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Some of the Effects of Domestic Sewage Discharged Into Hickman and Jessamine Creeks in Jessamine County, Kentucky

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SOME OF THE EFFECTS OF DOMESTIC SEWAGE DISCHARGED INTO HICKMAN AND JESSAMINE CREEKS IN JESSAMINE COUNTY, KENTUCKY

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ABSTRACT

A 6-week study was made in the summer of 1971 as an initial effort to determine the extent of pollution that the three sewage disposal plants in Jessamine County, Kentucky, are contributing to its streams. With the rapid population increase in Lexington and nearby municipalities, this study should furnish a basis of comparison for future investigations. Eighteen collecting stations were established in riffle areas of Hickman and Jessamine Creeks, and coliform bacteria, macro-invertebrate populations, fish populations and chemical water quality of each riffle area were studied.

Hickman Creek's flow was augmented by approximately 3,100,000 gallons/day (11,735 m^3/day) from one of the City of Lexington's sewage disposal plants, and Jessamine Creek's flow by 500,000 gallons/day (1,893 m^3/day) from the cities of Nicholasville and Wilmore. The Lexington and Wilmore facilities were greatly overloaded.

Chemical analyses were directed toward finding out the fluctuations of phosphates, sulfates, and nitrates. Water disappearing through limestone faults posed investigational problems. Hickman Creek showed evidences of pollution for a greater distance downstream than did Jessamine. Diversity of clean water indicator organisms was higher in lower Jessamine than in lower Hickman; this was particularly true for darters

(Etheostoma) and stoneflies (Plecoptera). Jessamine Creek was also supporting limited game fishing.

Descriptors: Water pollution*, Streams*, Benthos*, Fish

Identifiers: Stream order

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This paper was written in the fall of 1971 and presented before the Kentucky Academy of Science, Zoological Section, in October. It was again presented in the spring of 1972 at the annual meeting of the North American Benthological Society at Ames, Iowa.

FOREWORD

The Kentucky Water Resources Research Institute is publishing the following report by Dr. Henry Howell and Mr. Mike Jones to make more readily available this information on stream pollution problems in Central Kentucky, particularly as it pertains to Hickman Creek.

More by coincidence than design several studies have focused on Hickman Creek during the years when urban growth has caused serious problems to arise. At least three reports (1, 2, 3) are published and readily available; one report (4) is departmentally printed and two (5, 6) are Master's dissertations. Development of pollution problems has been well summarized for Hickman Creek (4).

This study of Howell and Jones was conducted during the time that sewage from south Lexington was only given lagoon retention and chlorination while a new secondary treatment facility was being constructed to replace an inadequate upstream facility. Degradation of the stream was visibly evident and odors from the lagoons added greatly to public concern. Lexington was legally pressed both by state public health officers and by neighboring Jessamine County for operating a health hazard and public nuisance. Interestingly, Howell and Jones found fewer coliform bacteria below the Hickman Creek lagoons than below the Nicholasville treatment plant despite the greater number of people served and volumes handled by the Hickman lagoons. Though unacceptable in many regards, these lagoons must have achieved impressive reductions

of coliforms. Subsequent operation of the West Hickman treatment plant in conjunction with the lagoons has remedied the serious problem. Howell and Jones' work also presents additional background data on fish and riffle macro-invertebrates for judging the subsequent degree of recovery of the biotic community.

Robert A. Kuehne
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February 14, 1976

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INTRODUCTION

The population in the Inner Blue Grass Sub-Region of the Blue Grass Physiographic Region is mushrooming rapidly around centrally located Lexington, in Fayette County. Jessamine County lies to the south of Lexington, and much of the city's expansion is in that direction since most of the famous race horse farms are on the north side where there is little likelihood of urban growth. Nicholasville and Wilmore, lying 15 miles south and southeast, are the two largest cities in Jessamine County, and their citizens are beginning to become fearful that they will lose their identity to the gradual southward encroachment of Greater Lexington. Jessamine County's citizens are likewise concerned that Lexington not be allowed to further pollute any part of the county's environment as occurred increasingly in Hickman Creek (through the 1960's).

The problem of adequate domestic sewage disposal is not a new one to the City of Lexington, which sits on a structural dome with streams radiating outward from it. Their largest facility is on the South Fork of Elkhorn Creek, and the plant there became increasingly overloaded in the late 1950's and completely eliminated a small stream game fishery. In addition, the Federal Fish Hatchery, 45 miles down stream, was experiencing the effects of domestic sewage pollution in its ponds as the annual production of bass, bream and catfish took serious tumbles, despite corrective measures.

The Division of Fisheries, Department of Fish and Wildlife Resources, Commonwealth of Kentucky, instituted a series of studies early in the 1960's to gather data which it hoped could be used to convince the City of Lexington and the Water Control Commission that it would be better to have the South Elkhorn sewage effluents returned to the Kentucky River where assimilation could occur to a greater degree than is possible in the Elkhorn Creek (Carter, 1961; Jones, 1968; Laflin, 1969). For comparison these workers contrasted the relatively clean waters of the North Fork with the waters of the South Fork. In each study the North Fork had a greater standing crop of fishes. Laflin found that in 1968 the North Fork should still be able to support a limited game and pan fishery, and that even with the new plant built in 1963 on the South Fork, there were too few fish for any kind of fishery. In the North Fork, as typical riffle species, he found three kinds of darters and the banded sculpin; in the South Fork there were no darters, but the blacknose dace and banded sculpin were present. Laflin also included study of benthos and water quality in his 1968 investigation. Benthos diversity was the lowest in South Elkhorn in July.

The present study was made from 14 June through 27 July 1971, to determine the extent of pollution the three sewage disposal plants in Jessamine County were contributing to its streams. Another purpose was to ascertain if a 4 to 6 week collecting period

in the middle of the summer still reflected what the water quality had been during the preceding months. Any data gathered could likewise furnish a basis of comparison for future investigations. In this initial study collecting stations were established in riffle areas of Hickman and Jessamine Creeks (Figure 1), and the macro-invertebrate populations, fish populations, and chemical water quality of each riffle area were studied.

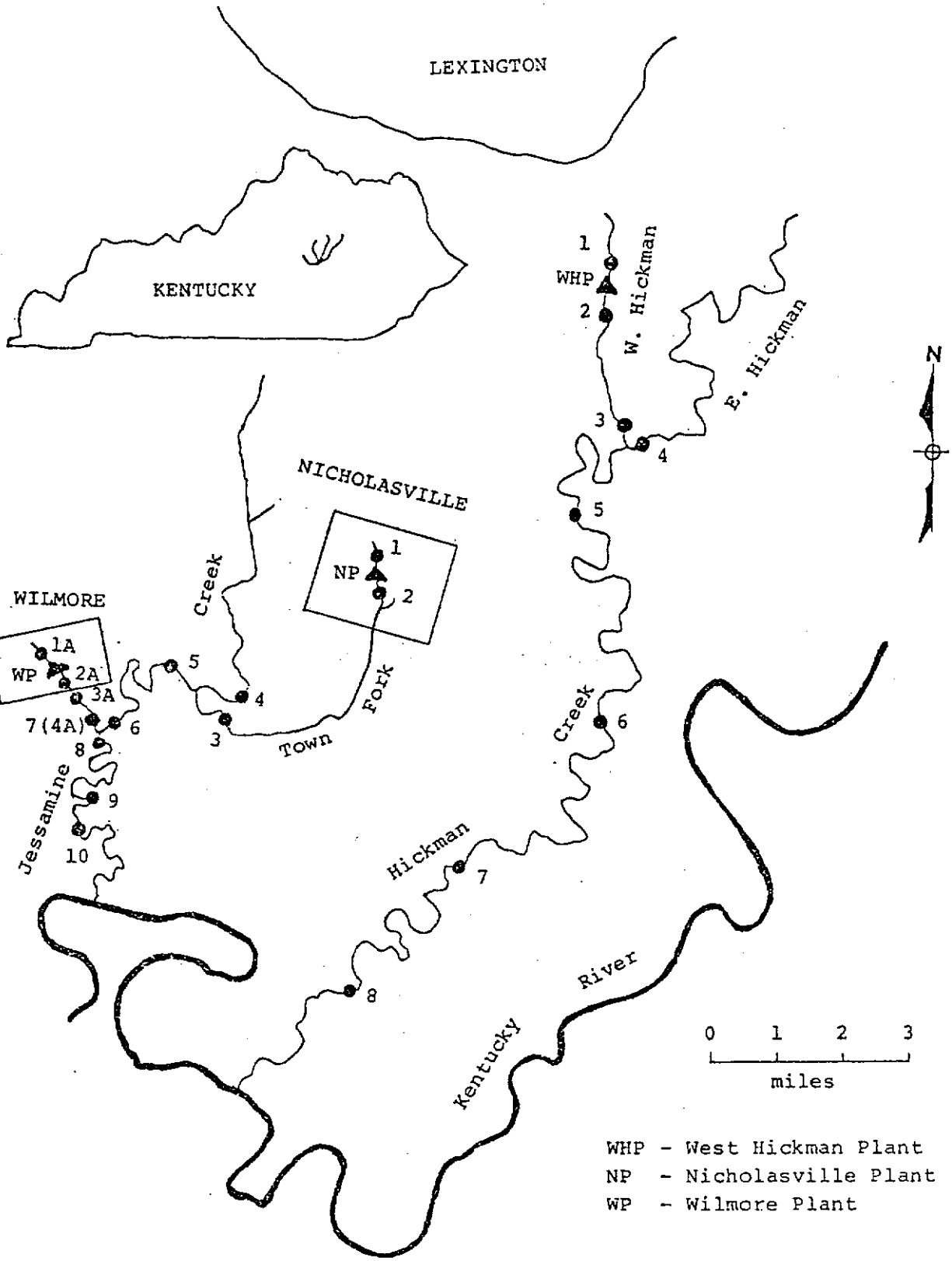

Figure 1. Map of Hickman and Jessamine creeks showing sampling stations and location in Kentucky.

PHYSICAL CHARACTERISTICS OF THE DRAINAGE BASINS

Both Hickman and Jessamine Creeks are a part of the Kentucky River drainage. The Kentucky River flows through a 300' (91.2 m) deep gorge in this part of the state, and the two creeks in their courses have cut through that much limestone to reach the mother stream.

Hickman Creek rises in the southern part of Fayette County, and drains an area of 97 mi^2 (251.2 km^2), most of which lies in Jessamine County. The City of Lexington was in the process of constructing West Hickman Sewage Treatment Plant (hereafter WHP) a $6,000,000 tertiary disposal plant on the west fork of this creek, to be completed by late spring, 1972. Meanwhile the only treatment about 3.00 mgpd (11,356 m^3/day) of raw sewage underwent was the partial treatment received in a series of four 5-acre lagoons. Outlying subdivision package disposal plants contributed an additional 60,000-80,000 gpd (227-302 m^2/day) of effluent.

Jessamine Creek drains an area of 42 mi^2 (108.8 km^2) in the middle of Jessamine County, and has on it two disposal plants. The Nicholasville Sewage Treatment Plant (hereafter NP) was affording secondary treatment to an average of 435,000 gpd (1,647 m^3/day), and the capacity could supposedly be increased to treat over double that amount. The Wilmore Sewage Treatment Plant (hereafter WP) could handle about 100,000 gpd (379 m^3/day) with secondary treatment, and for much of the year it was overloaded

by 20,000-30,000 gpd (76-114 m^3/day). Bids were being taken for a new 500,000 gpd (1,893 m^3/day) plant.

Both creeks are streams of the fourth order (Kuehne, 1962). At the site of WHP the stream is third order. The NP and WP are on side streams of third and second order.

MATERIALS AND METHODS

Riffle collecting stations were chosen because good water quality indicator organisms, if present, are more readily found in riffle communities. Since the available student help could only be in the field for six weeks, it was not possible to sample both riffle and pool stream communities. The 8 stations on Hickman Creek and 13 stations on Jessamine Creek are indicated in Figure 1. The mileage from the sewage disposal plants is shown in Tables 1 and 2. For both streams, Stations 1 and 2 are taken at the nearest riffles above and below the sewage plants. For Wilmore Branch the station symbols assigned were 1-A through 4-A, with 4-A being the last station before convergence with Jessamine Creek. In depicting the data for Jessamine Creek, the values included for Station 7 are identical with those in Station 4-A.

All water samples were taken in sterile 225 ml flasks. In collecting the sample, the mouth of the flask was pointed downstream and allowed to slowly fill in the rapidly moving water. The samples were brought into the laboratory for chemical analyses and coliform bacterial determinations; pH was determined in the

field. The membrane filter technique as outlined in Standard Methods (1971) was used for total coliform counts. The bacterial culturing was started usually within one to two hours after collecting the samples. Three or four samples spread over a 30-day period were taken at each station.

For the chemical analyses a Hach DREL Engineering Laboratory kit was used. Analyses were usually made the same day the samples were taken. When it was impossible to run them on the same day, samples were refrigerated until the next day.

A modified Surber Square-foot sampler was used to collect bottom organisms. At each riffle station, two samples were taken, and the organisms from both samples were placed in a single quart collecting jar. At each riffle an effort was made to take one sample in an area where the rocks averaged 1-4 in. (2.54-10.16 cm) in diameter, and another sample where the rocks ranged from 4-6 in. (10.16-17.78 cm) in diameter. The bottom organisms were brought into the laboratory and each collection was hand-picked while the organisms were still alive.

Fish and crayfish were collected with a 10-foot minnow seine by kicking three locations at each riffle station. The fish were preserved in 10 percent formalin, and the crayfish were discarded after being counted.

RESULTS AND DISCUSSION

Coliform Counts

The coliform counts and chemical analyses of the water samples are presented in Tables 1 and 2. The coliform counts are geometric means, usually based on four samples. For Hickman Creek (Table 1) the coliform count increased from 7,500/100 ml above the Lexington lagoons to 14,500/100 ml below the lagoons. Station 4 is on East Hickman Creek just above its confluence with West Hickman. The count for East Hickman was 6,500/100 ml. Between Station 5 and Station 6 the coliform count dropped from 6,000 at mile 6.75 to 1,000 at mile 10.45. This drop may be partially explained by the fact that a substantial part of the flow from the lagoons could have been disappearing in the creek bed through faults in the limestone. In August after the field data had been collected, a series of faults just below mile 7.0 were discovered through which over 2,500,000 gpd (9,464 m^3/day) were disappearing. This was at the bend in the creek which closely approached the Kentucky River (Figure 1). The zero bacterial count at Station 8 could be due to distance from the disposal plant and to the inflow of one of the larger side branches three miles above the collecting station.

On Jessamine Creek the highest coliform count, 155,150/100 ml, was found just above the sewage disposal plant in Nicholasville (Table 2). This branch flows through the middle of the city and probably picks up its high count from a few privys in the low

Table 1. Coliform Counts and Chemical Analysis of Water Samples from Hickman Creek on Which Lexington Sewage Lagoons are Located, Collected in July, 1971.

Station number	Miles from sewage plant lagoons	Coliform bacteria per 100 milliliters	Sulfate milligrams per liter	Ortho phosphate milligrams per liter	Meta phosphate milligrams per liter	Nitrate nitrogen milligrams per liter	pH
1	-0.14	7,500	34	2.15	0.23	5.74	8.1
2	0.14	14,100	48	6.60	1.31	5.30	8.0
3	2.25	9,000	35	5.00	0.50	5.00	7.7
4	2.55	6,500	15	1.10	neg.	5.00	7.5
5	6.75	6,000	35	4.20	neg.	5.75	7.6
6	10.45	1,000	37	2.70	neg.	6.00	7.5
7	16.85	1,000	35	2.20	neg.	9.00	8.6
8	22.60	neg.	30	1.83	neg.	5.00	7.5

Table 2. Coliform Counts and Chemical Analysis of Water Samples from Jessamine Creek on Which Nicholasville and Wilmore Sewage Disposal Plants are Located, Collected in July, 1971.

Station	Miles from sewage disposal plant	Coliform bacteria per 100 milliliters	Sulfate milligrams per liter	Ortho phosphate milligrams per liter	Nitrate nitrogen milligrams per liter	pH
1	-0.10	155,150	34	2.10	7.64	7.2
2	0.10	0	98	9.13	6.90	6.7
3	4.20	12,000	40	4.25	7.08	8.1
4	5.10[1]	4,330	31	1.65	7.00	8.3
5	5.85	11,150	27	2.77	7.00	8.0
6	9.15	12,400	33	2.84	6.75	8.1
7(4-A)	9.20[2]	14,970	51	4.20	6.92	8.4
8	9.30	14,970	34	3.36	6.50	8.1
9	12.96	8,015	49	1.12	5.25	7.8
10	13.91	-	27	2.60	4.25	8.5
1-A	-0.05	23,510	67	1.59	7.94	7.9
2-A	0.05	45,415	106	11.23	8.33	7.5
3-A	0.55	39,360	59	3.90	7.00	7.5
4-A(7)	1.07	14,970	51	4.20	6.92	8.4

[1]On Jessamine Creek just above confluence with Town Fork.

[2]On Wilmore Branch just above confluence with Jessamine Creek.

income housing area. So much chlorine is mixed with the final effluent of the disposal plant, that at Station 2 no coliforms could ever be cultured; the use of sodium thiosulfate was not tried. At Stations 1-A and 2-A, above and below WP, the coliform count doubled below the plant, from 23,510 to 45,415/100 ml. This compares with what occurred below the Lexington lagoons (Table 1, Stations 1 and 2). In the short Wilmore Branch, 1.1 miles long, the count was reduced by 2/3's at Station 4-A, also shown as Station 7 for comparison with the main creek in Table 2. The coliform count of 8,015 at Station 9 is still too high for good water quality.

It is questionable whether coliform counts alone should be considered as indicators of water quality. The Commonwealth of Kentucky established a Stream Use Classification (KRS 224 -WP-4-1, adopted November, 1971), and for public water supply and food processing industries the coliform group is not to exceed 5,000/100 ml as a monthly arithmetical mean; and for recreation the total coliform level is not to exceed 1,000/100 ml. This figure is slightly higher than that recommended by the Tennessee Pollution Control Board (1962) where a coliform mean of less than 50/100 ml indicates a natural stream, and where a mean between 50 and 500/100 ml indicates a state of contamination normal for inland streams free of pollution, but subject to surface wash. Carroll, Gentry and Little (1969) in studying the fecal coliforms in some of

Georgia's recreational waters concluded that in reservoir water the fecal coliform should not exceed a geometric mean of 200/100 ml; and that in freshwater streams the level should not exceed 500/100 ml.

Chemical Analyses

Sulfate, ortho phosphate, meta phosphate, and nitrate nitrogen were determined and recorded as mg/l.

An examination of Tables 1 and 2 shows that sulfate is the highest just below the point where the sewage effluent is introduced. Below the Nicholasville plant there were 98 mg/l, and below the Wilmore plant 106 mg/l. On Jessamine Creek there is some indication that the sulfate content is sharply lowered within the first few miles below the plants (contrast Stations 2 and 3, and Stations 2-A and 3-A). In both Jessamine and Hickman creeks the sulfate, after the initial reduction, seems to fluctuate between 25 and 35 mg/l. Three samples from the Kentucky River in July also ranged from 25-35 mg/l. No doubt the beds of filamentous algae and water willow (Justicia americana) that were growing vigorously in the water of the creeks, incorporated some of the sulfate (Boyd, 1968). Sulfate reducing bacteria also probably play an important role in cycling the sulfur. When collecting the first water samples in late June and early July, hydrosoil samples were also taken where possible and tested for the presence of hydrogen sulfide. It was easiest to detect in the stations

immediately below the sewage disposal plants, where it ranged from a trace to 5.0 mg/l, increasing with the amount of organic matter in the hydrosoil.

Ortho phosphate increased from 2.15 mg/l to 6.60 mg/l below the Lexington lagoons, and then there followed a gradual decrease in the anion as one moved downstream. At the Nicholasville plant, phosphate increased from 2.10 mg/l above to 9.13 mb/l below the plant; in Wilmore the comparable figures were from 1.59 to 11.23 mg/l. Again it is likely that the aquatic vegetation accounted greatly for the rapid halving of the phosphorus in the creeks below the sewage plants. The Kentucky River had only 0.77 mg/l of phosphate.

Meta phosphate was also determined for each sample. There were only a couple of instances where the amount of meta phosphate had to be taken into consideration in calculating the ortho phosphate (Table 1, Stations 1 through 3), and meta phosphate has not been included in Table 2.

Nitrate nitrogen ranged from 4.25 mg/l to 8.33 mg/l in Jessamine Creek; in Hickman Creek the range was from 5.00 to 9.00 mg/l. In neither Creek was there any marked fluctuation of the nitrogen level. Hickman Creek basin does have more agricultural land in it.

The only station at which there was an acidic pH was at Station 2, just below the WP, where the pH was 6.7. At all other collecting stations on both streams alkaline pH's were found, ranging up to 8.6.

Benthos and Fish

It is well known that community diversity reveals much more about water quality than does the number of organisms in a community. Even though a year-around collecting program would be best to detect the maximum number of species present in a stream, this paper is presenting data from samples collected on one date for each station. A number of competent biologists have devised various types of indices to measure community composition and diversity in relationship to the extent of pollution in a stream. Among these should be mentioned the work of Kolkwitz and Marsson (1909), Richardson (1928), Patrick (1950), Beck (1954), Doudoroff and Warren (1957), Palmer (1959), and Hynes (1960). These same biologists would probably agree that in some instances very limited sampling and simple means of analyses can often be very useful in studies of aquatic environments. It is believed that this limited study of the macroscopic animals of Hickman and Jessamine Creek riffles does furnish the citizens of Jessamine County and the scientific community some valid information regarding the extent of pollution in the two streams.

Benthos

Where there is not a lot of industrial waste and high concentrations of dissolved materials, living organisms are perhaps the best indiators of water quality. Those species with relatively long life cycles (several months to a year) but low tolerance to

pollution are the best indicators of persistent high water quality.

The number of riffle benthos and number of species in each taxon is presented in Tables 3 and 4. The flow of West Hickman Creek was perceptibly greater than East Hickman, probably due to the addition of water from sewage treatment. A contrast of the diversity found at Stations 1-3 on West Hickman with that found on East Hickman at Station 4 just above the confluence of the two streams, shows that the total number of species/station ranged from 5-7 in the more polluted creek, and in East Hickman at the single station, 14 species were found.

The taxa most frequently represented in Stations 1-3 on Hickman were: Naididae, Tubificade, Hirudinea, Simuliidae and Chironomidae. These same groups were practically non-existent in the samples collected in the main creek (Stations 5-8). Trichoptera were the most ubiquitous group in both Hickman and Jessamine Creeks.

Stations 1 and 2 at the NP were not sampled for benthos; Town Fork was so polluted-appearing it was deemed unwise to take the samples. The first sample on Town Fork was taken at Station 3, 4.20 miles below the plant. Large amounts of filamentous algae were present, and isopods were the most numerous organism. Besides Trichoptera, other groups represented were Tubificidae, Coleoptera, Chironomidae and Gastropoda; and in all, there were six species, which number is the same as for Station 3 on West Hickman Creek.

Table 3. Numbers of Benthos Collected in Two Square-Foot Samples in the Riffles of Eight Collecting Stations on Hickman Creek in July, 1971

Taxa	Station number							
	1	2	3	4	5	6	7	8
Planaria			3(1)*	2(1)			2(1)	3(1)
Oligochaeta			1(1)	3(1)				
Naididae	20(1)							
Tubificidae		10(1)						
Hirudinea			27(1)	2(1)				
Isopoda	13(1)	3(1)		34(1)		2(1)	2(1)	1(1)
Plecoptera				2(2)				1(1)
Ephemeroptera	1(1)			4(2)	8(2)		8(1)	
Trichoptera	16(2)	1(1)	3(2)	28(3)	13(3)	5(2)	16(3)	3(2)
Megaloptera							1(1)	
Coleoptera							3(1)	
Elmidae				1(1)	11(1)	3(1)	3(1)	1(1)
Psephenidae						1(1)	5(1)	1(1)
Simuliidae	79(1)	21(1)	6(1)					
Chironomidae	5(?)	31(?)				1(1)		
Gastropoda				2(1)	6(2)		21(1)	110(1)
Total number of organisms	134	66	40	78	38	12	61	120
Total number of species	7	5	6	14	8	6	11	8

* Number in parenthesis is the total number of species in that taxon.

Table 4. Numbers of Benthos Collected in Two Square-Foot Samples in the Riffles of Six Collecting Stations on Jessamine Creek in July, 1971

Taxa	Station number					
	3	4	5	8	9	10
Planaria		3(1)*		1(1)	2(1)	
Tubificidae	1(1)					
Lumbriculidae		1(1)				1(1)
Hirudinea					1(1)	
Isopoda	517(1)	12(1)		3(1)	15(1)	5(1)
Plecoptera		4(2)		2(2)	3(2)	4(2)
Ephemeroptera			14(2)		7(4)	2(2)
Anisoptera					1(1)	
Zygoptera				1(1)		
Trichoptera	1(1)	20(3)	14(2)	9(4)		8(3)
Megaloptera		1(1)				3(2)
Coleoptera	1(1)					
Elmidae		20(2)	8(1)	3(1)	14(2)	57(1)
Psephenidae		19(1)	5(1)	7(1)		
Simuliidae				1(1)		
Chironomidae	4(1)	1(1)				
Gastropoda	4(1)	20(2)		5(1)	29(1)	12(1)
Pelycepoda		15(1)		3(1)	7(1)	
Total number of organisms	528	116	41	35	79	92
Total number of of species	6	16	6	14	14	13

* Number in parenthesis is the total number of species in that taxon.

Station 4 on Jessamine Creek, which is above the point of entry of Town Fork, had a similar pattern to that of Station 4 on East Hickman, with the greatest diversity of all being found in these less polluted waters. Station 4 had 16 species. Station 5, with six species, probably shows some of the effect of the NP effluent; however, mayflies (Ephemeroptera), riffle beetle (Elmidae), and water pennies (Psephenidae), had moved into the picture. At Station 7 (4-A) on Wilmore Branch only a trickle of water was flowing and no collecting was done. Likewise, since Stations 6 and 8 on the main stream are very close together and no WP effluent is entering between them sampling at Station 6 was omitted. Assuming that high stream diversity is a valid indicator of high water quality, at Station 8 Jessamine Creek has recovered fairly well from the sewage introduced into it at the Nicholasville plant, nor does the summer flow from Wilmore seem to affect it adversely. At this Station 14 species were found, and at the last two stations sampled there were similar numbers of species. Jessamine Creek showed more diversity in the species of immature stone flies, caddisflies, mayflies and meagalopterans than did Hickman Creek.

Fish Populations

The number of fish and crayfish collected in the riffles are shown in Tables 5 and 6. On Hickman Creek no fish could be caught at Stations 1 or 3. The four species taken at Station 2, Rhinichthys

Table 5. Number of Fish and Crayfish Collected with a Six-Foot Minnow Seine by Kicking Three Times at Each Riffle Collecting Station on Hickman Creek, July 1971

Taxa	Station number							
	1	2	3	4	5	6	7	8
Rhinichthys		3		3		-	1	
Notropis		1		1		-		
Etheostoma								
nigrum						-	1	
flabellare		5		20	5	-	1	1
spectabile		1		1		-		
Cottus				6	2	-		1
Total fish		10		31	7	-	3	2
Total species fish		4		4	2	-	3	2
Total crayfish			1	42	23	-	12	

Table 6. Total Number of Fish and Crayfish Collected with a 6-Foot Minnow Seine by Kicking Three Times at each Riffle Collecting Station on Jessamine Creek, July, 1971. The Number in Parenthesis Indicates When There is More Than One Species in That Taxon.

Taxa	Station number					
	3	4	5	8	9	10
Rhinichthys	1					
Notropis		3			2(2)	3(2)
Campostoma		1				
Micropterus		1				
Etheostoma						
flabellare		7	4	1	3	6
ceruleum				1	1	5
blennioides				1		
Cottus		6	1		1	
Total fish	1	18	5	3	7	14
Total species fish	1	5	2	3	5	4
Total crayfish		58	33	9	1	5

atratulus, Notropis sp., Etheostoma flabellare and E. spectabile, should probably not be included as valid samples for there had been a heavy rain the preceding day and the only fish found were small fingerlings. It is likely that they washed in from a small side stream which flows between two of the Lexington sewage lagoons. Further, on two subsequent trips, the only fish that could be seen were top minnows in the shallow pools below the riffle collecting station.

At Station 4 on East Hickman, adult specimens were represented among the fish collected; 31 fish (representing 4 species) were collected. No collection was made at Station 6. Along the main stream, Station 7 had the most diversity with 3 species being taken, Rhinichthys atratulus, Etheostoma nigrum and E. flabellare. E. flabellare occurred at five of the seven collecting stations.

On Jessamine Creek fish were found at all stations sampled. The largest sample of fish was taken at Station 4, where 18 fish were distributed among 5 different species. The capture of a stoneroller, Campostoma anamolum, and a smallmouth bass, Micropterus dolomieui is somewhat unusual for riffle communities. The darters were more common in lower Jessamine Creek than in lower Hickman Creek, as is evidenced by the data for the last three stations in each table. In Jessamine Creek the three species of darters collected were Etheostoma flabellare, E. caeruleum and E. blennioides. E. flabellare, again, seems to be the more tolerant form to changing water quality. In both creeks the sculpin, Cottus carolinae was more common in non-sewage water.

DISCUSSION AND SUMMARY

Two streams in Jessamine County have their flow augmented by the discharge of domestic sewage effluents. Hickman Creek's flow is augmented by approximately 3,100,000 gallons/day from the Lexington area, and Jessamine Creek's flow by 500,000 gallons/day from the cities of Nicholasville and Wilmore. The Lexington and Wilmore facilities are greatly overloaded.

In both streams unknown volumes of water disappear from the creek beds through limestone faults. Hickman Creek about mid-course usually disappears underground in late July or early August, and does not start flowing on the surface again until leaves begin falling in mid-to-late October and fill in the crevices of the creek bed. Numerous pools do remain through the dry season. Jessamine Creek does have flowing water throughout most of its course for the entire year; however, Wilmore Branch disappears through most of the summer and early fall for its lower 0.3 mi.

There is such a difference in the sewage load, stream gradient, and amount of water disappearing under ground, that no truly statistical comparison of the two streams can be justified. Chemical analysis was slanted more toward finding out the fluctuations of phosphates, sulfates, and nitrates. The sewage plant effluents increased the sulfates 300-400 per cent; phosphates increased 200-700 per cent. Nitrates fluctuated randomly. Both streams

were quickly able to reduce the amounts of sulfates within one to two miles of flow. It took most of the stream length to bring phosphates down to less than 2.00 mg/l.

In both creeks the coliform bacterial count was above the maximum water quality standards of 1,000/100 ml set by the state for recreational water use; and of 5,000/100 ml for public water supply use.

Vegetation patterns were evident. Slime fungi and blue green algae could be easily seen on riffle rocks below the sewage plants. Green algae seemed to gradually replace the bluegreens downstream. Huge water willow beds became common in the middle sections of the creeks where water depth and substrate were suitable. These beds were more common in lower Hickman than in lower Jessamine.

Figure 2 presents a summary of the macroscopic animals and total number of species collected in the riffles of Jessamine and Hickman Creeks in July, 1971. In Jessamine Creek the average number of species/collecting station was 15.7; in Hickman Creek the average number was 11.1. In Jessamine Creek there were approximately twice as many Plecoptera, Ephemeroptera, Elmidae, Gastropoda and darters collected at the last three stations than there were for the last three stations on Hickman Creek. The data on the macroscopic animals from Stations 1, 2, and 3 point toward a preponderance of pollution-tolerant forms; Oligochaeta, Hirudinae, Isopods, Chironomidae and Simuliidae.

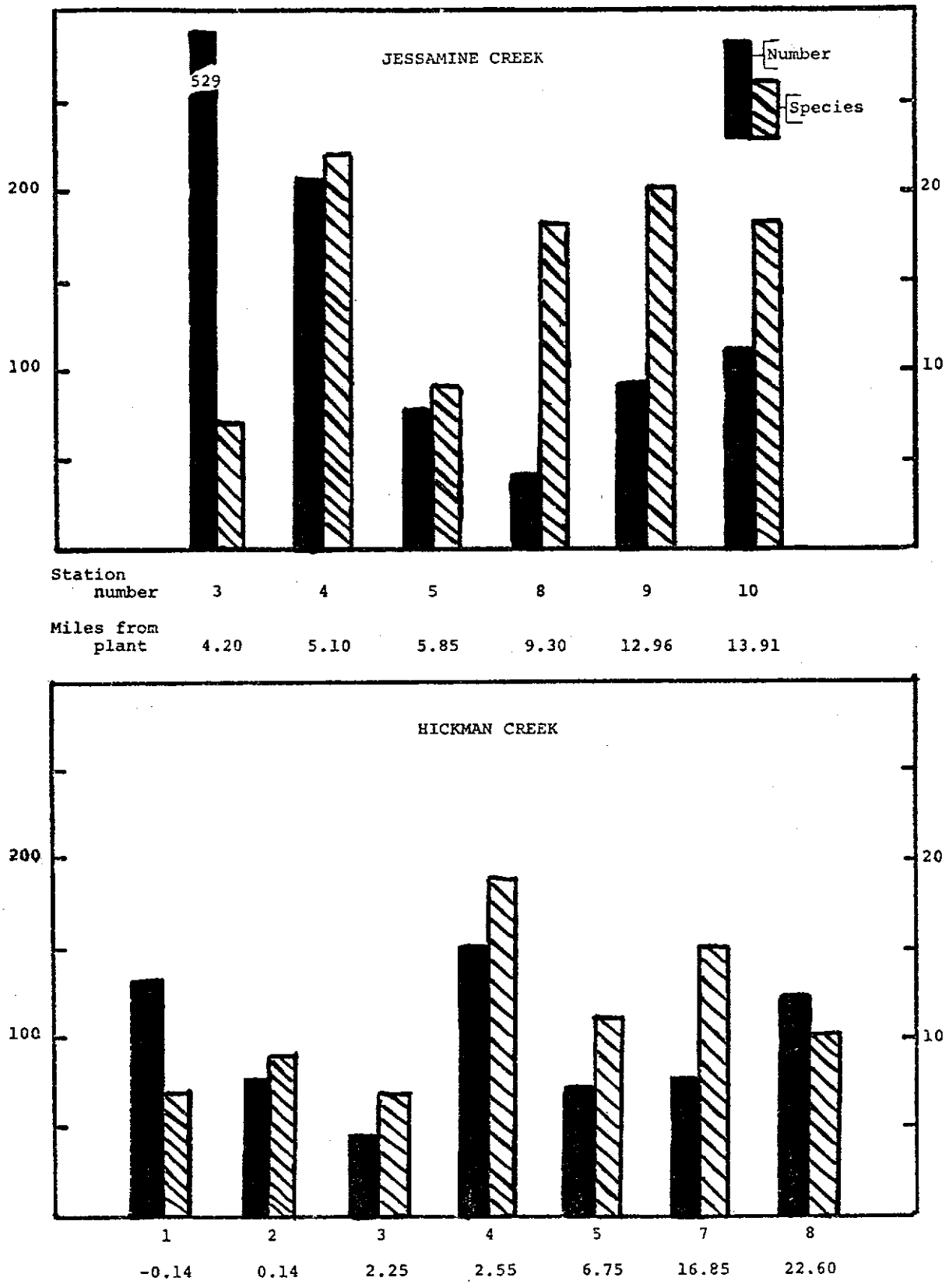

Figure 2. Total number of macroscopic animals and total number of species collected in the riffles of Jessamine and Hickman creeks, July, 1971.

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