Original: Fish Division
cc: Education-Game
Burton Ostenson
Karl F. Lagler

INSTITUTE FOR FISHERIES RESEARCH
DIVISION OF FISHERIES
MICHIGAN DEPARTMENT OF CONSERVATION
COOPERATING WITH THE
UNIVERSITY OF MICHIGAN

ALBERT S. HAZZARD, PH.D.
DIRECTOR

ADDRESS
UNIVERSITY MUSEUMS ANNEX
ANN ARBOR, MICHIGAN

December 30, 1940

REPORT NO. 642

FOOD OF OTTER TAKEN BY TRAPPERS IN MICHIGAN DURING MARCH AND APRIL, 1940

Introduction

The otter (Lutra c. canadensis) has been protected in Michigan for fifteen years prior to 1940. In the decade following 1920 it seemed that the otter faced virtual extinction in the state and open seasons were closed. Possibly as a result of this protection and possibly also as a result of general improvement in the habitat of the animal due to better forest fire control, the otter came back in sufficient numbers to once again become a noticeable part of the animal life of the waterways of northern Michigan. With this visible increase came protests from trout fishermen that the depredations of the otter were seriously affecting their angling success. The beaver trappers, too, began to voice feelings over the fact that the only legal disposition which they could make of otter caught in their beaver traps was to turn the carcasses over to the Conservation Department. This entailed no profit for the trapper and often spoiled good beaver sets. Some otter pelts undoubtedly were bootlegged, but this left the trapper at the mercy of the buyer and exposed him to the danger of arrest.

Source and amount of material

In response to the protests of anglers and trappers and in order to obtain materials for a better understanding of the place of the otter in Michigan, the Michigan Conservation Commission opened the season on otter in the spring of 1940. This season coincided with the beaver trapping period, and was opened in certain designated counties (Map 1). The season extended from April 1 to April 15 inclusive in the Upper Peninsula and March 20 to April 10 inclusive in the Southern Peninsula. Almost all the otter were taken after the spring break-up which occurred during the middle of the legalized period on each peninsula.

Trappers were required to turn in the carcasses of the otter trapped to conservation officers, at which time the pelt was sealed. The officer receiving the carcass was asked to record the following information on blanks provided: locality data; date; and kind of water (trout, non-trout); etc. From these reports, Dr. S. C. Whitlock of the Game Division has prepared a map (Map 1) showing the distribution of the catch as to trout or non-trout waters of 255 of the total 266 animals in the recorded take.

Ideally, a separate tag bearing locality data was attached to each carcass by the officer. Unfortunately, however, a number of carcasses were not so labelled, the label became blood soaked and illegible, or was accidentally torn off in subsequent handling. Of the 229 specimens ultimately available for food, parasite, and life-history study, only 165 had sufficient data to enable their classification as to the type of water from which they came--trout or non-trout. Sixty-four specimens thus lacked locality data.

The carcasses that accumulated at the various Conservation Department field headquarters were sent to the Pathology Laboratory of the Game Division in Lansing. As mentioned previously, only 229 out of the total catch of 266 arrived at this laboratory. It may be presumed that the remaining were unsuitable for shipment because of decay.

At the laboratory, the otter were autopsied and examined for parasites and diseases by the Game Division pathologists. Ostenson and John W. Gross, graduate student at Michigan State College, also worked here and recorded data on weights, measurements, sex, and breeding condition. Their findings are presented in another report. The stomachs and intestines, or their contents when a parasitological examination was made, were preserved in 10 per cent formalin or 70 per cent alcohol and were sent to the Zoology Department of the University of Michigan, where analysis of this material was made by the authors.

Acknowledgments

The authors wish to express their thanks to the Game Division for the opportunity to conduct this investigation. We are indebted to Dr. S. C. Whitlock of the Game Division for permission to use the map that he prepared and for his care in preserving the contents of the digestive organs. We wish to thank the Field Administration for recording the field data.

The Fish Division of the Conservation Department through its Institute for Fisheries Research hired an assistant, Mr. Carl B. Obrecht, to prepare material for identification. We are grateful to Mr. Obrecht for his care and diligence in pursuit of his duties.

Professor Carl L. Hubbs aided in the identification of certain difficult fish remains and Mr. Clifford Berg, certain beetles. To these individuals and all others who have aided us in this work, we offer our sincere thanks.

The problem

The particular phase of the investigations on the otter problem here reported deals with the spring food habits of this animal. It was desired to learn if the otter might be considered an undesirable predator of fishes. If so, might that consideration be used to favor continued open seasons. In addition, it is of considerable importance from fish and game management views to know the probable position of the otter in the ecology of northern Michigan lakes and streams.

Procedure

The material in the stomachs had usually been chewed up into bits 1/4- to 1/2-inch long or smaller and was always at least partially digested. Fish two or three inches long were often chopped into several pieces. Few were swallowed whole. Crayfish were always thoroughly chewed. The intestinal contents consisted of incompletely digested hard parts of food organisms such as scales, bones, fin rays, and the exoskeletons of crayfish and insects. Food fragments in the intestine were enmeshed in a "rope" of mucous about half an inch in diameter. This rope extended throughout the entire length of the intestine. The removal of food particles from the mucous (whose role is probably to protect the intestinal lining from abrasion by the hard parts and sharp fragments of food items) presented a serious technical problem in the

analysis of the intestinal contents. No accurate inspection would be possible in the presence of this gelatinous, cottony matter. No suitable solvent was found. After trying several methods, fragmentation by agitation was found to be most successful. The intestinal contents were placed in a jar, and water and buckshot or 4-penny nails were added.

The jar was shaken vigorously until the mucous was broken into bits, most of which would pass through a No. 20 screen. Consequently any food fragments smaller than 1/20 inch would also be lost. Scales of the trout might fall in this category and also fleshy remains. Total volumes of intestinal contents, because of this method, are only estimates. On some of the larger scales such as those of suckers there was some evidence of partial dissolution in the process of digestion.

Food organisms represented in stomachs and intestines were identified as specifically as practicable. The minimum number of individuals of each item represented was recorded and the size or age of game fish was estimated by comparison with whole individuals. In the stomachs, volumes of items were determined (to nearest 0.1 c.c.) by water displacement of the moist (but not wet) materials. Items of less than 0.1 c.c. were recorded as a trace. In the intestines, the fragmentation technique employed and the nature of the material rendered volumetric determinations impracticable. For these, the percentage estimation method was used. From point of view of technical validity arising from introduced errors, the tabular data presented on the results of analyses of the two organs are not comparable, except in a very general way. The presence, in stomachs or intestines, of bits of vegetative debris such as needles of conifers, bits of dead grass and the like was regarded as accidental and not food.

Food of otter from trout waters

Of the 229 otter handled, we had information that 91 individuals came from trout waters. Of these individuals, the stomachs of 43 contained food, and the intestines of 60. In the summary here presented (Table 1), the stomach analyses show the total volume 188.8 c.c. of food to be comprised of about 1/4 game and pan fish, 1/2 forage fish and the remainder largely crayfish with unidentified fish, frogs and insects also represented. In the intestines, the greater bulk and persistence of the hard parts give the crayfish the dominant place (2/5 of the totalpercentage by volume). Game and pan fish and forage fish each make up about 1/5, and the remaining 1/5 is divided among other fish (esocids unidentifiable as to mud pickerel, muskellunge or northern pike, although since mud pickerel are rare in the northern part of the state and muskellunge generally infrequent, the remains of this genus are doubtless dominantly of the northern pike), remains unidentifiable to kind of fish, frogs and insects. Trout occurred in 7 out of 43 stomachs and in 12 out of 60 intestines, or in 13 individual otter. These 13 otter are only a small part of the 70 animals from trout streams having food either in stomach or intestine or in both. The trout in these 13 otter represented a maximum of 32 individual salmonids if the remains of no trout occurring in a stomach was repeated in the intestine. Conversely reckoned, a minimum of 22 trout would be found for these 13 otter. The latter seems the more accurate of the two estimates. In addition, trout were found in one of 38 stomachs of otter from unknown localities, and in 5 of 36 intestines of this series. Trout in these were represented in 5 individuals for a maximum of 8 individual trout or a minimum of 7, reckoned as above. Of the trout found, it was possible to estimate the length when alive for 11 individuals. Their size ranged from 2 1/2 to 8 inches, an average of 4.8.

Table 1. Early spring food of otter taken from trout waters in Michigan.

Based on the contents of 43 stomachs (188.8 c.c.) and of 60 intestines.

FOOD ITEM	STOMACHS			INTESTINES		
	Number of individuals of each item eaten	% of total volume of food	% frequency of occurrence	Number of individuals of each item eaten	% of total volume of food	% frequency of occurrence
GAME AND PAN FISH		25.4	30.2		20.3	43.3
Trout	12			20		
Bullheads	...			3		
Perch	1			11		
Bass and sunfish	9			17		
FORAGE FISH		49.2	62.8		21.9	65.0
Suckers	1			9		
Minnows	17			18		
Mud minnows	54			48		
Darters	1			3		
Muddlers	56			56		
Sticklebacks	6			9		
OTHER FISH	1	Trace	2.3	2	2.5	3.3
UNIDENTIFIED FISH REMAINS		6.7	37.2		7.1	41.7
FROGS	4	2.3	9.3	6	3.7	10.0
INSECTS		0.7	16.3		3.6	21.7
Water beetles	8			12		
Water bugs	3			7		
Others	...			3		
CRAYFISH	23	15.8	41.7	60	40.8	55.0
SNAILS	...	...	...	2	Trace	1.7

Food of otter from non-trout waters

In the stomachs of otter from non-trout waters (Table 2), game and pan fish represent almost 1/2 of the volume of food, other fish, less than 1/4, amphibians, almost 1/4, and crayfish, only about 1/20.

In the intestines, it should be noted, the crayfish show a preponderance of the total volume of the contents, almost 3/8, game and pan fish 1/8, forage fish 1/4, and amphibians and insects each with a little less than an eighth.

Summary

The summary (Table 3) of all the food habits data obtained, including those from 38 stomachs and 36 intestines of otter which lacked specific locality data, give a limited picture of the early spring food of otter in Michigan. The large portion (36.7 per cent) of the total volume of stomach contents represented by "other vertebrates" is due to the presence of one snowshoe hare in one stomach and remains of part of a large bird (unidentified) in another. These items, however, are not repeated in other otter and thus are by no means staple items in the food of these animals.

It should be noted that percentage of volume of food organisms having fewer hard parts and more soft parts (such as fish) decreases markedly from stomach to intestine. Food items having more hard parts and lesser soft parts (such as crayfish) appear to increase decidedly in percentage of total volume from stomach to intestine.

Conclusions based on analyses of stomach contents, intestinal contents, or scat contents must each be reserved. Caution must also be exercised in interpreting frequency data in intestines due to persistence of hard parts. This persistence may lead to erroneous interpretation of the

Table 2. Early spring food of otter

taken from non-trout waters in Michigan

Based on the contents of
28 stomachs (345.7 c.c.)
and of 34 intestines.

	STOMACHS			INTESTINES		
FOOD ITEM	Number of individuals of each item eaten	% of total volume of food	% frequency of occurrence	Number of individuals of each item eaten	% of total volume of food	% frequency of occurrence
GAME AND PAN FISH		45.9	28.6		11.8	38.2
Bullheads	3			1		
Perch	6			4		
Bass and sunfish	9			18		
FORAGE FISH		17.2	50.0		24.5	67.6
Suckers	8			6		
Minnows	7			21		
Mud minnows	19			68		
Darters	1			...		
Muddlers	4			9		
Sticklebacks	6			3		
UNIDENTIFIED FISH REMAINS		2.6	42.9		9.0	50.0
AMPHIBIANS		23.5	14.3		11.4	29.4
Frogs	4			9		
Mudpuppies	5			2		
INSECTS		4.8	32.1		10.9	44.1
Water beetles	8			114		
Water bugs	7			12		
CRAYFISH	9	6.0	32.1	25	32.3	52.9

Table 3. Summary of early spring food of otter in Michigan

Based on the contents of 109 stomachs (1524.9 cc. of food) and of 130 intestines. The data in this table combine those of Tables 1 and 2 with the additional findings in 38 stomachs and 36 intestines from otter which lacked specific locality data.

	STOMACHS		INTESTINES	
FOOD ITEM	% of total volume of food	% frequency of occurrence	% of total volume of food	% frequency of occurrence
Game and pan fish	26.6	27.5	14.3	40.0
Forage fish	14.6	56.0	24.7	68.5
Other fish	0.5	2.8	1.6	4.6
Unidentified fish remains	2.8	38.5	9.7	43.8
Amphibians	12.1	11.0	7.5	20.8
Other vertebrates	36.7	1.8	0.9	0.8
Insects	1.2	17.4	5.1	30.0
Crayfish	5.4	34.9	36.2	54.6
Molluscs	...	...	Trace	1.5
Total	99.9		100.0	

significance of "number of individuals eaten" or "percentage frequency of occurrence."

It seems apparent that fish, crayfish, and amphibians constitute most of the spring food of the otter, whereas large aquatic insects comprise a minor amount although they are consistently taken. Rare items are molluscs, birds, and mammals. Reptiles are perhaps not yet available; otter are known, however, to feed on turtles. Principal food organisms are characteristic bottom dwellers (e.g., mud minnows, crayfish) and disclose something of the nature of the feeding habits of this animal.

The data obtained on the food of the otter in early spring as presented in this report have implications for fish management as well as for otter management. The information given is obviously limited in the small part of the year which it covers and in the relatively small numbers of individuals included. It is further restricted as to its interpretation by the small amount of knowledge recorded on the habits and physiology (rate of digestion, frequency of feeding, daily food requirements, etc.) of the otter and also the size and distribution of the population in the state. Judging from the relatively small number trapped during the past open season and from the breadth of diet shown in this report and in scat studies of Michigan otter by other agencies (U. S. Biological Survey, records in Game Division files, Institute for Fisheries Research Report Numbers 356 and 367), it would seem that far greater concern need be felt over the stability of the population of this predator in the state than could justifiably be expressed for any of its prey species due to the effects of predation by the otter. In instances where otter have very

restricted feeding grounds, such as in isolated kettle-hole lakes, this conclusion will not hold. Live-trapping and transportation to larger streams is recommended in these instances.

INSTITUTE FOR FISHERIES RESEARCH
A. S. Hazzard, Director

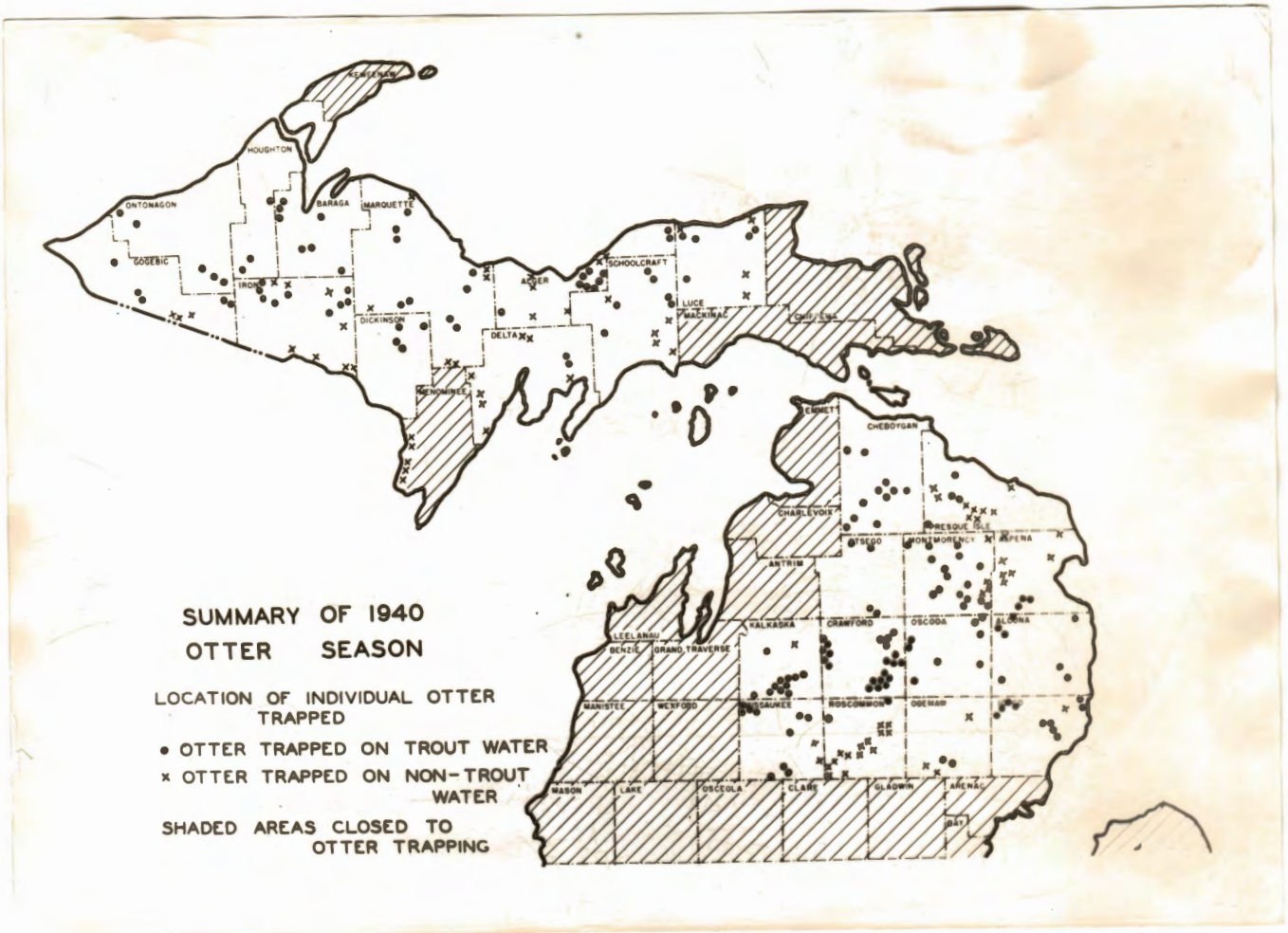
By: Karl F. Lagler
Department of Zoology
University of Michigan

and

Burton T. Ostenson
Zoology Department
Michigan State College

Approved by: A. S. Hazzard

Typed by: V. Andres



Map 1. Locations from which otter were trapped during the spring open season, 1940.