
Upper	3837	4.2	15.1	24.9	11.1%	0.7%
Middle	3837	7.6	13.9	22.8	2.1%	0.0%
Lower	3837	3.2	16.7	31.0	24.1%	6.2%

¹ Percent of hourly observations recorded above 20°C, and 24°C respectively.

Table 3. Electrofishing station information and catch rates for all species from the Snake River during fall 2001.

Species	EF1		EF2		EF3		Total	
	N	CPUE (N/hr)	N	CPUE (N/hr)	N	CPUE (N/hr)	N	CPUE (N/hr)
Black bullhead		0.0		0.0	2	14.7	2	2.5
Black nose dace	2	6.5	4	11.7	5	36.8	11	14.0
Blunt nose minnow		0.0	28	81.7	6	44.2	34	43.2
Black-side darter		0.0	2	5.8		0.0	2	2.5
Brook stickleback		0.0	4	11.7		0.0	4	5.1
Central mudminnow	7	22.7	27	78.8	11	81.0	45	57.2
Common shiner	2	6.5	4	11.7		0.0	6	7.6
Creek chub	8	25.9	23	67.1		0.0	31	39.4
Fathead minnow		0.0	22	64.2	8	58.9	30	38.1
Green sunfish	1	3.2		0.0	3	22.1	4	5.1
Hybrid sunfish		0.0	3	8.8	2	14.7	5	6.4
Iowa darter		0.0	2	5.8		0.0	2	2.5
Johnny darter	82	265.7	55	160.5		0.0	137	174.0
Mottled sculpin	2	6.5	35	102.1		0.0	37	47.0
Northern pike	5	16.2	5	14.6		0.0	10	12.7
Northern red-belly dace		0.0	15	43.8		0.0	15	19.1
Pearl dace		0.0	1	2.9		0.0	1	1.3
Shiner y-o-y	3	9.7		0.0	3	22.1	6	7.6
White sucker	5	16.2	7	20.4	10	73.6	22	27.9
Yellow bullhead	3	9.7		0		0	3	3.8
Total	120		237		50		407	
Effort (hour)		0.31		0.34		0.14		0.79

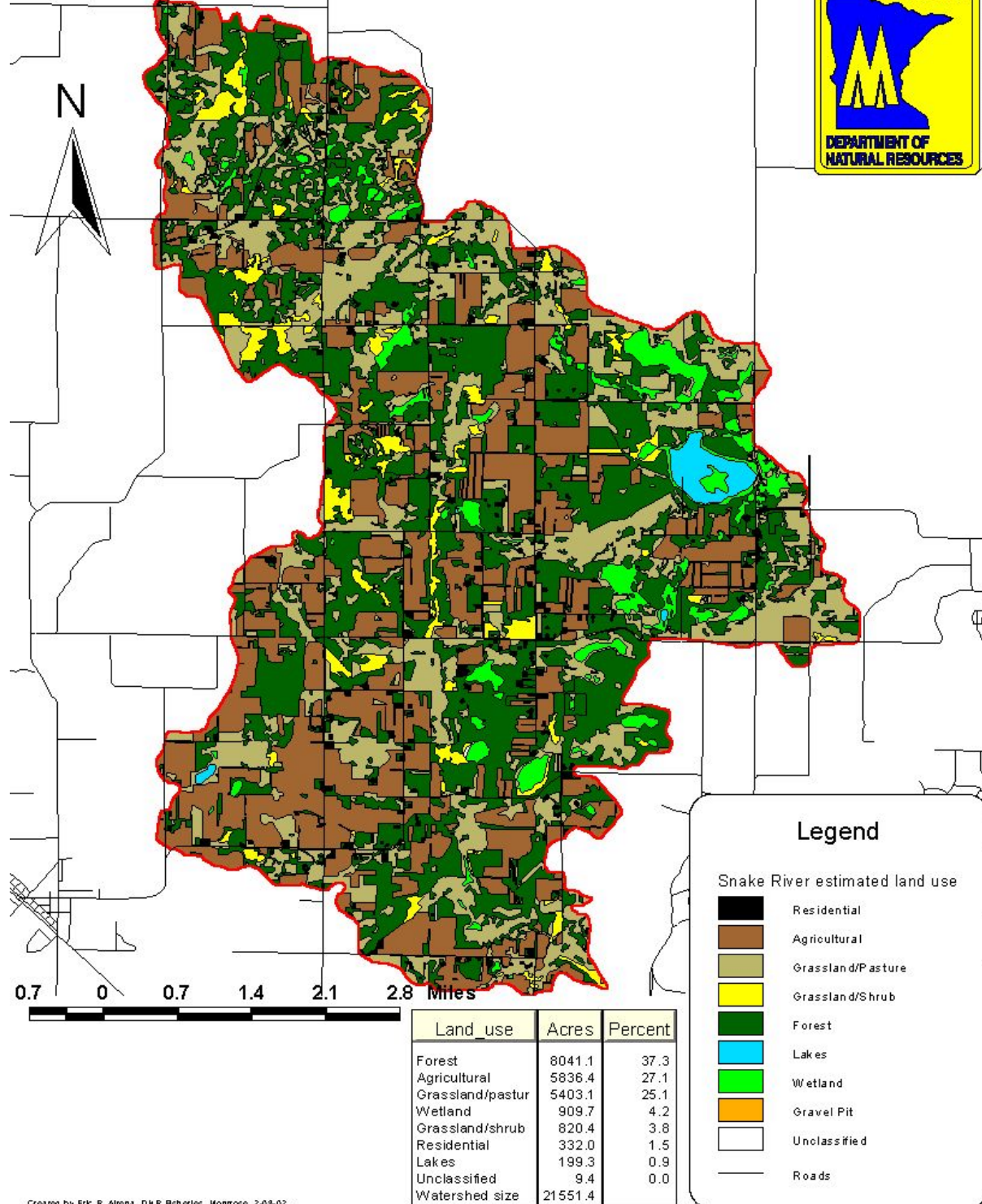
Snake River watershed location.



Created by Eric R. Altona DNR Fisheries, Montrose, 2-8-02

Figure 1. Location of the Snake River, Minnesota.

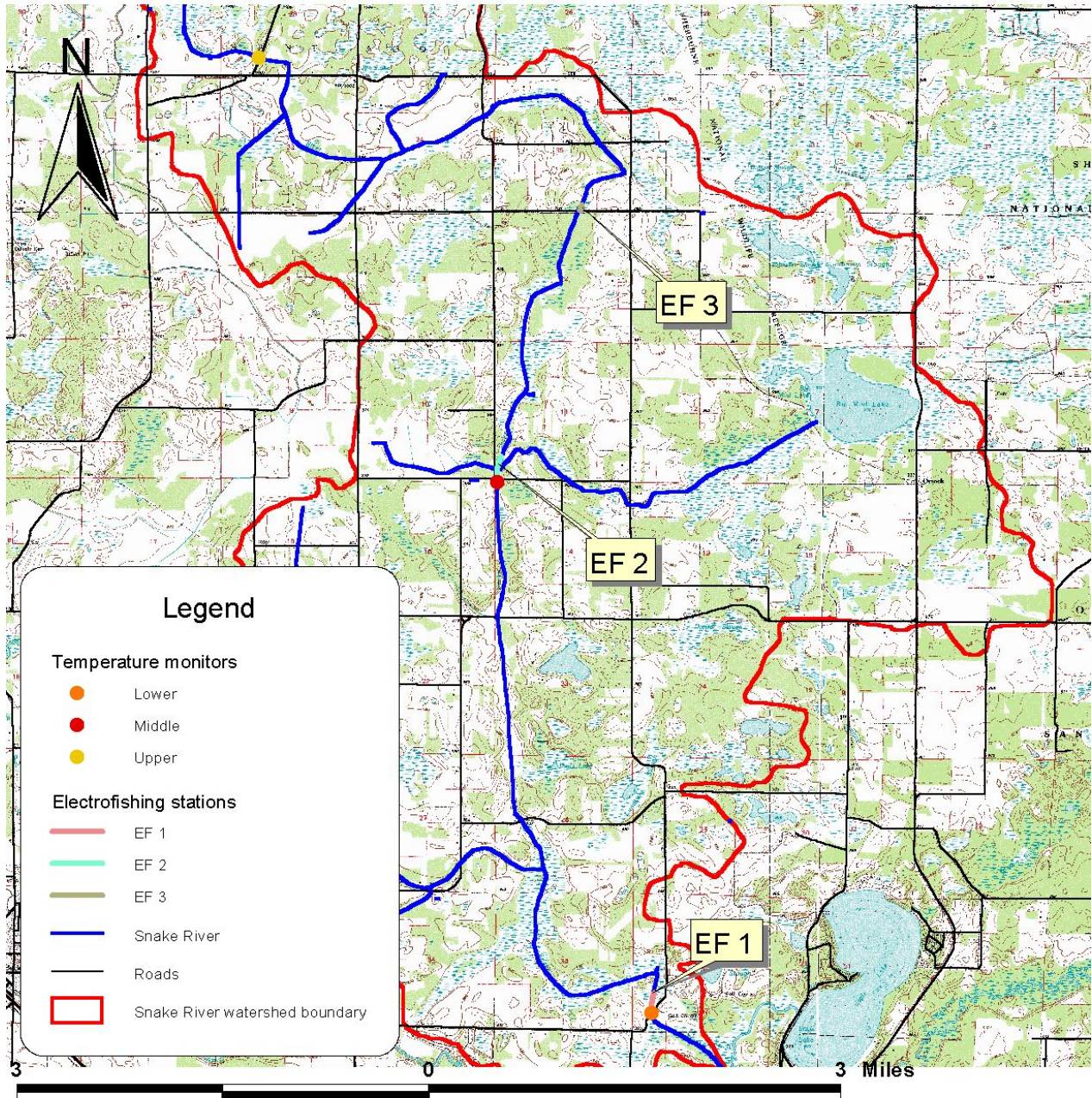
Snake River watershed estimated land use.



Created by Eric R. Alena, DNR Fisheries, Montrose, 2-08-02.

Figure 2. Estimated 1991 land use within the Snake River (M-65-7) major watershed.

Electrofishing and temperature monitor locations



Created by Eric R. Altana DNR Fisheries, Montrose, 2-08-02.

Figure 3. Location of temperature monitors and electrofishing stations on the Snake River during

2001.

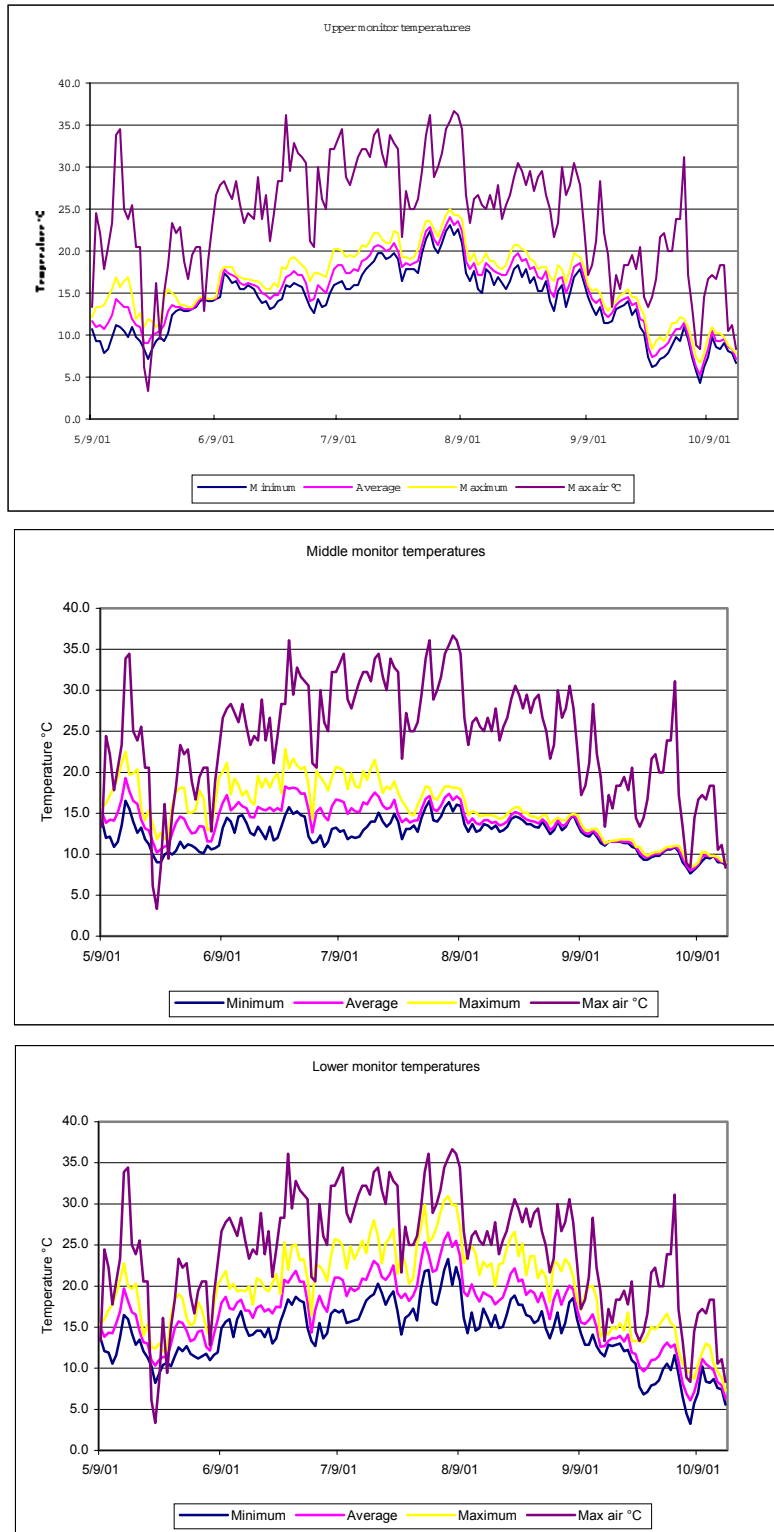


Figure 4. Minimum, average, and maximum daily water temperatures (°C) recorded by three automated Stowaway Tidbit® monitors, located on the Snake River from May through October 2001.

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Author Date

Area Fisheries Supervisor Date

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