6-1934

The Bottom Fauna of Drakes Creek: A Quantitative & Qualitative Study

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1934

THE BOTTOM FAUNA OF DRAKES CREEK
A QUANTITATIVE AND QUALITATIVE STUDY

BY

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A THESIS

SUBMITTED IN PARTIAL FULFILLMENT

OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF ARTS

WESTERN KENTUCKY STATE TEACHERS COLLEGE

JUNE, 1934

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INTRODUCTION

An ecological study of the invertebrate animal forms exclusive of microscopic forms found in the waters of Drakes Creek in Warren County, Kentucky, was undertaken for the purpose of determining both the nature and the amount of invertebrate animal life found in these waters. The Kentucky Fish and Game Commission has made several plantings of game fish in the waters studied. However, the fishermen report no appreciable increase of the fish life in these waters. In view of the failure of the fish to propagate properly in these waters, and because the other physical factors appeared favorable for the propagation of game fish, it was believed that food might be a limiting factor in the propagation of fishes in these waters. An ecological study was therefore made of the invertebrate animal forms exclusive of microscopic animals found in these waters at different depths and under different physical conditions.

No ecological studies seem to have been made of the waters of Drakes Creek. In addition to the above stated objective, it therefore seemed desirable to make a general study of the animal forms exclusive of microscopic forms independent of the problem of food supply for game fish.

REVIEW OF LITERATURE

No literature dealing with the distribution of animal life in Kentucky rivers from the ecological standpoint or from the standpoint of adequate food supply for game fish seems to exist. However, extensive ecological studies of both microscopic animals

forms and larger forms have been made of the waters of rivers and lakes of numerous other states. Among the studies reported in the literature those conducted in Ohio, Illinois, and Wisconsin seem to have the most direct bearing upon the conditions and forms found in the study reported in this paper.

Baker's ('18) report of the fish food of lower South Bay of Oneida Lake, shows that animal life was abundant and that the number of forms and total population varied with the character of the substratum. Boulder bottoms, which were the most sparsely inhabited, had an average population of 3.45 mollusks and 7.06 associated animals per unit area four inches square. Sand areas, with an average of 16.51 mollusks and 17.7 associated animals, were the most densely populated. Mollusks made up the greater part of the total population of all the groups. Naididae, Helicopsyche, Hyalella, chironomid larvae, other dipterous larvae, and crustaceans were forms most abundant of the associated animals. The number of forms and total population declined with increasing depth.

Forbes ('28) found that the valuation of the small bottom fauna of Rock River, Illinois, gave the richest yield where the bottom consisted chiefly of small rocks. This yield was made up largely of May-fly larvae. The forms comprising the largest number of individuals found in the mud-bottom sections of Rock River, were large burrowing May-fly larvae and small oligochaete worms.

Juday ('24) found from his survey of Green Lake, Wisconsin, that the greatest variety of forms was found in the second zone,

which was from one to ten meters in depth. The zone from the water-line to one meter in depth with thirty-six different forms was second as to number of forms. The first zone yielded the smallest number of individuals or 1,155 animals per square meter of bottom.

Krecker and Lancaster ('33) found that shifting sandy beaches, with an average total population of 100 individuals to the square yard, were the most sparsely inhabited areas. Shelving rock areas, with an average total population of 7700 individuals per square yard, were the most densely populated. As to depth the greatest total population was found at the eighteen inch contour, while the smallest total population occurred at the seventy-two inch depth. The fewest number of forms were collected from sand bottoms, the largest variety from rubble. Chironomid larvae, Hydropsyche, Heptagenia, Goniobasis, and Physa made up the major portion of the total population.

Muttkowski ('31) observed from his study of the fauna of Lake Mendota that insect larvae made up from forty to sixty per cent of the fish food of that lake.

Richardson ('21) reported on his survey of the shore fauna of the middle and lower Illinois River that the animal life of both the shallow and deeper waters from Chillicothe to Lagrange was from eighty-six to ninety-nine per cent mollusks. Insect larvae were more abundant on sand and gravel shores than on mud; the reverse was true in case of the mollusks. Mud bottoms with vegetation yielded a greater number of small invertebrate animals than those devoid of it.

Richardson ('28) concluded from his study of more than a thousand fish stomachs that Sphaeriidae, Chironomidae, Ephemeridae, and Hydropsychidae were the four most important groups from the standpoint of fish food found in the Illinois streams.

DESCRIPTION OF HABITATS

The types of habitats studied are the following: boulder, flat rock, gravel, gravel and vegetation, sand, sand and vegetation, mud, and mud and vegetation. Each of these had dead leaves present except those exposed to strong currents.

Boulder areas were found at points where strong currents had carried away the gravel and finer material. The boulders ranged in size from six to eighteen inches in diameter. In many cases they were covered with moss, which gave better protection for the animals that inhabit this type of bottom. Stations eleven, nineteen, twenty-two, thirty-one, and thirty-two are of this type.

Flat rock areas existed where the current was not quite so great as in case of boulder. As a rule the water was shallow and small rapids were constantly being made. The size of these rocks averaged about two by six by twelve inches. Stations one, eight, thirteen, fourteen, and twenty-seven were selected from this type of bottom.

Gravel shoals were subjected to a slow current. In many places the current was not strong enough to carry away all the finer material. On these bottoms of coarse sand and gravel, vegetation was found in many places from the water-line to the depth of thirty-six inches. Stations nine, eighteen, twenty-

eight, thirty, and thirty-five were devoid of vegetation, while ten, twelve, sixteen, seventeen, and twenty-six had much vegetation.

Sand occurred in places where there was very little current. The sand was fine and in some cases contained traces of mud. Vegetation was found often on this type of bottom. Stations two, thirty-six, thirty-seven, and twenty-five were of sand substrata, while three, six, fifteen, twenty, and twenty-one were of sand covered with plants.

Mud areas were found in sections of the creek where the water had collected in pools due to the formation of gravel bars or boulder dams. Above each of two man-built dams was a large pool of still water. In the mud areas scanty vegetation was found at stations four, five, twenty-four, and thirty-four, but no vegetation appeared at stations seven, twenty-three, twenty-nine, and thirty-three.

METHODS OF STUDY

Samples of the bottom fauna were taken during September, 1933, at varying depths from each station established on Drakes Creek. All collections were preserved in a ten per cent solution of formaldehyde. They were later examined under a binocular microscope and identified. Stations were established at varying intervals along the creek, special efforts being made to select stations from the different types of bottom that existed. The three depths chosen at each station were (a) from water line to six inches, (b) thirty-six inches, and, (c) seventy-two inches.

The study of the population and distribution of forms is

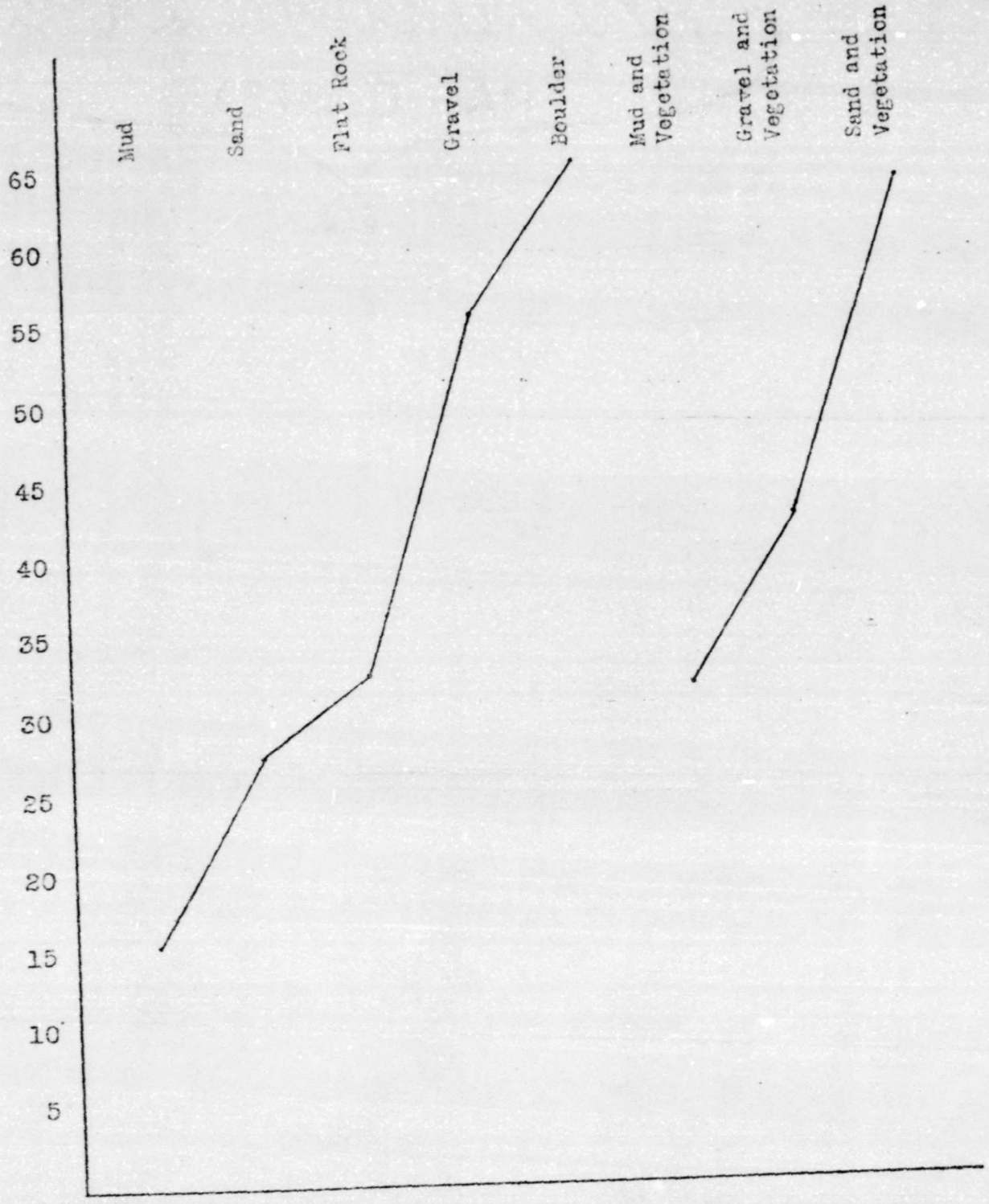


Fig. 1. Average total population in relation to the type of substratum. Figures indicate the total average population per square yard.

based on one square yard of bottom. In collecting the animals the square yard was marked off by stakes and the forms were collected and placed in a suitable container to which a formaldehyde solution was added. The bottle was labeled with the number of the station and the depth of the water. A record was also made of vegetation and the movement of water. Each station was also located and numbered on a geological map ('24). In the case of stony bottom, where the dip net could not be used, each stone was picked up by hand, and the animals were collected either with forceps or swept into a pail of water by means of a small brush. The animals were then strained out and preserved. On other types of bottom the dip net and dredge were used. The samples were scooped up in the dip net, washed, and examined for forms. The dredge was used in collecting at the seventy-two inch depth. In the treatment of vegetation, the plants were pulled up by hand and carefully washed in a pail of water to remove the clinging animals. After this process the dip net was used to collect any additional forms. The individuals were then strained out and preserved.

RESULTS AND DISCUSSION

Influence of Vegetation on Population.- Figure 1 shows the relation between population and type of bottom. Mud bottom, with an average of sixteen individuals to the square yard, had the fewest number of animals. This was followed in order of increasing population by sand, flat rock, gravel, and boulder. Gravel had a larger total population than flat rock. This was due to the large number of Goniobasis and Amnicola found on gravel areas.

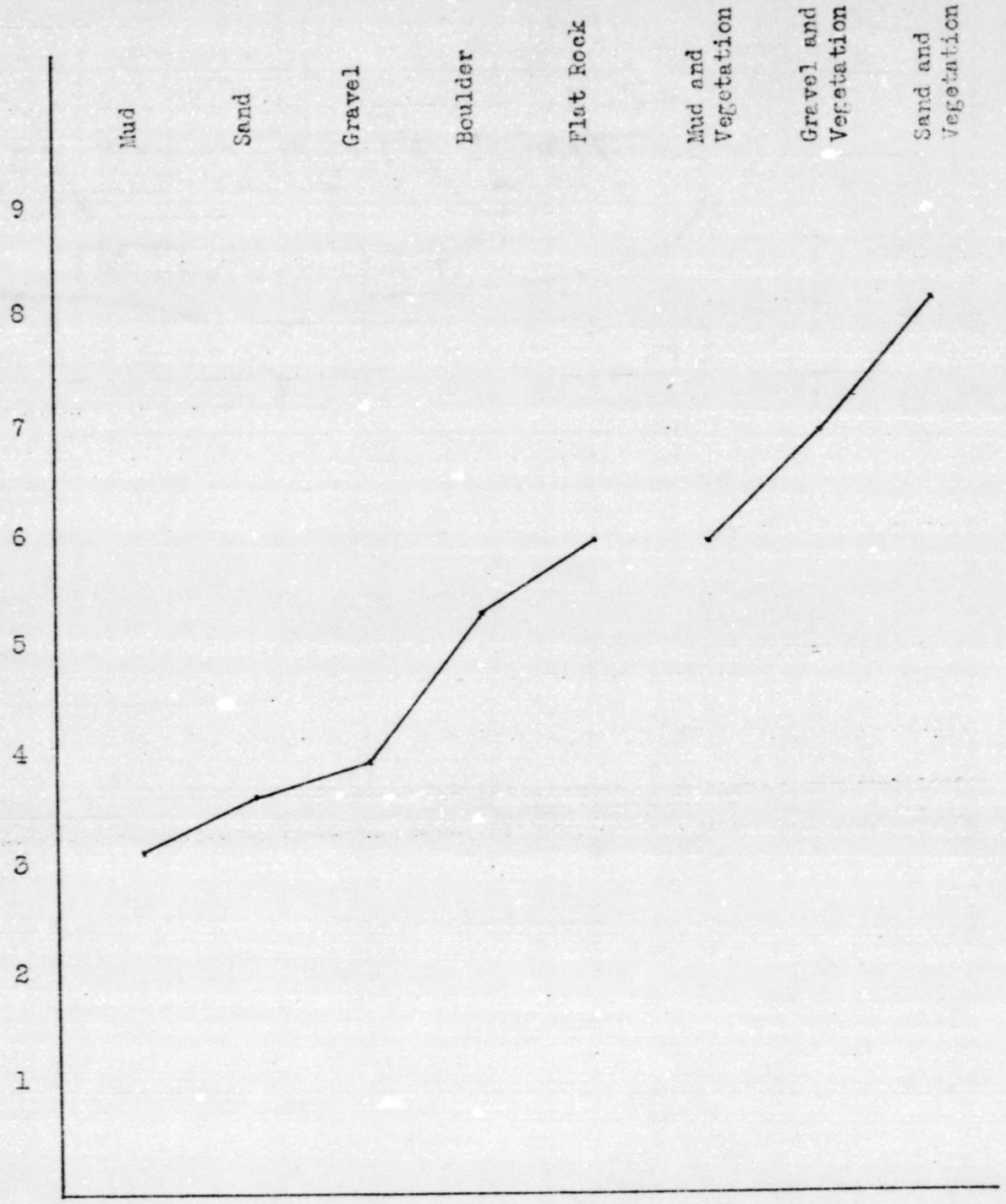


Fig. 2. Average number of different kinds of animals per square yard on different types of substrata.

Boulder bottoms with an average total population of sixty-six individuals to the square yard, were the most densely populated areas. This was due to the large protected areas and the stability of the large stones. The number of animals found per unit area on the different types of bottom is small when compared with the number of individuals found by Baker ('18), Juday ('24), and Krecker and Lancaster ('33) from their studies of bottom faunas.

Figure 1 also shows the relation between total average population and habitats with vegetation. Mud bottom was followed in the same order of increasing population, by sand and gravel, as was found when no vegetation was present. Animals were found in largest numbers where plants were most abundant. This was the result of the plants supplying the animals with food and protection. Mud bottom with vegetation had an average of thirty-two individuals per square yard, while the greatest average number of individuals per square yard found on bottom with vegetation was sixty-four.

Figure 2 shows the relation between the number of forms and the type of bottom. The number of forms increased as the size of the units of the substratum increased, with one exception, flat rock areas had a greater average number of forms per square yard than boulder areas. This line of increase also holds true when the number of forms is studied in relation to the velocity of the water. The number of forms increased from the lowest average, three and three tenths, found on mud bottom, to the highest, six, found on flat rock areas. This increase was caused by the large stones furnishing better protection and being more stable than

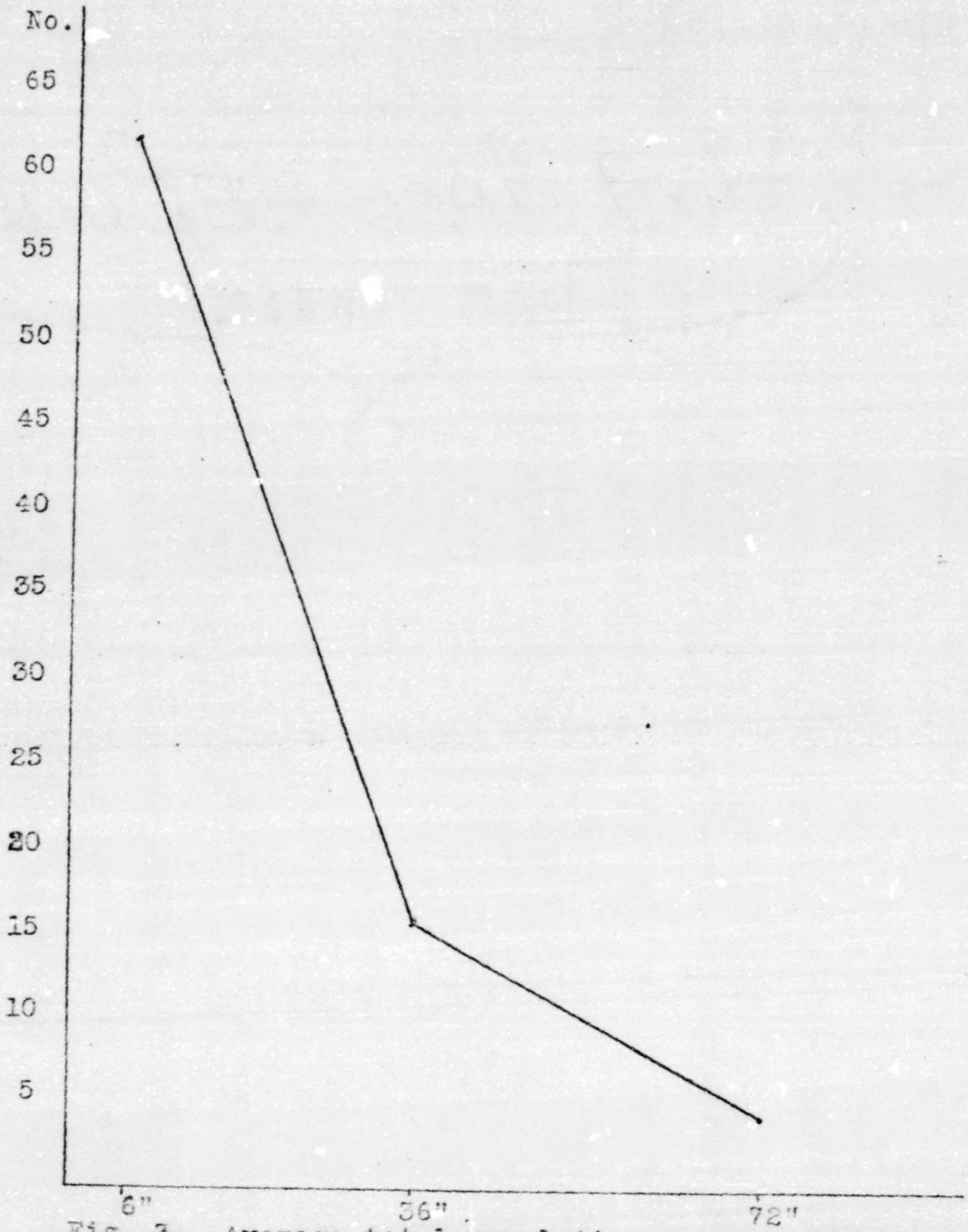


Fig. 3. Average total population per square yard at the depths chosen.

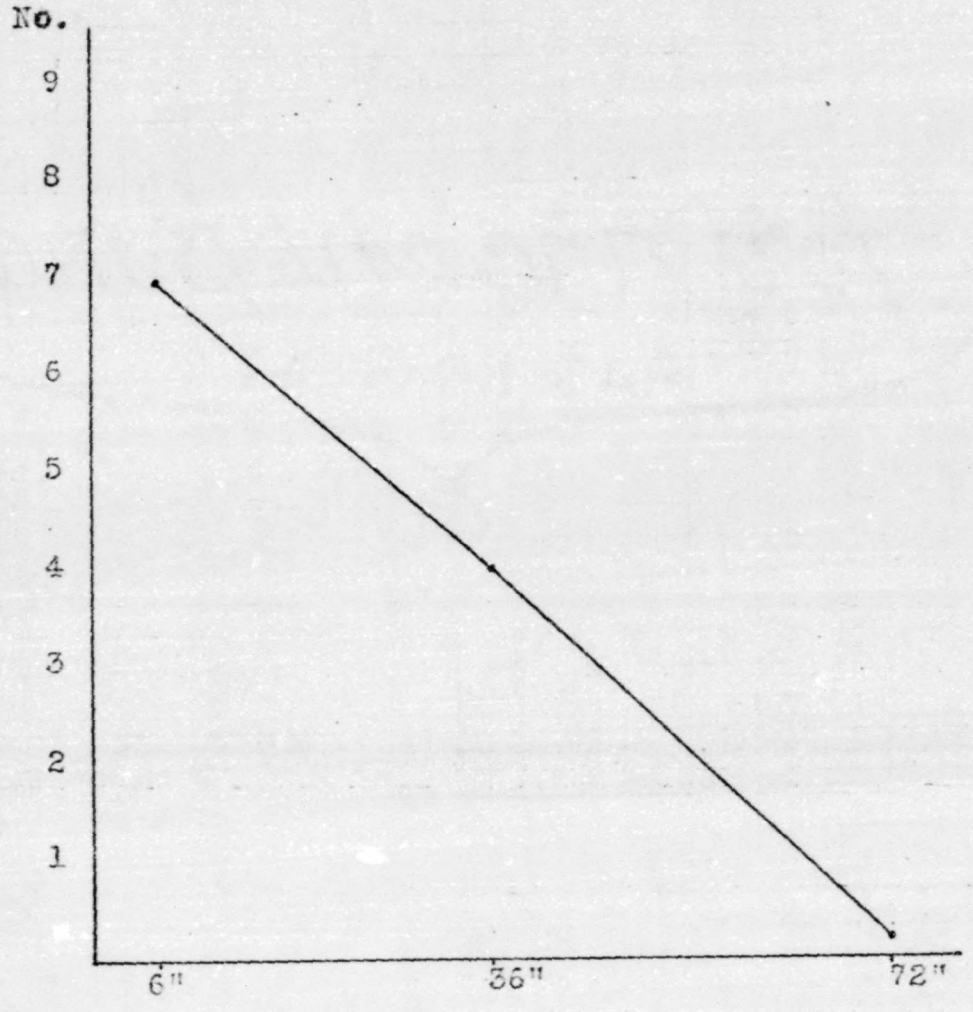


Fig. 4. Average number of forms per square yard at the depths chosen.

TABLE I, A General Distribution of Individuals at Each Station

Animal	Stations and Their Three Depths in Inches																
	I			II			III			IV			V		
	6	36	72	6	36	72	6	36	72	6	36	72	6	36	72
Annelida															
Limnodrillus															
Crustacea															
Cambarus				1			6							3	
Asellus										1					
Palaemonetes															
Gammarus															
Insecta															
Ameletus				3											
Anisoptera	2							1			1				
Beetle (La.)	1						1	10		1					
Belastoma				1											
Caddis Fly(La.)											1				
Chironomid(La.)								2			3				
Corydalus	6														
Crane Fly(La.)	1														
Dytistidae															
Epeorus															
Ephemerida							1								
Gyrinidae															
Heptagenia	9														
Hexagenia								1		1	6				
Notonecta													2		
Potamanthus															
Parnidae							6								
Perla															
Psephenus							1								
Pteroarcys															
Sialis	1							1							
Tabanus							1	1							
Zygoptera											1			3	
Mollusca															
Amnicola					24		45			3					
Ancylus															
Angulata				9						56	9		3		
Anodonta				2											
Compeloma	32										3				
Goniobasis				18	37		42				1			3	
Lastena															
Margaritana															
Pleurocera															
Ratundaria															
Sphaerium								3		8	8		28		
Tritigonia										1					
Unio															
	52			34	61		103	19		51	32		33	9	

TABLE I. Continued.

Animal	Stations and Their Three Depths in Inches																	
	VI			VII			VIII			IX			X		
	6	36	72	6	36	72	6	36	72	6	36	72	6	36	72
Annelida															
Limnodrilus															
Crustacea															
Cambarus	5	2			1		1			14			19		
Asellus							20						1		
Palaemonetes		1													
Gammarus															
Insecta															
Ameletus															
Anisoptera	5									2			22		
Beetle (La.)				1									1		
Belastoma															
Caddis Fly(La.)															
Chironomid(La.)	3			10		18							3		
Corydalus															
Crane Fly(La.)															
Dytistidae															
Epeorus															
Ephemerida															
Gyrinidae															
Heptagenia	1						10								
Hexagenia	2	6		7			1						2		
Notonecta															
Potamanthus	2					1									
Parnidae													24		
Perla							4								
Psephenus															
Pteroarcys															
Sialis	1														
Tabanus															
Zygoptera		2					1				2		3		
Mollusca															
Amnicola	2				3					23					
Ancylus							25			2			2		
Angulata	9				4		2			2					2
Anodonta	1									90	14				
Compeloma															
Goniobasis															
Lastena															
Margaritana		1													1
Pleurocera															
Ratundaria															
Sphaerium		1													
Tritigonia															
Unio															
	31	13		18	8	19	64			133	16		77	3	

TABLE I, Continued.

Animal	Stations and Their Three Depths in Inches																	
	XI			XII			XIII			XIV			XV		
	6	36	72	6	36	72	6	36	72	6	36	72	6	36	72
Annelida															
Lumnodrilus															
Crustacea															
Cambarus				26	3										
Asellus	2												30		
Palaemonetes													2		
Gammarus				3											
Insecta															
Ameletus															
Anisoptera	3			13			1			1			3	1	
Beetle (La.)															
Belastoma															
Caddis Fly(La.)															
Chironomid(La.)															
Corydalus	13														
Crane Fly(La.)															
Dytistidae															
Epeorus				1											
Ephemerida															
Gyrinidae															
Heptagenia	21						3			27				2	
Hexagenia														5	
Notonecta															
Potamanthus															
Parnidae				3									15		
Perla							5								
Psephenus															
Pteroarcys															
Sialis															
Tabanus															
Zygoptera				1									2		
Mollusca															
Amnicola															
Ancylus															
Angulata	6			23									3		
Anodonta															
Compeloma										15			2		
Goniobasis	42			83	1										
Lastena															
Margaritana															
Pleurocera															
Ratundaria															
Sphaerium				1										1	
Tritigonia															
Unio															
	87			153	5		9			43			157	9	

TABLE I, Continued.

Animal	Stations and Their Depths in Inches																	
	XVI			XVII			XVIII			XIX			XX		
	6	36	72	6	36	72	6	36	72	6	36	72	6	36	72
Annelida															
Limnodrilus															
Crustacea															
Cambarus	9			18			2						7	6	
Asellus				3						1					
Palaemonetes	6														
Gammarus				4											
Insecta															
Ameletus															
Anisoptera	2			8											
Beetle (La.)				1											
Belastoma															
Caddis Fly La.															
Chironomid(La)	2							1					3		
Corydalus										71					
Crane Fly(La.)															
Dytistidae	2														
Epeorus															
Ephemerida															
Gyrinidae		1													
Heptagenia	1	1		1						8					
Hexagenia															
Notonecta													3		
Potamanthus															
Parnidae	4			7											
Perla															
Psephenus							1								
Pteroarcys				1											
Sialis				1									2	3	
Tabanus															
Zygoptera		3		4			25						11		
Mollusca															
Amnicola															
Anyclus															
Angulata	28			11	1								10	5	
Anodonta													3		
Compeloma					3					7					
Goniobasis	75	28		4	6		34	1		6			27		
Lastena													3		
Margaritana															
Pleurocera													2		
Ratundaria		1													
Sphaerium			1												
Tritigonia															
Unio			1												
	127	34	2	73	10		62	1		93			71	14	

TABLE I, Continued.

Animal	Stations and Their Three Depths in Inches																	
	XXI			XXII			XXIII			XXIV			XXV		
	6	36	72	6	36	72	6	36	72	6	36	72	6	36	72
Annelida															
Limnodrilus	1						1								
Crustacea															
Cambarus	6	2						1		1	3		3		
Asellus	8	2		1										1	
Palaemonetes															
Gammarus	2	1													
Insecta															
Ameletus															
Anisoptera	5	1					1								
Beetle (La.)	1	3		2					5		4		1	8	
Belastoma															
Caddis Fly(La.)															
Chironomid(La.)		3						3	27		8		3	6	
Corydalus				6											
Crane Fly(La.)															
Dytistidae															
Epeorus															
Ephemerida															
Gyrinidae	1														
Heptagenia	2			14			7	1			3		2	2	
Hexagenia	2							2							
Notonecta															
Potamanthus											1				
Parnidae		1													
Perla				4											
Psephenus				2											
Pteroarcys	1														
Sialis		3					1	2		4				7	
Tabanus															
Zygoptera	1	1					3	1		1	3		2		
Mollusca															
Amniccla															
Ancylus		1						1							
Angulata	22	4		3			10	5		24			23	4	
Anodonta															
Compeloma															
Goniobasis	31	1		46			3	6			1		4		
Lastena															
Margaritana															
Pleurocera															
Retundaria															
Sphaerium		1													
Tritigonia										5					
Unio															
	83	24		78			25	22	32	35	23		38	28	

TABLE I, Continued:

Animal	Stations and Their Three Depths in Inches																	
	XXVI			XXVII			XXVIII			XXIX			XXX		
	6	36	72	6	36	72	6	36	72	6	36	72	6	36	72
Annalida															
Limnodrilus															
Crustacea															
Cambarus	11						4			3	2		2		
Asellus				3											
Palaemonetes	1									1					
Gammarus										1					
Insecta															
Ameletus	9									1	2				
Anisoptera											1		1		
Beetle (La.)															
Belastoma															
Caddis Fly(La.)															
Chironomid(La.)													17		
Corydalus				1											
Crane Fly(La.)															
Dytistidae															
Epeorus															
Ephemerida															
Gyrinidae	1														
Heptagenia	4			1											
Hexagenia	1														
Notonecta															
Potamanthus															
Parnidae	1													1	
Perla				5											
Psephenus				6			1	1							
Pteroarcys										1					
Sialis			1							1	1			1	
Tabanus															
Zygoptera	1	1					1			1					
Mollusca															
Amnicola	4						40						25		
Ancylus															
Angulata	18			1			12	4		2	2		7		
Anodonta															
Compeloma															
Goniobasis	96	18		11			97	6		6			35	36	
Lastena															
Margaritana										1					
Pleurocera								1							
Rotundaria															
Sphaerium							1								
Tritigonia															
Unio															
	147	20		26			156	12		18	6	18	71	36	

TABLE I. Continued.

Animals	Stations and Their Three Depths in Inches																	
	XXXI			XXXII			XXXIII			XXXIV			XXXV		
	6:	36:	72	6:	36:	72	6:	36:	72	6:	36:	72	6:	36:	72
Annelida															
Limnodrilus															
Crustacea															
Cambarus										7	6		4		
Asellus	4														
Palaemonetes															
Gammarus											1				
Insecta															
Ameletus															
Anisoptera	1									1					
Beetle (La.)										3					
Belastoma															
Caddis Fly(La.)	1														
Chironomid(La.)							12	2			3				
Corydalus				2											
Crane Fly(La.)															
Dytistidae															
Epeorus															
Ephemerida															
Gyrinidae															
Heptagenia	6			11											
Hexagenia															
Notonecta															
Potamanthus											1				
Parnidae															
Perla	1														
Psephenus	7			1											
Pteroarcys															
Sialis							1								
Tabanus							2	1		2	1				
Zygoptera							2			2			1		
Mollusca															
Amnicola							1	2		4			2	8	
Ancylus															
Angulata	2	4					1	1		35			24		
Anodonta															
Compeloma															
Goniobasis	4			24			1	1		10			19	2	
Lastena															
Margaritana															
Pleurocera	2						1								
Rotundaria															
Sphaerium							1				1				
Tritigonia															
Unio															
	28	4		36			22	7		64	13		50	10	

TABLE I, Continued.

Animal	Stations and Their Three Depths in Inches												Total
	6	36	72	6	36	72	6	36	72	6	36	72	
Annelida													
Limnodrillus					2								1
Crustacea													
Cambarus													211
Asellus													49
Palaemonetes													12
Gammarus													7
Insecta													
Ameletus													14
Anisoptera													85
Beetle (La.)													36
Belastoma													1
Caddis Fly(La.)													1
Chironomid(La.)													129
Corydalus													99
Crane Fly(La.)													1
Dytistidae													2
Epeorus													1
Ephemerida													1
Gyrinidae													3
Heptogenia													136
Hexagenia													34
Notonecta													5
Potamanthus													5
Parnidae													62
Perla													19
Psephenus													20
Pteroarcys													2
Sialis													38
Tabanus													5
Zygoptera	1												50
Mollusca													
Amnicola													234
Ancylus													24
Angulata	2			2									375
Anodonta													7
Compeloma													62
Goniobasis	22	10		12			6						1019
Lastena													3
Margaritana													4
Pleurocera													7
Retundaria													1
Sphaerium													60
Tritigonia													1
Unio													1
	25	10		16			6						2629

TABLE II. A Distribution of Forms According to Habitat and Depth

Animal	Depth in Inches			Type of Habitat								
	6	36	72	Mud	Sand	Gravel	Boulder	Flat Rock	Mud and Vegetation	Sand and Vegetation	Gravel and Vegetation
Annelida											
Limnodrilus	1									1	
Crustacea											
Cambarus	181	30		8	6	20		1	20	64	86
Asellus	45	3			1		8	23	1	12	3
Palaemonetes	11	1								1	11
Gammarus	6	1							1	2	4
Insecta											
Ameletus	14				9					5	
Anisoptera	80	5				2	4	4	1	16	54
Beetle La.	13	17	6	4	9		2	1	8	6	2
Belostoma	1			8	1						
Caddis Fly La.	1						1				
Chironomid La.	36	31	62	89	9	1			14	11	5
Corydalus	99						92	7			
Crane Fly La.	1							1			
Dytistidae	2										2
Epeorus	1										1
Ephemerida	1									1	
Gyrinidae	2	1								1	2
Heptagenia	132	6		15	2		60	49	10	5	7
Hexagenia	11	33		2	2			1	2	16	3
Notonecta	5								2	3	
Potamanthus	2	2	1	1						2	
Parnidae	61	1				1				22	39
Perla	19						5	14			
Psephenus	19	1				3	10	6		1	
Pteroarcys	2									1	1
Sialis	15	19		6	7	1		1	7	10	2
Tabanus	3	2		3						2	
Zygoptera	29	21		6	4	5		1	10	11	13
Mollusca											
Amnicola	197	37		6	24	123			7	58	16
Ancylus	29					2		25			2
Angulata	329	46		25	40	49	15	3	107	53	83
Anodonta	7				2					4	1
Compeloma	56	6					7	47	3	2	3
Goniobasis	843	176		17	104	342	122	11	13	101	309
Lastena	3									3	
Margaritana	2	2		2						1	1
Pleurocera	5	2		1		1	2			3	
Ratundaria		1									1
Sphaerium	44	16		1		1			50	6	2
Tritigonia	1								1		
Unio	1										1
	2310	450	69	194	220	557	328	195	257	424	654

smaller ones. Gravel bottom furnishes more foothold for the invertebrate animals than sand or mud.

Figure 2 also brings out the fact that the number of forms found on bottom with vegetation was larger than on bottom without vegetation. Vegetation caused a change in the ranking of the various types of bottom based on the average number of forms from that found where vegetation was absent. Mud bottom, with an average of six forms per square yard, had the fewest number of forms. This was followed by gravel bottom, with seven, and sand bottom, with eight and two tenths. This difference was caused by the large number of plants found on sand bottom. Sand bottom also had traces of gravel that offered the animals surfaces to which they could cling.

Distribution as to Depth.- Figure 3 shows the average total population at each depth. Sixty-two individuals were found per square yard within the six-inch countour. There were sixteen animals found per unit area at the thirty-six inch depth, while only four were found at the seventy-two inch depth.

Figure 4 shows the number of forms found per square yard at each depth. The number of forms decreased as the depth increased. An average of seven forms per square yard was found at the six-inch depth. The thirty-six inch depth yielded four individuals to the square yard, while the seventy-two inch depth yielded only an average of two tenths of one.

Animals Found.- Table I gives a list of the different forms and the distribution of the individuals of each form as to depth and type of bottom at each station. Here, the number of individ-

uals found is recorded under the conditions where they were found.

Table II shows the distribution and abundance of the various forms of animals with regard to depth, and with regard to the bottoms with and without vegetation. The genera are not given in all cases because the insect larvae were numerous and difficult to identify. These technical identifications would have no distinct bearing on the problem and would also make the analysis of the data too complicated. Under this circumstance the family or sub-order is recorded.

There were forty-one groups of animals found, thirty-five of which were listed as genera and nine as families or sub-orders. Twenty-three of the total number of forms were insects, twelve were mollusca, and four were crustacea. Seven of the mollusca were mussels, which occurred in small numbers as to individuals, and four were snails, which made up the greater part of the total population of all the groups found.

Goniobasis and Angulata were found under all conditions except at the seventy-two inch depth. No form was found under all conditions studied. Cambarus, Anisoptera, Sialis, and Zygoptera were found on all types of bottom except one. This type varied with the groups mentioned.

Beetle larvae, chironomid larvae, and Potamanthus were the only forms that were found at all depths. These forms were also found on a majority of the types of bottom studied. Chironomid larvae were most abundant of the three forms and were found in largest numbers, on mud bottom, at the seventy-two inch depth.

Thirty-five forms were found to have their largest number

of individuals per square yard within the six inch contour, three at the thirty-six inch depth, and only one at the seventy-two inch depth.

When the total number of individuals of each of the four divisions, under which the genera and families are grouped, are compared with the total number of individuals found, 63.5 per cent are mollusca, 26.5 per cent are insects, and eight and nine tenths per cent are crustacea. Fifty-six and six tenths per cent of the individuals of the mollusca were Goniobasis, which shows that the number of individuals of the other forms of mollusca is small.

The results of this investigation do not coincide with all the other investigations of this nature that have been made. However, the results seem to be in accord with Richardson's ('21) results obtained from his study of the middle and lower Illinois River, except in one case, the forms that he found to be of most importance as fish food (Richardson '28) in the middle Illinois River are forms found in this study to have the fewest number of individuals per square yard. The per cent of insects found in Drakes Creek is very small as compared with the number found by Krecker and Lancaster ('33) from their study of the shallow waters of western Lake Erie. The small number of insects indicate that the amount of young game fish food is small, for Muttkowiski ('31) found that insects made up from forty to sixty per cent of the fish food of Mendota Lake, Wisconsin. The forms that were most abundant in Drakes Creek, as Goniobasis, Angulata, and Amnicola, have not been found by other investigation to be eaten

in very great abundance by game fish. From these results it may be said that fish food is a limiting factor in the propagation of game fish in the waters of Drakes Creek.

SUMMARY

An ecological study of the invertebrate animal forms exclusive of microscopic forms found in the waters of Drakes Creek in Warren County, Kentucky, was undertaken for the purpose of determining both the nature and the amount of invertebrate animal life found in these waters. The Kentucky Fish and Game Commission has made several plantings of game fish in the waters studied. In view of the failure of the fish to propagate properly in these waters, it was believed that food might be a limiting factor in the propagation of fishes in these waters. An ecological study was therefore made of the invertebrate animal forms exclusive of microscopic animals found in these waters at different depths and under different physical conditions.

No ecological studies seem to have been made of the waters of Drakes Creek. It therefore seemed desirable to make a general study of the animal forms exclusive of microscopic forms independent of the problem of food for game fish.

No literature dealing with the distribution of animal life in Kentucky rivers from the ecological standpoint or from the standpoint of adequate food supply for game fish seems to exist. However, extensive ecological studies of this nature have been made in several other states. In these studies it was found that the number of forms and the total population varied with the character of the substratum and the depth of the water. It was also found by these studies that young game fish feed extensively on insect larvae.

The types of habitats studied are the following: boulder,

flat rock, gravel, gravel and vegetation, sand, sand and vegetation, mud, mud and vegetation. Each of these had dead leaves present except those exposed to strong currents. Vegetation was found in varying amounts on three types of bottom. Four or five stations were selected from each type of habitat.

Figure 1 shows the relation between population and type of bottom, and also between population and type of bottom with vegetation. Mud bottom, with sixteen individuals to the square yard, had the fewest number of animals. This was followed in order of increasing population by sand, flat rock, gravel, and boulder. Boulder bottom, with an average total population of sixty-six individuals to the square yard, was the most densely populated area. The number of animals found per unit area on the different types of bottom is very small when compared with the number of individuals found by Baker ('18) and Juday ('24) from their studies of bottom faunas. The bottom with vegetation had a greater number of animals per unit area than bottom without vegetation. Mud bottom with vegetation had an average of thirty-two individuals per square yard, while gravel areas with vegetation had an average population of sixty-four.

Figure 2 shows the relation between the number of forms and the type of bottom with vegetation and also between the number of forms and the type of bottom without vegetation. The greatest number of forms found on bottoms without vegetation per square yard was found on stony bottoms. Flat rock had a greater number of forms than boulder. The number of forms increased from the lowest average, three and three tenths, found on mud bottom, to the highest, six, found on flat rock. A greater number of forms

per square yard was found on bottoms with vegetation than on bottoms without vegetation. The largest number of forms was found on sand bottom with vegetation.

Figure 3 shows the average total population at the three depths chosen. A decline is shown in the number of individuals with increasing depth. Sixty-two animals per square yard were found at the six-inch depth, sixteen were found at the thirty-six inch depth, while only four were found at the seventy-two inch depth.

Figure 4 shows the number of forms found at the different depths chosen. The greatest number of forms per square yard was seven, found at the six-inch depth, while the lowest number of forms was two tenths, found at the seventy-two inch depth.

Table I gives a list of the different forms and the distribution of each form as to depth and type of bottom at each station.

Table II shows the distribution and the abundance of individuals with regard to depth, and with regard to the type of bottom with vegetation and type of bottom without vegetation. The genera were not given in all cases due to the numerous insect larvae.

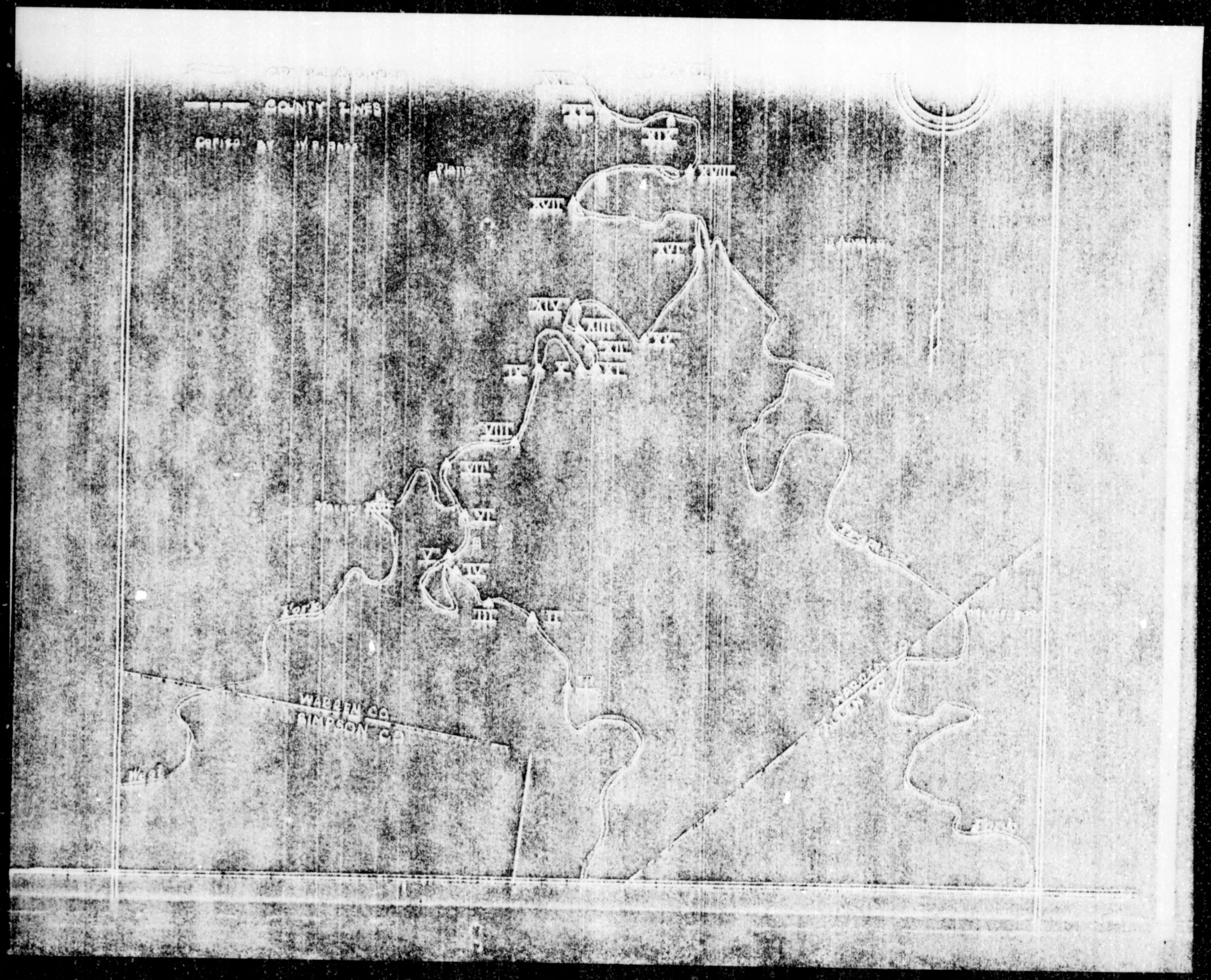
There were forty-one groups of animals found, twenty-three of which were insects, thirteen were mollusca, and four were crustacea. Eight of the mollusca were mussels, which occurred in small numbers. Four groups of snails made up the greater portion of the total population.

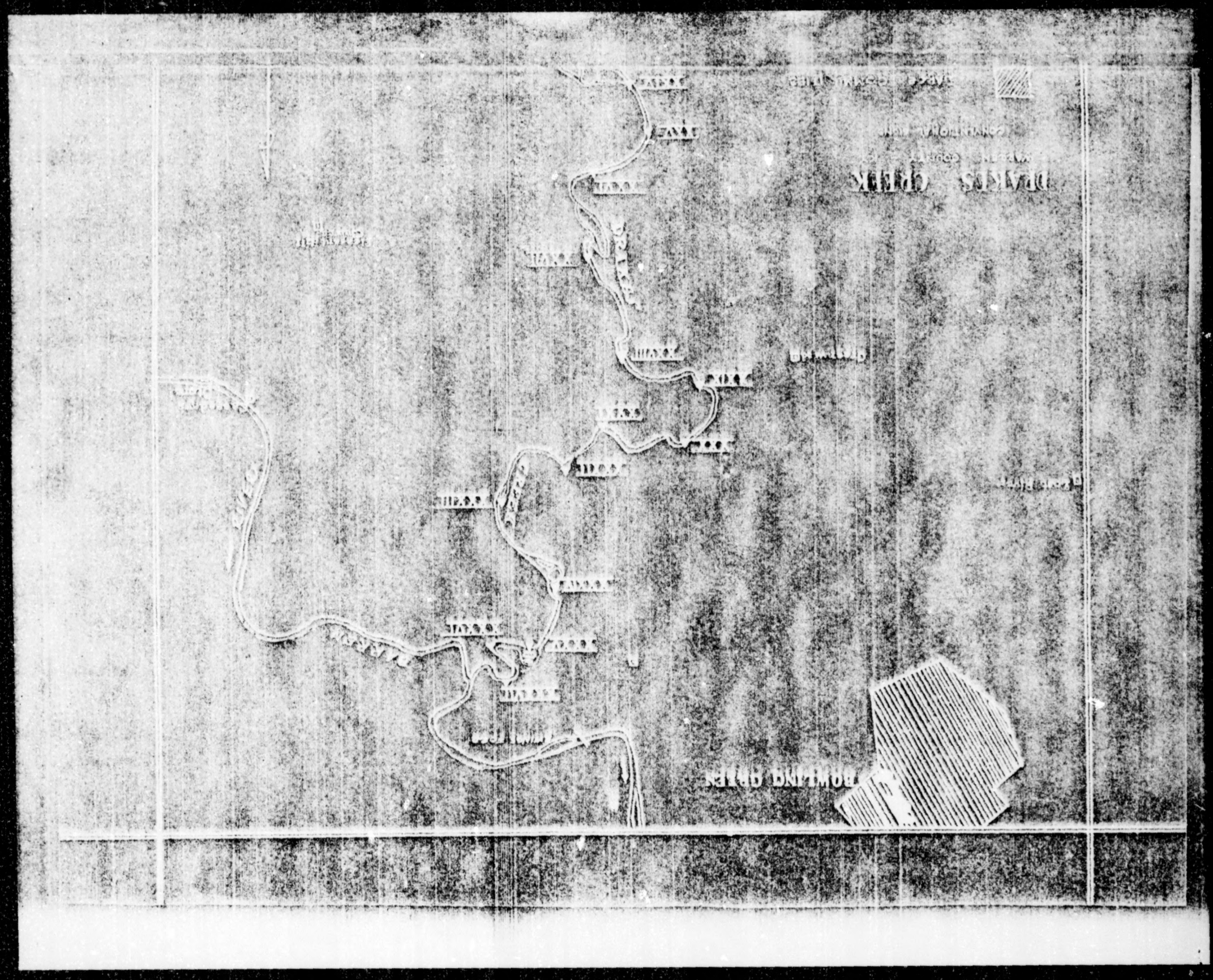
Goniobasis, Angulata, Cambarus, Anisoptera, Sialis, and Zygoptera were found under a greater variety of conditions than the other forms.

Beetle larvae, Chironomid larvae, and Potamanthus were the only forms that were found at all depths. The chironomid larvae were found in largest numbers at the seventy-two inch depth.

Thirty-five forms were found to have their greatest number of individuals per square yard within the six-inch contour, three at the thirty-six inch depth, and only one at the seventy-two inch depth.

Sixty-three and five tenths per cent of the total number of individuals were mollusca, 26.5 per cent were insects, and eight and nine tenths per cent were crustacea. Fifty-six and six tenths per cent of the mollusca were Goniobasis. The number of insects was very small when compared with the number found by Krecker and Lancaster ('33). From the standpoint of fish food the per cent of insects found in Drakes Creek is small, for Muttkowiski ('31) found that from forty to sixty per cent of the fish food of Mendota Lake was insects. Forms that were most abundant in Drakes Creek, as Goniobasis, Angulata, and Amnicola, have not been found to be eaten in large quantities by game fish. From these results it is probable that fish food is a limiting factor in the propagation of game fish in Drakes Creek.


COUNTY LINES
Plains
XVIII
XVII
XIV
VIII
VII
VI
V
III
II
I



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ACKNOWLEDGMENTS

Acknowledgments are due the following persons, who by assistance in various ways have so materially aided in the pursuit of the work:

Dr. M. C. Ford, Director Ogden Department of Science, Western Kentucky State Teachers College, who assisted in the writing of this thesis.

Dr. L. Y. Lancaster, Professor of Zoology, Western Kentucky State Teachers College, who suggested the survey, aided the writer in making collections, and gave much other valuable.

Mr. Raymond Hightower, who aided in the making the collections.