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A STUDY OF THE BENTHIC MACROINVERTEBRATE COMMUNITY IN THE CHICAGO SANITARY AND SHIP CANAL AND LOWER DES PLAINES RIVER DURING 2000

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1. INTRODUCTION

Since the mid-1980's, the water quality of the lower Des Plaines River (Lockport lock to the Kankakee River) and upper Illinois River has improved greatly (ComEd 1996). However, over that same time period, the sediment quality of the lower Des Plaines River has remained poor in several areas (Burton 1995, ComEd 1996). In response to the water quality improvements, the Illinois Environmental Protection Agency (IEPA) has proposed to determine the future water use in the lower Des Plaines River (Use Attainability Analysis). Although the fish community of the lower Des Plaines River has been studied extensively over the past 20 years (EA 1996 and 2001), relatively little information exists on the benthic community, particularly between the Lockport lock and Interstate 55 (I-55) (ESE 1994 and 1995, MWRD 1992).

During the summer of 2000, the Metropolitan Water Reclamation District of Greater Chicago (District) conducted benthic macroinvertebrate monitoring on the Chicago Sanitary and Ship Canal and the lower Des Plaines River at 9 stations between the Lockport lock and I-55 and one station on the upper Des Plaines River. The objectives of the 2000 benthic program were to:

- Characterize and establish a recent baseline of the benthic community.
- Use the benthic community data to provide insight regarding water and sediment quality.
- Examine the potential utility of larval Chironomidae deformities as a tool for the assessment of sediment quality.

2. METHODS

Benthic macroinvertebrates were monitored at ten stations in the Chicago Sanitary and Ship Canal, the lower Des Plaines River between the Lockport lock and I-55, and the upper Des Plaines River (Figure 2-1). Table 2-1 describes the ten monitoring stations. One sampling station was on the Chicago Sanitary and Ship Canal in the Lockport pool. One sampling location was on the upper Des Plaines River. The remaining eight stations were on the lower Des Plaines River. Two stations were in the Brandon Road pool, and six stations were in the Dresden Island pool.

Field sampling was conducted by District personnel using a combination of Hester-Dendy (HD) artificial substrates and Ponar grabs. Each HD sampler consisted of nine, three-inch square plates with uniform spacing. The total surface area of one HD sampler, excluding the bolt and spacers was 0.031 m^2. At each of the station, three HD samplers were deployed near the main channel border approximately 20 to 50 feet from the deep-draft navigation channel. The triplicate HD samplers were suspended from a horizontal length of 1-inch PVC pipe. The pipe was supported approximately 1.5 to 2 feet above the substrate by a float and anchor system (Figure 2-2). Each HD sampler array was attached to a structure on shore by a steel cable.

HD samplers in the Lockport and Brandon Road pools were deployed on 10 July and retrieved on 22 August with the exception of the Lockport Forebay location (Location 1), which was retrieved on 07 September due to high water. The Dresden Island pool HD samplers were deployed on 12 July and retrieved on 24 August with the exception of the Treats Island location (Location 9), which was retrieved on 05 September.

HD samplers were retrieved by first locating the cable on shore and using it to lift the anchor and sampler to a point just below the surface of the water. The sampler array was placed in a U.S. Standard Testing No. 60 (250 μ) sieving bucket while still submerged, then removed from the water. The samplers were then removed from the anchoring system and disassembled. Both the samplers and contents of the sieving bucket were rinsed into a one-gallon plastic bottle and preserved in 10% formalin.

Ponar grab samples were collected at each station in conjunction with the HD retrieval. The grab samples were collected using a 6" X 6" Petite-Ponar sampler. Three grab samples were collected at each location within 30 to 50 feet of the HD samples. All three grabs were combined in the field and washed in a No. 60 mesh sieving bucket to remove most of the fine sediment. The sample was then transferred to a one-gallon bottle and preserved with 10% formalin.

In the laboratory, each sample was processed by first pouring the contents of the sample bottle into a No. 60 mesh sieve where it could be rinsed. Under a stream of water, the individual HD plates and hardware were scrubbed with a 2-inch paintbrush into the sieve. The sample was then rinsed from the sieve into a white plastic tray partially filled with water. Sample aliquots were removed from the tray and placed in a small petri dish for counting under a dissecting

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FIGURE 2-1

MAP OF LOWER DES PLAINES RIVER SHOWING SAMPLING STATIONS 1 THROUGH 10 (NUMBERED CIRCLES)

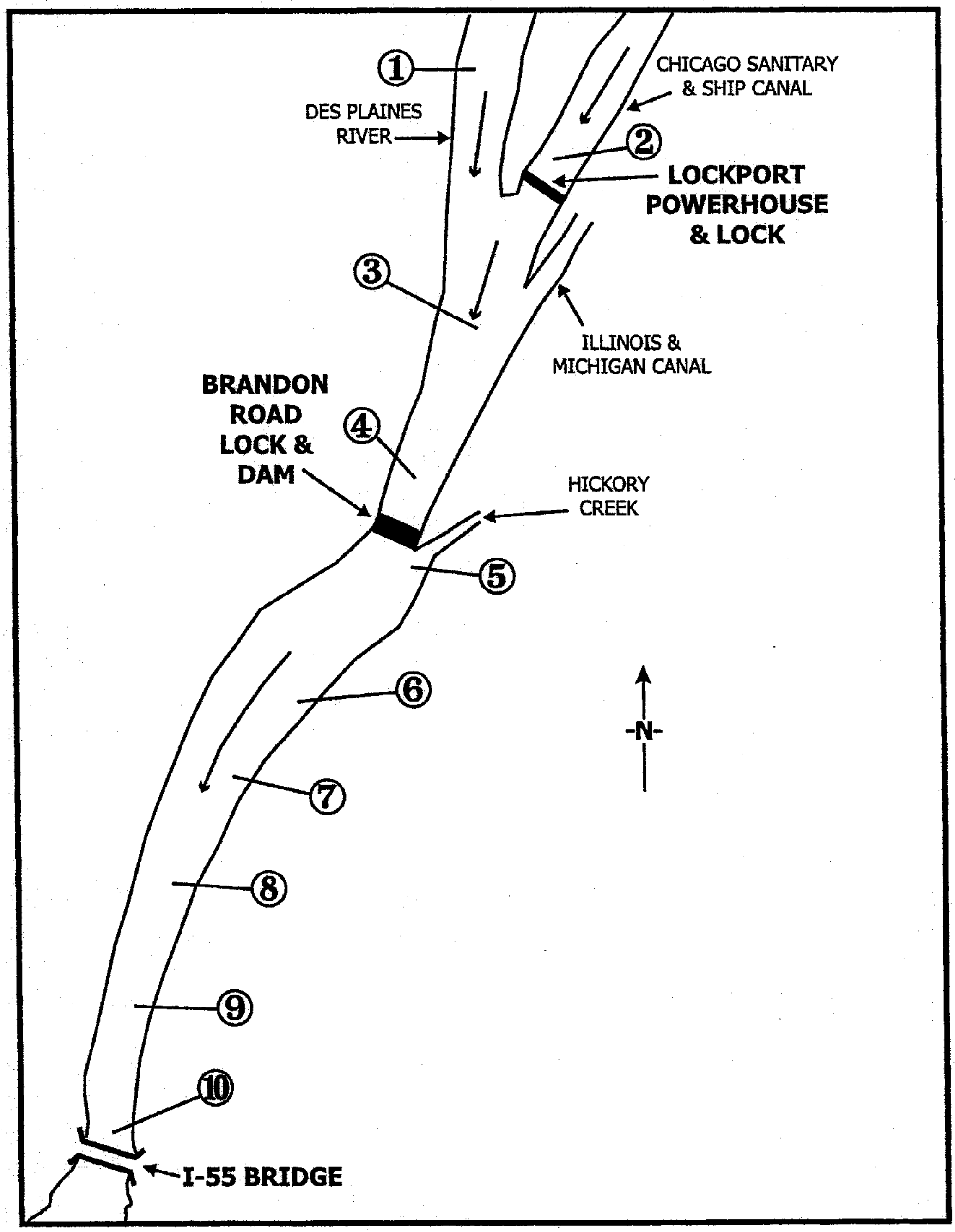
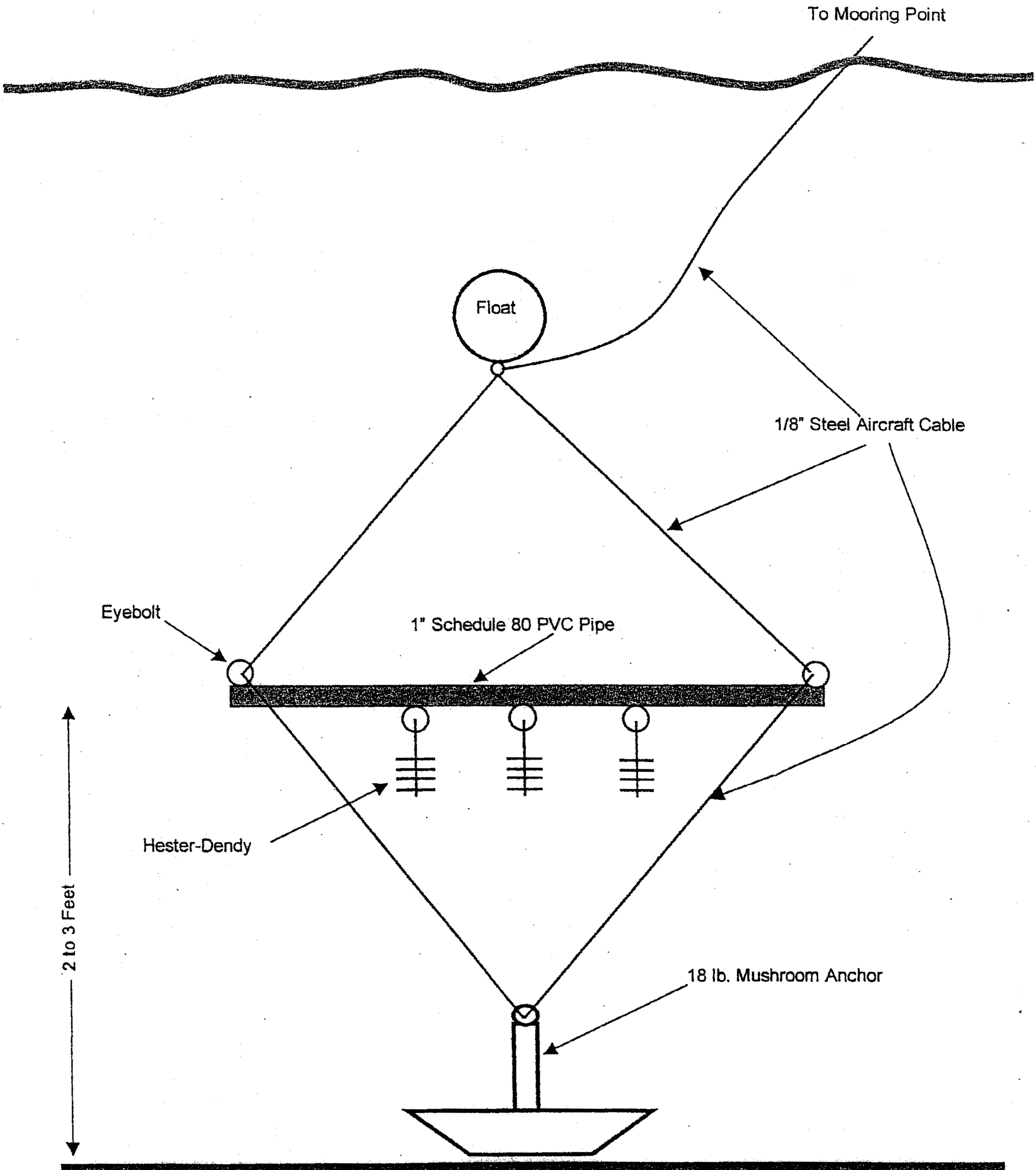


Table 2-1. Description of benthic macroinvertebrate monitoring stations in the Chicago Sanitary and Ship Canal and the upper and lower Des Plaines River during August 2000.

Sampling Station	Waterway	Navigation Pool	Station Description
1 - Lockport Forebay	Chicago Sanitary & Ship Canal	Lockport Pool	RM 291.1 - 500 ft upstream Lockport Power House along the west bank of the canal.
2 - Material Service Road	Upper Des Plaines River	Flows into Brandon Road Pool	RM 291.0 - One mile upstream of the junction of the Des Plaines River and the Chicago Sanitary & Ship Canal along the east bank.
3 - Jackson Street	Lower Des Plaines River	Brandon Road Pool	RM 288.3 - Immediately upstream of the Jackson Street bridge along the east bank.
4 - Interstate 80	Lower Des Plaines River	Brandon Road Pool	RM 286.9 - Immediately upstream of the Interstate 80 bridge along the west bank.
5 - Brandon Road Dam Tailwater	Lower Des Plaines River	Dresden Island Pool	RM 285.3 - Brandon Dam tailrace, 0.4 miles downstream of the Brandon Road bridge along the southeast bank.
6 - Joliet Generating Station No. 9	Lower Des Plaines River	Dresden Island Pool	RM 285.0 - Overhead conveyor, 0.75 miles downstream of the Brandon Road bridge along the southeast bank.
7 - Santa Fe Light	Lower Des Plaines River	Dresden Island Pool	RM 283.4 - 50 ft downstream of the Santa Fe Light and daymarker along the southeast bank.
8 - Amoco Chemical Dock	Lower Des Plaines River	Dresden Island Pool	RM 280.9 - Submerged pipeline crossing, 0.1 mile upstream of the Treats Island upper daymarker along the east bank.
9 - Treats Island	Lower Des Plaines River	Dresden Island Pool	RM 279.7 - 300 ft upstream of overhead power lines east of Treats Island along the southeast bank.
10 - Jackson Creek Cut-off	Lower Des Plaines River	Dresden Island Pool	RM 278.3 - 75 ft southwest of the Jackson Creek Cut-off peninsula tip along southeast bank.

Figure 2-2. Hester-Dendy Sampling Array



microscope with 15X to 40X magnification. Following counting, the samples were preserved with 70% isopropanol solution. The subject samples were delivered to EA Engineering, Science, and Technology, Inc. (EA) in Deerfield, Illinois for further processing and taxonomic identification.

Upon arrival at EA's laboratory, the samples were logged in. Except for Oligochaeta, macroinvertebrate identifications were made to the lowest practical taxonomic level using the most current literature available (see Section 5). If necessary, Chironomidae larvae were subsampled. Chironomid larvae were placed in a grided petri dish. Squares were randomly chosen until at least 100 larvae were removed. Chironomid larvae were then cleared in 10% potassium hydroxide and permanently mounted in CMC-10. All specimens were identified, enumerated, and coded on EA's standard laboratory bench sheet for data processing.

Each slide-mounted chironomid specimen was examined for a variety of head capsule deformities. For Orthocladinae, Chironomini, and Tanytarsini specimens, the structures examined for deformities included the mentum, mandibles, premandibles, and pecten epipharyngis (Sæther 1980). Tanypodinae structures included the ligula, dorsomentum, mandibles, paraligula, and pecten hypopharyngis (Sæther 1980). Guidance as to what constituted a deformity as well as descriptions of deformities for the structures and taxa listed above was derived from a variety of sources, most notably Dermott (1991), Dickman et al. (1992), Groenendijk et al. (1998), Hudson and Ciborowski (1996), Warwick (1985 and 1991), and Warwick and Tisdale (1988), among others. A conservative approach was used to distinguish deformities or malformations from broken or severely worn larval structures. In general, deformities and malformations were easily distinguished from worn or damaged structures for the specimens examined during this study. However, if any suspicion existed as to the cause of an irregular structure, that irregularity was not counted as a deformity.

Comparisons were made between monitoring stations and between the three navigational pools. Metrics used included density, relative abundance (percent), total taxa richness, number of Ephemeroptera+Plecoptera+Trichoptera (EPT) taxa, dominant taxa composition, and percent Chironomidae head capsule deformities.

3. RESULTS AND DISCUSSION

Hester-Dendy Artificial Substrates

Hester-Dendy samples collected from the 10 sampling stations yielded a combined total of 47 taxa (Tables 3-1 through 3-4). Chironomidae was the most taxa rich group with 21 taxa followed by Ephemeroptera with seven taxa.

Among the navigational pools, Brandon Road yielded the highest mean richness with 23 taxa (Tables 3-1 through 3-4). The Dresden Island pool was similar to the number of taxa observed at the single location in the Lockport pool (15 and 17 taxa, respectively) (Table 3-1 and 3-3). The difference in taxa richness between the Brandon Road pool and the other two navigational pools was due to slightly higher numbers of both chironomid and ephemeropteran taxa at the two Brandon Road pool stations.

Despite the overall higher number of ephemeropteran and trichopteran taxa in the Brandon Road pool, mean EPT richness was relatively similar among the three pools ranging between two and three taxa, approximately (Table 3-1 through 3-4). This was due to the fact that the majority of EPT taxa collected in the Brandon Road pool originated upstream in the upper Des Plaines River (Station #2).

Mean density (number of organisms per meter squared) among the three pools was highest in the Lockport pool (Station #1) and lowest in the Brandon Road pool (Tables 3-1 through 3-4). Dresden Island pool exhibited a mean HD density similar to that observed at Station #1 in the Lockport pool. The mean density in the Brandon Road pool was less than half that observed in the other two pools. This was due to lower numbers of Oligochaeta and the chironomid *Dicrotendipes simpsoni* in the Brandon Road pool compared to Station #1 and lower numbers of the trichopteran *Cyrnellus fraternus* compared to the Dresden Island pool.

Among the benthic taxa observed in the three pools, Oligochaeta was the most dominant taxon by percent at Station #1 and in the Brandon Road pool followed by the chironomid *D. simpsoni*. However, in the Dresden Island pool, the trichopteran *Cyrnellus fraternus* was the dominant taxon.

Five most dominant benthic taxa observed in Hester-Dendy samples (percent)

Taxa	Lockport Pool	Brandon Road Pool*	Dresden Island Pool*
Oligochaeta	61.3	23.4	20.2
Cyrnellus fraternus	0.1	5.4	33.6
Dicrotendipes simpsoni	16.0	14.3	16.0
Stenochironomus sp.	0.0	0.72	6.0
Corbicula fluminea	0.1	11.7	6.5

*Percent values based on the mean of all stations within each pool

TABLE 3-1 TOTAL DENSITY (NUMBER/METER SQUARED), RELATIVE ABUNDANCE (PERCENT), AND TOTAL RICHNESS OF BENTHIC INVERTEBRATES COLLECTED WITH HESTER-DENDY SAMPLERS IN THE CHICAGO SANITARY AND SHIP CANAL, (LOCKPORT POOL) AUGUST AND SEPTEMBER 2000.

	STATION 1 LOCKPORT FOREBAY	
TAXA	#/m2	%
Hydra sp.	32.3	0.60
Turbellaria	57.4	1.06
Oligochaeta	3319.0	61.34
Gammarus fasciatus	427.0	7.89
Argia sp.	3.6	0.07
Cyrnellus fraternus	3.6	0.07
Hydropsyche orris	25.1	0.46
Cricotopus bicinctus grp.	28.7	0.53
Nanocladius sp.	14.4	0.27
Nanocladius distinctus	326.5	6.03
Dicrotendipes neomodestus	14.4	0.27
Dicrotendipes simpsoni	868.3	16.05
Glyptotendipes sp.	14.4	0.27
Polypedilum flavum	211.7	3.91
Polypedilum illinoense	57.4	1.06
Corbicula fluminea	3.6	0.07
Pisidium sp.	3.6	0.07
TOTAL DENSITY (#/METER SQUARED)	5410.8	100.00
TOTAL RICHNESS	17	
EPT TAXA RICHNESS	2	

TABLE 3-2 TOTAL DENSITY (NUMBER/METER SQUARED), RELATIVE ABUNDANCE (PERCENT), AND TOTAL RICHNESS OF BENTHIC INVERTEBRATES COLLECTED WITH HESTER-DENDY SAMPLERS IN THE UPPER DES PLAINES RIVER, AUGUST AND SEPTEMBER 2000.

	STATION 2 MATERIAL SERVICE RD	
TAXA	#/m2	%
Turbellaria	157.9	12.36
Oligochaeta	7.2	0.56
Gammarus fasciatus	111.2	8.71
Isonychia sp.	3.6	0.28
Baetis intercalaris	43.1	3.37
Leucrocuta sp.	35.9	2.81
Stenacron sp.	21.5	1.69
Stenonema terminatum	183.0	14.33
Tricorythodes sp.	200.9	15.73
Coenagrionidae	3.6	0.28
Argia sp.	14.4	1.12
Cheumatopsyche sp.	143.5	11.24
Stenelmis crenata grp.	53.8	4.21
Procladius (Holotanypus)	3.6	0.28
Nilotanypus fimbriatus	3.6	0.28
Thienemannimyia grp.	3.6	0.28
Thienemanniella xena	3.6	0.28
Nanocladius sp.	7.2	0.56
Nanocladius distinctus	14.4	1.12
Dicrotendipes neomodestus	7.2	0.56
Dicrotendipes simpsoni	10.8	0.84
Polypedilum flavum	93.3	7.30
Polypedilum illinoense	3.6	0.28
Polypedilum scalaenum grp.	35.9	2.81
Stenochironomus sp.	17.9	1.40
Rheotanytarsus sp.	21.5	1.69
Corbicula fluminea	50.2	3.93
Musculium transversum	21.5	1.69
TOTAL DENSITY (#/METER SQUARED)	1277.4	100.00
TAXA RICHNESS	28	
EPT TAXA RICHNESS	6	

TABLE 3-3 TOTAL DENSITY (NUMBER/METER SQUARED), RELATIVE ABUNDANCE (PERCENT), AND TOTAL RICHNESS OF BENTHIC INVERTEBRATES COLLECTED WITH HESTER-DENDY SAMPLERS IN THE LOWER DES PLAINES RIVER (BRANDON ROAD POOL), AUGUST AND SEPTEMBER 2000.

	STATION 3 JACKSON STREET		STATION 4 INTERSTATE 80	
TAXA	#/m2	%	#/m2	%
Hydra sp.	7.2	0.29	175.8	7.84
Turbellaria	14.4	0.57	39.5	1.76
Urnatella gracilis	3.6	0.14	--	--
Oligochaeta	746.3	29.71	828.8	36.96
Gammarus fasciatus	150.7	6.00	82.5	3.68
Stenacron sp.	25.1	1.00	21.5	0.96
Cyrnellus fraternus	222.5	8.86	161.5	7.20
Procladius (Holotanypus)	7.2	0.29	7.2	0.32
Ablabesmyia mallochi	--	--	17.9	0.80
Ablabesmyia monilis	14.4	0.57	--	--
Thienemannimyia grp.	7.2	0.29	7.2	0.32
Nanocladius sp.	7.2	0.29	10.8	0.48
Nanocladius distinctus	32.3	1.29	53.8	2.40
Cryptochironomus sp.	7.2	0.29	--	--
Dicrotendipes neomodestus	--	--	7.2	0.32
Dicrotendipes simpsoni	545.4	21.71	459.3	20.48
Glyptotendipes sp.	7.2	0.29	7.2	0.32
Polypedilum flavum	--	--	28.7	1.28
Polypedilum scalaenum grp.	17.9	0.71	7.2	0.32
Stenochironomus sp.	7.2	0.29	10.8	0.48
Physella sp.	3.6	0.14	190.2	8.48
Ferrissia sp.	10.8	0.43	3.6	0.16
Corbicula fluminea	653.0	26.00	118.4	5.28
Musculium transversum	--	--	3.6	0.16
Pisidium sp.	21.5	0.86	--	--
TOTAL DENSITY (#/METER SQUARED)	2511.7	100.00	2242.6	100.00
TAXA RICHNESS	21		21	
EPT TAXA RICHNESS	1		1	

TABLE 3-4 TOTAL DENSITY (NUMBER/METER SQUARED), RELATIVE ABUNDANCE (PERCENT), AND TOTAL RICHNESS OF BENTHIC INVERTEBRATES COLLECTED WITH HESTER-DENDY SAMPLERS IN THE LOWER DES PLAINES RIVER (DRESDEN ISLAND POOL), AUGUST AND SEPTEMBER 2000.

	STATION 5 BRANDON TAILWATER		STATION 6 JOLIET NO. 9		STATION 7 SANTA FE LIGHT		STATION 8 AMOCO CHEMICAL DOCK		STATION 9 TREATS ISLAND		STATION 10 JACKSON CR. CUTOFF	
TAXA	#/m2	%	#/m2	%	#/m2	%	#/m2	%	#/m2	%	#/m2	%
Hydra sp.	28.7	1.48	7.2	0.72	7.2	0.12	10.8	0.19	17.9	0.57	--	--
Turbellaria	495.2	25.46	7.2	0.72	--	--	--	--	3.6	0.11	--	--
Prostoma graescens	39.5	2.03	--	--	--	--	--	--	--	--	--	--
Oligochaeta	599.2	30.81	150.7	15.11	1471.1	25.40	25.1	0.44	294.2	9.34	3232.9	40.12
Gammarus fasciatus	17.9	0.92	89.7	8.99	14.4	0.25	25.1	0.44	--	--	10.8	0.13
Baetis intercalaris	3.6	0.18	3.6	0.36	--	--	--	--	--	--	--	--
Callibaetis sp.	--	--	--	--	--	--	3.6	0.06	--	--	--	--
Stenacron sp.	--	--	50.2	5.04	--	--	--	--	--	--	--	--
Coenagrionidae	3.6	0.18	--	--	--	--	--	--	--	--	--	--
Argia apicalis	--	--	--	--	--	--	--	--	3.6	0.11	--	--
Epitheca (Epicordulia)	--	--	--	--	--	--	3.6	0.06	--	--	--	--
Cyrnellus fraternus	35.9	1.85	147.1	14.75	2242.6	38.72	3455.3	59.96	1546.5	49.09	2992.5	37.13
Macronychus glabratus	--	--	--	--	--	--	10.8	0.19	--	--	--	--
Stenelmis crenata grp.	--	--	--	--	--	--	3.6	0.06	--	--	--	--
Procladius (Holotanypus) sp.	--	--	--	--	--	--	17.9	0.31	21.5	0.68	--	--
Ablabesmyia monilis	--	--	--	--	305.0	5.27	53.8	0.93	226.0	7.18	21.5	0.27
Cricotopus bicinctus grp.	35.9	1.85	39.5	3.96	--	--	17.9	0.31	--	--	7.2	0.09
Cricotopus sylvestris grp.	7.2	0.37	--	--	--	--	--	--	10.8	0.34	--	--
Nanocladius sp.	17.9	0.92	21.5	2.16	--	--	35.9	0.62	--	--	7.2	0.09
Nanocladius distinctus	118.4	6.09	57.4	5.76	--	--	111.2	1.93	--	--	39.5	0.49
Chironomus plumosus grp.	--	--	--	--	--	--	--	--	10.8	0.34	--	--
Cryptochironomus sp.	7.2	0.37	--	--	--	--	--	--	--	--	--	--
Dicrotendipes neomodestus	32.3	1.66	3.6	0.36	--	--	17.9	0.31	10.8	0.34	--	--
Dicrotendipes simpsoni	161.5	8.30	111.2	11.15	889.8	15.37	1747.4	30.32	767.9	24.37	520.3	6.46
Polypedilum flavum	7.2	0.37	14.4	1.44	--	--	--	--	--	--	--	--
Polypedilum illinoense	7.2	0.37	7.2	0.72	14.4	0.25	--	--	--	--	7.2	0.09
Stenochironomus sp.	240.4	12.36	154.3	15.47	211.7	3.66	111.2	1.93	10.8	0.34	197.3	2.45
Xenochironomus xenolabis	--	--	--	--	14.4	0.25	--	--	21.5	0.68	--	--
Menetus dilatatus	46.6	2.40	--	--	--	--	--	--	--	--	--	--
Ferrissia sp.	--	--	71.8	7.19	3.6	0.06	--	--	--	--	--	--
Corbicula fluminea	39.5	2.03	53.8	5.40	617.2	10.66	104.1	1.81	204.5	6.49	1022.6	12.69
Musculium transversum	--	--	--	--	--	--	7.2	0.12	--	--	--	--
Pisidium sp.	--	--	7.2	0.72	--	--	--	--	--	--	--	--
TOTAL DENSITY (#/METER SQUARED)	1944.7	100.00	997.5	100.00	5791.2	100.00	5762.5	100.00	3150.3	100.00	8058.8	100.00
TAXA RICHNESS	20		18		11		18		14		11	
EPT TAXA RICHNESS	2		3		1		2		1		1	

Oligochaeta and *D. simpsoni* are generally considered tolerant of environmental stress. In their study of New York streams and rivers, Simpson and Bode (1980) found *D. simpsoni* (listed as *D. nervosus* Type II) to have a broad pollution tolerance range. It was the dominant chironomid species in waterways affected by wastewater treatment plants (WWTP) discharges. Similarly, the Ohio Environmental Protection Agency (OEPA) lists both Oligochaeta and *D. simpsoni* among thirteen taxa they consider extremely pollution tolerant (OEPA 1988, Yoder and Rankin 1995). The tricopteran *C. fraternus*, the Asiatic mussel *Corbicula fluminea*, and the chironomid *Stenochironomus* are common in large rivers and are considered either facultative or slightly tolerant of disturbance in most regions of the United States (Barbour et al. 1999, Wiggins 1996).

In the present study, head capsule deformities were exhibited by four different chironomid taxa collected from the HD samples (Table 3-5). Of the four taxa, only one has been used extensively in deformity investigations, *Procladius (Holotanypus)* (Dermott 1991, Warwick 1991, and Warwick and Tisdale 1988). It was relatively rare in the HD samples. Although the number of chironomid specimens examined usually exceeded 100, the majority of the specimens were taxa which appear to be resistant to the development of head capsule deformities or were relatively early instar specimens, which generally do not exhibit deformities as consistently as more mature larvae (Burt et al. unpublished, Hämäläinen 1999, Hudson and Ciborowski 1996). The percent incidence of deformity varied little among the three pools ranging from zero at Station #1 to 2.2 percent in Brandon Road pool. Although these values are well below background levels recorded by other investigators (Lenat 1993, Hudson and Ciborowski 1996), due to the small sample size, it is difficult to determine what, if anything, these data mean.

Among the 10 HD sampling stations, Station #2, upstream of the junction of the Des Plaines River and Chicago Sanitary and Ship Canal, exhibited the highest taxa richness (28 taxa, Table 3-2) while Stations #7 and 10, in the Dresden Island pool, had the lowest richness with 11 taxa (Table 3-4). By comparison, Station #5 in the Brandon Road Dam tailrace is similar in terms of habitat to Station #2. However, Station #5 is more riffle-like and generally of better habitat quality. As such, the Brandon tailrace site would be expected to produce a higher quality benthic community. However, the reverse appears to be true. Station #2 exhibited higher total and EPT richness as well as higher EPT abundance compared to Station #5. In addition, tolerant taxa such as Oligochaeta and *Dicrotendipes simpsoni* were noticeably more abundant at Station #5 compared to Station #2. Although it is unclear as to what factors may be contributing to the differences, these data suggest that water and/or sediment quality may be a limiting factor at Station #5.

Overall, total taxa richness did not appear to exhibit any substantial upstream to downstream trend. Although taxa richness was relatively low at Stations #7 and 10, the densities of Oligochaeta and *Cyrnellus fraternus* were collectively higher compared to the other stations. As with total taxa richness, EPT taxa richness was relatively similar among most sites but noticeably higher at Station #2 (Tables 3-1 through 3-4).

Table 3-5. Head capsule deformities observed on Chironomidae larvae collected from Hester-Dendy samples in the Chicago Sanitary and Ship Canal and the Upper and Lower Des Plaines River, August and September 2000.

Taxa	Lockport Pool	Upper Des Plaines River	Brandon Road Pool		Dresden Island Pool					
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	Sta. 9	Sta. 10
***Procladius (Holotanypus)* sp.**										
Number Examined		1	1	1				1	2	
Percent Deformed		0.0	0.0	100.0				100.0	0.0	
Dicrotendipes neomodestus										
Number Examined	1	2		1	5	1		1	1	
Percent Deformed	0.0	0.0		0.0	20.0	0.0		0.0	0.0	
Dicrotendipes simpsoni										
Number Examined	61	3	86	75	26	29	70	95	75	68
Percent Deformed	0.0	0.0	0.0	1.3	0.0	3.4	0.0	2.1	0.0	2.9
Polypedilum flavum										
Number Examined	15	26		5	1	4				
Percent Deformed	0.0	3.8		0.0	0.0	25.0				
TOTAL SAMPLE										
Total Number of Midges Examined	108	63	102	101	102	107	106	111	105	106
Percent Deformed	0.0	1.6	0.0	2.0	1.0	1.9	0.0	2.7	0.0	1.9
TOTAL PER NAVIGATION POOL										
Total Number of Midges Examined	108		266				637			
Percent Deformed	0.0		2.2				1.2			

Benthic macroinvertebrate density among the 10 stations ranged from 998 organisims/m^2 at Station #6 to 8059 organisms/m^2 at Station #10 (Tables 3-1 through 3-4). The higher total density observed at Station #10 was predominantly due to higher numbers of Oligochaeta, *Cyrnellus fraternus*, and *Corbicula fluminea*.

Oligochaeta was the most dominant taxon in half of the HD samples (Stations #1, 3, 4, 5, and 10; Table 3-1). Only *D. simpsoni* and *C. fraternus* were as consistently abundant throughout the study area. In contrast, Station 2 was dominated by two ephemeropteran taxa, *Stenonema terminatum* and *Tricorythodes* sp. Although these two taxa are classified as being moderately tolerant of pollution, both are generally considered less tolerant than Oligochaeta and *D. simpsoni* (Barbour et al. 1999). However, their increased abundance at Station #2 is likely a result of a more suitable habitat rather than any water quality improvements.

Incidence of chironomid head capsule deformities was below 3.0 percent at all ten stations (Table 3-5). The highest percentage of deformities (2.7%) was found at Station #8. Data collected by Burt et al. (In prep.) in the Great Lakes region, suggest that deformities as low as 1.3 percent may represent elevated levels above natural background conditions. However, small sample sizes of suitable taxa made interpretation of the HD chironomid deformities problematic.

Ponar Sampler

A total of 43 benthic taxa were identified from ponar grab samples collected from the 10 sampling stations. The total number of taxa was similar to the total taxa observed in the HD samples (Tables 3-6 through 3-9). As with the HD samples, Chironomidae was the most taxa rich group among the three pools with 22 taxa. No other major taxonomic group was represented by more than three taxa.

Among the three pools, Dresden Island pool yielded the highest mean richness with 13 taxa (Tables 3-6 through 3-9). Mean taxa richness in the Lockport and Brandon Road pools were relatively similar (four and seven taxa, respectively). The difference in taxa richness between the Dresden Island pool and the other two pools was primarily due to a higher number of chironomid taxa, which was nearly three times greater than the number of chironomid taxa from the Lockport and Brandon Road pools combined.

As was observed in the HD data, mean EPT richness was similarly low among the three pools with the mean number of EPT ranging from zero in the Lockport pool to one in the Brandon Road pool (Tables 3-6 through 3-9).

Mean Ponar densities exhibited a pattern similar to mean HD densities in the Dresden Island and Brandon Road pools. However, Station #1 displayed a considerably higher number of macroinvertebrates than HD densities (Tables 3-6 through 3-9). This difference was due to the substantially greater number of oligochaets at Station #1 compared to all other stations.

TABLE 3-6 TOTAL DENSITY (NUMBER/METER SQUARED), RELATIVE ABUNDANCE (PERCENT), AND TOTAL RICHNESS OF BENTHIC INVERTEBRATES COLLECTED WITH A PONAR GRAB IN THE CHICAGO SANITARY AND SHIP CANAL (LOCKPORT POOL), AUGUST AND SEPTEMBER 2000.

	STATION 1 LOCKPORT FOREBAY	
TAXA	#/m2	%
Oligochaeta	332134.6	99.19
Gammarus fasciatus	1865.9	0.56
Procladius (Holotanypus)	717.7	0.21
Corbicula fluminea	143.5	0.04
TOTAL DENSITY (#/METER SQUARED)	334861.8	100.00
TOTAL TAXA RICHNESS	4	
EPT RICHNESS	0	

TABLE 3-7 TOTAL DENSITY (NUMBER/METER SQUARED), RELATIVE ABUNDANCE (PERCENT), AND TOTAL RICHNESS OF MENTHIC INVERTEBRATES COLLECTED WITH A PONAR GRAB FROM THE UPPER DES PLAINES RIVER, AUGUST AND SEPTEMBER 2000.

	STATION 2 MATERIAL SERVICE RD	
TAXA	#/m2	%
Turbellaria	14.4	0.49
Plumatella	14.4	0.49
Oligochaeta	358.8	12.25
Gammarus fasciatus	86.1	2.94
Baetis intercalaris	14.4	0.49
Tricorythodes	43.1	1.47
Trichocorixa	14.4	0.49
Cheumatopsyche	14.4	0.49
Stenelmis crenata grp.	387.5	13.24
Cricotopus bicinctus grp.	172.2	5.88
Cryptochironomus	43.1	1.47
Polypedilum illinoense	43.1	1.47
Polypedilum scalaenum grp.	1234.4	42.16
Tanytarsus guerlus grp.	129.2	4.41
Ferrissia	14.4	0.49
Corbicula fluminea	315.8	10.78
Musculium transversum	28.7	0.98
TOTAL DENSITY (#/METER SQUARED)	2928.1	100.00
TAXA RICHNESS	17	
EPT RICHNESS	3	

TABLE 3-8 TOTAL DENSITY (NUMBER/METER SQUARED), RELATIVE ABUNDANCE (PERCENT), AND TOTAL RICHNESS OF BENTHIC INVERTEBRATES COLLECTED WITH A PONAR GRAB IN THE LOWER DES PLAINES RIVER (BRANDON ROAD POOL), AUGUST AND SEPTEMBER 2000.

	STATION 3 JACKSON STREET		STATION 4 INTERSTATE 80	
TAXA	#/m2	%	#/m2	%
Turbellaria	28.7	0.35	--	--
Oligochaeta	7664.6	94.18	5755.7	98.04
Procladius (Holotanypus) sp.	373.2	4.59	71.8	1.22
Nanocladius distinctus	--	--	28.7	0.49
Cryptochironomus sp.	43.1	0.53	--	--
Dicrotendipes simpsoni	--	--	14.4	0.24
Corbicula fluminea	28.7	0.35	--	--
TOTAL DENSITY (#/METER SQUARED)	8138.3	100.00	5870.5	100.00
TAXA RICHNESS	5		4	
EPT RICHNESS	0		0	

TABLE 3-9 TOTAL DENSITY (NUMBER/METER SQUARED), RELATIVE ABUNDANCE (PERCENT), AND TOTAL RICHNESS OF BENTHIC INVERTEBRATES COLLECTED WITH A PONAR GRAB IN THE LOWER DES PLAINES RIVER (DRESDEN ISLAND POOL), AUGUST AND SEPTEMBER 2000.

TAXA	STATION 5 BRANDON TAILWATER		STATION 6 JOLIET NO. 9		STATION 7 SANTA FE LIGHT		STATION 8 AMOCO CHEMICAL DOCK		STATION 9 TREATS ISLAND		STATION 10 JACKSON CR. CUTOFF	
	#/m2	%	#/m2	%	#/m2	%	#/m2	%	#/m2	%	#/m2	%
Turbellaria	--	--	129.2	1.37	--	--	--	--	--	--	--	--
Prostoma graescens	--	--	14.4	0.15	--	--	--	--	--	--	--	--
Oligochaeta	5195.9	87.23	889.9	9.45	4248.6	78.31	7923.0	89.03	5583.4	87.61	6286.7	78.92
Glossiphoniidae	--	--	--	--	--	--	28.7	0.32	--	--	--	--
Helobdella sp.	--	--	14.4	0.15	--	--	--	--	--	--	--	--
Gammarus fasciatus	--	--	43.1	0.46	--	--	--	--	--	--	--	--
Caenis punctata	--	--	14.4	0.15	--	--	--	--	--	--	--	--
Coenagrionidae	--	--	28.7	0.30	--	--	--	--	--	--	14.4	0.18
Corduliidae	--	--	--	--	--	--	--	--	14.4	0.23	--	--
Cyrnellus fraternus	--	--	--	--	28.7	0.53	57.4	0.65	28.7	0.45	43.1	0.54
Hydroptila sp.	--	--	43.1	0.46	--	--	--	--	--	--	--	--
Dubiraphia sp.	100.5	1.69	--	--	--	--	--	--	28.7	0.45	--	--
Tanypus neopunctipennis	--	--	--	--	28.7	0.53	--	--	200.9	3.15	--	--
Procladius (Holotanypus) sp.	287.1	4.82	229.7	2.44	301.4	5.56	315.8	3.55	71.8	1.13	28.7	0.36
Coelotanypus sp.	--	--	--	--	--	--	28.7	0.32	14.4	0.23	--	--
Ablabesmyia mallochi	14.4	0.24	--	--	--	--	--	--	--	--	--	--
Ablabesmyia monilis	--	--	--	--	--	--	28.7	0.32	--	--	--	--
Cricotopus bicinctus grp.	--	--	4578.7	48.63	--	--	28.7	0.32	--	--	14.4	0.18
Cricotopus sylvestris grp.	--	--	358.8	3.81	--	--	--	--	--	--	--	--
Nanocladius sp.	--	--	--	--	--	--	28.7	0.32	--	--	--	--
Nanocladius distinctus	--	--	57.4	0.61	14.4	0.26	28.7	0.32	--	--	--	--
Chironomus plumosus grp.	86.1	1.45	--	--	100.5	1.85	57.4	0.65	215.3	3.38	28.7	0.36
Cryptochironomus sp.	14.4	0.24	172.2	1.83	287.1	5.29	172.2	1.94	114.8	1.80	57.4	0.72
Dicrotendipes neomodestus	--	--	301.4	3.20	--	--	86.1	0.97	--	--	14.4	0.18
Dicrotendipes simpsoni	--	--	229.7	2.44	129.2	2.38	86.1	0.97	14.4	0.23	--	--
Glyptotendipes sp.	--	--	--	--	14.4	0.26	--	--	14.4	0.23	--	--
Parachironomus sp.	--	--	--	--	14.4	0.26	--	--	--	--	--	--
Paracladopelma sp.	--	--	--	--	--	--	--	--	--	--	43.1	0.54
Polypedilum flavum	--	--	416.2	4.42	--	--	--	--	--	--	--	--
Polypedilum halterale grp.	--	--	--	--	--	--	--	--	--	--	14.4	0.18
Polypedilum illinoense	--	--	57.4	0.61	--	--	--	--	--	--	--	--
Polypedilum scalaenum grp.	--	--	--	--	14.4	0.26	--	--	--	--	--	--
Stenochironomus sp.	--	--	--	--	--	--	--	--	--	--	28.7	0.36
Ferrissia sp.	--	--	746.4	7.93	--	--	28.7	0.32	--	--	--	--
Corbicula fluminea	186.6	3.13	1090.8	11.59	244.0	4.50	--	--	71.8	1.13	1377.9	17.30
Pisidium casertanum	71.8	1.20	--	--	--	--	--	--	--	--	14.4	0.18
TOTAL DENSITY (#/METER SQUARED)	5956.6	100.00	9415.7	100.00	5425.5	100.00	8899.0	100.00	6372.9	100.00	7966.1	100.00
TAXA RICHNESS	8		19		12		14		12		13	
EPT RICHNESS	0		1		1		1		1		1	

As with the HD samples, oligochaets and the clam *Corbicula fluminea* were among the five most dominant taxa in the Ponar samples. However, unlike the HD results in which dominance was more evenly distributed among two or more taxa, Oligochaeta was unquestionably the dominant taxon collected in the Ponar samples. Only two other taxa in the Ponar samples, *Procladius (Holotanypus)* and *Corbicula fluminea* showed a relative abundance greater than three percent. As stated above, most oligochaetes are generally considered to be tolerant of poor water and sediment quality. The abundance of oligochaets in the Ponar samples is not entirely surprising given their affinity for soft sediments which preclude many of the other less tolerant benthic organisms. However, elevated numbers of oligochaetes in the ponar samples may indicate stressed conditions beyond those attributable to poor habitat.

Five most dominant benthic taxa observed in Ponar samples (percent)

Taxa	Lockport Pool	Brandon Road Pool*	Dresden Island Pool*
Oligochaeta	99.2	68.2	71.8
Procladius (Holotanypus) sp.	0.2	1.9	3.0
Chironomus plumosus grp.	0.0	0.0	1.3
Cryptochironomus sp.	0.0	0.67	2.0
Corbicula fluminea	<0.1	3.7	6.3

*Percent values based on the mean of all locations within each pool

Similar to the HD samples, chironomid head capsule deformities were exhibited by four different taxa collected in the Ponar samples (Table 3-10). Three of the four taxa, *Procladius (Holotanypus)* sp., *Chironomus plumosus* grp., and *Cryptochironomus* sp. have been studied extensively for susceptibility to a variety of head capsule deformities (Dermott 1991, Dickman et al. 1992, Lenat 1993, van Urk 1992, Warwick 1985, Warwick 1991, and Warwick and Tisdale 1988). The incidence of deformities ranged from 80 percent (n=5) in the Lockport pool to nine percent (n=133) in the Brandon Road pool. *Procladius (H.)* was the only taxa that exhibited deformities in all three pools. The percentage of *Procladius (H.)* with one or more deformities was relatively similar between the Brandon Road and Dresden Island pools, but was substantially higher in the Lockport pool. This difference may simply be the result of an extremely small sample size in the Lockport pool. *C. plumosus* grp. was the only other taxon to exhibit a relatively high rate of deformities. Although the sample sizes of both *Cryptochironomus* sp. and *Polypedilum scalaenum* grp. were similar to the other two taxa, head capsule deformities were relatively rare for these taxa. Hudson and Ciborowski (1996) also found that deformities in *Cryptochironomus* and *Polypedilum* were rare during their study of the St. Claire and Detroit rivers in Michigan and Ontario.

Hudson and Ciborowski (1996) have suggested that a sample size of $\geq$125 mature individuals of chironomid taxa known to exhibit deformities is necessary in order to achieve a level of confidence that will detect statistical differences. As was the case with the HD deformity analysis, samples of targeted taxa were generally small ($\leq$50 individuals) and often consisted of a large number of early instars. As such, it is difficult to develop any reliable conclusions based on the chironomid deformity data.

Table 3-10.Head capsule deformities observed on Chironomidae larvae collected in Ponar samples from the Chicago Sanitary and Ship Canal and the Upper and Lower Des Plaines River, August and September 2000.

	Lockport Pool	Upper Des Plaines River	Brandon Road Pool		Dresden Island Pool					
Taxa	**Sta. 1**	**Sta. 2**	**Sta. 3**	**Sta. 4**	**Sta. 5**	**Sta. 6**	**Sta. 7**	**Sta. 8**	**Sta. 9**	**Sta. 10**
***Procladius (Holotanypus)* sp.**										
Number Examined	5		19	5	17	4	15	7	5	2
Percent Deformed	80.0		36.8	80.0	64.7	25.0	40.0	14.3	0.0	0.0
***Chironomus plumosus* grp.**										
Number Examined					6		7	2	15	2
Percent Deformed					50.0		42.8	50.0	66.7	50.0
***Cryptochironomus* sp.**										
Number Examined		3	3		1	3	20	6	8	4
Percent Deformed		0.0	0.0		100.0	0.0	0.0	0.0	0.0	0.0
***Polypedilum scalaenum* grp.**										
Number Examined		78					1			
Percent Deformed		1.3					0.0			
TOTAL PER SAMPLE										
Total Number of Midges Examined	5	103	22	8	25	108	56	26	45	16
Percent Deformed	80.0	0.9	31.8	50.0	60.0	0.9	16.1	7.7	22.2	6.2
TOTAL PER NAVIGATION POOL										
Total Number of Midges Examined	5		133				276			
Percent Deformed	80.0		9.0				13.8			

Chironomid deformities in Ponar samples from the three navigation pools			
Taxa	Lockport Pool	Brandon Road Pool	Dresden Island Pool
Procladius (Holotanypus) sp.	80.0% (n=5)	45.8% (n=24)	38.0% (n=50)
Chironomus plumosus grp.	—	—	56.2% (n=32)
Cryptochironomus sp.	—	0% (n=6)	2.4% (n=41)
Polypedilum scalaenum grp.	—	1.3% (n=78)	0% (n=1)

Given the fact that the chironomid taxa examined in the HD samples are not prone to structural irregularities in response to stress whereas those examined in the Ponar samples are demonstrably more inclined to exhibit head capsule deformities, comparisons between the Ponar and HD deformity results are problematic, at best. However, if, in fact the sediment rather than water is the primary source of toxicity among the 10 Ponar sampling stations these results are consistent with that hypothesis.

Taxa richness among the 10 Ponar sampling stations ranged from 19 taxa at Station #6 to four at Stations #1 and 4 (Table 3-3). Total Ponar taxa richness among the two Brandon Road pool stations exhibited a pattern similar to the HD data. Station #2 in the upper Des Plaines River, exhibited the highest number of taxa (17 taxa), while Stations #3 and 4 in the Brandon Road pool were similar to each other but substantially lower than Station #2 (five and four taxa, respectively). In the Dresden Island pool, taxa richness was relatively similar among five of the six stations but slightly lower at Station #5 in the Brandon Road tailrace. The slightly lower number of taxa may be an artifact associated with the habitat (rocks) in the area. Since the tailwater is essentially a long and wide riffle subject to relatively high flows compared to other areas, soft substrates are likely in a constant state of flux. These conditions would effectively exclude many macroinvertebrates due to the level of disturbance associated with the constant high flows. As with the HD samples, EPT richness was similarly low at all Ponar stations. Station #2 showed the highest number of EPT taxa (5).

Benthic macroinvertebrate density among the 10 stations ranged from 2928 organisms/m^2 at Station #2 to 334,862 organisms/ m^2 at Station #1 (Tables 3-6 through 3-9). The substantially higher density observed at Station #1 was due to the higher number of Oligochaeta which was over 900 times more abundant at Station #1 compared to Station #2.

Oligochaeta was the dominant benthic taxa at all but two of the Ponar locations (Table 3-3). In fact, at six of the 10 stations oligochaets accounted for over 80 percent of the benthic community. In contrast, a riffle beetle, *Stenelmis crenata* grp. was the dominant taxon at Station #2. Hilsenhoff (1992) found that *Stenelmis crenata* was common in warm flowing shallow streams in Wisconsin on a variety of substrates from wood to rocks but was absent from heavily polluted streams. The genus *Stenelmis* is considered facultative in most regions of the U.S. (Barbour et al. 1999). The dominant benthic taxon at Station #6 was the chironomid *Cricotopus bicinctus* grp. Species in this group are generally tolerant of a variety of environmental conditions and often become the dominant midge if not the dominant taxa in heavily polluted systems (Epler 1995, OEPA 1988, and Simpson and Bode 1980).

As stated above, only two of the four chironomid species that exhibited deformities, were widespread and displayed deformities on a consistent basis. Incidence of deformities for *Procladius (H.)* ranged from 80 percent at Stations #1 and 4 to zero percent at Stations #9 and 10 (Table 3-4). Malformation of the pecten hypopharyngis was the most common deformity observed in *Procladius (H.)*. Additionally, several specimens, particularly at Stations #3, 4, and 7 exhibited more severe deformities with missing, extra, or malformed teeth of the ligula. In nearly all cases, *Procladius* larvae exhibited multiple deformities. *C. plumosus* grp. was collected from five of the six stations in the Dresden Island pool. However, at each of the stations, one or more *C. plumosus* grp specimens exhibited a deformity. Incidence of deformities was similar ranging from 42.8 to 66.7 percent. The most common deformities among *C. plumosus* grp. were missing teeth and larger than normal gaps (Köhn gaps) among the mentum teeth. Elevated levels of deformities as those exhibited by both *Procladius (H.)* and *C. plumosus* grp. in the current study have been related to elevated levels of heavy metals such as copper, zinc, cadmium, and lead and polycyclic aromatic hydrocarbons (PAHs) (Dickman et al. 1992, Groenendijk et al. 1998, Janssens de Bisthoven et al. 1998a, Janssens de Bisthoven et al. 1998b, and van Urk 1992.)

Hester-Dendy and Ponar Results Combined

Based on combined results of HD and Ponar samples collected from the 10 stations, total taxa richness ranged from 18 taxa at Station #1 in the Lockport pool to 34 taxa at Station #6 in the Dresden Island pool (Table 3-11). Total richness at the other eight stations tended to be more similar to Station #1 than to Station #6.

As with total taxa richness, EPT taxa richness was relatively similar among most stations (i.e., one or two taxa). However, overall EPT richness was noticeably higher at Stations #2 and #6. The higher EPT richness at these two stations was due to an increased number of ephemeropteran taxa, which were generally absent at the other stations. In addition to having the highest EPT richness within the study area, Stations #2 and #6 had the highest Chironomidae relative abundance, the lowest Oligochaeta relative abundance, and the lowest incidence of Chironomidae head capsule deformity (Table 3-11).

EPT relative abundance was highest at Stations #2, #7, #8, #9, and #10 compared to the other five stations which generally were similar in EPT relative abundance (Table 3-11). At Station #2, the higher percent abundance of EPT was largely due to relatively higher numbers of several ephemeropteran taxa. In contrast, the higher EPT relative abundance observed at Stations #7 through #10 was due to increased numbers of one taxa, *Cyrnellus fraternus*.

Table 3-11. Mean summary of select biological metrics (mean values) for combined results from Hester-Dendy and Ponar samples collected in the Chicago Sanitary and Ship Canal and Upper and Lower Des Plaines River, August and September 2000.

Station	Density (#/m^2)	Total Richness	EPT Richness	% Oligochaets	% EPT	% Chironomids	% Chironomid Deformity
1	340,273	18	2	98.6	<0.1	0.7	3.5
2	4,206	34	6	8.7	16.7	43.9	1.2
3	10,650	21	2	79.0	2.3	10.0	5.6
4	8,113	21	2	81.2	2.2	9.0	5.5
5	7,901	25	2	73.3	0.5	13.1	12.6
6	10,413	26	5	10.0	2.5	65.4	1.4
7	11,217	19	1	51.0	20.2	20.9	5.6
8	14,662	23	2	54.2	24.0	20.3	3.6
9	9,523	20	1	61.7	16.5	18.1	6.7
10	16,025	19	1	59.4	18.9	6.4	2.4

Summary

In the present study, the benthic community in the Lockport, Brandon Road, and Dresden Island pools was found to be of poor quality in that most stations were dominated by highly tolerant benthic organisms such as oligochaetes and the chironomids, *Dicrotendipes simpsoni* and *Cricotopus bicinctus* grp. With a few exceptions, intolerant benthic groups such as Ephemeroptera and Trichoptera generally were not well represented. However, when present, EPT were generally collected in relatively low numbers compared to more tolerant taxa.

In general, HD samples had higher numbers of benthic species, higher EPT taxa richness, a more even distribution of abundance among the taxa, higher numbers of intolerant organisms, and fewer chironomid deformities compared to Ponar samples. It is likely that these differences are the result of bias associated with sampling techniques. Overall, HD and Ponar samples did not exhibit any consistent longitudinal trends among the 10 stations. However, based on the combination of the HD and Ponar results, the health of the benthic community at Stations #2 and #6 appeared to be better compared to the other eight stations. In addition, although density and total richness was somewhat similar between the Brandon Road and Dresden Island pools, the composition of the benthic community within these pools differed. The relative abundance of pollution tolerant oligochaets was generally higher in the Brandon Road pool compared to the Dresden Island pool. In contrast, EPT and chironomid taxa generally made up a greater percentage of the community in the Dresden Island pool compared to the Brandon Road pool. These differences may be a function of slightly higher water and/or habitat quality in the Dresden Island pool.

Chironomid head capsule deformities were more common in Ponar samples than in HD samples. However, due to the small sample size of mature individuals and appropriate taxa, it is unclear if these results are related to differences in sediment quality or simply an artifact associated with sampling. Incidence of deformities varied considerably in Ponar samples. Since thresholds of natural background levels of chironomid deformities have not been determined, interpretation of these data is problematic at best.

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