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Braidwood-389

Final Report: Characterization of Unionid Communities near the Braidwood Nuclear Station Kankakee River Discharge Location

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1.0 Introduction

Exelon's Braidwood Nuclear Station (Braidwood) is considering constructing a diffuser pipe across the Kankakee River to replace their existing discharge canal. A recent survey for unionids (freshwater mussels) in the Kankakee River near the proposed diffuser pipe location indicated unionids are present (HDR, 2008). However, the unionid survey was conducted with a mussel brail, which is useful for indicating the presence or absence of unionids, but does not yield adequate information with respect to distribution and species composition (Dunn, 2000). Also, since no dive sampling was conducted in the previous study, unionid habitat in the survey area was not evaluated in areas with depths >2m (see HDR, 2008). Braidwood requires unionid distribution and species composition information to determine if unionids can be avoided during construction and operation of the diffuser pipe, and if unionids cannot be avoided, determine species composition and density information that could be used for an evaluation and biological assessment by the Illinois Department of Conservation and/or U.S. Fish and Wildlife Service.

The Kankakee River harbors a diverse unionid community that includes Illinois listed species. The unionid study in August 2008 (see HDR, 2008) resulted in 14 live unionid species (Table 1-1), including two Illinois listed species (*Cyclonaias tuberculata* and *Venustaconcha ellipsiformis*). In addition, shells of two other Illinois listed species were encountered (*Elliptio dilatata* and *Plethobasus cyphyus* [also a candidate for federal listing]). Results from this study will supplement previous findings and more specifically characterize the unionid community and distribution within the potential impact area.

In-stream construction activity may disrupt the substrate and, consequently, the animals living in the substrate. Unionids within the area directly affected by construction could be crushed by equipment or permanently buried under excavation spoil. Disruption of the substrate could result in displacement of unionids to unsuitable habitat, which could lead to reduced fitness or death. Construction activities could also lead to altered flow patterns that may increase sedimentation, which is a putative source of unionid declines throughout North America (Fuller, 1974; Aldridge *et al.*, 1987; Williams *et al.*, 1993; Box and Mossa, 1999). Construction impacts to unionids have successfully been mitigated by minimizing the area used for constructing and relocating unionids from areas of unavoidable impact (Dunn *et al.*, 2000).

Ecological Specialists, Inc. was contracted to survey for unionids within the potential impact area proposed for construction of the diffuser. The objective of this unionid study was to determine the distribution, species composition (specifically Illinois listed species), and density of unionids from approximately 100m upstream to 100m downstream of the proposed diffuser pipe location. This report summarizes the results of the unionid survey and the habitat conditions found in the project area. Fieldwork was conducted 21-22 October 2008.

2.0 Methods

Semi-quantitative, quantitative, and qualitative sampling methods were used to evaluate the unionid community in the Kankakee River potentially impacted by construction of the diffuser. The objective of semi-quantitative sampling was to determine unionid distribution. For semi-quantitative sampling, five 200m transects were placed perpendicular to the flow starting approximately 20-40m upstream of the proposed diffuser (Figure 2-1). Transect 1 was positioned about 10m from the right descending bank (RDB) and Transects 2-5 were spaced approximately 15-30m across the width of the river adjacent to Transect 1. A diver traversed each transect, collecting all unionids within 1m of the line in 10m sections for a total of 20 samples per transect.

The objective of qualitative sampling was to estimate species richness, while quantitative sampling was used to determine unionid density, species abundance, adult to juvenile distribution, and live to shell ratio. The effort required to find protected species is often considerable and they are rarely collected by brailing or in quantitative samples (Kovalak *et al.*, 1986). Five 10 min qualitative samples and five $0.25m^2$ quantitative whole substrate samples were collected in areas with higher densities and/or where listed species were present (see Figure 2-1).

Live unionids were identified, counted and recorded as adult or juvenile (Lampsilines and Anodontines $\leq$3yrs, Amblemines $\leq$5yrs; external annuli count). Species designated in Illinois as endangered, threatened, or of special concern were measured (mm) and aged (external annuli count). Depth (m) and substrate (Wentworth scale) were also recorded at each semi-quantitative and quantitative sample. Since water and/or air temperature was low, animals were returned to the substrate as quickly as possible.

3.0 Results

A total of 126 live unionids of 13 species were collected during the survey: *Actinonaias ligamentina* (n=97), *Amblema plicata* (n=13), *C. tuberculata* (n=1), *Elliptio dilitata* (n=2), *Fusconaia flava* (n=1), *Lampsilis cardium* (n=2), *Lasmigona costata* (n=1), *Leptodea fragilis* (n=2), *Megalonaias nervosa* (n=2), *Quadrula metanevra* (n=1), *Quadrula p. pustulosa* (n=1), *Utterbackia imbecillis* (n=1), *V. ellipsiformis* (n=2) (Table 3-1). Two species (*C. tuberculata*, and *E. dilatata*) are listed as Endangered and one as a species of Special Concern (*V. ellipsiformis*) by the IDNR. No juvenile unionids were observed.

Unionids were sparsely scattered throughout the survey area, however all listed species were collected in the upstream half of the survey area within 50m of the right descending bank (RDB) (see Figure 2-1). The three listed species were along Transect 1, about 10-15m off the RDB within an area approximately 5-20m upstream and 0-15m downstream of the proposed diffuser (see Figure 2-1). An average of 1.2 unionids were collected per $10m^2$ sample over the study area. Only one live unionid (*A. ligamentina*) was collected from the five qualitative samples within the area that appeared denser and where listed species were collected along transects. Quantitative samples within the same area resulted in an average of 0.80unionids/m^2. The CPUE (number live unionids collected per collector per hour of effort) from the five qualitative samples was 12.1. This study's CPUE is similar to the CPUE values calculated from the August survey (17.3 upstream and 10.3 downstream of the existing outfall canal) (HDR, 2008).

Habitat varied little throughout the survey area with exception of shallower depths near the banks. River habitat within the survey area was a run. Depths along Transects 1 and 5 ranged from 0.8-2.1m while depths along Transects 2-4 ranged from 1.5-3.7m (Table 3-2; Figure 3-1). Substrate was generally a mix of boulder, cobble, gravel and sand. In general, more boulder and less gravel was observed near the center of the river along Transects 3 and 4 (see Figure 3-1). No obvious correlation between unionid presence and habitat characteristics was observed.

4.0 Discussion

Habitat with the survey area is not typically ideal for unionids within the Kankakee River. Run habitats within the Kankakee River, like the habitat within this study's survey area, are not known to harbor abundant and species-rich unionid communities. In a 1978 unionid survey of 13 sites within the Kankakee River, unionid communities in pools or runs generally ranked low in abundance and diversity compared to areas with riffles and areas below dams (Suloway, 1981). A unionid study at two sites on the Kankakee River conducted by ESI in 2002 showed that of the two sites sampled, the site with the riffle/run habitat resulted in twice as many species and 17 times more live unionids than the site with a run habitat (ESI, 2003). Although this study's survey area appears to harbor a relatively moderate to high species richness, unionid abundance (density) was relatively low and unionids were scattered throughout the site.

A total of 17 species were collected live in the study area, including the Illinois T&E species *C. tuberculata*, *E. dilatata*, Illinois Special Concern species *V. ellipsiformis*, and the Federal Candidate species *P. cyphyus* (see Table 1-1). Unionids were scattered throughout the site in a low density in both this and the HDR (2008) study. However, two areas of higher unionid densities were found; on the left descending bank (LDB) upstream of the diffuser location (see HDR, 2008) and on the RDB directly in-line with the proposed diffuser (see Figure 2-1). Species such as *Lampsilis siliquoidea*, *Lasmigona complanata*, and *Pyganodon grandis*, were primarily limited to the silty area near the LDB, upstream of the diffuser location, which is typical habitat for these species. The freshly dead shell of *P. cyphyus* was also found along the LDB upstream of the discharge canal. Most of the Illinois T&E species, however, were found on the RDB.

Although the survey area harbors a relatively species-rich unionid community, unionid density is relatively low and no recruitment was observed. The low abundance of unionids may be due to the general lack of suitable substrate. By and large, substrate throughout the site appeared stable but did not contain much area with finer particles (*i.e.*, sand and gravel) into which the unionids can burrow. Also , no juvenile unionids were observed suggesting little or no recruitment occurring within the survey area. Therefore, it is likely a denser, stable, and reproducing unionid community upstream, probably in a riffle habitat, seeds the study area. However, Illinois listed unionid species were present, and therefore impacts to unionids by construction and operation of the diffuser within the area should be minimized.

To limit impact on the unionid community, the diffuser should avoid the area within approximately 20m of the RDB and be placed at the most downstream angle allowed. Although unionids in this area are still relatively sparse, this area appeared to be the densest in general and harbored Illinois listed species. In addition, listed species are more likely present in areas where unionids are denser; and therefore, construction activities should avoid the area upstream of the current outfall canal along the left descending bank since results from the August survey suggest unionids also occur in higher densities in this area (see HDR, 2008).

Since unionids were scattered throughout the survey area with no observable correlation of habitat to distribution, and Illinois listed species were encountered, listed species may occur throughout the survey area. Therefore, IDNR and USFWS should be consulted early in the permitting process to identify any Agency concerns with the diffuser construction and operation.

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Figures

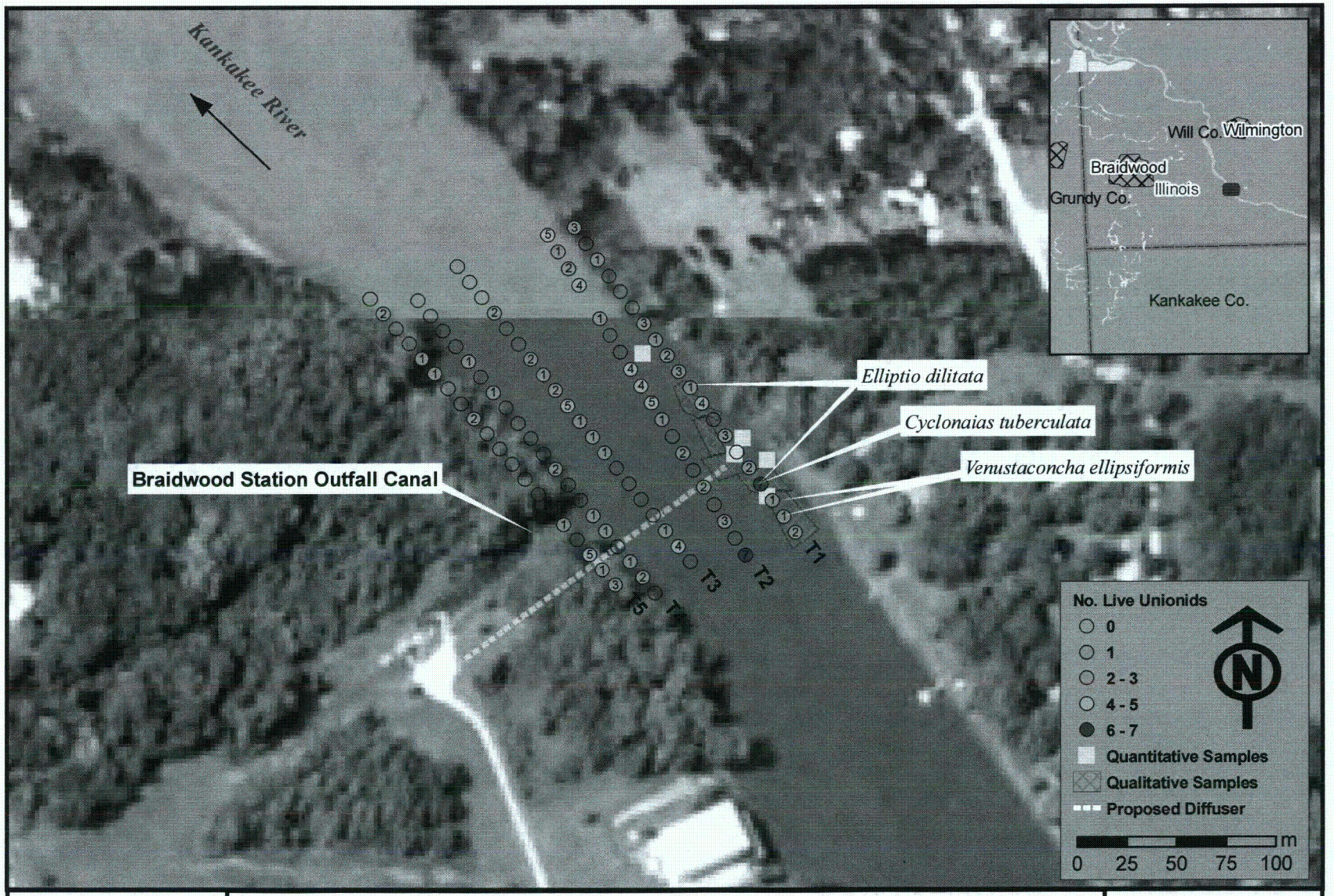

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Figure 2-1. Live unionids collected along sampling transects and qualitative and quantitative sample locations in the Kankakee River near the Braidwood Nuclear Station discharge location, October 2008.

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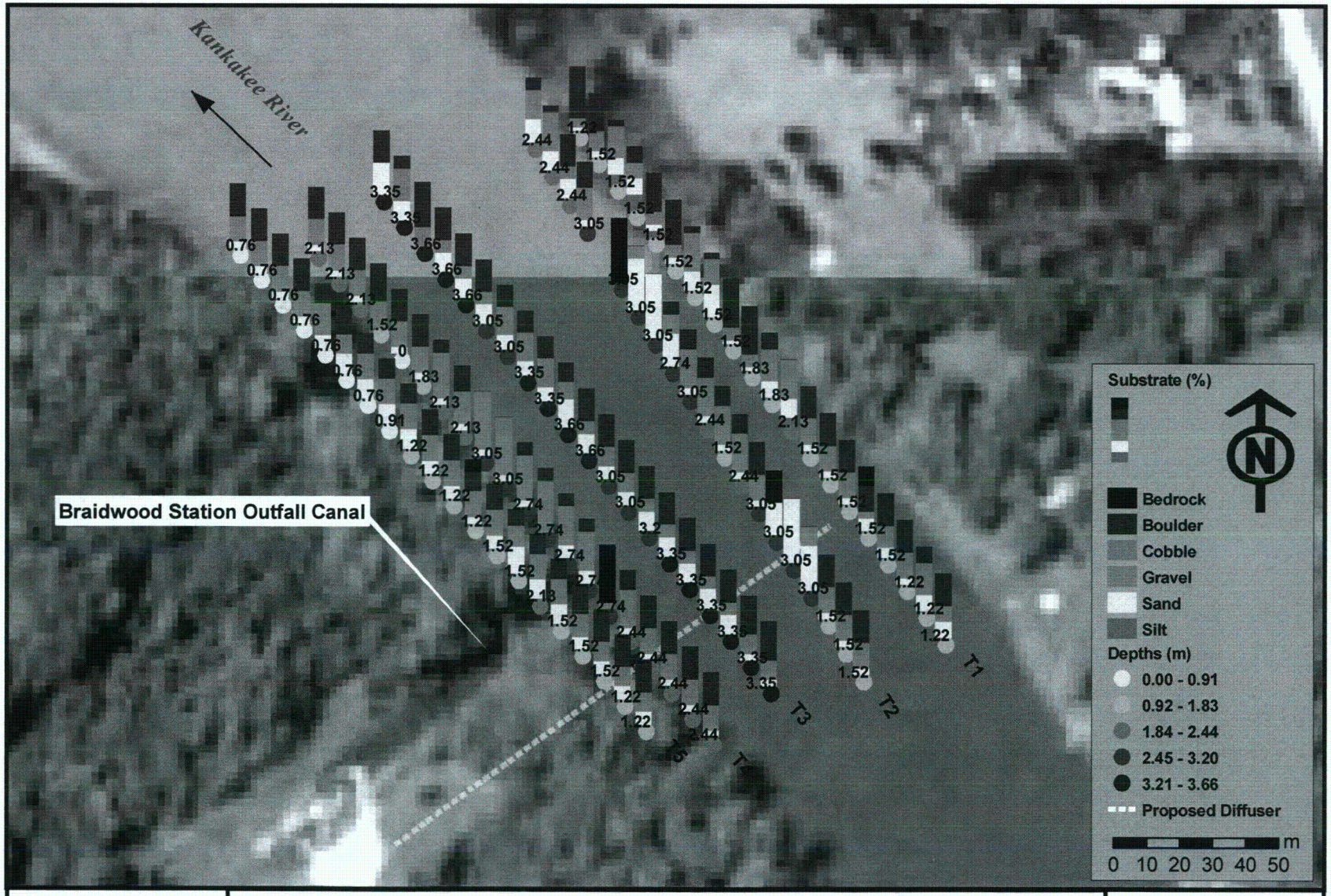

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Figure 3-1. Depth (m) and substrate observed along unionid sampling transects in the Kankakee River near the Braidwood Nuclear Station discharge location, October 2008.

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Tables

Table 1-1. Unionids collected near the Braidwood Nuclear Station outfall for this and a recent study, Illinois, Kankakee River, 2008.

	Number Live[1] (HDR, 2008)	Number Live (this study)	Collected Live (ESI, 2008; HDR, 2008)
Species[2]			
Alasmidonta marginata	D	0	
Actinonaias ligamentina	115	97	X
Amblema plicata	28	13	X
***Cyclonaias tuberculata* (T)[3]**	**3**	**1**	**X**
***Elliptio dilatata* (T)**	**R**	**2**	**X**
Fusconaia flava	WD	1	X
Lampsilis cardium	3	2	X
Lampsilis siliquoidea	5	0	X
Lasmigona complanata	10	0	X
Lasmigona costata	13	1	X
Leptodea fragilis	3	2	X
Ligumia recta	D	0	
Megalonaias nervosa	D	2	X
***Plethobasus cyphus* (E)**	D	0	
Pleurobema sintoxia	5	0	X
Potamilus alatus	D	0	
Pyganodon grandis	3	0	X
Quadrula metanevra	2	1	X
Quadrula p. pustulosa	12	1	X
Strophitus undulatus	D	0	
Utterbackia imbecillis	7	1	X
***Venustaconcha ellipsiformis* (SC)**	**1**	**2**	**X**
Total Live	210	126	
Total Number of Live Species	14	13	
Total Number of Live Species for Both Studies			**17**

[1]D=collected only a fresh-dead shell; R=collected as a relic shell (HDR, 2008)

[2]Turgeon *et al.*, 1998

[3]T=Illinois state-threatened; E=Illinois state-endangered; SC=Illinois Special Concern species (IESPB, 2006)

Table 3-1. Characteristics of unionids collected near the Braidwood Nuclear Station outfall, Illinois, Kankakee River, October 2008.

	Number Live	% Abundance	% Adult	% Juvenile[1]	Age (annuli count)	Length (mm)
Species[2]						
Actinonaias ligamentina	97	77.0	100.0	0.0		
Amblema plicata	13	10.3	100.0	0.0		
Cyclonaias tuberculata (T)[3]	1	0.8	100.0	0.0	18	93
Elliptio dilatata (T)	2	1.6	100.0	0.0	13/15	100/90
Fusconaia flava	1	0.8	100.0	0.0		
Lampsilis cardium	2	1.6	100.0	0.0		
Lasmigona costata	1	0.8	100.0	0.0		
Leptodea fragilis	2	1.6	100.0	0.0		
Megalonaias nervosa	2	1.6	100.0	0.0		
Quadrula metanevra	1	0.8	100.0	0.0		
Quadrula p. pustulosa	1	0.8	100.0	0.0		
Utterbackia imbecillis	1	0.8	100.0	0.0		
Venustaconcha ellipsiformis (SC)	2	1.6	100.0	0.0	15/17	72/76
Total Live	126					
Total Number of Live Species	13					

[1]Lampsilines and Anodontines ≤3yrs, Amblemines ≤5yrs

[2]Turgeon *et al.*, 1998

[3]T=Illinois state-threatened; SC=Illinois Special Concern species

Table 3-2. Depths, substrate, and number live unionids collected along sample transects near Braidwood, Illinois, Kankakee River. (page 1 of 2)

Transect	Distance Along Transect (m) Min.	Max.	No. Live Unionids	Depth (m)	Substrate (%) Bedrock	Boulder	Cobble	Gravel	Sand	Silt	Clay
1	0	10	2	1.2	0	50	0	25	25	0	0
	10	20	1	1.2	0	25	25	25	25	0	0
	20	30	1	1.2	0	50	20	20	10	0	0
	30	40	7	1.5	0	50	25	10	15	0	0
	40	50	2	1.5	30	40	0	10	20	0	0
	50	60	0	1.5	0	50	30	10	10	0	0
	60	70	3	1.5	0	50	30	10	10	0	0
	70	80	0	1.5	0	50	30	10	10	0	0
	80	90	4	2.1	0	0	30	30	30	10	0
	90	100	1	1.8	0	25	25	25	25	0	0
	100	110	3	1.8	0	75	10	10	5	0	0
	110	120	2	1.5	0	75	10	10	5	0	0
	120	130	1	1.5	0	10	20	20	50	0	0
	130	140	3	1.5	0	10	30	30	30	0	0
	140	150	0	1.5	0	70	10	10	10	0	0
	150	160	0	1.5	0	60	10	10	10	10	0
	160	170	0	1.5	0	25	0	25	25	25	0
	170	180	1	1.5	0	10	25	25	25	15	0
	180	190	0	1.5	0	60	20	10	10	0	0
	190	200	3	1.2	0	80	10	5	5	0	0
2	0	10	7	1.5	0	50	20	20	10	0	0
	10	20	0	1.5	0	50	20	20	10	0	0
	20	30	3	1.5	0	50	20	20	10	0	0
	30	40	0	3.0	0	0	10	20	70	0	0
	40	50	2	3.0	0	0	0	0	100	0	0
	50	60	0	3.0	50	0	0	0	50	0	0
	60	70	2	3.0	0	50	0	40	10	0	0
	70	80	0	2.4	0	30	30	30	10	0	0
	80	90	1	1.5	0	30	30	30	10	0	0
	90	100	5	2.4	0	30	30	30	10	0	0
	100	110	4	3.0	0	30	30	30	10	0	0
	110	120	4	2.7	0	20	0	30	50	0	0
	120	130	0	3.0	0	0	0	0	100	0	0
	130	140	0	3.0	0	0	0	20	80	0	0
	140	150	1	3.0	100	0	0	0	0	0	0
	150	160	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	160	170	4	3.0	0	40	30	20	10	0	0
	170	180	2	2.4	0	50	20	0	30	0	0
	180	190	1	2.4	0	10	30	30	30	0	0
	190	200	5	2.4	0	20	40	10	40	0	0
3	0	10	0	3.4	0	60	20	10	10	0	0
	10	20	4	3.4	0	60	20	10	10	0	0
	20	30	1	3.4	0	50	10	10	30	0	0
	30	40	0	3.4	0	50	10	10	30	0	0
	40	50	0	3.4	0	50	10	10	30	0	0
	50	60	0	3.4	0	50	10	10	30	0	0
	60	70	0	3.2	0	50	10	10	30	0	0
	70	80	1	3.0	0	50	30	0	20	0	0
	80	90	1	3.0	0	50	30	0	20	0	0
	90	100	1	3.7	0	50	20	0	30	0	0

Table 3-2. Depths, substrate, and number live unionids collected along sample transects near Braidwood, Illinois, Kankakee River. (page 2 of 2)

	Distance Along Transect (m)				Substrate (%)						
Transect	Min.	Max.	No. Live Unionids	Depth (m)	Bedrock	Boulder	Cobble	Gravel	Sand	Silt	Clay
3 (cont.)	100	110	5	3.7	0	20	20	0	30	0	0
	110	120	2	3.4	0	30	40	0	20	0	0
	120	130	1	3.4	0	30	40	0	20	0	0
	130	140	2	3.0	0	30	40	0	20	0	0
	140	150	0	3.0	0	50	20	0	30	0	0
	150	160	0	3.7	0	50	20	0	30	0	0
	160	170	2	3.7	0	50	20	0	30	0	0
	170	180	0	3.7	0	70	30	0	0	0	0
	180	190	0	3.4	0	20	50	0	30	0	0
	190	200	0	3.4	0	50	0	0	50	0	0
4	0	10	0	2.4	0	50	30	10	10	0	0
	10	20	2	2.4	0	50	30	10	10	0	0
	20	30	1	2.4	0	50	30	10	10	0	0
	30	40	0	2.4	0	50	30	10	10	0	0
	40	50	1	2.4	0	30	50	10	10	0	0
	50	60	1	2.7	90	0	0	10	0	0	0
	60	70	0	2.7	0	20	50	10	20	0	0
	70	80	0	2.7	0	20	50	10	20	0	0
	80	90	2	2.7	0	20	50	30	0	0	0
	90	100	0	2.7	0	20	40	30	10	0	0
	100	110	0	3.0	0	0	30	60	10	0	0
	110	120	0	3.0	0	0	10	80	10	0	0
	120	130	0	2.1	0	40	30	20	10	0	0
	130	140	1	2.1	0	20	50	20	10	0	0
	140	150	0	1.8	0	50	30	10	10	0	0
	150	160	1	n/a	0	50	30	10	10	0	0
	160	170	0	1.5	0	60	30	10	0	0	0
	170	180	0	2.1	0	50	20	20	10	0	0
	180	190	0	2.1	0	50	20	20	10	0	0
	190	200	0	2.1	0	50	20	20	10	0	0
5	0	10	3	1.2	0	50	20	10	20	0	0
	10	20	1	1.2	0	50	20	10	20	0	0
	20	30	5	1.5	0	50	20	10	20	0	0
	30	40	0	1.5	0	50	30	10	20	0	0
	40	50	1	1.5	0	30	30	10	30	0	0
	50	60	0	2.1	0	30	30	10	30	0	0
	60	70	0	1.5	0	30	30	10	50	0	0
	70	80	0	1.5	0	40	30	10	20	0	0
	80	90	0	1.2	20	30	20	20	10	0	0
	90	100	0	1.2	0	40	20	20	20	0	0
	100	110	0	1.2	0	40	20	20	20	0	0
	110	120	2	1.2	0	30	30	10	30	0	0
	120	130	0	0.9	0	30	30	10	30	0	0
	130	140	0	0.8	0	30	30	10	30	0	0
	140	150	1	0.8	0	40	20	10	30	0	0
	150	160	1	0.8	0	30	30	20	20	0	0
	160	170	0	0.8	0	50	20	20	10	0	0
	170	180	0	0.8	0	50	20	20	10	0	0
	180	190	2	0.8	0	50	20	20	10	0	0
	190	200	0	0.8	0	50	20	20	10	0	0