The Metropolitan Sanitary District of Greater Chicago

DEPARTMENT OF RESEARCH AND CONTROL

RESEARCH REPORT

TITLE: A BIOLOGICAL SURVEY ON THE ILLINOIS RIVER FROM SPRING VALLEY TO HENRY - WINTER, 1967 - 1968; I.

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Abstract

Samples for biological analysis were collected from the Illinois River from Spring Valley to Henry on November 20 and December 6, 1967; and March 6, 1968. This study was part of a combined effort (see MSDGC waterways' section report by Minkin, Kahle, and Soiya, titled "A Chemical Survey on the Illinois River from Spring Valley to Henry - Winter 1967-1968; II") to describe the conditions of the Illinois River as they existed before the start of operations at the new Jones and Laughlin Steel Mill so that an evaluation of possible pollution from this source could be made more meaningful.

The small degree of diversity in bottom faunal types together with relatively high concentrations of some toxic materials indicate that the river has likely degraded from its natural state. However, our data show the segment of the river under study to be biologically similar both up and downstream from the Jones and Laughlin Steel Mill site. Conditions being thus, any alteration which may be noticed in the downstream direction after the mill begins operation, as compared to that upstream, might reasonably be attributed to the effects of this mill.

Introduction

Due to its association with heavily populated areas, the Illinois River has a relatively long history of pollution. Forbes and Richardson (1913) described the opening of the Chicago drainage canal in 1900 as a revolutionary event in the biological history of the river. Due to the raw sewage that emptied from it into the Illinois River system, the first 26 miles of the River from its origin at the Desplaines-Kankakee River junction to the Marseilles Dam, experienced septic conditions. Dissolved oxygen was low, and no fish were present in this segment. Below the dam, the river progressively improved, but subnormal dissolved oxygen concentrations were observed even 60 miles farther downstream. In those days, the area between Spring Valley and Hennepin, although there was some local contamination from LaSalle and Peru, was the first area in which the grayish sewage smelling water of the upper reaches gave way to a greenish, more normal water lacking a foul odor. The river between Hennepin and Henry at this time appeared almost normal, but in the colder months, the bottom mud would become offensive due to decomposing sludge. Traveling down the river from its origin, the area between Spring Valley and Hennepin was also the first in which a normal clean water bottom fauna began to appear. Isopods, ostracods, amphipods, and river shrimp were all present. Dragon fly larvae were found and caddis fly larvae became abundant on mussel shells. Tubifex worms, which are so characteristic of water with a high degree of organic pollution became less abundant.

The severity of this early condition of organic pollution has been largely relieved by the installation of modern sewage treatment facilities but the river continues to be menaced by increasing population and industrialization which, hand in hand, threaten further pollution. The purpose of our recent survey of the Illinois River was to describe the conditions of the river as they existed between Spring Valley and Henry before the start of operations at the new Jones & Laughlin Steel Mill so that an evaluation of possible pollution from this source could be made more meaningful.

Procedures

Eight locations were sampled along the river from Spring Valley to Henry, Fig. 1. Samples were taken on November 20 and December 6, 1967, and March 6, 1968. At most of the stations, transverse sampling was conducted at least once. In these cases, midstream and lateral samples were taken, the lateral samples being taken at about two-thirds of the distance from mid-river to each bank.

Plankton was collected quantitatively by filtering a known amount of water (6, 24 and 12 liter on the respective days) through a #20 bolting silk plankton net, bringing to 24 ml. volume and counting the organisms in a one ml. subsample. Bottom samples were taken with a 110 square inch Petterson dredge, one dredging per sample; the organisms were separated from the bottom materials by straining through #30 and #100 mesh screens respectively.

Plankton was counted using a Sedgewick-Rafter counting cell and a 23X binocular microscope. Counts were expressed as organisms per liter. Bottom organisms retained by the #30 mesh screen were counted and expressed as organisms per square yard of bottom area. Those retained by the #100 mesh screen were identified using a 30x binocular microscope, but were not quantitated due to their small numbers and lack of a suitably sensitive quantitative method. They were merely recorded as to observed presence or absence from a sample.

Results and Discussion

The plankton, Table I, were represented by a wide variety of plant and animal forms which were relatively evenly distributed throughout the segment of the river under study. Forbes and Richardson (1919) made the observation that the clean water phytoplankton, Tabellaria Floculosa and T. fenestrata which entered the Illinois River from Lake Michigan through the Chicago drainage canal decreased in number and were sometimes entirely eliminated from the river before they reached Pekin, Illinois (a point downstream of our sampling area). At other times, however, they would decrease in abundance as they traveled downstream, and then begin to increase. It was thought that the pollution of the river was causing their reduction and that if any survived travel through the pollution zone, their population was able to recover and replenish.

A similar phenomenon has recently been observed in the reversed flow waterway system of the Metropolitan Sanitary District of Chicago (Youngsteadt and Wei, 1968). The amount of Tabellaria and other plankton was noted to decline upon traveling downstream through the system. In this case, however, no recovery was observed within the system. It seems likely, therefore, that if the Jones & Laughlin Steel Mill becomes a source of pollution, a similar phenomenon might develop below the mill's waste discharge location, i.e., the plankton may no longer remain evenly distributed throughout the segment under study, but may decrease in number downstream from the mill.

Bottom Fauna, Tables 2 and 3: The segment of the Illinois River under study was primarily sandy in composition with some areas of mud, shells, and gravel, Tables 2 and 3. In this respect the bottom is comparable both up and downstream from the Jones & Laughlin Steel Mill site. Likewise the bottom fauna appears to be similar and comparable both up and downstream from this site. This condition, as with the case for the phytoplankton, should facilitate the evaluation of changes which might occur below the source of waste discharge at the Jones & Laughlin Steel Mill.

Unfortunately, the bottom fauna was not abundant nor was it particularly diverse, a situation which restricts the degree of possible change demonstrable due to pollution when compared to a fauna which is abundant and diverse. In addition to the two macrofaunal types listed in Table 2, only one aquatic insect (a dragon fly larvae) and one nematode were observed throughout the entire area of study. Many mussel shells but no mussels, were taken. Snail shells were found, but whether the animal was present or not was not noted. From their earlier work, Forbes & Richardson (1913) reported, in addition, isopods, amphipods, and caddis fly larvae on mussel shells. That these forms were not found in our survey could indicate a changing or deteriorating condition of the river, or a less thorough sampling procedure during our survey. Metropolitan Sanitary District of Greater Chicago (MSDGC) water chemistry data for the period and area of this survey (Minkin, et. al., 1968) supports the idea that a deteriorated condition does exist in the Illinois River and shows that the toxic materials including ammonia, zinc, copper, iron and lead were all outside the specific criteria for this river system and therefore could have played a part to reduce the diversity of the bottom fauna. For instance, 2.5 ppm ammonia, has been reported as lethal to goldfish and perch in hard water (Doudoroff and Katz, 1950) while the above cited MSDGC records show Illinois River ammonia up to 4.1 ppm. Sprague (1964) has reported the incipient lethal level of zinc and copper to young Atlantic salmon as 0.6 and 0.048 ppm respectively. For the Illinois River, the above cited MSDGC records show zinc and copper up to 1.54 and 0.59 ppm respectively. In addition, Sprague also noted that a combination of zinc and copper is twice as toxic as if their effects were additive. It can thus be seen that the Illinois River did contain toxic components which could have limited the variety of aquatic life therein. It is also of interest that Mills et al. (1966) have documented the biological changes due to the activities of man which have occurred in the Illinois River during the past 70 years and have noted that the changes in the biota since the late 1890's have been variable, that some organisms have responded favorably, but that in general, there has been a drastic and undesirable reduction in the numbers and kinds of desirable plants and animals that live on or in the river.

For the immediate purpose of analyzing the steel mill, however, it is necessary to concentrate more heavily on conditions as they exist now than on how past conditions have been altered. Therefore, since the up and downstream portions of the river from the Jones & Laughlin Steel Mill appear biologically similar, any alteration in the biology of the river below the mill after it begins operations as compared to that above may reasonably be attributed to the effects of the steel mill.

Conclusions

A small degree of diversity in bottom faunal types together with relatively high concentrations of some toxic materials indicate that the Illinois River has likely degraded from its natural state. However, our data show the segment of the river under study to be biologically similar both up and downstream from the Jones & Laughlin Steel Mill site. Conditions being thus, any alteration which may be noticed in the down stream direction after the mill begins operation, as compared to that upstream, might reasonably be attributed to the effects of this mill.

Literature Cited

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FIGURE 1. LOCATION OF SAMPLING STATIONS ALONG THE ILLINOIS RIVER. ARROWS INDICATE STATIONS.

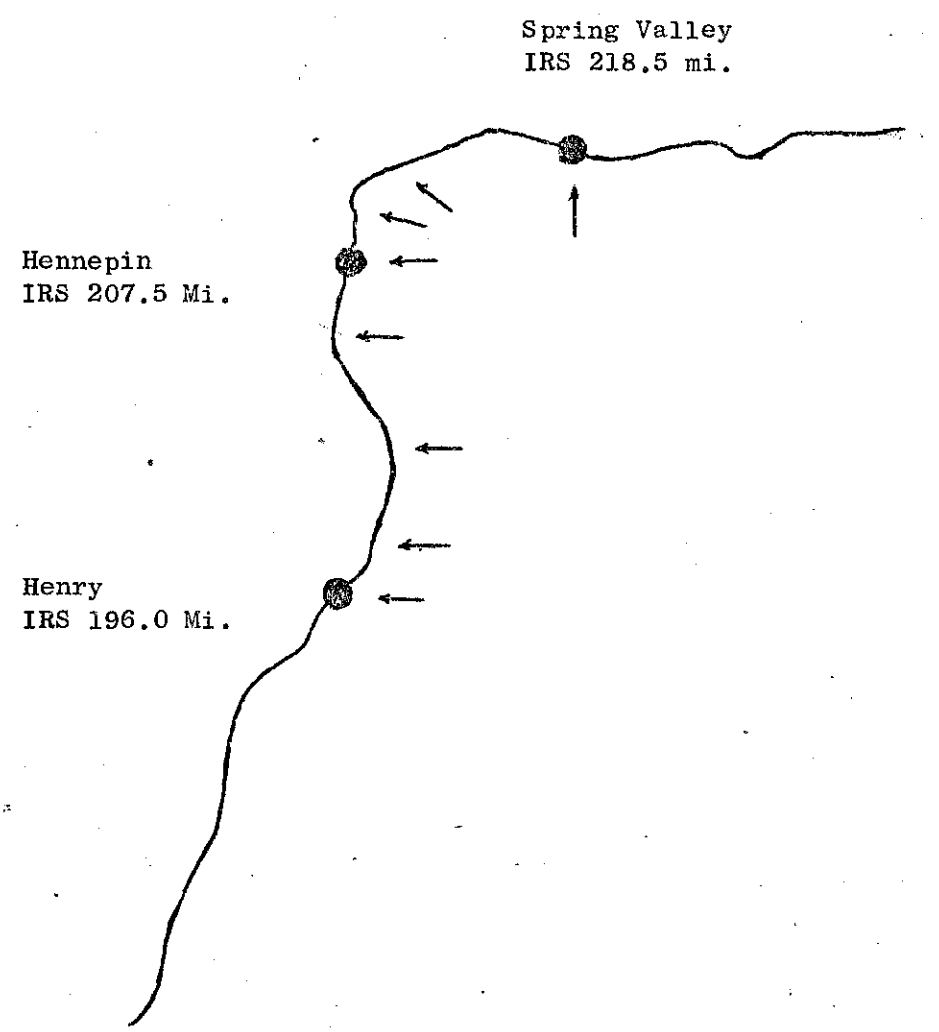

Table 1. RESULTS OF THE ILLINOIS RIVER PLANKTON SURVEY BEFORE THE BEGINNING OPERATIONS OF THE NEW JONES & LAUGHLIN STEEL MILL AT HENNEPIN, ILL.

PLANKTON IN NUMBERS OF ORGANISMS PER LITER (MID-STREAM SURFACE SAMPLES)

SAMPLING STATIONS IRS MILEAGE SYSTEM	ZOOPLANKTON														
	Stalked Ciliate, likely VORTICELLA			KERATELLA			POLYARTHRA			COPEPODA			CLADOCERA		
	11/20/67	12/6/67	3/6/68	11/20/67	12/6/67	3/6/68	11/20/67	12/6/67	3/6/68	11/20/67	12/6/67	3/6/68	11/20/67	12/6/67	3/6/68
218.5 (Spring Valley)	0			4			0			0			0		
212.0		1	30		0	0		0	0		1	0		1	0
209.0		0	44		0	0		0	0		2	0		1	0
PROPOSED J&L DISCHARGE															
207.5 (HENNEPIN)	1	0	66	0	1	0	4	0	0	0	0	2	0	1	0
205.0		0	166		1	0		0	2		1	0		0	0
201.0		0	62		1	2		0	0		1	0		0	0
198.1		0	34		1	0		0	0		0	0		0	0
196.0 (Henry)	0			4			0			0			0		

SAMPLING STATIONS IRS MILEAGE SYSTEM	PHYTOPLANKTON														
	PEDIASSTRUM			CLOSTERIUM			FRAGILARIA			TABELLARIA			ASTERIONELLA		
	11/20/67	12/6/67	3/6/68	11/20/67	12/6/67	3/6/68	11/20/67	12/6/67	3/6/68	11/20/67	12/6/67	3/6/68	11/20/67	12/6/67	3/6/68
218.5 (Spring Valley)	0			0			4			360			44		
212.0		2	0		1	0		0	0		1296	0		65	0
209.0		5	0		0	0		0	0		909	20		15	2
PROPOSED J&L DISCHARGE															
207.5 (HENNEPIN)	4	5	0	0	0	0	0	0	0	244	300	12	56	14	2
205.0		4	0		1	0		0	2		1620	40		24	0
201.0		5	0		1	0		0	0		480	40		20	0
198.1		3	0		0	0		1	0		540	0		22	0
196.0 (Henry)	4			0			2			116			44		

Table 2. RESULTS FROM THE ILLINOIS RIVER BOTTOM FAUNA SURVEY BEFORE THE BEGINNING OPERATIONS OF THE NEW JONES & LAUGHLIN STEEL MILL AT HENNEPIN, ILLINOIS

Sampling Stations IRS Mileage System		BOTTOM ORGANISM SURVEYS (#30 MESH SCREEN) 12 - 6 - 67			3 - 6 - 67		
		PHYSICAL DESCRIPTION OF BOTTOM MATERIAL	ANNELIDS #/Yd^2	MIDGE LARVAE #/Yd^2	PHYSICAL DESCRIPTION OF BOTTOM MATERIAL	ANNELIDS #/Yd^2	MIDGE LARV #/Yd^2
218.5 (Spring Valley)	East						
	Mid						
	West						
212.0	East	Sand	141	12			
	Mid	Sand	177	12	Sand, Shells	94	0
	West	Sand, Mud	1300	0			
209.0	East	Sand, Gravel, Shells	130	48			
	Mid	Sand	200	0	Sand, Organic detritis, Mud	304	0
	West	Sand, Mud	283	0			
Proposed J&L Discharge							
207.5 (Hennepin)	East	Mud	660	0	Mud	351	0
	Mid	Sand, Mud	59	0	Sand	94	0
	West	Sand, Mud	1050	0	Mud, Sand, Shells	71	23
205.0	East	Sand, Shells	130	0			
	Mid	Shells	0	0	Sand	117	0
	West	Sand, Shells	271	0			
201.0	East	Sand, Shells	35	0			
	Mid	Sand, Shells	247	0	Sand, Shells	819	0
	West	Sand	789	12			
198.1	East	Mud	330	12			
	Mid	Mud	153	0	Mud	1112	0
	West	Mud	448	0			
196.0 (Henry)	East						
	Mid						
	West						

Table 3. RESULTS FROM THE ILLINOIS RIVER BOTTOM FAUNA SURVEY BEFORE THE BEGINNING OPERATIONS OF THE NEW JONES & LAUGHLIN STEEL MILL AT HENNEPIN, ILLINOIS

SAMPLING STATIONS IRS MILEAGE SYSTEM	STREAM BANK	PHYSICAL DESCRIPTION OF BOTTOM MATERIAL	12/6/67 BOTTOM ORGANISM SURVEY FOR PRESENCE (+) OR ABSENCE (-) OF VARIOUS BOTTOM FORMS (#100 MESH SCREEN)			
			ANNELIDS	NEMATODES	OSTROCODS	COPEPODS
	East					
218.5	Mid					
(Spring Valley)	West					
	East	Sand	+	-	-	-
212.0	Mid	Sand	+	-	+	-
	West	Sand, Mud	+	-	+	-
	East	Sand, Gravel, Shells	+	-	-	-
209.0	Mid	Sand	+	-	-	-
	West	Sand, Mud	-	-	+	-
PROPOSED J&L DISCHARGE						
	East	Mud	+	-	+	-
207.5	Mid	Sand, Mud	+	-	+	-
(Hennepin)	West	Sand, Mud	+	+	+	+
	East	Sand, Shells	+	-	+	+
205.0	Mid	Sand	-	-	-	-
	West	Sand, Shells	+	+	-	-
	East	Sand, Shells	-	-	-	-
201.0	Mid	Sand, Shells	+	-	-	-
	West	Sand	+	+	-	-
	East	Mud	+	+	+	-
198.1	Mid	Mud	-	+	-	-
	West	Mud	+	+	+	-
	East					
196.0	Mid					
(Henry)	West					