Fishery and Habitat Analysis of the Illinois River and Its Tributaries For the Arapaho National Wildlife Refuge

PURPOSE AND SCOPE

The purpose for the Challenge Cost Share Agreement was for the cooperative effort to conduct a refuge wide survey of aquatic environments. The surveys included two pass estimates of the stream resources within the refuge boundaries. Qualitative invertebrate sampling in both stream and standing water resources. Stream habitat analysis with recommendations for improvement and a limited search for historical data to replace that lost in the recent refuge fire.

Information gathered is used to compare the current refuge information to that collected in previous years and to resources not under refuge control. The baseline data is used to assess existing habitat statuses, determine desired future conditions and needed improvements to achieve these. Baseline data will also be used to monitor future management strategies.

HABITAT ANALYSIS

Illinois River

The natural functions of rivers are to transport water and sediment. Peak flows and sediment loads are two of the most important channel forming processes. The constant adjustments taking place in these systems are better understood with knowledge of the climates, geology and land use within the local watershed. Land uses, above the Arapaho Refuge and within refuge boundaries, historically, have determined how the current Illinois River channel is functioning.

Rosgen (1985) developed a stream classification system that provided guidelines for identification of stream channel types. This stream classification system utilizes the following criteria: channel gradient, sinuosity, width/ratio, dominate particle size of bed and bank material, channel entrenchment, channel confinement, landform features and stream bank stability.

Utilizing this stream classification system, the Illinois River on the Arapaho Refuge is currently a channel undergoing a few minor modifications. A reduction in grazing and grazing management on the Arapaho Refuge has played a large role in these channel modifications. The channel is attempting to reduce total width and in the process deepen the overall channel. As this occurs, the channel type will move from a C-channel to an E- channel. The major difference between these two channel types is the width/depth ratio. Width/depth ratio is a measurement of the relationship of channel width to mean depth in a riffle section. Table 1 presents the measured stream characteristics and the

delineative criteria for both C and E channel types. E channels are considered to be the most stable channel types and generally provide the best trout habitat. The continued cattle operation upstream of the refuge will limit the changes that will be seen in the coming years. However, the lower reaches of the Illinois on the refuge should continue to move to more stable habitat.

Overall, the largest impact on the Illinois River aquatic life and stream stability is water quantity and to some extent water quality. Reviews of historic gauge readings for gauges located on the Rand-Gould cutoff and a gauge near Walden showed a wide variation in stream flows from year to year (Table 2). From 1929 to 1947, the Illinois River had a recorded flow of zero for 134 days near Walden. These zero days occurred in the months from June to November and were generally consecutive in nature. During the same period, the average flow for the river was only 38.6 cfs and the maximum flow was 1650 cfs. There were 78 % of the days during this period that the Illinois River flows were below the average flow of 38.6 cfs. Sampling conducted by the Colorado Division of Wildlife in 1993 also showed stream flows at or near zero near Walden. Stream flows for the upstream gauge, near the Rand-Gould cutoff, show low flow conditions in recent years (1989-1997), but never a flow of zero.

This water quantity issue could be mitigated over time with continued grazing management. By limiting grazing in the riparian zone, the stream during the low flow time will begin to narrow by encroaching vegetation into the channel. Then during the high flow events the bank vegetation will catch sediment and begin to build new banks and a narrower channel. As this happens the lower reaches on the refuge will be more likely to have year round flows on a continuous basis.

The habitat on the Illinois can be divided into two major areas. The two areas are, upstream the Ward 1 Diversion and downstream of the Ward 1 Diversion. The influence of woody riparian cover (willows) seems to be the deciding factor in the presence or absence of trout populations. The bottom substrate is entrenched gravel to small cobble through most of the entire reach with aquatic vegetation (i.e. *Elodea, Potamogeton,* and filamentous algae) growing in most of the pool and run areas. Instream structure is limited to willow root balls, aquatic vegetation and other small woody debris along with the occasional beaver pond.

Improvements to the aquatic habitat on the Illinois River are not recommended at this time. Channel morphology, substrate size and bed load would not allow the proper application of structures in the river. As the river moves toward a more E type channel the river will become more hydraulically efficient and will maintain a high sediment transport capability. The channel will remain very stable unless the streambanks are disturbed, and significant changes in sediment supply and/or streamflow occur. If the streambanks are disturbed the smaller substrate size, with a higher bed load will allow the stream to erode and major channel shifts may occur.

Potter Creek and Spring Creek

These two streams can be discussed together since they are similar channel types with very similar habitat. Both streams can be classified as E type channels with areas that show the effects of historic overgrazing and abuse. Water availability and sedimentation appear to control the aquatic life these streams. Neither stream is what could be considered trout habitat, but both support viable native fish populations. The small particle size of the bottom substrate and water velocities limit the reproduction of the trout species but are conducive to production of the native species.

Habitat improvement is not recommended for either of these streams. Riparian and upland vegetation management will provide the most protection for these streams.

Ponds and Reservoirs

Very little time was spent sampling the lentic environments on the refuge. Many of the ponds and lakes will not support fish populations outside of native species that have evolved in these type habitats. Water depth and winter survival is the limiting factor in most of these systems. With the large amounts of aquatic vegetation growing in the standing bodies of water, wintertime BOD does not allow the survival of fish, due to low oxygen. Winterkill is a common problem with many of the lakes in the lower elevations of North Park. Without some major habitat renovations, little can be done to improve the fishery potential of the standing water resource.

AQUATIC INVERTEBRATES

Qualitative invertebrate sampling was conducted in association with all stream sampling done with respect to fisheries. Table 3 provides the location and findings of invertebrate sampling conducted on the refuge during 1998. All the various taxa were keyed to the family level due to the large number of early instars that were in the samples. Because of the small size of the specimens, few are of use for a reference collection.

Beginning to collect quantitative macroinvertebrate information is probably the most cost effective monitoring tool for evaluating health of a stream and it's riparian zone. There is program in place on the Colorado State Forest which it being utilized for monitoring water quality and associated habitat quality. After considering all of the biotic components of an aquatic ecosystem, macroinvertebrates are one of the best suited for monitoring and assisting with resource decisions. The Colorado Division of Wildlife would be interested in assisting with the systematic collection of invertebrates for a program similar to the one on the Colorado State Forest.

Streams - Illinois River

There were 17 taxa identified at the three sites on the Illinois River. In general, both numbers and taxa decreased as you went from the upstream station to the lower end of the refuge. Greater numbers of Ephemeroptera families were collected at the upstream sites, with Tricorythidae being the only family found at the lower site. Only one taxa of stonefly (Perlodidae) was found at all three sites. Nine taxa were found at two of the three sampling sites, and seven taxa were found at one site only.

When habitat for each taxon is considered a large percentage (40 %) is found to thrive in depositional type habitat. In addition to this, another 33 % are found in both erosional and depositional type habitat and 27 % of the taxon are found in erosional habitat. This distribution based on habitat use is considered within the range for North Park streams (B. Kondratieff, personal communication). With the lower gradient and type of upland vegetation in the Illinois drainage, deposition of sediments is a natural occurrence. If the river channel over time continues to narrow, due to good riparian management, a slight shift in diversity may be realized.

Potter Creek

In addition to leeches and tubificids worms, five aquatic invertebrate families were found in Potter Creek. Only three orders were collected being Ephemeroptera (mayflies), Tricoptera (caddis flies) and Diptera (true flies). Low species diversity within aquatic invertebrates indicates that Potter Creek has times of very low flow or being virtually dry.

Spring Creek

Spring Creek shows the highest amount of silt deposition, of the streams surveyed on the refuge. Deposition maybe a natural phenomenon with the type of uplands, surrounding the stream, and the influence of Thirty-one Reservoir. Of the invertebrates sampled, all five taxa thrive in depositional type habitat. In addition to the insects, scuds, snails and leeches were abundant in the stream, all of which are generally found in lentic or standing water habitats.

Ponds

The diversity of aquatic invertebrates was greatest in the pond and lakes on the refuge. The most often sampled was the order Hemiptera (true bugs), with the families Corixidae (water boatmen) and the Notonectidae or backswimmers. One other Hemiptera which was not sampled, that is known to inhabit the standing water on the refuge was the giant water bugs (Belostomatidae). All three of these families are very predacious, feeding on other insects, larval amphibians and small fish.

Dytiscidae (predacious diving beetle) was also found at a high percentage of the standing water sites. These beetles have been known to attack and eat most any type of aquatic life. They have recently been shown to play a major role in demise of boreal toad (*Bufo boreas*) tadpoles in breeding ponds (Mark Jones, CDOW, personal communication). All of the predacious insects found in these ponds tend to survive on the mosquito larvae that are found in most North Park waters.

The beetle family Haliplidae (crawling water beetles) was the unique family discovered in the sampling. Two species were found *Haliplus stagninus* and *H. apicalis*, with these being the first documented specimens for *H. stagninus* to be found Colorado (R. Durfee, Colorado State University, personal communication). These collections also represent the southern most known distribution for this species as well. These specimens have been put deposited into the invertebrate museum at Colorado State University.

FISHERY RESOURCE

Illinois River

The Illinois River is a transition stream beginning as a trout stream in the headwaters to a native species stream by the time it meets up with the Michigan River. This transition takes place as the stream crosses the Arapaho National Wildlife Refuge. The splitting of the stream channel into two channels appears to be the basis of this fishery transition. The low flows that are realized once the channel splits are ultimately responsible of the trout giving way to the more tolerant native species.

Beginning upstream of the refuge near the confluence of the Illinois River with the Taylor Draw, the Illinois River is typical of a headwater trout stream (Table 4). Brook and brown trout dominate a small stream functioning near carrying capacity at nearly 114 kg/ha. This biomass is higher than the biomass down on the lower end of the Illinois River due to the more highly productive invertebrate community and the presence of the less territorial brook trout. Little is known about the river downstream of Taylor Draw due to land ownership until the stream reaches the southern refuge boundary.

Sampling at the Allard Bridge Crossing (headquarters access) is quite characteristic of the fishery resource from the south refuge boundary downstream to where the channel splits into two channels. This area has the highest diversity of habitat and highest species count (six native, one non-native)(Table 4). However, the controlling affects of a top-level predator (brown trout) keep the total number of fish below what is found downstream. The brown trout biomass has shown a significant increase since the 1994 sampling. Most of this increase can be explained by the efficiency of the equipment used to conduct the sampling. For both 1994 sampling efforts backpack electrofishing was used, while for the 1998 sampling a more powerful truck mounted sampling unit was utilized. A smaller portion of the increase can be explained by more stable fall and winter flows that allow better reproduction and recruitment of brown trout into the system over the past four years. The increased recruitment was most evident for the age I brown trout

measuring 10-15 cm total length. White sucker populations also show higher numbers and biomass estimates for the same reason for the increase seen with brown trout.

Rainbow trout have been sampled in the river at the Allard Bridge in some previous samples. These are probably survivors of a fish stocked by the Colorado Division of Wildlife. They do not develop into a fishery because temperatures at times when newly hatched fry would be emerging from the gravel are approaching 70°F (21°C) (Figure 1).

The site near the Ward 1 Ditch was use to characterized the portion of the Illinois River where the flow is split into two channels (Table 5). Trout become a very small component of the fishery and the more tolerant native species begin to dominate the fishery. Creek chub, longnose dace, and white sucker were the most numerous fish sampled. With few adult size white sucker being sampled, there is a limiting factor exerting pressure on the adult life stage. With the low fall and winter flows in the Illinois River habitat requirement for adult size (30 cm) white sucker or brown trout is only available in the beaver pond habitat found along the river. The remaining native species being smaller size fish can utilize the smaller habitat areas of the stream in this section. Johnny darters and longnose dace utilize the lower end of the riffle habitat while the fathead minnows and creek chubs use the pool habitat.

The remaining sampling was conducted downstream of Spring Creek in the area of the grazing study that has been conducted over the past five years. One station was located in the middle of grazing paddock 25 and a second station was located in paddock 23. The most significant changes in this lower section of stream is the change in the overall riparian area and the fact there was water flowing in the stream at the time of sampling. Sampling conducted in 1994 showed no willow development and no water visibly flowing from pool to pool. In 1998 there was evidence of willows beginning to grow on the streambanks and water flowing continuously downstream. In addition to these, a newly constructed beaver dam was located in this lower section of the refuge. Don Gore (retired Division of Wildlife game warden, personal communication) stated that this was the first time in almost 50 years he had ever seen beaver activity in this section of the Illinois River. This increase in the diversity and quality of the riparian habitat becomes evident in the increase of the numbers of fish. In paddock 25 fish numbers increased from 1.9 fish per 100 feet of stream to 100 fish per 100 feet of stream. In the upper section (paddock 24) the increase was from almost 9 fish per 100 feet to 212 fish per 100 feet (Table 5). Another improvement in the fishery was the multiple year classes found for all six native species. In 1994, only young of the year and juvenile size fish were found in the lower sections of the Illinois River. In addition, in 1998 fish from young of the year to adult size were found at all stations within the Refuge boundaries.

Potter Creek

Potter Creek provides the least amount of fishery habitat of the three streams sampled on the Arapaho Refuge. It is apparent both with the bugs and the fish there are certain times of the year the stream has no flowing water between pools. The habitat is much better suited to the native species and not trout. The low flows, which this stream realizes,

coupled with the lack of good pool and riffle development limits Potter creek for trout production. Longnose dace, white sucker and fathead minnow comprise the majority of the fishery sample. Most all the fish captured were utilizing the heavy mats of vegetation for habitat. Johnny darters were the least abundant fish in both tributary streams, opting for the better-developed riffle-run areas of the Illinois River (Table 5).

Spring Creek

Species that are generally found in lentic systems or pool habitat (fathead minnow and creek chub) dominated the fish found in Spring Creek. Johnny darters and longnose dace were less numerous than was found in the more riffle dominated Illinois River. Spring Creek had the highest number of fish per 100 feet of stream for any of the sampling done on the refuge (317/100ft.) (Table 5). This higher density of fish can be attributed to these species being able to thrive in somewhat degraded habitat (silt deposition) and having more stable water flows because of Thirty-one Reservoir.

SUMMARY AND RECOMMENDATIONS

Overall, the aquatic habitat on the Arapaho National Wildlife Refuge is in good, stable condition. This has been accomplished by proper grazing management, good riparian management and sound land use practices. Only minor habitat problems were evident in areas near the refuge boundaries, which can be attributed to upstream land use practices.

Within the streams themselves, little if any habitat improvement could be accomplished base on existing habitat. Over time as the streams continue to become more hydrologically efficient, the stream channel will become narrower and deeper. This will improve the overall habitat by maintaining flowing water during the low flow periods of the year. Water quantity is one area of concern, and being able to monitor stream flows would assist in resource management decisions. Establishing a new gauging station or repairing the old gauge near Walden would be extremely helpful for this monitoring effort.

Establishing a quantitative baseline for aquatic invertebrates, similar to what is being done at the Colorado State Forest, would be helpful. Gaining invertebrate knowledge would assist in identifying problems within the streams as they arise. As stated earlier the Colorado Division of Wildlife would be willing to assist with the collection of samples. Many qualified labs could do the insect identification and analysis.

Native and introduced fish species appear to be co-existing. The brown trout populations are associated with the woody riparian cover, and provide a nice wild trout fishery. The native species are able to use all the streams of the refuge. All fish species have benefited of the recent higher water years with populations being stable and possibly expanding. Monitoring of the fish populations will continue to be necessary on an every 5-year basis, unless a major habitat-altering event occurs.

Table 1. General stream type description and delineative criteria for C-type and E-type channels classification. Also, present are the measured and estimated values for the Illinois River on the Arapaho National Wildlife Refuge. Definitions for Criteria is listed below.

Criteria	C-type Channel	E-type Channel	Illinois River
General Description	Low gradient, meandering, point-bar riffle-pool, alluvial channels with broad well defined flood plains	Low gradient, meandering riffle/pool stream with low width depth ratio and little deposition. Very efficient and stable	Low gradient riffle/pool stream with moderate width/depth ratio. Moderate to high deposition, with a well defined floodplain
Entrenchment Ratio	>2.2	>2.2	>25
Width / Depth Ratio	>12	<12	23
Sinuosity	>1.2	>1.2	2.08
Slope %	<2	<2	0.48
Landforms/Soils/Features	Broad valleys with terraces, alluvial soils, well defined meandering channel, riffle-pool bed morphology	Broad Valley/meadows. Alluvial materials with floodplains. Well vegetated banks. Riffle-pool morphology with very low width/ depth ratios.	Broad valley, entrenchment increases moving downstream, bank becoming well vegetated, and well developed floodplain

Definitions:

Entrenchment Ratio- Flood prone width / Bankfull width.

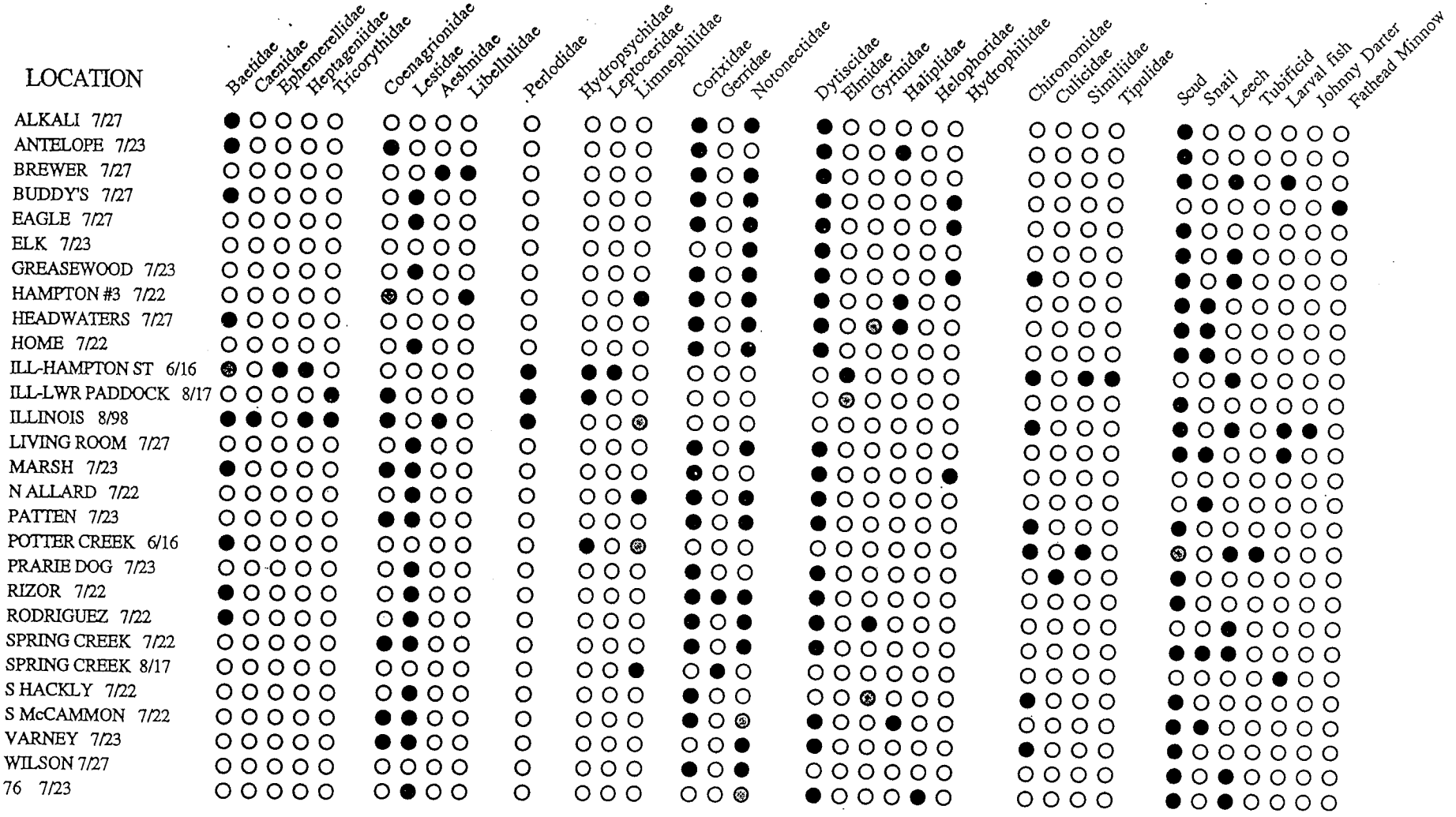
Width Depth Ratio- Bankfull Surface width (W) / Mean Depth (D) of the Bankfull cross-section.

Sinuosity- Stream length / Valley length

Slope- Gradient or the rise/ run of the longitudinal profile of a stream.

Table 3. Qualitative sampling of macroinvertebrates in the lakes,streams and ponds on the Arapaho National Wildlife Refuge, 1998. (identification by Dr. K. B. Rogers)

1998 REFUGE SURVEYS



● PRESENT
○ ABSENT
◉ PRIME SPECIMEN

Table 4. Current and historic fisheries sampling station within the Arapaho National Wildlife Refuge, with species composition for both game and non-game (native) native species.

ILLINOIS RIVER SITE	SAMPLING AGENCY AND DATE	% Game Species	Trout Biomass	Trout/100 ft	% Native Species	Native fish/100ft
AT HORSE CREEK	DOW 1988	100 % BRK	85 KG/HA	30	0	0
AT PARKVIEW CREEK	DOW 1988	100% BRK, BRN, RBT	106 KG/HA	45	0	0
AT TAYLOR DRAW	DOW 1988	100% BRK, BRN, RBT	114 KG/HA	20	0	0
AT COUNTY RD 27	DOW 1988	79% BRN	85 KG/HA	13	21% WHS	4
AT DEER CREEK	DOW 1988	41% BRN	47 KG/HA	7	59% WHS	8.6
REFUGE SOUTH BNDRY.	USFWS 1992	3% BRN	33 KG/HA	1	97%*	43
ALLARD BRIDGE	USFWS 1992	12% BRN, RBT	53 KG/HA	21	88%*	140
	DOW 1994	11% BRN	46 KG/HA	4	89%*	28
	DOW1998	7% BRN	90 KG/HA	13	93%*	169
WARD 1 DITCH	USFWS 1992	1% BRN	12 KG/HA	1	99%*	234
	DOW 1998	1% BRN	<1 KG/HA	1	99%*	202
REST ROTATION willow	DOW 1994	0%		0	100%*	249
REST ROTATION open	DOW 1994	0%		0	100%*	45
PADDOCK 24	DOW 1994	0%		0	100%*	8
PADDOCK 24	DOW 1998	0.10%	<1 KG/HA	0.2	99%*	212
PADDOCK 25	DOW 1994	0%		0	100%*	2
PADDOCK 25	DOW 1998	0.10%	<1 KG/HA	0.2	99%*	100

*Mixed species

Table 5. Occurrences of native fish at all stream sites sampled (fish/100 ft.) within the Arapaho National Wildlife Refuge.

STREAM	FISH PER 100 FT OF STREAM BY SPECIES*						TOTAL NATIVE FISH /100 FT. OF STREAM
	FHM	WHS	CRC	JOD	LND	LNS	
POTTER CREEK	33	30	14	4	92	0	173
SPRING CREEK	120	65	121	2	11	0	319
ILLINOIS PADDOCK 24	0	48	93	23	48	0	212
ILLINOIS PADDOCK 25	5	13	37	24	21	0	100
ILLINOIS RIVER -WARD 1 DITCH	2	29	49	29	93	0	202
ILLINOIS RIVER -ALLARD BRIDGE	1	71	82	2	13	1	170

*FHM= Fathead Minnow, WHS= White Sucker, CRC= Creek Chub, JOD= Johnny Darter, LND= Longnose Dace, LNS= Longnose Sucker

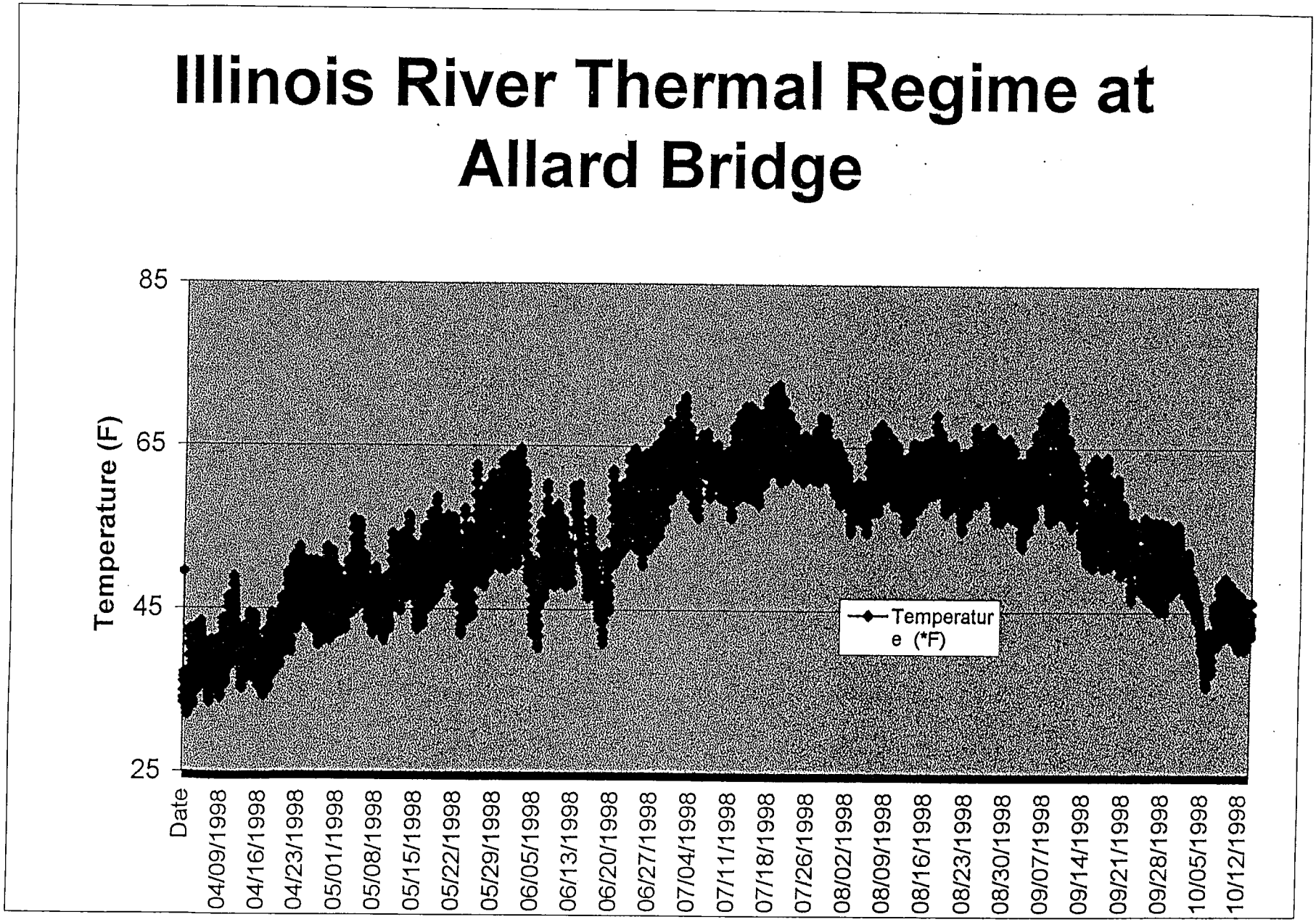


Figure 1. Thermal regime of the Illinois River at the Allard Bridge for 1998. Temperature was recorded hourly.

APPENDIX

Forwarded date: Friday, December 18, 1998 8:17:53 MST
Comments by: RogersK@AquaticDEN2@DNRDOWWP
Comments:

FYI

Hasta

---------- [Original Message] ----------

Hey Kevin,
Thanks for the information, the specimens are all labeled and deposited in the musuem. Here is the breakdown of the Haliplus species in each pond:

S. McCammon; H.stagninus (2 males, 1 female)
Headwaters; H.stagninus (1 male)
Hampton #3; H.apicalis (1 male)
Antelope; H.apicalis (1 male), H.stagninus (1 male)

Both species are nice records for Colorado. I have previously seen specimens of H.apicalis from a fen south of Fairplay, but I had not seen H.stagninus from Colorado before. These records represent the southernmost known distribution for both species. Can't wait to see any additional haliplids you might come across.
Thanks again,

Rich Durfee