ABSTRACT

Charlie F. Heath, Jr. FEEDING HABITS OF VERTEBRATES IN MALLARD CREEK. (Under the direction of Dr. Joseph G. Boyette) Department of Biology, 1971.

Samples were taken from Mallard Creek during the summer of 1969 and returned to the laboratory for stomach analyses. Specimens were weighed, measured, sexed and some were temporarily processed by freezing when time did not permit immediate stomach analyses.

Although several collecting methods were used, rotenone accounted for the largest sample of fishes. Turtles were taken on set-hooks. Seventeen species of vertebrates were collected. Nine species were collected in numbers of nine or more.

Data collected from stomach analyses indicated that no species was entirely herbivorous, but golden shiners, brown bullheads and snapping turtles relied heavily on plant material. These animals served primarily as first level consumers in the Mallard Creek system.

Pumpkinseed, yellow perch, white perch and american eel ate some plant material but fed primarily on invertebrates. In pumpkinseed, all plant material was found in the larger fish. Yellow perch consumed a variety of foods but fish was the major food in the largest perch (230-277 mm). White perch fed primarily on fish but took invertebrates

also. The american eel fed primarily on invertebrates, most of which were insects. The pumpkinseed, yellow perch, white perch, and a merican eel occupied significant positions as second and higher level consumers in the Mallard Creek system.

The bluespotted sunfish served as a secondary consumer and fed exclusively on invertebrates; while the adult chain pickerel served as a top level consumer, feeding exclusively on fish.

FEEDING HABITS OF VERTEBRATES

IN

MALLARD CREEK

A Thesis

Presented to

the Faculty of the Department of Biology

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In Partial Fulfillment

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Master of Arts in Biology

by

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INTRODUCTION

Food and feeding habits of most fishes have been incompletely studied. There are data on only a few fishes, game or nongame, and many other common aquatic vertebrates have been equally uninvestigated. Turtles, for example, are found in aquatic communities everywhere, but few studies have been conducted on their feeding habits.

This study was an attempt to gather basic information on the feeding habits of the most prevalent aquatic vertebrates in a small tributary of the Pamlico River, coastal North Carolina. This tributary, Mallard Creek, flows into the Pamlico River from the north about 25 miles inland from the mouth. Collections were made periodically throughout the summer of 1969. Information was compared, when possible, with reports from other localities throughout the United States.

Vertebrates examined in this study are as follows:

Brevoortia tyrannus (Latrobe)	menhaden
Esox niger Lesueur	chain pickerel
Notemigonus crysoleucas (Mitchill)	golden shiner
Erimyzon oblongus (Mitchill)	chubsucker
Ictalurus nebulosus LeSueur	brown bullhead
Anguilla rostrata (LeSueur)	american eel
Fundulus diaphanus (LeSueur)	killifish
Gambusia affinis (Baird and Girard)	top minnow
Lepomis gibbosus (Linnaeus)	pumpkinseed
Micropterus salmoides Lacepede	largemouth bass
Enneacanthus gloriosus (Holbrook)	bluespotted sunfish
Enneacanthus obesus (Girard)	banded sunfish
Perca flavescens (Mitchell)	yellow perch
Roccus americana (Gmelin)	white perch
Leiostomus xanthurus Lacepede	spot
Chelydra serpentina Linnaeus	snapping turtle
Pseudemys scripta (Schoepff)	yellow-bellied turtle

This study is part of a combined effort involving a number of ECU students and faculty attempting a baseline ecological evaluation of the area. Kohlweiss (1971) has completed a survey of the parasites of sunfish in Mallard Creek. My study was an attempt to identify the aquatic vertebrates, their foods, and their feeding habits.

REVIEW OF LITERATURE

Literature was reviewed for each species studied, but information was not found on some.

A complete study on feeding habits of Esox niger (chain pickerel) was presented by Raney (1942) for the Edmund Niles Huyck Preserve at Renneselaerville, New York. The study was divided into the food of young (27mm - 101mm), and the food of juvenile and adult pickerel (121mm - 495mm). He reported the stomach contents of 104 young pickerel as being all aquatic in origin. Insects composed 64%, of which mayfly and dragonfly larva were the most important. Only 33% of the volume was fish and consisted of golden shiner and pumpkinseed sunfish. Although from one to six fish were found in the stomachs in each of 28 young pickerel, the majority contained only one. The only crustaceans were Daphnia and unidentified Isoptera which occurred in extremely small numbers. Of 234 juvenile and adult pickerel stomachs, 145, or 62%, contained food. All food was aquatic in origin, 42% were crayfish, only 9% were insects. Of food fish, the golden shiner made up 13.8% and the common bullhead 13.2%; while other fish made up less than 5% each of the total volume. These included the pumpkinseed sunfish, yellow perch and chain pickerel. Of insects reported, dragonflies comprised 8% of the volume. Raney noted that all bullheads taken by the chain pickerel were young while the shiners were adult.

A study of the chain pickerel in South Central Florida showed that of 115 fish, only 38.3% contained food (Buntz, 1966). The author reported that in 44 fish some 47 food items were found and that only two fish contained more than one food item. He found that 40.4% of the food items were unidentifiable fish remains and 21.3% were bluegill (Lepomis macrochirus). The other fishes (black crappie, warmouth, bluespotted sunfish, golden shiner, brook silverside) each occupied less than 9% of the total volume.

The golden shiner (Notemigonus crysoleucas) is of no special economic importance to man except as cultured for bait, but does occur in the diet of crappie, bass and bluegill (Rice, 1942). Examination of stomachs of 40 fish, 36 to 44 mm in total length, from Bayou du Chien, gave the following results: Ostracoda, diatoms, Volvox, and sand, each 25% by volume.

Little work has been done on the chubsucker (Erimyzon oblongus) probably because it is of little economic importance. Rice (1942) reported the stomach contents of 20 fish from Reelfoot Lake, Tennessee, and found that 95% consisted of ostracods, while the remainder was made up of Volvox and traces of Arcella.

Stomach examination of 79 killifish (Fundulus diaphanus) was reported by Smith (1946). According to this author, the killifish is selective in its feeding habits and feeds predominantly on the bottom. The report indicates a dominance of microcrustaceans as food,

including Acantholeberis curvirostris (69.5%), Ophryoxus gracilis and Alona quadrangularis (8.9%), Canthocamptus (6.2%), with the ostracods, Chydorus flaviformis, and C. bicornutus, less than 3%. Each fish averaged 4.2 organisms. Macroscopic organisms reported by Smith in the killifish included Chironomid larvae and pupae (60.8%), Hyalella (21.5%) and Amnicola, Chaoborus larvae and pupae, and insect imagoes (less than 10% each). These were found in 130 fish.

Work on natural mosquito control methods has led to an accumulation of data on the feeding habits of Gambusia affinis, one of the organisms found in Mallard Creek. Investigations reported by Barnickol (1940) indicate a larger percentage of the diet being of animal origin with 4% to 18% plant material. Insects constituted 22% of the total food, with Diptera and Coleoptera comprising 7% and 6% respectively. Other insects included Hemiptera (4%), Odonata (2%), and Hymenoptera (traces). All these insects were in the nymphal or larval stage of development. Amphipods and isopods comprised 3% of the volume; Cladocera, and copepods, 2%.

Plant foods reported by Barnickol included Wolffia (19% of total volume), various algae, and Ceratophyllum found in only one of 316 stomachs. The amount of algae eaten was found to be greater where higher aquatic plants were less plentiful.

According to Barnickol, Gambusia contained 7% sand when found in areas where hydrophytes were sparse. Twenty fish averaging 12.8 mm contained 52% microcrustacea, as well as Hydracarina, rotifers and algae. Juvenile fish were predominantly plankton feeders.

A study by Hess and Tarzwell (1941) on Gambusia in Wheller Reservoir in the vicinity of Decatur, Alabama, supports the work of Barnickol (1940) excepting disagreement on arthropods taken as food. Hess and Tarzwell (1941) report Entomostraca comprising over 50% of the total food in three habitats studied. One habitat provided 93.7% Entomostraca. Chironomidae occupied the next largest volume. Small percentages of Coleoptera, Diptera, Hemiptera and Odonata were also reported.

Hess and Tarzwell (1941), while studying Gambusia, found variations in the stomach contents and explained this by differences in habitat. The forage ratios for the anopheline and culicine mosquitos, which were under special study, were positively correlated with population densities. However, selection was greater toward the culicine mosquito even when population densities were equal.

The feeding habits of the yellow perch (Perca flavescens) have not been studied in great detail but investigations by Moffett and Hunt (1945) added significantly to the data. This investigation covered the period from January to March, 1941, in Cedar Lake, Michigan. Their study revealed that fish comprised over 90% of the total volume except for one sample in which it dropped to 62%. Most of the food fish taken were bluegill ranging between 30 and 40 mm in length. When perch were grouped according to size it was found that fish measuring less than 119 mm contained 7.38% crustacea (mostly planktonic). Fish from 120 to 139 mm contained 67.7% fish and

22% insects. The other size classes fed mainly on other fish. Ostracods were the predominant form of crustacean, odonates were the predominant form of insect.

The work of Moffett and Hunt (1945), later confirmed by Kutkuhn (1954), indicated that yellow perch fed on other fish and to a lesser extent on insects and crustaceans. Kutkuhn found yellow perch of North Twin Lake in Iowa, dependent on the yellow bass as its principal food in contrast to the bluegill reported to be the principal food by Moffett and Hunt.

Little work has been done on the food of Leiostomus xanthurus (Smith, 1907; Welsh and Breder, 1923; Hildebrand and Cable, 1930; Roelofs, 1954). The fish collected by Roelofs were taken from various localities in the Pamlico Sound of North Carolina. From 73 spots examined, he reported 50% to 90% of the stomach contents as annelids, when annelids were present at all. However, two thirds of the fish did not contain annelids. All fish contained large quantities of copepods. Almost 72% of the fish contained parasitic nematodes and 41.1% contained sand. Organisms found in less than 25% of the fish and in small quantities included diatoms, Foraminifera, ostracods, mysids, amphipods, decapods, mites, pelecypods, fish, algae, and various other plants. In the 135 stomachs examined by Hildebrand and Cable (1930) large numbers of copepods, large amounts of sand and small numbers of ostracods, minute mollusks and annelid worms were found. Sand sometimes constituted 50% of the content.

According to Alexander (1943) only three reports give information on feeding habits of the snapping turtle (Chelydra serpentina) prior to 1943. He reported a variety of food consumed by the snapping turtle and showed that food items varied with the habitat. The 470 turtles examined were taken from 4 different habitats; lakes, ponds, streams, and swamp. Peltandra made up 23% by volume of the plant diet in the swamps, algae 17.4%, and smaller percentages of Potamogeton, pond lily, Elodea, Najas, and skunk cabbage. In streams, algae composed 99% of the plant food, whereas in ponds and lakes it was 17.9% and 3.8% respectively. Only items making up the largest volume of food were mentioned in the latter three habitats. Animal foods in snapping turtles, according to Alexander, included crayfish with the largest percent by volume in all habitats and smaller percentages of insects, snails, fiddler crabs, shrimp, fish of various kinds, frogs, salamanders, snakes, birds, moles and muskrats. Paper and miscellaneous debris also were found. Fish and aquatic plants made up the largest part of the snapping turtle's diet with crayfish ranking third. He also stated that the faster moving game fish were not found in any number.

The feeding habits of the yellow-bellied turtle (Pseudemys scripta) are not well known and published material is scarse. Minyard (1948) examined P. scripta from two different ponds in Louisiana and found that the largest part of the diet was plant material. In one pond from which 59 stomachs were examined, 57.5% of the food by volume was vegetative matter, which included

Ceratophyllum (24.6%), Cladophora, Cletil occidentalis and Piaropus crassipes each making up less than 3% of the total volume. In the same pond, she reported animal material constituted 41.6% of the total volume. Animal life was largely represented by crayfish at 30.9% of the volume. Insects were reported along with paper and watermelon rinds. Minyard (1948) examined 45 P. scripta stomachs from a pond environment and discovered that 84.7% of the content was plant material, of which 31.8% was Oscillatoria with Cornus asperifolia and Persicaria making up smaller percentages. The remaining gut contents were made up primarily of animal derivatives (11.1% by volume). Crayfish (3.4%) and odonates (2.3%) were the major animals represented. A variety of other insects were reported but totaled less than 1%. Minyard also reported frog eggs, a snake (Natrix rhombifera) and 0.5% by volume of unidentified bones in stomachs.

No literature was found on foods of the following organisms: brown bullhead (Ictalurus nebulosus), american eel (Anguilla rostrata), white perch (Roccus americana), largemouth bass (Micropterus salmoides), banded sunfish (Enneacanthus obesus), bluespotted sunfish (Enneacanthus gloriosus), menhaden (Brevoortia tyrannus), and pumpkinseed (Lepomis gibbosus).

MATERIALS AND METHODS

Collections for this study were made by seine, angling, rotenone, set-hook, and dip net from Mallard Creek from June through August, 1969. As indicated, Mallard Creek (Fig. 1) is a tributary to the Pamlico River, located 23.5 miles inland from the mouth of the Pamlico in Beaufort County. Access is at the end of County Road 1335. The main body of the creek is 2 miles long, has an average width of 250 feet, contains approximately 60 acres of surface area, with a maximum depth of about 7 feet and an average depth of about 3 feet (Fish, 1969). The main mass of water entering this creek is wind-driven river water from the Pamlico River except for run-off water during heavy rains. Salinity varies from zero to several ppt, depending on weather conditions. The highest reading during this study was 10 ppt.

The banks of Mallard Creek are not occupied by human dwellings, and a rich growth of managed pines border the east and west banks. Immediately bordering the creek is marsh, predominantly covered by black needle rush (Juncus) and saw grass (Spartina) as is typical of slightly brackish marshlands in North Carolina. Occasional wax myrtle, red cedar and cypress are found throughout the entire marsh area. There are only two hard-bank approaches to Mallard Creek, both on the east bank.

Collecting was done from point A at the mouth of the creek to point B nearing the creek's origin in the West Branch (Fig. 1).

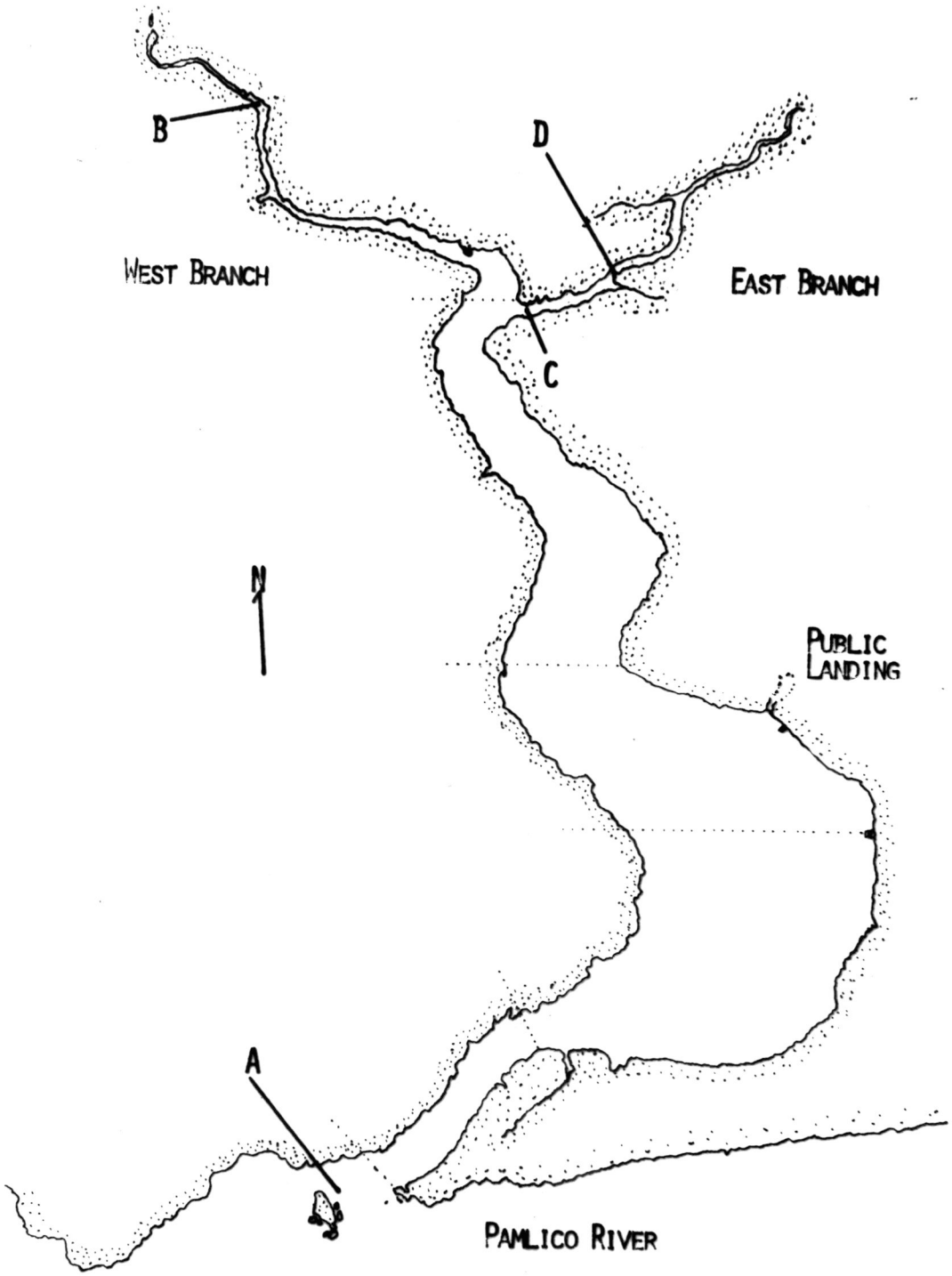
Attempts to collect above this point were unsuccessful. All specimens were kept on ice and returned to the lab for inspection. Seventeen species of vertebrates were collected and examined.

Water levels from June through August varied about one foot from the mean as established through recording levels on a marked stake, except for one instance when it fell 18 inches below the mean. These fluctuations as well as current were caused by winds rather than lunar tides.

Mud in this creek ranged to 8.5 feet, and contained large amounts of decaying plant matter. This substrate supported a thick growth of aquatic plants, mainly Myriophyllum and Potamogeton. Large quantities of separated and broken eel grass (Zostèra) were blown in from the Pamlico River.

The largest sample was taken with rotenone used in a concentration of 1 ppm. This toxin was dispersed from a boat moving in a zig-zag fashion from bank to bank in a fifty yard section between seines at points C and D in the East Branch (Fig. 1). Seines were put at points C and D to prevent entry of other organisms and loss of those trapped in the fifty yard section. As the toxin took effect, organisms were removed with a dip net and placed on ice. Permanganate was dispersed periodically at point C to prevent contamination of the remainder of the creek and subsequently was dispersed throughout the entire sampled section.

Figure 1. Mallard Creek


B
D
WEST BRANCH
EAST BRANCH
C
N
PUBLIC
LANDING
A
PAMLICO RIVER

Set-hooks, composed of a six foot pole, five feet of 120 lb. test nylon line and a 4/0 Eagle Claw hook, were set on both sides of the creek at fifty yard intervals with cut eel as bait. Each set was checked and rebaited at approximately fifteen minute intervals. This method was used from about 5:00 p.m. until 12:00 p.m. in order to collect sufficient numbers of brown bullheads (Ictalurus nebulosus), snapping turtles (Chelydra serpentina), and yellow-bellied turtles (Pseudemys scripta), which were the only vertebrates caught on set-hooks. Past experience showed that P. scripta would take bait more frequently during daylight than C. serpentina.

Aside from rotenone, angling was the method which accounted for the largest number of specimens. This technique included rod and reel as well as cane poles rigged with hook, line and cork. Several different baits were tried, but earthworms proved best. Other baits included artificial lures and freshwater clams. The artificial lures were difficult to work because of the thick mats of floating vegetation. Most samples were taken within three feet of the bank, but all areas were fished. A small minnow trap was set several times but was unsuccessful.

Several attempts were made with a seine net but without success. Seining required a boat because the substrate was extremely muddy and unstable. Other factors restricting use of the seine were floating vegetation, bottom snags, and thick growths of black needle rush (Juncus) growing in shallow water.

Specimens were returned to the laboratory, tagged, weighed, sexed, measured, and frozen for later examination if time did not permit immediate stomach analysis. Stomach contents were sorted in a small dish of water and counts were made. Vegetation components were recorded on a percentage of volume basis since each piece could not be considered an entire plant. When stomachs contained considerable material, like components were sorted and counted over a sheet of graph paper, since the number of items in each square could be eliminated after counting. Some items were recorded as individual pieces of organisms since they were dislocated. Observation of contents was done with a binocular dissection microscope (10X to 25X). Items not readily identified were preserved in 70% alcohol for later consideration.

RESULTS

Seventeen species of vertebrates were examined during the course of this study (Table I). Included were 417 fish of 14 genera and 15 species, and 2 genera and 2 species of turtles. Nine species of fish and one turtle were taken in sufficient quantity to make relatively firm conclusions about their feeding in Mallard Creek (Tables II-X). The small number of chubsucker, largemouth bass, spot, banded sunfish, topminnow, and yellow-bellied turtle made generalizations from data unsound but adds to our knowledge of these organisms.

Individual tables have been prepared for fish occurring in largest numbers and having largest numbers of food items: pumpkinseed, Tables II and III; chain pickerel, Table IV; yellow perch, Tables V and VI; and white perch, Tables VII and VIII. Some data not obvious in the tables follows:

> In pumpkinseed, acanthocephalans from 6 to 116 per specimen were found in the small intestine of 94 fish.
>
> One chain pickerel contained 2 Gammarus.
>
> One white perch contained 3 Acanthocephala, while 4 others contained 2 each and another contained nine nematodes.

Summary tables were prepared for the remaining species which were few in number or contained few different food items (Tables IX and X). The items on Tables IX and X are indicated by frequency of occurrence in the specimens. Size of the specimens and details on food are not evident in tables. These have been summarized in Appendix 1.

TABLE I

Aquatic Vertebrates from Mallard Creek
Percent with Food = $\frac{\text{No. of Specimens with Food}}{\text{Total No. of Specimens}}$

Name of Organism	Total No. of Organisms	Organisms with Food (%)
Lepomis gibbosus (pumpkinseed)	152	88.9
Esox niger (chain pickerel)	18	72.2
Perca flavescens (yellow perch)	99	89.9
Roccus americana (white perch)	36	86.1
Erimyzon oblongus (chubsucker)	2	100.0
Brevoortia tyrannus (menhaden)	1	0.0
Micropterus salmoides (largemouth bass)	1	100.0
Leiostomus xanthurus (spot)	6	83.3
Anguilla rostrata (eel)	17	41.2
Notemigonus crysoleucas (golden shiner)	19	94.7
Ictalurus nebulosus (brown bullhead)	15	86.7
Fundulus diaphanus (freshwater killifish)	4	100.0
Enneacanthus gloriosus (bluespotted sunfish)	34	82.4
Enneacanthus obesus (banded sunfish)	9	88.9
Gambusia affinis (topminnow)	4	75.0
Chelydra serpentina (snapping turtle)	9	100.0
Pseudemys scripta (yellow-bellied turtle)	4	100.0

TABLE II

Foods of *Lepomis gibbosus* from Mallard Creek
(number of organisms by actual count except where qualified)

Standard Length of Specimen (mm)	No. of Stomachs		Plant Material				+Annelida	Mollusca			Crustacea			
	With Food	Without Food	Filamentous algae	*Myriophyllum	Plant roots	Unidentified Veg.		*Amnicola*	Mollusc shells	Pelecypoda	*Corophium*	*Gammarus*	*Eubranchipus*	Isopoda
35-72	51	4						17			85	192		
73-110	48	10	*103	**1@ 90% 2@ 20%	29	2 leaves	1	381	1	1	1053	9		7
111-148	35	3	*44			10% 5% 2% 2% 2%	2	2171	1		654		1	
149-186	1	0				80%								

*Does not indicate entire plant
**For each specimen: $\frac{\text{Volume of Myriophyllum}}{\text{Total stomach contents}}$

+Used as bait

TABLE II (Continued)

Plecoptera	Ephemeroptera	Odonata		Coleoptera		Hemiptera	Trichoptera	Diptera					Hymenoptera	Fish	Anura	Unidentified as to origin
Philopotamus	Isonychia	Aphylla	Unidentified	Cybister	Dryopid	Arctocorixa	Leptocella	Dasyhelia	Calopsectra	Adult Diptera	Anopheles	Diptera parts	Formicidae			
						13		83	34					1@.4 cm		
2	1		1	2		8	1	5	7	1	1	18 wings	15		4 larvae	
		2	2		2	2			2			6 wings				42 leathery eggs
						19										

TABLE III

Foods of 152 *Lepomis gibbosus* from Mallard Creek
Percent Frequency = No. of Specimens with Food Item / Total No. of Specimens per Class
Range per Individual Indicates Actual Count

Food Organisms	35-72 mm		73-110 mm		111-148 mm		149-186 mm	
	Percent Freq.	Range per Individual	Percent Freq.	Range per Individual	Percent Freq.	Range per Individual	Percent Freq.	Range per Individual
Filamentous algae		2	5.2	2-52	5.3	0-22		
Myriophyllum			5.2	20-90				
Plant roots			5.2	3-19				
Unidentified vegetation			1.7	0-2	13.2	2-10%	100.0	0-80
Annelida			1.7	0-1	5.3	0-1		
Mollusca								
Amnicola	30.9	1-5	32.8	4-74	73.7	5-572		
Mollusc shell			1.7	0-1	2.6	0-1		
Pelecypoda			1.7	0-1				
Crustacea								
Corophium	58.2	1-32	37.9	1-200	13.2	7-435		
Gammarus	65.5	2-15	5.2	3-12				
Eubranchipus					2.6	0-1		
Isopoda			3.5	3-4				

TABLE III

(Continued)

Food Organisms	35-72 mm		73-110 mm		111-148 mm		149-186 mm	
	Percent Freq.	Range per Individual	Percent Freq.	Range per Individual	Percent Freq.	Range per Individual	Percent Freq.	Range per Individual
Insecta								
Philopotamus			1.7	0-2				
Isonychia			1.7	0-1				
Aphylla					2.6	0-2		
Unidentified Odonata			1.7	0-1	5.3	0-2		
Cybister			3.5	0-1				
Dryopid					2.6	0-2		
Arctocorixa	12.7	1-2	7.0	1-19	5.3	0-2	100.0	0-19
Leptocella			1.7	0-1				
Dasyhelia	20.0	3-14	1.7	0-5				
Calopsectra	21.8	1-27	5.2	1-4	2.6	0-2		
Adult Diptera			1.7	0-1				
Anopheles			1.7	0-1				
Diptera parts			8.6	1-4	5.3	1-4		
Formicidae					2.6	0-15		
Fish	1.8	0-1						
Anura			1.7	0-4				
Unidentified as to origin					2.6	0-42		

TABLE IV

Foods of Esox niger from Mallard Creek
(Number of Organisms by Actual Count except Where Qualified)

Standard Length of Specimen (mm)	No. of Stomachs With Food	No. of Stomachs Without Food	Crustacea	Fish								
			Gammarus	Anguillidae	Cyprinidae	Ictaluridae	Cyprinodontidae	Centrarchidae	Percidae	Partially identified Perciforms	Unidentified Sciaenidae	Unidentified Fish	Fish Parts
51-104	4	4	2		1@.9cm 1@1.1cm				1@1.6cm	1@1.0cm			
258-308	4	0						1@5.0cm 1@4.7cm	1@5.5cm 1@3.4cm		1@8.4cm	2@5.7cm 1@6.0cm	*1with 20%
309-359	1	1				1@5.1cm						2@3.0cm	
360-410	1	0				1@7.0cm 1@4.6cm							
411-461	2	0		1@2.4cm	1@6.3cm		1@5.2cm					1@5.0cm 1@4.0cm	*1with 10%
513-563	1	0										3@9.0cm	*1with 20%

*For each specimen: $\frac{\text{Volume of Fish parts}}{\text{Total stomach contents}}$

TABLE V

Foods of *Perca flavescens* from Mallard Creek
(number of organisms by actual count except where qualified)

Standard Length of Specimen (mm)	No. of Stomachs		Plant Material	Mollusca	Crustacea			Insecta		
	With Food	Without Food						Odonata		Orthoptera
				Amnicola	*Rithropanopeus*	*Corophium*	*Gammarus*	*Enallagma* (nymph)	Unidentified	Locustidae
38-85	14	0				1	191			
86-133	34	1	*4%	44		235	3368	2	3	
134-181	19	2	*2%	14		157	694		1	
182-229	19	5	*4%	190	4	292	631			1
230-287	3	2			3			2		

*For each specimen: $\frac{\text{Volume of plant material}}{\text{Total stomach contents}}$

TABLE V (Continued)

Insecta (cont'd)						Fish					
Hemiptera	Diptera				Hymenoptera	Ictalurus	Gambusia	Enneacanthus	Perca	Lepomis	Unidentified
Arctocorixa	Ceratopogonidae	Calopsectra	Dasyhelia	Unidentified	Formicidae						
9		4	2	2	6		1@2.3cm		1@2.5cm		1@1.4cm 3@1.3cm 8@1.5cm
7	1	7	2	2							
2		19		3	1	20@2.5 cm		1@4.3cm 1@4.0cm	1@2.0cm	1@4.5cm 1@5.3cm	1@ .7cm 1@1.3cm
							1@3.2cm				

TABLE VI

Foods of *Perca flavescens* from Mallard Creek
Percent Frequency = No. of Specimens with Food Item / Total No. of Specimens per Class

Food Organisms	38-85 mm		86-133 mm		134-181 mm		182-229 mm		230-277 mm	
	% Freq.	Range per Individual	% Freq.	Range per Individual	% Freq.	Range per Individual	% Freq.	Range per Individual	% Freq.	Range per Individual
Plant Material			2.9	0-4%	2.9	0-2%	2.9	0-4%		
Mollusca										
Amnicola			40.0	1-5	23.3	1-4	45.8	1-75		
Crustacea										
Rithropanopeus							12.5	1-2	40.0	1-2
Corophium	7.1	0-1	80.0	1-32	33.3	1-6	37.5	5-83		
Gammarus	100.0	1-25	94.3	11-341	61.9	5-137	58.3	2-103		
Insecta										
Enallagma (nymph)			5.7	0-1					20.0	0-2
Unidentified Odonata			8.5	0-1	4.8	0-1				
Locustidae							4.2	0-1		

TABLE VI (Continued)

Food Organisms	38-85 mm		86-133 mm		134-181 mm		182-229 mm		230-277 mm	
	% Freq.	Range per Individual	% Freq.	Range per Individual	% Freq.	Range per Individual	% Freq.	Range per Individual	% Freq.	Range per Individual
Insecta (cont'd)										
Arctocorixa			22.8	1-3	14.3	1-3	8.3	0-1		
Ceratopogonidae					4.8	0-1				
Calopsectra			11.0	0-1	19.0	1-3	20.8	1-7		
Dasyhelia			5.7	0-1	9.5	0-1				
Unidentified Diptera			5.7	0-1	9.5	0-1	12.5	0-1		
Formicidae			2.9	0-6			4.2	0-1		
Fish										
Ictalurus							4.2	0-20		
Gambusia			2.9	0-1					20.0	0-1
Enneacanthus							8.3	0-1		
Perca			2.9	0-1			4.2	0-1		
Lepomis							8.3	0-1		
Unidentified			8.5	1-8			8.3	0-1		

TABLE VII

Foods of Roccus americana from Mallard Creek
(number of organisms by actual count except where qualified)

Standard Length of Specimen (mm)	No. of Stomachs With Food	No. of Stomachs Without Food	Plant Material			Annelida	Mollusca	Crustacea				
			Filamentous algae	Myriophyllum	Zostera	Unidentified vegetation	Amnicola	Corophium	Gammarus	Penaeus	Callinectes	Cyprídopsis
85-111	10	2			4 blades			49	85			6
112-138	18	3		+50%	5% 90% 40%	10%	3	5	175	228	1 claw	11
139-165	3	0	*14		3 blades		1			15	3	

*Does not indicate entire plant
**Used as bait
+For each specimen: $\frac{\text{Volume of algae}}{\text{Total stomach contents}}$

TABLE VII (Continued)

Insecta				Fish					
Coleoptera	Diptera			Gambusia	Perca flavescens	Micropogon	Leiostomus	Unidentified Fish	Sand Grains
Larvae	Anopheles	Calopsectra	Unidentified						
	2		4 eggs	1@1.1cm 3@0.9cm	1@1.5cm	1@1.4cm		2@0.7cm 2@0.6cm 1@0.8cm 1@0.4cm	20
1		26					1@2.5cm 1@3.2cm 1@2.3cm 1@3.0cm	4@2.4cm 2@2.5cm	
1							1@3.2cm 1@3.0cm 1@2.5cm	2@2.5cm	

TABLE VIII

Foods of 36 *Roccus americana* from Mallard Creek
Percent Frequency = No. of Specimens with Food Item / Total No. of Specimens per Class
Range per Individual Indicates Actual Count

Food Organisms	85-111 mm		112-138 mm		139-165 mm	
	% Freq.	Range per Individual	% Freq.	Range per Individual	% Freq.	Range per Individual
Plant Material						
Filamentous algae					66.7	5-9
Myriophyllum			4.8	0-50%		
Zostera	16.7	0-2	14.3	5-40%	33.3	0-1
Unidentified vegetation			4.8	0-10%		
Annelida			14.3	0-1	33.3	0-1
Mollusca						
Amnicola			4.8	0-5		
Crustacea						
Corophium	41.7	2-27	19.0	3-130		
Gammarus	58.3	2-23	28.6	1-110	33.3	0-15
Penaeus					33.3	0-3
Callinectes			4.8	0-1		
Cypridopsis	8.3	0-6	4.8	0-9		
Insecta						
Coleoptera larvae			4.8	0-1	33.3	0-1
Anopheles	8.3	0-2				
Calopsectra			24.8	4-8	19.0	4-8
Unidentified Diptera	8.3	0-4				
Fish						
Gambusia	25.0	1-2				
Perca	8.3	0-1				
Micropogan	8.3	0-1				
Leiostomus			14.3	1-2	66.6	1-2
Unidentified fish	41.7	1-2	9.5	2-4	33.3	0-2
Sand Grains	8.3	0-20				

TABLE IX

Foods of Six Vertebrates from Mallard Creek

Contents	Erimyzon oblongus	Brevoortia tyrannus	Micropterus salmoides	Leiostomus xanthurus	Chelydra serpentina	Pseudemys scripta
No. of stomachs with food	2	0	1	5	9	4
No. of stomachs without food	0	1	0	1	0	0
Plants						
Myriophyllum				[2]16.7%	22.2%	
Potamogeton					33.3%	100%
Zostèra					66.7%	100%
Juncus					11.1%	
Hybiscus					22.2%	
Spartina					33.3%	
Terrestrial plant leaves					33.3%	50.0%
Wood debris					22.2%	
Animals						
Mollusca						
Amnicola				66.7%	11.1%	
Crustacea						
Eubranchipus	50%					

TABLE IX (Continued)

Contents	*Erimyzon oblongus*	*Brevoortia tyrannus*	*Micropterus salmoides*	*Leiostomus xanthurus*	*Chelydra serpentina*	*Pseudemys scripta*
Animals (contd)						
Gammarus	100%			33.3%		
Corophium	100%		100%			
Ostracoda	50%					
Callinectes					55.6%	25.0%
Rothropanopeus					55.6%	
Cambarus						25.0%
Insecta						
Diptera	50%					
[1]Annelida				16.7%		
Fish						
Esox					11.1%	
Unidentified Fish				16.7%		
Anguillidae					11.1%	
Bird bones					44.4%	

[1]Bait used for capture

[2]All numbers indicate frequency of occurrence: $\frac{\text{No. of organisms with food}}{\text{Total No. of organisms}}$

TABLE X

Foods of Seven Mallard Creek Fishes

Contents	Anguilla rostrata	Notemigonus crysoleucas	Ictalurus nebulosus	Fundulus diaphanus	Enneacanthus gloriosus	Enneacanthus obesus	Gambusia affinis
No. of stomachs with food	7	18	13	4	28	8	3
No. of stomachs without food	10	1	2	0	6	1	1
Plants							
Potamogeton			6.7%				
Myriophyllum		73.7%	40.0%				
Zostèra		15.8%	40.0%				
Unidentified aquatic plant parts	5.8%					[2]11.0%	75.0%
Animals							
Rotifers	5.8%						50.0%
Ostracods	5.8%						
Rithropanopeus (mud crab)			6.7%				
Gasterotrich				25%			
Corophium			20.0%	75%	64.7%	55.6%	

TABLE X (Continued)

Contents	Anguilla rostrata	Notemigonus crysoleucas	Ictalurus nebulosus	Fundulus diaphanus	Enneacanthus gloriosus	Enneacanthus obesus	Gambusia affinis
Animals (cont'd)							
Gammarus			20.0%	50%	50.0%	66.7%	
Unidentified crustacea		15.8%					
Amnicolidae	5.8%		13.3%		2.9%		25.0%
Insecta							
Orthoptera							
Locustidae	5.8%						
Coleoptera							
(Dryopid)			13.3%		2.9%		
Culicidae					5.9%		25.0%
Odonata	5.8%				2.9%		
Diptera			6.7%		11.8%	22.2%	
Unidentified insects	11.5%						
Unidentified fish	5.8%						
Acanthocephala	17.6%	6.7%					
Cestoda			6.7%				
[1]Anguillidae			26.7%				

[1]Bait used for capture
[2]All numbers indicate frequency of occurrence = $\frac{\text{No. subject organisms with food}}{\text{No. subject organisms}}$

DISCUSSION

Information was gathered on the food and feeding habits of some aquatic vertebrates of Mallard Creek during the summer of 1969. The menhaden, chubsucker, killifish, topminnow, largemouth bass, banded sunfish, spot and yellow-bellied turtle, although collected, were too few in number for results to be reliable as bases for inference. Data on these are tabulated (Appendix 1) but discussion is not in order. Table XI has been prepared to show general nutrient sources for animals collected in quantity and summarizes much of the data from the section on results. While no vertebrate studied was exclusively herbivorous, some of the omnivores (golden shiner, brown bullhead, snapping turtle) fed primarily on plant material.

In general, observations on these primarily herbivorous animals are in agreement with those cited in the review of literature with one notable exception, the golden shiner. Rice (1942) reported ostracods, diatoms, Volvox, and sand occupying equal volumes in 40 fish (30-44 mm in length). In my study, three fish contained crustaceans, but only one in any great amount (85%). All other specimens contained 80% or greater vegetation. Eight stomachs contained mainly Myriophyllum and three others mainly Zostèra. This indicates a greater use of vegetative food than found by Rice. Annelids make up a portion of the diet, since several golden shiners were taken on hooks baited with earthworms. Differences in data could be due to availability of food or to the greater size range in my sample (45-185 mm).

TABLE XI

Food Category Summary for Major Animals Sampled

Animal	Carnivorous on Vertebrates	Carnivorous Invertebrates	Herbivorous	Scavenger on Plant Material	Scavenger on Animal Material
Chain pickerel	XXX	X			
Golden shiner		X	XXX		
Brown bullhead	X	XXX	XXX		
American eel	X	XXX		X	
Pumpkinseed	X	XXX	X		
Bluespotted sunfish		XXX			
Yellow perch	XXX	XXX	X		
White perch	XXX	XX	X		
Snapping turtle	XX	X	XXX	XXX	X

XXX = Major component of diet
XX = Important component of diet
X = Present in small quantity

The snapping turtle is known to be omnivorous; however, it is noteworthy that in Mallard Creek the blue crab seems to take the place of crayfish recorded as food of these turtles in other areas (Alexander, 1943).

Lack of published studies on the brown bullhead prevents comparisons with literature. As stated, the volume of plant material recorded indicates a tendency toward a herbivorous habit. Bullheads are generally known to be omnivorous, and those collected took eel as bait. Crustaceans were found more frequently than other food of animal origin. The most important insects seemed to be dryopids (13.3%) while the mollusc, Amnicola, was found in about equal quantity. Cestodes occurred infrequently but not in the stomach, and were certainly parasitic.

To the extent that they are herbivorous, these animals function as first level consumers in the Mallard Creek system. Two of these as adults (brown bullhead, snapping turtle) are too large to be preyed upon by any predator, other than man, observed in the area. This would suggest that portions of energy flow and material cycling in this system involving these animals are relatively direct and uncomplicated. Young golden shiners, however, are known to serve as forage fish for several other fishes and they represent a focus in a complex food web.

Bullheads, pumpkinseed, yellow perch, white perch, and american eel fed heavily on invertebrates but took some plant material as well. Some also ate vertebrates. Pumpkinseed were the dominant fish in my sample; and although no specific study of their foods was found, such

general references as Collins (1959) indicated that they were omnivorous. Data on 152 pumpkinseed (Table II) in my study suggest some trends. No plant material was found in smaller fish (35-72 mm) and most plant material was in the larger fish (111-148 mm). However, only 13 of 152 fish contained plant material and much of this may have been taken incidental to predation.

The results of Moffett and Hunt (1945) are similar to my findings on the yellow perch, except for traces of vegetation (2 and 4%) in 3 specimens in my study. They did not list vegetation and the amount which I saw could have been taken incidental to predation. Fish up to 85 mm contained crustaceans exclusively. Greater sampling occurred in fish above this size range and greater numbers and frequencies of crustaceans appeared. With this increased size, fish, insects, and molluscs increased and fish became the most prominent food item. In the largest size range (230-227 mm) mud crabs provided the largest volume of food. This should not be overgeneralized because of the inadequate sample. Considering the total sample, one could infer that with increasing age and size there is greater dependence on vertebrates as food by the yellow perch.

Data on feeding habits of the white perch were not found in the literature. Although this fish exhibited omnivorous feeding habits, there was a stronger trend toward a fish diet, while invertebrates occupied a second level of occurrence. Plants appeared, but did not appear to be very significant. Food types remained approximately the same in all size ranges sampled.

Food studies on the american eel were not found in the literature. Plant material appeared to be of little importance and was found in only one specimen, and vertebrates (fish) composed only a small portion of the diet. The major food item was invertebrates of which insects occupied the larger part.

Although each member of this second group of fish took some plant material, plants appeared of some importance only to the bullhead.

Pumpkinseed, yellow perch, white perch, and the american eel occupied a significant position among the second and higher level consumers of Mallard Creek. They did ingest some plant material but did not seem significant as primary consumers during the summer of 1969.

In my study, the bluespotted sunfish and chain pickerel were found to be totally carnivorous. However, the bluespotted sunfish was exclusively carnivorous on invertebrates and the chain pickerel on invertebrates and vertebrates.

Literature was not found on the bluespotted sunfish. These fish fed mainly on crustaceans and on insects, and occupied a secondary consumer level in the Mallard Creek system. It was in a position similar to the pumpkinseed, but being smaller as adults and less populous, bluespotted sunfish were probably less important than pumpkinseed in the trophic dynamics of the Mallard Creek community.

Feeding data for the chain pickerel in my study are similar to those reported by Buntz (1966) and Raney (1942). The young Mallard Creek chain pickerel (51-104 mm) were carnivorous on vertebrates and to

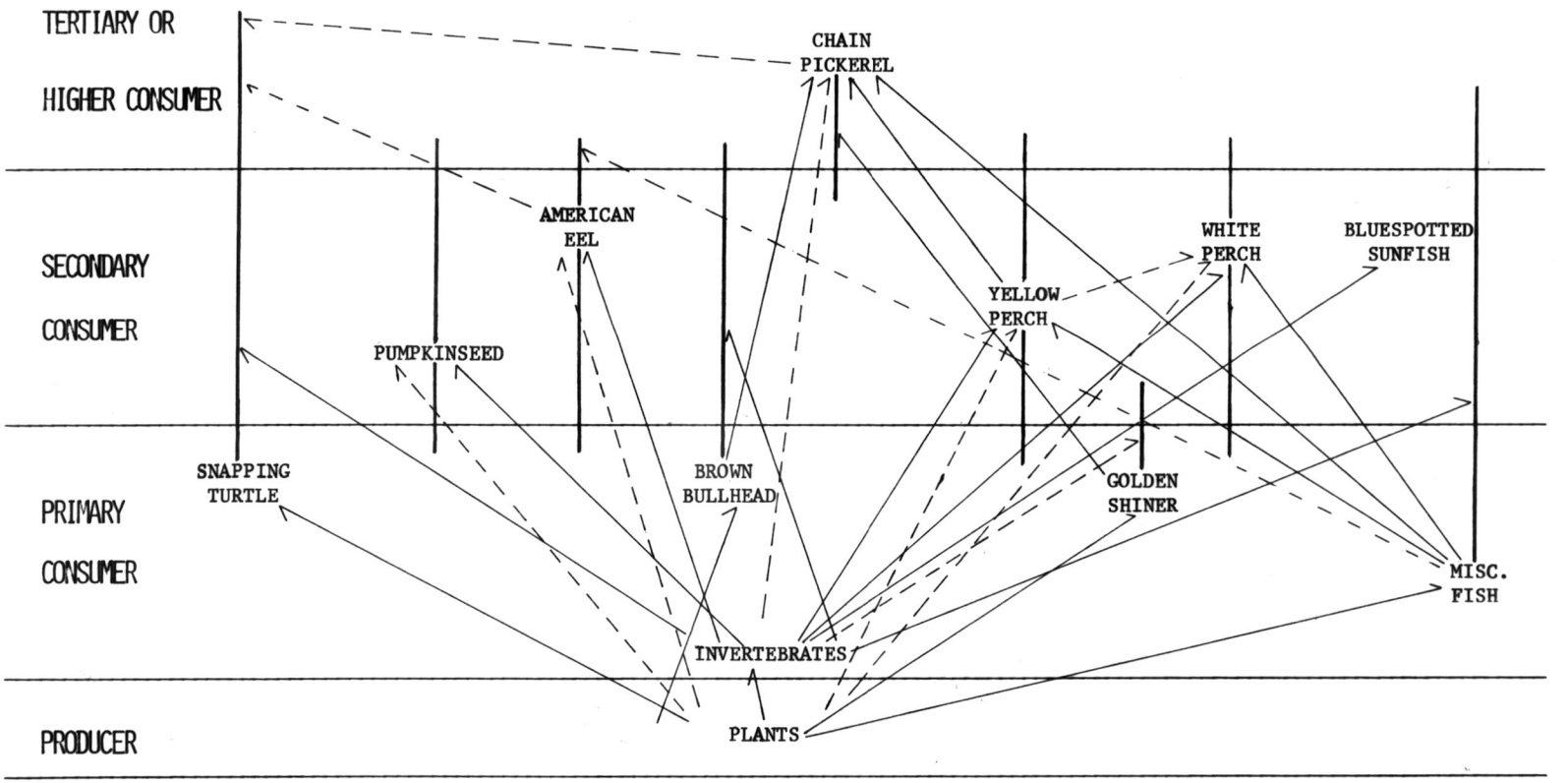
some extent on invertebrates. The larger sizes (258-461mm) fed exclusively on other fish with no species specific selection. This fish was a top level consumer in the Mallard Creek habitat.

A summary of trophic range and energy flow is presented in Figure 2.

Figure 2. Trophic range and energy flow for some Mallard Creek organisms

Vertical lines indicate trophic range

Arrows indicate energy flow: Solid for major routes; broken for minor


TERTIARY OR
HIGHER CONSUMER
SECONDARY
CONSUMER
PRIMARY
CONSUMER
PRODUCER
CHAIN
PICKEREL
AMERICAN
EEL
WHITE
PERCH
BLUESPOTTED
SUNFISH
YELLOW
PERCH
PUMPKINSEED
SNAPPING
TURTLE
BROWN
BULLHEAD
GOLDEN
SHINER
MISC.
FISH
INVERTEBRATES
PLANTS

CONCLUSIONS

Seventeen species of aquatic vertebrates were collected in Mallard Creek, and gut contents were examined and recorded for each specimen. Nine species were collected in sufficient number to reveal their trophic position in the Mallard Creek system during summer.

The golden shiner, snapping turtle, and brown bullhead though omnivorous were significant as first level consumers feeding mainly on Myriophyllum, Zostèra and Potamogeton. The bullhead was also an important secondary consumer, taking significant quantities of invertebrates.

The pumpkinseed, yellow perch, white perch, bluespotted sunfish, and american eel occupied the secondary consumer level primarily and fed mainly on invertebrates. White perch and yellow perch fed frequently on other fishes thus having some possible function in the tertiary trophic level.

The chain pickerel was significant as a secondary and tertiary consumer in the Mallard Creek system, feeding primarily on fish.

SUMMARY

1. Field collections were taken from Mallard Creek, a tributary of the Pamlico River, in Beaufort County. Largest numbers of specimens were taken with rotenone and hook and line. Seventeen species of vertebrates were collected.

2. Collections were returned to the laboratory, weighed, measured, sexed and frozen when immediate stomach analysis was not possible. Stomach content identifications were made with a binocular dissection microscope.

3. Although omnivorous, the golden shiner, brown bullhead and snapping turtle relied heavily on plant material. They served primarily as first level consumers in the Mallard Creek system.

4. Pumpkinseed, yellow perch, white perch and american eel fed heavily on invertebrates but took some plant material as well. All pumpkinseed fed primarily on molluscs and crustaceans, while adult yellow perch and white perch depended on other fish. The american eel depended primarily on invertebrates, especially insects. These animals occupied significant positions as second and higher level consumers in Mallard Creek.

5. Bluespotted sunfish were totally carnivorous on invertebrates and occupied a secondary consumer level in Mallard Creek.

6. Adult chain pickerel were exclusively carnivorous on other fish and occupied the top consumer level in Mallard Creek. Young chain pickerel fed on some crustaceans.

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APPENDIX

Addenda on Specimen Size and Foods

Two chubsuckers, 127 and 153 mm in length, were examined (Table IX). The smaller contained 72 Gammarus, 7 Corophium, 4 ostracods, and 1 dipteran. The other contained 94 Gammarus, 3 Corophium, and 1 Eubranchipus.

One menhaden examined (40 mm) contained no food.

One largemouth bass examined (50.0 mm) contained 3 Corophium (Table IX).

Six spots, from 76 to 132 mm were examined (Table IX). Two pieces of Myriophyllum were found in the largest specimen. Four other individuals contained Amnicola numbering 45, 132, 18, and 3. Twenty-nine Gammarus were found in the 76 mm specimen.

The stomachs of 17 eels, 102 to 410 mm, were examined (Table X). One 290 mm specimen contained 2 pieces of an unidentified plant, 4 rotifers, 16 Amnicola, 28 ostracods and 1 acanthocephalan. The 410 mm specimen contained a member of the Family Locustidae and a 153 mm specimen contained parts of an adult odonate. One 151 mm specimen contained parts of an insect and a 140 mm specimen contained all insect parts except for 2 acanthocephalans. The only other specimen containing food was a 325 mm eel which had two (6 cm and 3 cm) unidentified fish. This same eel contained 1 parasitic acanthocephalan.

The golden shiners examined for stomach contents were from 45 to 185 mm long (Table X). Ninety-five percent of the contents in each of

8 specimens ranging from 73 to 185 mm was Myriophyllum. Four other specimens in this same size range contained 90% Myriophyllum; two others contained 80% and 85%. Eighty-five percent of the stomach contents of a 98 mm specimen was crustacean parts, while a 185 mm and an 83 mm specimen contained crustacean traces. Eel grass comprised 95% of the stomach contents of the 101 and 161 mm specimens and 80% of the 83 mm specimen.

Examined stomachs from brown bullheads measuring 309 mm, 284 mm, 325 mm, 293 mm, 300 mm, 287 mm and 293 mm were comprised of 80%, 70%, 90%, 95%, 75%, 75%, and 80% Zostèra respectively (Table X). The 284 mm specimen contained 30% Myriophyllum and 1 acanthocephalan, while the 325, 300, and 293 mm specimens contained 8%, 15%, and 20% Myriophyllum respectively. Two other specimens measuring 266 mm and 300 mm contained 80% and 90% Myriophyllum respectively. In addition to 75% Zostèra, the 287 mm specimen contained the claw of a mud crab (Rithropanopeus). Two 300 mm specimens contained pieces of eel which were taken as bait, and one contained 90% Myriophyllum. The 293 mm specimen contained 7 cestodes. One other 300 mm specimen contained 2 Amnicola, 1 Coleoptera, 1 cestode and 2 Diptera wings. The 266 mm specimen contained 12 Amnicola and 10% plant material in addition to the 80% Myriophyllum previously mentioned. Three small specimens measuring 50 mm, 44 mm, and 44 mm contained the following respectively: 40 Corophium; 2 Gammarus and 16 Corophium; 3 Gammarus, 16 Corophium and 2 Dryopids.

Of the four freshwater killifish examined (Table X), 1 gasterotrich and 2 Corophium were found in the 66 mm specimen. The two 54 mm specimens contained 2 Gammarus and 5 Corophium, and 1 Gammarus and 4 Corophium respectively.

The bluespotted sunfish examined were from 22 to 60 mm in length and contained large numbers of crustaceans (Table X). One 57 mm specimen contained 5 Corophium and 2 Diptera larvae; a 54 mm specimen contained 3 Gammarus, 2 Corophium, 4 Diptera wings and 2 Culicidae larvae; a 47 mm specimen contained 2 Corophium, 1 Gammarus, 4 Diptera wings, 1 Coleoptera larvae and 1 Culicidae larvae and another 54 mm specimen contained 1 Corophium and 1 Amnicola. One 51 mm specimen contained an adult odonate and a 44 mm specimen contained 2 adult dipterans. Seven other specimens ranging from 44 to 51 mm contained only from 3 to 5 Corophium. Three other specimens from 42 mm to 60 mm contained from 1 to 11 Gammarus and from 1 to 10 Corophium, but never more than 16 organisms per stomach.

Nine banded sunfish, from 42 to 57 mm in length, contained large quantities of crustaceans (Table X). Diptera wings and fragments comprised the entire stomach contents of one 44 mm specimen while another contained 2 Diptera larvae and 4 Corophium. A third 44 mm specimen contained 3 Gammarus, 5 Corophium and algae while a fourth 44 mm specimen contained 4 Gammarus and 4 Corophium. The 42 mm and 57 mm specimens contained 3 Gammarus and 1 Corophium and 7 Gammarus and Corophium parts respectively. One 51 mm specimen contained 3 Corophium, while the other contained only 1 Gammarus.

Of the four topminnows, three contained plant material (Table X). Five percent of the volume of a 36 mm specimen was plant material. The 38 mm specimen had 10% plant material by volume and 1 Culicidae and 4 rotifers. The 44 mm specimen contained 5% plant material, 2 Amnicola and 4 rotifers.

Nine snapping turtles, ranging from 1.59 kg with a carapace length of 18.42 cm to 6.81 kg with a carapace length of 36.83 cm, were examined (Table IX). The 1.59 kg specimen contained a larger variety of items than any of the others, but only 1 item, Hybiscus, which was not found in other specimens. Large amounts of vegetation were found in all. The total volume of Zostèra was recorded as 40%, 60%, 50%, 60%, 30%, and 70% per specimen. Ten percent, 20%, and 50% of the stomach contents of 3 specimens was comprised of Potamogeton. Several pieces of Spartina were found in 3 specimens, and Juncus was found in another. The remainder of the stomach contents of the specimen containing 60% Potamogeton was Myriophyllum. Partially decayed wood and leaves were found in 3 other specimens. A bird's bill was found in the 1.59 kg specimen and bird bones were found in a 3.41 kg and 3.17 kg specimen, one bone measuring 7.0 cm. Callinectes claws and shell fragments were found in 5 specimens while 6 crabs measuring 2.2 cm (lateral measurement) were found in a 3.86 kg specimen. A 3.41 kg specimen contained a Callinectes measuring 7.0 cm. Four of the turtles containing Callinectes also contained Rithropanopeus; the 3.63 kg individual contained 5 (1.8 cm each) and a 3.41 kg specimen contained 3 (2.1 cm each).

A 4.54 kg specimen contained 1 Amnicola, and 1 nematode was found in the 3.41 kg specimen. The 4.99 kg specimen contained a 11.0 cm chain pickerel (Esox niger) and gar (Lepisosteus sp.) scales were found in a 3.24 kg specimen. The 6.81 kg specimen contained only one Callinectes which measured 7.0 cm x 3.6 cm.

The yellow-bellied turtle stomachs contained large quantities of vegetation (Table IX). The following percent volume per individual were recorded for Potamogeton: 1.47 kg specimen (carapace length of 223 mm), 80%; 2.5 kg specimen (length 267 mm), 15%; 1.82 kg specimen (length 236 mm), 60%; 2.72 kg specimen (length 281 mm), 60%. Stomach contents for Zostèra was 65% for the 1.48 kg specimen, 80% for the 2.5 kg specimen, 30% for the 1.82 kg specimen and 30 for the 2.72 kg specimen. Two nematodes were found in the 1.48 kg turtle, and tree leaves in the 2.5 kg and 2.72 kg specimens. Callinectes parts were found in the 1.82 kg turtle and Cambarus was found in the same specimen.