



INSTITUTE FOR FISHERIES RESEARCH
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ALBERT S. HAZZARD, PH.D.
DIRECTOR

ADDRESS
UNIVERSITY MUSEUMS
ANN ARBOR, MICHIGAN

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THE FOOD AND HABITS OF THE COMMON AQUATIC TURTLES
OF MICHIGAN CONSIDERED IN RELATION TO FISH MANAGEMENT¹

by

Karl F. Lagler

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This report on the ecology and economic relations of the turtles native to the state of Michigan is based on a combination of field and laboratory investigations and is one of a series of studies of predation on fish in this state. Many researches have been conducted on physical, chemical and biological features of fresh-water communities which determine fish yield, but few studies have been made on the role of predation in the dynamic economy of such associations. Although in fish management the control of predatory and so-called "noxious" animal species is widespread, current practices often have little basis or justification in known facts and are for the most part of unknown effect. It is the purpose of this series of investigations on the nature and extent of vertebrate predation on fish to discover the effects of this predation; to learn which, if any, "predators" are retarding the production of fish; to experiment with methods of controlling serious depredations; to establish

¹ This report is an abstract of a detailed study on the ecology and economic relations of all the turtle species of Michigan.

"a clean bill of health" for the species so deserving; and to inform naturalists, sportsmen, and fish culturists of the ecological relations and the economic status of the animals studied.

The part of this series reported here deals with the work on the food habits of the aquatic turtles of Michigan considered in relation to fish management. These turtles, the musk, snapping, Blandings, map, Bell's, western painted, and soft-shelled, were observed extensively in the field and collected mostly by means of conventional turtle traps. The field work was conducted from April through October in the summers of 1937 and 1938. The specimens and data gathered during these summers were analyzed at the University Museums in Ann Arbor during the winters of 1937-38 and 1938-39. The work was made possible by the cooperation of the American Wildlife Institute, the Institute for Fisheries Research of the Michigan Department of Conservation, and the University of Michigan.

It was early apparent that food studies would provide the most convenient, though limited, index to the relations of turtle species listed to fish yield. Consequently, analyses were made of the food in the digestive organs of 965 specimens collected on natural waters. No consideration is given here to the specimens studied from fish hatcheries and rearing stations.

Table I shows what we found to be the food of 105 musk turtles. It should be noticed, that we have studied the contents of both stomachs and colons in order to obtain fullest possible information and also that the stomachs of some individuals and colons of others contained no food. The percentage composition by volume calculations for stomach contents are based on the actual measured volume for each item. Those for colons are averages of estimated percentages.

Table I

THE FOOD OF THE MUSK TURTLE ON NATURAL WATERS IN MICHIGAN

Based on seventy-three stomachs containing 17.7 cc. of food and on sixty-six colons containing 51.4 cc. of food. The organs are from 105 turtles collected on thirteen lakes and three non-trout streams. Data on eight specimens from fish hatcheries are not included.

Food Item	Stomachs		Colons	
	Composition by Volume (%)	Frequency of Occurrence (%)	Composition by Volume (%)	Frequency of Occurrence (%)
Game Fish	6.2	0.8	1.6	1.1
Unidentified fish	...	...	Traces	1.6
Carrion	40.1	5.8	4.9	3.2
Crayfish	6.2	3.3	10.6	9.7
Insects	16.9	34.2	23.6	26.9
Snails and clams	23.2	28.3	34.7	24.7
Cryptogams and Phanerogams	3.4	15.0	7.7	14.0
Vegetable debris	4.0	12.5	16.7	18.8

Game fish encountered in the food of the musk turtle were a small yellow perch and two small centrarchids. The carrion was composed of dogfish, bluegill, sunfish, and other fish remains. Thirty-four different insects were identified and were mostly aquatic forms and their larvae. Ten kinds of snails and clams were found and twelve plants. The most common plant materials eaten were algae and the seeds of water lily and Potamogeton sp.

The musk turtle is conclusively demonstrated as an omnivore by these data. It would seem that the principle conflicts of the musk turtle and fish are to be seen in the numbers of fish food organisms which their turtle eats.

Table II is a summary of the food of the snapping turtle. Considering only the stomach contents, game fish, carrion, and vegetation appear as the most important foods of this turtle. Summarily stated on the basis of food found in stomachs, about one-third of the food of the snapping turtle in Michigan is composed of game fish and an average of one out of every three turtles taken may be expected to contain this kind of food. Another third is composed of vegetable matter, almost entirely the leaves and petioles of aquatic plants, which three out of every four individuals may be expected to contain. The last third is largely the remains of dead animals, but also represents significant quantities of crayfish, snails, and insects.

Table II

THE FOOD OF THE SNAPPING TURTLE ON NATURAL WATERS IN MICHIGAN

Based on 173 stomachs containing 4,133 cc. of food and on 261 colons containing more than 8,855 cc. of food. The organs are from 281 turtles collected on seventy-one lakes and eleven non-trout and six trout streams. Data on twenty-one specimens from Wintergreen Lake (W. K. Kellogg Bird Sanctuary) and on twenty-one from fish hatcheries are not included. More specific determinations of food items are given in Table .

Food Item	Stomachs		Colons	
	Composition by Volume (%)	Frequency of Occurrence (%)	Composition by Volume (%)	Frequency of Occurrence (%)
Game fish	34.2	32.4	2.1	51.7
Forage fish	0.3	5.8	0.4	10.3
Unidentified fish	0.9	12.7	2.1	35.2
Other vertebrates	1.1	2.3	1.1	7.2
Carrion	19.6	6.4	1.3	2.7
Invertebrates	7.8	49.7	23.9	82.4
Vegetable matter	36.2	74.6	69.2	93.5

If one regards the results of the analyses of colon contents only, about one-fourth of the food appears to be composed of invertebrates, principally crayfish, and three-fourths to be composed of aquatic vegetation. The implications which may be drawn from a comparison of the figures for the stomach material with those for the colons have a direct bearing on the validity of food studies based solely on intestinal content, pellet, or dropping analyses. The misleading features of: (1) persistence of certain hard parts of some animals, such as the exoskeletons of crayfish and insects; (2) differential rate of digestion of various materials ingested; and (3) of the postponed intestinal digestion of certain food substances such as plant materials in omnivores or carnivores, are very evident in this table.

Two of the specimens were found to contain fish eggs--presumably centrarchid.

Assuming that all the game fish represented in stomachs and colons were alive and healthy when taken, the turtles averaged less than one such fish per individual. When one considers that the remains of fish in the colons could not be identified as carrion or otherwise, it seems likely that the incidence of game fish is less than one-half of a specimen per turtle.

A summary of our findings on the food of Blanding's turtle is given in Table III. On the basis of the specimens studied, it seems that on natural waters the principal significance of Blanding's turtles to fish is reflected in the diet of aquatic invertebrates which they have in common. As for the other aquatic turtles studied, it would be desirable to have additional information on the relation of this species to nesting game fish, particularly bass and sunfish. This is suggested by the discovery of 101 fish eggs in the stomach of one individual.

Table III

THE FOOD OF BLANDING'S TURTLE ON NATURAL WATERS IN MICHIGAN

Based on fifty-one stomachs containing 195.8 cc. of food, and forty-one colons containing 140.7 cc. of food. The organs are from sixty turtles collected on seventeen lakes and two non-trout streams. Data on one specimen from a trout stream and six from fish hatcheries are not included.

Food Item	Stomachs		Colons	
	Composition by Volume (%)	Frequency of Occurrence (%)	Composition by Volume (%)	Frequency of Occurrence (%)
Game fish	1.6	5.9	Traces	7.3
Forage fish	2.7	5.9	...	...
Fish remains	0.7	7.8	Traces	7.3
Bird remains	5.6	2.0	1.8	2.4
Carrion	4.7	5.9	...	...
Leeches	0.1	3.9	...	...
Crustaceans	56.6	74.5	60.1	85.4
Insects	21.4	54.9	30.3	68.3
Molluscs	2.6	17.6	0.5	12.2
Cryptogams	1.2	21.6	Traces	36.6
Phanerogams	0.5	31.4	0.3	29.3
Vegetable debris	2.2	39.2	7.0	51.2

Map turtles (Table 4) have long been known to be almost entirely malacophagous. In our study of a small number of these turtles we found crayfish and insects as important food, in addition to snails and clams.

Table IV

THE FOOD OF THE MAP TURTLE ON NATURAL WATERS IN MICHIGAN

Based on twelve stomachs containing 38.2 cc. of food and twenty-four colons containing 95.6 cc. of food. The organs are from twenty-seven turtles collected on six lakes, four rivers, and some unknown waters.

Food Item	Stomachs		Colons	
	Composition by Volume (%)	Frequency of Occurrence (%)	Composition by Volume (%)	Frequency of Occurrence (%)
Game fish	1.8	8.3	Trace	4.2
Forage fish	11.3	8.3	...	...
Unidentified fish	2.4	8.3	0.6	8.3
Carrion	5.0	8.3	...	...
Crayfish	52.4	8.3	13.0	25.0
Water mites	...	...	Traces	8.3
Insects	8.6	41.7	12.0	50.0
Snails	17.3	83.8	57.7	79.2
Clams	1.3	8.3	12.5	37.5
Plants	...	...	4.2	16.7

Very few specimens of Bell's turtle, which occurs only on the Upper Peninsula in Michigan, were obtained for study. The food of this turtle is much like that of the Western Painted turtle (Table V). For both, insects and their aquatic larvae, crustaceans, molluscs, and aquatic plants are the principle foods. On the whole, they seem to compete with fish for food rather than to prey upon them. Some evidence is on hand, however, which suggests that these turtles may be important predators of fish in their very early life history stages.

Table V

THE FOOD OF THE WESTERN PAINTED TURTLE ON NATURAL WATERS IN MICHIGAN*

Based on 394 stomachs containing 408.5 cc. of food. The turtles were collected from fifty-three lakes or ponds, seven non-trout and four trout streams. Data on nineteen specimens from fish hatcheries are not included.

Food Item	Composition by Volume (%)	Frequency of Occurrence (%)
Game fish	1.0	1.0
Forage fish	0.3	1.5
Fish remains	0.1	0.8
Frog remains	0.4	0.3
Carrion	2.5	1.5
Spiders and water mites	Traces	3.0
Leeches and oligochaete "earthworms"	0.4	3.4
Crustaceans	5.0	15.5
Insects	19.5	55.1
Molluscs	5.5	15.7
Cryptogams	30.7	58.9
Phanerogams	30.8	48.2
Vegetable debris	3.7	35.5

* Owing to the large number of Western painted turtles for study, the contents of the stomachs only were analyzed.

Fifteen specimens of the river-loving soft-shelled turtle (Amyda s. spinifera) were had for food study. Crayfish and burrowing mayfly larvae were the most important foods of these individuals.

TABLE VI

THE FOOD OF THE SOFT-SHELLED TURTLE ON NATURAL WATERS IN MICHIGAN

Based on eleven stomachs containing 45.8 cc. of food and six colons containing 35.3 cc. of food. The organs are from fourteen turtles collected on seven lakes and two rivers.

Food Item	Stomachs		Colons	
	Composition by Volume (%)	Frequency of Occurrence (%)	Composition by Volume (%)	Frequency of Occurrence (%)
Fish remains	Trace	1.9	...	...
Crayfish	47.4	45.5	46.7	66.7
Insects	52.4	90.9	53.3	83.3
Snails	0.2	9.1	...	...
Cryptogams	Trace	9.1	Trace	33.3
Vegetable debris	0.2	27.3	Trace	33.3

On the basis of these findings on the food of 965 of the common aquatic turtles of Michigan, it seems that only snappers may have any considerable importance as a fish predator; and that the musk, Blanding's, map, Bell's, western painted and soft-shelled turtles are more important to fish as competitors for food than as predators.