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An Investigation of the Stomach Contents of *Micropterus Dolomieu*

Richard Evan Horrall

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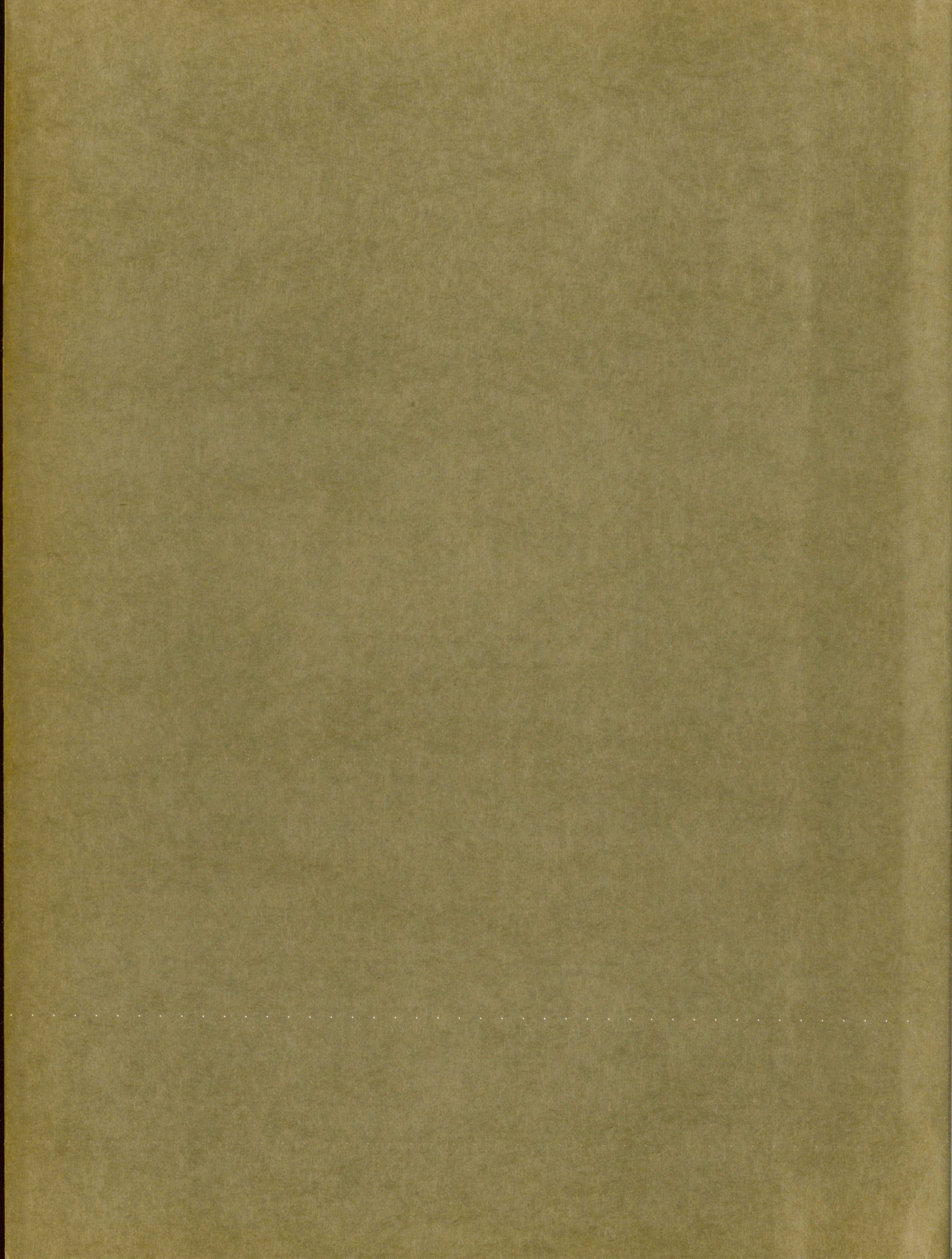
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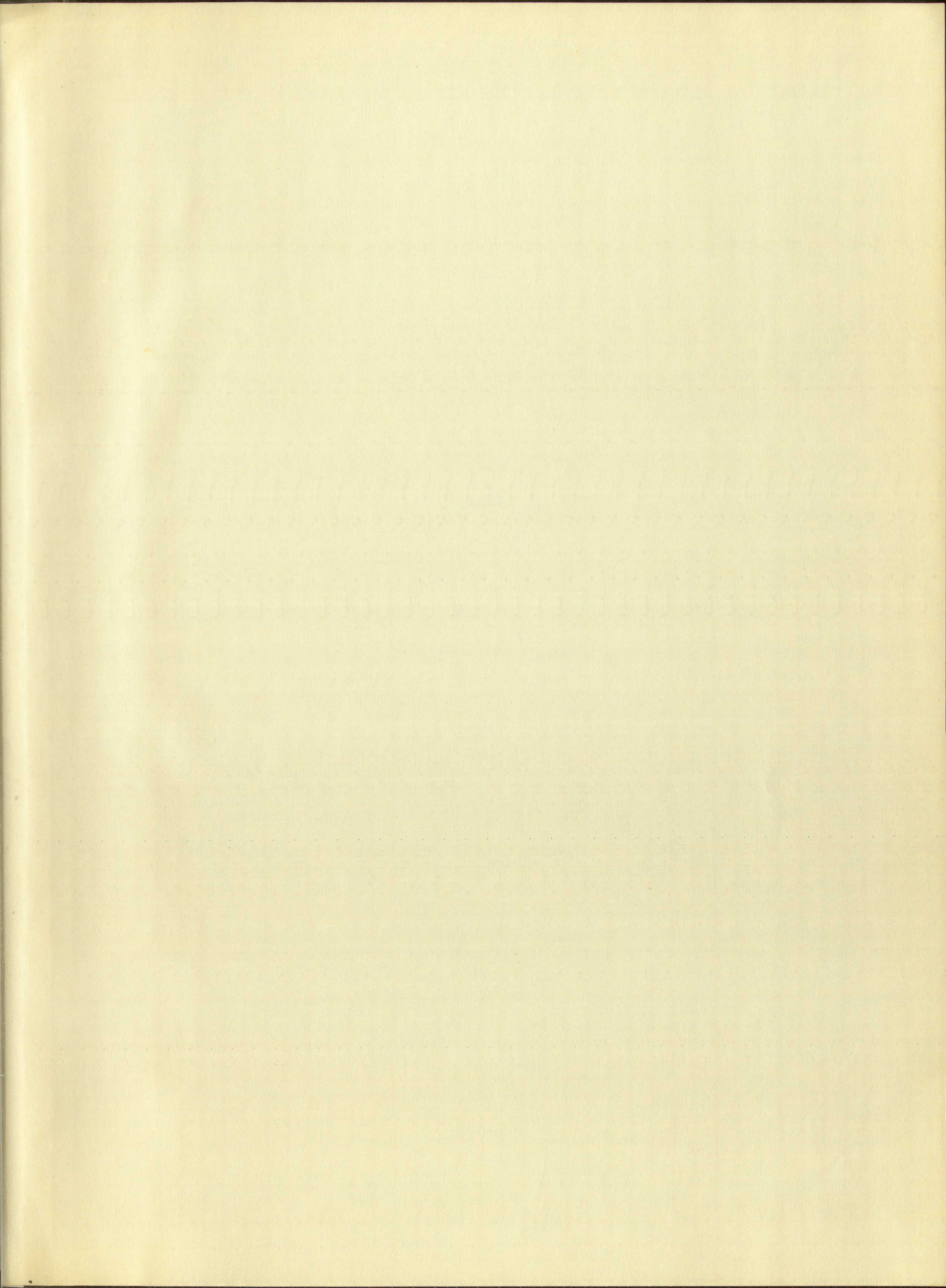
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AN INVESTIGATION OF THE STOMACH CONTENTS
OF MICROPTERUS DOLOMIEU (LACEPEDE)

A Thesis
Presented to
the Faculty of the Department of Biology
University of New Mexico

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts

by
Richard Evan Horrall

May 1938

AN INVESTIGATION OF THE EFFECTS OF
OF AROMATIC AMIDES ON THE

by

Presented to

the Faculty of the Department of Chemistry
University of the Pacific

In partial fulfillment of

of the Requirements for the Degree

DOCTOR OF PHILOSOPHY

UNIVERSITY OF THE PACIFIC
STOCKTON, CALIF.
1960

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MASTER OF SCIENCE

J R Hammond

DEAN

June 2, 1938

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requirements for the degree of

MASTERS OF SCIENCE

by
JAMES E. ...

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Thesis Committee

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UNIVERSITY OF NEW MEXICO

1953

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CHAPTER I

THE PROBLEM

During the last eight to ten years there has been an awakening of interest in conservation. With this interest has come the application of scientific methods to conservation methods to replace the former replacement technique of hatcheries and game farms.

I. THE PROBLEM

Statement of the problem. It was the purpose of this study to scientifically analyze the stomach contents of Micropterus dolomieu. The study was based upon 168 stomachs taken from various sized fish caught by hook and line from the streams of Northern Illinois.

Importance of the study. This investigation is but a step in the complete survey of the streams and lakes of Illinois. According to the present scientific methods of fish conservation, the food of these fish must be determined before an accurate and successful method of stream and lake planting can be determined. The small fish thus planted must be assured of an available supply of their select foods if the maximum of satisfactory results is to be obtained. Due to legal restrictions the size group herein studied has been only those mature fish ten inches or more in length. The study of the food of these fish is essential in order that a rapid rate of growth may be maintained. That an increased supply of food correspondingly increases rate of

During the last few years, the study of the history of the United States has been one of the most popular and important branches of knowledge. The study of the history of the United States has been one of the most popular and important branches of knowledge. The study of the history of the United States has been one of the most popular and important branches of knowledge.

History of the United States is a study of the development of the United States from its early days to the present. It is a study of the growth of the United States from a small colony to a great nation. It is a study of the progress of the United States from a primitive state to a modern civilization.

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growth was shown by an unpublished study of Tonto and Horton Creeks near Payson, Arizona.¹ The investigations which necessarily must follow this type of work are: (1) the determination of the food of the size groups less than ten inches in length; (2) collection of scale samples to determine the age and rate of growth of the various size and age groups; (3) the complete analysis of the available food from each stream and lake surveyed; (4) the determination of methods of improvement of conditions for protection of the young as well as the adult fish; (5) the determination of methods of increasing certain types of foods considered as select as based upon stomach analyses; (6) the determination of the migrations of the fish following plantings to establish factually the numerical distribution and final fate of each fish.

Statement of organization into chapters. In Chapter II the reader will find a statement of the method of procedure and sources of data. Chapter III gives a complete report of the stomach contents of the fish studied. Chapter IV is a summary chapter of findings, conclusions and recommendations.

¹

United States Forest Service Stream and Lake Survey;
June 1937

growth of the...
Horton...
which...
the...
that...
determining...
and...
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II the...
section...
report...
IV is a...
recommendation.

UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF PLANT INDUSTRY
WASHINGTON, D. C.

Review of literature. The literature treating this subject was found to be lacking except for general opinions based on observation. Forbes² states that his colleagues have examined, "but three specimens," and found their food consisted, "wholly of fishes and crawfishes, approximately a third of the first and two thirds of the second. Among the fishes were a stonecat(Noturus flavus) and a log-perch (Percina caprodes)."

²

Forbes Stephen A., The Fishes of Illinois. (Springfield; Natural History Survey of Illinois, Vol. III, 1920), p. 265

Review of Literature

subject was found to be similar to the results of some
based on observation. Other studies have
have obtained, "The results of the study
concluded, "The results of the study
third of the first and two thirds of the second
flashes were a distance (approximately 100-150
(Personal communication).

Forbes, Richard A., The Effects of Light on the Human Eye.

National Eye Institute, Bethesda, Maryland, 1965.

CHRONOLOGICAL CONTENT

CHAPTER II

METHOD OF PROCEDURE AND SOURCES OF DATA

The stomach specimens were collected by means of hook and line fishing in the streams and lakes of Winnebago, Boone, Ogle, and Stephenson counties in northern Illinois. The stomach of each fish was removed immediately after being caught and placed in a two ounce bottle of four percent formalin. The stomachs were opened in the laboratory and the complete volume and weight of contents recorded. A complete macroscopic examination followed which sufficed to separate readily identifiable portions. All unidentified portions along with debris obtained by filtration were placed in small vials. The contents of these vials were then examined microscopically and as complete identification as possible obtained. The remaining debris consisted mostly of portions of viscera of fish and slightly decomposed stomach wall.

METHOD OF THE PREPARATION OF THE SPECIMENS

The specimens were prepared by the following method. The tissue was first fixed in formalin for 24 hours and then cleared in cedar oil for 48 hours. The cleared tissue was then embedded in cedar oil and sectioned in a microtome. The sections were stained with hematoxylin and eosin and mounted on glass slides. The slides were then cleared in cedar oil and mounted in cedar oil.

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CHAPTER III

REPORT OF STOMACH ANALYSES

In this chapter will be found a complete report of the stomach analyses discussed according to the following food groups: (1) *Cambarus*, (2) Fishes, (3) *Rana*, (4) *Locustidae*, (5) Other insects, (6) Worms.

An investigation of the contents of 168 stomachs of *Micropterus dolomieu* can not be taken to be conclusive evidence of the complete food habits of this fish. The stomachs analyzed were all from specimens ten inches or more in length, determined to be mature by dissection.

The total volume of the *Cambarus* found in the stomachs included parts as well as whole animals. From this standpoint the total volume of the *Cambarus* eaten by the fish may far exceed that represented in the findings. In view of the fact that the calcium carbonate of the exo-skeleton of the *Cambarus* is less rapidly digested than the fish, insects, or worms the volume actually found probably represented a reliable ratio to other food groups. In eighteen stomachs chelipeds or legs were the only parts found.

The sizes of the *Cambarus* varied greatly from 10.7 cubic centimeter specimen from stomach number 135 to .7 cubic centimeter specimen in stomach number 164. The variation in the sizes of the *Cambarus* gives no indication of selection according to size on the part of *Micropterus dolomieu*. The selection of *Cambarus* by fish of all sizes collected indicated that this animal served as the principal food for all size groups ten inches or more in length.

CHAPTER III

REPORT OF STATION A-1000

In this chapter will be found a summary of the

stomach analyses conducted during the 1934 season.

Group: (1) Capelin, (2) Herring, (3) Mackerel,

(4) Other fishes, (5) Bones.

An investigation of the contents of the stomachs of

Microstomus dolomieu was not at first as carefully conducted

as the complete food habits of this fish.

Fixed were all from specimens for which the sex was

determined to be reliable by dissection.

The total volume of the stomach contents of the stomachs

included parts as well as whole fish. From this analysis

the total volume of the stomachs was found to be

exceed that reported in the literature. In other words, it

shows that the volume of the stomachs of the fish is

in less rapidly increased than the fish, hence, it is

the volume actually in the stomachs is not as large as

to other food groups. In other words, the stomachs of the

were the only parts found.

The sizes of the stomachs varied greatly from 10 to 100

centimeters in length and from 1 to 100 millimeters

in width. The width of the stomachs was found to be

greater than the length of the fish. The width of the

the part of Microstomus dolomieu was found to be

fish of all sizes. The width of the stomachs was found to be

the principal food of the fish was found to be

1934.

According to the coefficient of expectancy for *Cambarus* (.929) approximately one crayfish can be expected to be found in each stomach. The average volume of this specimen will be ³2.738 cubic centimeters.

Of the three genera of fish found in the stomachs analyzed, little evidence can be seen of any selection of Micropterus dolomieu within this food group. The fishes varied in size from that of a *Notropis* fry .3 cubic centimeters in stomach number 29 to an *Etheostoma* 12.2 cubic centimeters in stomach number 68.⁴ The average size of the *Etheostoma* and *Ameiurus* found in the stomachs was much greater than the average size of the *Notropis* that were found. Though the total volumes represented by the fishes found in the stomachs were approximately similar, the coefficient of frequency per stomach for all three groups was ⁵.643 cubic centimeters.

Although frogs are common along the banks of most of the Illinois streams, only four stomachs contained samples of *Rana*. Frogs, for the most part, are beyond the reach of feeding bass, tending to remain in extremely shallow water or in dense vegetation in the streams; the frogs are not so available to fish as they would seem to be by casual observation.

³ Averages and Totals of Data on Fish, Table III, p.17 of this Study.

⁴ Stomach Analyses, Table II, pps. 12,13,14,15,16, of this study.

⁵ Averages and Totals of Data on Fish, Table III, p.17 of this study.

According to the local records of the Department of Agriculture, the average yield of the crops in the area is approximately 100 bushels per acre. The average yield of the crops in the area is approximately 100 bushels per acre.

Of the three species of fish found in the area, the most common is the bluegill. The average yield of the bluegill is approximately 100 bushels per acre. The average yield of the bluegill is approximately 100 bushels per acre. The average yield of the bluegill is approximately 100 bushels per acre.

With the exception of the bluegill, the other two species of fish found in the area are the largemouth bass and the smallmouth bass. The average yield of the largemouth bass is approximately 100 bushels per acre. The average yield of the smallmouth bass is approximately 100 bushels per acre.

The average yield of the bluegill is approximately 100 bushels per acre. The average yield of the bluegill is approximately 100 bushels per acre. The average yield of the bluegill is approximately 100 bushels per acre.

The average volume of the frogs found in the stomachs was eight cubic centimeters, however, they appeared in only four stomachs of the 168 analyzed. The average volume expectancy per stomach was found to be .192 cubic centimeters.

Samples of Locustidae were comparatively numerous in the stomachs analyzed. Parts of eighty-three specimens were found, however these made up a total volume of only 24.8 cubic centimeters due to the fact that only small portions of the Locustidae are not readily digestible.⁶ Undoubtedly, this food group is of the floating type having fallen onto the surface of the water. The fact that the year 1937 witnessed a peak in the cycle of abundance of Locustidae in the Middle West must be taken into consideration. For the latter reason, the average expectancy per stomach is .148 cubic centimeters.⁷ It is well to mention again the fact that these soft-bodied insects are rapidly digested. This fact, together with their frequency, is indicative of a greater volume of food than is actually represented.

⁶ Table II, op. cit., pps. 12,13,14,15,16 of this study.

⁷ Table III, op. cit., p.17 of this study.

The present study is a continuation of the work of the

was first published in 1954, and was revised in 1958.

Four specimens of the fish were analysed. The first was taken from the

peritoneum and found to be a male.

Analysis of the material from the second specimen, a female,

showed a different pattern of development from the first.

However, these two specimens are of the same species.

Centipede and scorpion are the two main groups of the

Phocastidae and not the Phocastidae. This is

known from the classical description of the group.

The first of the two specimens is a male, and the

cycle of development of the Phocastidae is the same as that of the

other Phocastidae. The second specimen is a female, and the

development of the Phocastidae is the same as that of the

other Phocastidae. The third specimen is a male, and the

development of the Phocastidae is the same as that of the

other Phocastidae. The fourth specimen is a female, and the

development of the Phocastidae is the same as that of the

other Phocastidae. The fifth specimen is a male, and the

development of the Phocastidae is the same as that of the

other Phocastidae. The sixth specimen is a female, and the

development of the Phocastidae is the same as that of the

other Phocastidae. The seventh specimen is a male, and the

development of the Phocastidae is the same as that of the

other Phocastidae. The eighth specimen is a female, and the

development of the Phocastidae is the same as that of the

other Phocastidae. The ninth specimen is a male, and the

development of the Phocastidae is the same as that of the

Insects other than Locustidae included: Damsel flies (Agrionidae), Dragon flies (Libellulidae), May flies (Ephemeridae), Mosquitoes (Culex), Bot fly (Oestridae), and Beetles (Coleoptera). Of these, Coleoptera were the most numerous, 19 samples having been found. The Agrionidae, Libellulidae, and Ephemeridae were nymphs, while the Culex, Oestridae and Coleoptera were adults. This entire food group represented two percent by volume of the entire stomach contents.⁹ By weight, the group represented 1.46 percent¹⁰ of the total weight of the stomach contents. The insects exclusive of Locustidae had an average expectancy per stomach of .078 cubic centimeters.

Three types of worms were found, Hirudinea, fresh-water Oligochaeta, and Nematoda. Of these, the Hirudinea were the most numerous, twenty-two having been found. The combined volume of these worms represents only .7 percent of the total volume of the stomach contents.¹¹ It is highly probable that the Nematoda were parasitic on Locustidae which had been eaten and subsequently digested. The undigested condition of these threadlike Nematoda among advanced digested portions is an indication of their resistance to digestive process. The Hirudinea was well represented in frequency in the stomachs analyzed.

⁹

Percent of Stomach Contents by Weight, Figure II, p.19, in this study.

¹⁰

Percent of Stomach Contents by Weight, Figure II, p.19, of this study.

The frequency coefficient was .131 as compared to .018 each for the Oligochaeta and the Nematoda. The worms had an average expectancy of .021 cubic centimeters per stomach.

11

Percent of Stomach Contents by Volume, Figure I, p. 18
of this study.

TABLE I
DATA ON FISH

Specimen number	Length	Date	Time of day	Where collected	Lure	Air temperature	Condition of fish	Condition of stomach
1	10"	8/14/37	4 P.M.	1	Fly	80°F.	Fair	c
2	10"	7/9/37	5 P.M.	2	Fly	85°F.	Good	b
3	10"	7/13/37	11 A.M.	1	Fly	90°F.	Good	b
4	10"	7/2/37	2 P.M.	1	Fly	95°F.	Good	c
5	10"	8/9/37	5 P.M.	5	Fly	80°F.	Good	b
6	10"	8/1/37	6:45 P.M.	3	Fly	85°F.	Good	b
7	10"	7/24/37	6:15 P.M.	4	Fly	80°F.	Fair	c
8	10"	7/27/37	4 P.M.	2	Fly	85°F.	Good	c
9	10"	6/29/37	3 P.M.	3	Fly	90°F.	Fair	c
10	10"	8/3/37	12 Noon.	3	Worm	90°F.	Good	b
11	10"	8/11/37	5:30 P.M.	3	Fly	85°F.	Good	b
12	10"	8/9/37	6:15 P.M.	1	Fly	85°F.	Good	b
13	10"	8/5/37	6:30 P.M.	2	Fly	75°F.	Good	b
14	10"	7/17/37	4 P.M.	4	Fly	85°F.	Good	b
15	10"	7/16/37	12 Noon.	6	Spinner	95°F.	Good	b
16	10.5"	7/3/37	2:30 P.M.	1	Fly	90°F.	Fair	d
17	10.5"	7/30/37	4:30 P.M.	2	Fly	90°F.	Good	c
18	10.5"	8/1/37	7 P.M.	4	Fly	80°F.	Good	c
19	10.5"	6/29/37	5 P.M.	4	Fly	85°F.	Fair	b
20	10.5"	7/2/37	4:45 P.M.	5	Fly	90°F.	Fair	b
21	10.5"	8/3/37	4:30 P.M.	3	Fly	80°F.	Good	c
22	10.5"	6/23/37	11:30 A.M.	1	Fly	85°F.	Good	c
23	10.5"	7/18/37	7:30 P.M.	3	Fly	75°F.	Good	b
24	10.5"	7/15/37	5 P.M.	4	Fly	85°F.	Good	c
25	10.5"	7/29/37	5 P.M.	3	Fly	80°F.	Good	b
26	10.5"	7/26/37	4 P.M.	3	Fly	85°F.	Fair	b
27	10.5"	7/14/37	2 1 P.M.	2	Crayfish	90°F.	Fair	c
28	10.5"	8/9/37	2:30 P.M.	1	Fly	90°F.	Good	c
29	10.5"	7/29/37	5:15 P.M.	3	Fly	80°F.	Good	b
30	10.5"	6/29/37	5 P.M.	10	Fly	85°F.	Good	c
31	10.5"	8/14/37	4:30 P.M.	1	Fly	85°F.	Good	c
32	10.5"	8/4/37	3 P.M.	3	Fly	85°F.	Good	c
33	10.5"	8/28/37	12 Noon :	3	Fly	90°F.	Fair	b
34	10.5"	8/30/37	5 P.M.	4	Fly	90°F.	Fair	c
35	10.5"	7/31/37	4 P.M.	2	Fly	85°F.	Good	b
36	10.5"	8/1/37	4 P.M.	5	Fly	86°F.	Good	c
37	10.5"	8/12/37	5:30 P.M.	4	Fly	85°F.	Fair	e
38	10.5"	9/4/37	5 P.M.	2	Fly	80°F.	Fair	c
39	10.5"	8/12/37	3:45 P.M.	2	Fly	85°F.	Good	b
40	10.5"	8/11/37	5 P.M.	2	Spinner	85°F.	Good	b
41	10.5"	8/12/37	5:30 P.M.	4	Fly	86°F.	Good	b
42	10.5"	7/22/37	5 P.M.	1	Fly	85°F.	Good	b
43	10.5"	8/4/37	5:30 P.M.	1	Fly	85°F.	Good	c
44	10.5"	7/2/37	4:15 P.M.	4	Fly	90°F.	Good	c
45	10.5"	10/24/37	12 Noon.	3	Fly	50°F.	Good	c
46	10.5"	8/9/37	5 P.M.	3	Fly	90°F.	Good	b
47	10.5"	8/7/37	1 P.M.	5	Fly	90°F.	Fair	b
48	10.5"	8/13/37	5:30 P.M.	7	Fly	85°F.	Good	b
49	11"	8/4/37	1 P.M.	1	Fly	90°F.	Good	c
50	11"	7/31/37	6 P.M.	9	Fly	80°F.	Fair	c
51	11"	6/29/37	4 PM.	2	Fly	90°F.	Fair	b
52	11"	7/9/37	10 A.M.	1	Spinner	90°F.	Good	b
53	11"	7/24/37	4 P.M.	3	Fly	80°F.	VeryGood	b
54	11"	7/10/37	3:30 P.M.	3	Fly	90°F.	Good	b
55	11"	8/10/37	5:30 P.M.	5	Fly	85°F.	Good	b
56	11"	8/7/37	6:30 P.M.	4	Fly	80°F.	Good	b
57	11"	7/29/37	4 P.M.	3	Fly	85°F.	Good	c
58	11"	9/5/37	6:30 P.M.	4	Fly	80°F.	Good	a
59	11"	6/25/37	5:30 P.M.	3	Fly	85°F.	Fair	b
60	11"	8/11/37	5 P.M.	3	Fly	85°F.	Good	b
61	11"	8/12/37	4:30 P.M.	4	Fly	80°F.	Good	a
62	11"	7/13/37	4 P.M.	5	Fly	85°F.	VeryGood	c
63	11"	7/30/37	5 P.M.	1	Fly	90°F.	Good	c
64	11"	7/6/37	5:30 P.M.	1	Fly	85°F.	Good	b
65	11"	7/24/37	2:00 P.M.	3	Fly	88°F.	Good	a
66	11"	7/5/37	6:45 P.M.	3	Fly	85°F.	Good	b
67	11"	6/28/37	1 P.M.	2	Fly	90°F.	Fair	b
68	11"	8/6/37	4 P.M.	2	Fly	90°F.	Good	c
69	11"	6/20/37	6 P.M.	8	Worm	80°F.	Good	c
70	11"	7/19/37	5 P.M.	6	Fly	85°F.	Fair	a
71	11"	7/26/37	4:45 P.M.	1	Fly	85°F.	Good	b
72	11"	6/27/37	2 P.M.	5	Fly	90°F.	Good	b
73	11"	7/5/37	1:30 P.M.	2	Fly	74°F.	Fair	c
74	11"	8/14/37	5:15 P.M.	2	Fly	85°F.	Fair	c
75	11"	7/11/37	7 P.M.	1	Fly	85°F.	Good	a
76	11"	8/7/37	5:30 P.M.	3	Fly	85°F.	Good	b
77	11"	7/28/37	10:30 A.M.	4	Fly	90°F.	Good	c
78	11"	8/15/37	2 P.M.	3	Fly	95°F.	Good	c
79	11"	7/14/37	4 P.M.	3	Fly	95°F.	Good	c
80	11"	7/15/37	5:30 P.M.	7	Fly	85°F.	VeryGood	b
81	11"	8/12/37	4 P.M.	4	Fly	80°F.	Good	b
82	11"	7/7/37	5 P.M.	1	Fly	90°F.	Good	a
83	11"	7/19/37	4:30 P.M.	3	Fly	90°F.	Fair	b
84	11"	6/27/37	5:15 P.M.	3	Fly	85°F.	Good	c
85	11"	8/2/37	6 P.M.	1	Fly	75°F.	Good	b
86	11"	7/22/37	5 P.M.	1	Fly	85°F.	Good	b
87	11"	8/4/37	6 P.M.	3	Fly	85°F.	Good	c
88	11"	8/5/37	4 P.M.	3	Fly	90°F.	Good	c

TABLE I (continued)

DATA ON FISH

Specimen number	Length	Date	Time of day	Where collected	Lure	Air temperature	Condition of fish	Condition of stomach
89	11"	8/12/37	2:30 P.M.	1*	Fly	75°F.	Fair	c**
90	11"	7/23/37	4 P.M.	2	Grayfish	90°F.	Good	a
91	11"	6/24/37	3:30 P.M.	4	Fly	90°F.	Good	b
92	11.5"	7/13/37	1:30 P.M.	5	Fly	95°F.	Good	d
93	11.5"	7/18/37	4:15 P.M.	4	Fly	88°F.	Good	c
94	11.5"	9/5/37	11 A.M.	9	Fly	90°F.	Fair	b
95	11.5"	7/11/37	2 P.M.	2	Fly	90°F.	Good	b
96	11.5"	6/25/37	5 P.M.	1	Fly	85°F.	Good	b
97	11.5"	7/29/37	4:30 P.M.	4	Fly	85°F.	Good	d
98	11.5"	9/21/37	4 P.M.	4	Fly	80°F.	Good	c
99	11.5"	9/18/37	5:30 P.M.	1	Fly	85°F.	Fair	d
100	11.5"	7/13/37	6:15 P.M.	5	Fly	80°F.	Good	b
101	12"	8/2/37	5 P.M.	1	Fly	85°F.	Good	b
102	12"	8/1/37	4:30 P.M.	10	Fly	90°F.	VeryGood	c
103	12"	8/11/37	5:30 P.M.	1	Fly	85°F.	Good	c
104	12"	8/14/37	4 P.M.	3	Fly	85°F.	Good	b
105	12"	8/12/37	5 P.M.	1	Fly	85°F.	Fair	c
106	12"	8/8/37	5 P.M.	1	Fly	90°F.	Good	b
107	12"	7/25/37	4:15 P.M.	3	Fly	90°F.	Fair	b
108	12"	8/11/37	2:30 P.M.	3	Fly	90°F.	Good	c
109	12"	7/4/37	4 P.M.	1	Spinner	90°F.	Good	c
110	12"	8/4/37	5 P.M.	2	Fly	90°F.	Good	b
112	12"	7/21/37	5 P.M.	6	Worm	90°F.	Fair	a
113	12"	8/12/37	6:30 P.M.	7	Fly	85°F.	Good	d
114	12"	6/26/37	11:30 A.M.	8	Minnow	76°F.	Good	c
115	12"	7/3/37	12 Noon.	9	Fly	95°F.	Good	b
116	12"	7/15/37	4 P.M.	3	Fly	90°F.	Good	d
117	12"	8/11/37	5:30 P.M.	3	Fly	75°F.	VeryGood	c
118	12"	8/4/37	7 P.M.	1	Fly	80°F.	Good	a
119	12"	8/10/37	4:30 P.M.	2	Fly	90°F.	Good	b
120	12"	9/2/37	5 P.M.	1	Fly	85°F.	Fair	c
121	12"	7/12/37	4:30 P.M.	4	Fly	75°F.	Excellent	c
122	12"	7/22/37	5 P.M.	3	Fly	85°F.	Good	b
123	12"	8/12/37	4:30 P.M.	3	Fly	90°F.	Fair	b
124	12"	6/30/37	4:15 P.M.	6	Fly	85°F.	VeryGood	b
125	12"	7/12/37	4:45 P.M.	4	Fly	75°F.	Fair	d
126	12"	7/4/37	3:45 P.M.	8	Spinner	95°F.	Good	c
127	12"	7/19/37	5:30 P.M.	10	Fly	90°F.	Good	b
128	12"	8/8/37	6:30 P.M.	2	Fly	80°F.	VeryGood	a
129	12"	8/4/37	4 P.M.	1	Fly	90°F.	Good	b
130	12"	8/7/37	3:30 P.M.	1	Fly	90°F.	Good	b
131	12"	6/21/37	4 P.M.	3	Minnows	90°F.	Fair	c
132	12.5"	7/25/37	5:15 P.M.	3	Minnows	85°F.	Good	d
133	12.5"	8/2/37	3 P.M.	1	Minnows	88°F.	Good	c
134	12.5"	7/13/37	5:45 P.M.	9	Minnows	85°F.	Good	b
135	12.5"	8/2/37	3 P.M.	4	Grayfish	90°F.	VeryGood	a
136	12.5"	8/16/37	4 P.M.	1	Fly	90°F.	Good	b
137	13"	7/26/37	6 P.M.	1	Fly	80°F.	Good	b
138	13"	6/27/37	5:45 P.M.	3	Spinner	85°F.	Fair	b
139	13"	7/1/37	6 P.M.	3	Fly	85°F.	Good	c
140	13"	7/10/37	5:15 P.M.	5	Fly	85°F.	Good	c
141	13"	7/16/37	5 P.M.	7	Fly	75°F.	Excellent	b
142	13"	7/12/37	4 P.M.	8	Fly	85°F.	Good	b
143	13.5"	8/1/37	5:30 P.M.	1	Fly	80°F.	Good	d
144	13.5"	6/30/37	3:30 P.M.	3	Fly	88°F.	VeryGood	c
145	14"	6/22/37	12 Noon.	6	Fly	90°F.	Good	b
146	14"	7/11/37	5 P.M.	2	Fly	85°F.	Good	a
147	14"	7/8/37	4 P.M.	5	Fly	85°F.	Good	b
148	14.5"	7/2/37	3:45 P.M.	1	Grayfish	90°F.	VeryGood	c
149	15"	8/9/37	4 P.M.	2	Fly	80°F.	Good	c
150	15"	8/14/37	5 P.M.	4	Fly	85°F.	VeryGood	c
151	15"	8/1/37	4 P.M.	3	Worm	85°F.	VeryGood	b
152	15"	7/25/37	5:30 P.M.	3	Worm	90°F.	Excellent	b
153	15"	8/9/37	4:30 P.M.	2	Worm	80°F.	Good	c
154	15"	8/4/37	3 P.M.	2	Worm	90°F.	VeryGood	c
155	15"	8/3/37	5 P.M.	1	Worm	85°F.	VeryGood	b
156	15.5"	7/31/37	6 P.M.	1	Spinner	80°F.	Excellent	c
157	15.5"	7/24/37	4 P.M.	3	Fly	85°F.	Excellent	a
158	16"	7/21/37	4:30 P.M.	5	Fly	90°F.	VeryGood	b
159	16"	7/20/37	5 P.M.	7	Spinner	90°F.	Good	d
160	16"	7/1/37	4:30 P.M.	9	Fly	90°F.	VeryGood	c
161	16"	7/24/37	3:30 P.M.	3	Fly	85°F.	Excellent	b
162	16"	7/16/37	4:30 P.M.	4	Fly	88°F.	VeryGood	c
163	16"	8/10/37	6 P.M.	2	Spinner	80°F.	Excellent	c
164	16.5"	9/17/37	5:15 P.M.	1	Fly	80°F.	VeryGood	b
165	17"	8/5/37	5 P.M.	10	Spinner	80°F.	Excellent	c
166	17"	8/4/37	1 P.M.	3	Fly	90°F.	Good	b
167	18"	7/6/37	5:30 P.M.	1	Minnows	85°F.	Good	d
168	18.5"	8/5/37	4:30 P.M.	8	Minnows	90°F.	Excellent	a

KEY

- *1. North Kishwaukee 6. Saint Croix
 2. South Kishwaukee 7. Michigan
 3. Piscasaw 8. Long Lake
 4. Beaver 9. Keyle
 5. Coon 10. Nippersink

- **a. Undigested
 b. Partly digested
 cc Advanced digestion
 d. Empty
 e. Wholly digested

(Continued) I THAT

TABLE II
STOMACH ANALYSES

Specimen number	Gambarus		Notropis		Etheos- toma		Ameiurus		Rana		Locust- idae		Libellu- lidae		Agrion- idae		Culex		Oest- ridae		Coleop- tera		Ephemer- idae		Hiru- dinea		Nematoda		Fresh-water Oligochaeta		
	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	
1	3	6.6	1	1.1							1	.1			1	.5															
2	1	4.7									1	.4																			
3			1	.8																								1	.3		
4	1	3.									1	.8																			
5	1	1.8									1	.1																			
6											1	.4																			
7	1	9.1													1	.3															
8	1	3.									1	1.1																			
9	1	9.6																													
10	1	1.8	1	1.4																1	.1				1	.1					
11	1	4.9											1	.3																	
12			1	.1							2	.2																			
13																	1	.1													
14	5	10.3							1	7.7																					
15	3	3.4									2	.4																			
16																															
17	1	1.2																													
18			1	6.5																			1	.1							

Specimen number	Genus	Species	Locality	Altitude	Collector	Date	Notes
1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
3	1	1	1	1	1	1	1
4	1	1	1	1	1	1	1
5	1	1	1	1	1	1	1
6	1	1	1	1	1	1	1
7	1	1	1	1	1	1	1
8	1	1	1	1	1	1	1
9	1	1	1	1	1	1	1
10	1	1	1	1	1	1	1
11	1	1	1	1	1	1	1
12	1	1	1	1	1	1	1
13	1	1	1	1	1	1	1
14	1	1	1	1	1	1	1
15	1	1	1	1	1	1	1
16	1	1	1	1	1	1	1
17	1	1	1	1	1	1	1
18	1	1	1	1	1	1	1

TABLE II (continued)

STOMACH ANALYSES

Specimen number	Cambarus		Notropis		Etheos- toma		Ameiurus		Rana		Locust- idae		Libellu- lidae		Agrion- idae		Culex		Oest- ridae		Coleop- tera		Ephemer- idae		Hiru- dinea		Nematoda		Fresh-water Oligochaeta	
	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume
19	1	1.6																	1	.2										
20			1	.2																					1	.1				
21	1	3.									1	.2									1	.2								
22	1	2.3																							1	.1				
23			1	.2																										
24	5	1.6									1	.3							1	.2										
25	1	2.																												
26	1	2.9																												
27							1	6.9																						
28	1	7.6																			1	.1								
29			1	.3																										
30	1	.4											1	.5																
31											1	.1																		
32	1	9.	1	1.1																										
33			1	.3							2	.6							1	.2										
34	1	1.									3	.7																		
35	2	6.3																							1	.1				
36	1	.1																												
37	1	.3									1	1.1											1	.2						
38	2	9.6	1	.7																					2	.2				
39											1	.4																		
40	1	1.2																												
41	5	6.2																							1	.1				
42																														
43	1	3.																			1	.3								
44											3	.4																		
45	1	3.																												
46	2	20.8																												
47			1	.3																										
48	2	3.9																							1	.1				
49	1	.3	1	.7																										
50																					1	.1								
51											1	.1																		
52	1	.1									2	.6																		
53	1	5.3																			1	.8								
54																														
55	1	3.1	1	1.1							1	.3															1	.1		

TABLE II (continued)

STOMACH ANALYSES

Specimen number	Cambarus		Notropis		Etheostoma		Ameiurus		Rana		Locustidae		Libellulidae		Agrionidae		Culex		Oestridae		Coleoptera		Ephemeroidea		Hirudinea		Nematoda		Fresh-water Oligochaeta	
	Num-ber	Vol-ume	Num-ber	Vol-ume	Num-ber	Vol-ume	Num-ber	Vol-ume	Num-ber	Vol-ume	Num-ber	Vol-ume	Num-ber	Vol-ume	Num-ber	Vol-ume	Num-ber	Vol-ume	Num-ber	Vol-ume	Num-ber	Vol-ume	Num-ber	Vol-ume	Num-ber	Vol-ume	Num-ber	Vol-ume	Num-ber	Vol-ume
56	1	8.4									3	.4																		
57	5	3.9							1	8.	3	.8																		
58			1	1.5																	1	.3								
59	1	1.2																												
60	1	3.1									1	.3													1	.1				
61																														
62	1	5.6									1	.4							1	.3										
63	2	6.									1	.7									1	.6								
64	1	1.6																												
65	1	.9																												
66	1	1.2	1	1.2							1	.3													1	.1				
67	2	4.5																												
68					1	22.2																								
69	1	4.9																												
70	1	1.1																							1	.1				
71	1	.4									1	.5																		
72	1	1.1									1	.4									1	.3								
73																														
74	2	9.3	1	1.1											1	.5											1	.1		
75	3	3.8																												
76	2	6.2																												
77			2	1.2							1	.5																		
78	5	20.2																			1	.2								
79	1	7.4											1	.1																
80			1	.8																										
81	1	0.									2	.8																		
82											1	1.																		
83	1	10.2																												
84			1	1.6							2	.6																		
85	1	9.1																												
86	1	1.1																							1	.1				
87																														
88	1	5.2									1	.1	1	.5																
89	1	1.															1	.1												
90			1	1.4																										
91	5	9.6																												
92									1	9.4																				
93			1	1.1																										
94	1	3.1									2	.3												1	.2					

[illegible]

1

Specimen number	Cambarus		Notropis		Etheos- toma		Ameiurus		Rana		Libellu- lidae		Agrion- idae		Culex		Oest- ridae		Coleop- tera		Ephem- eridae		Hiru- dines		Nematoda		Locust- idae		Fresh-water Oligochaeta	
	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume	Num- ber	Vol- ume
95			1	.5															1	.2										
96	1	5.1																												
97																														
98	1	8.9																										2	.3	
99																														
100			2	2.7																			1	.1						
101	2	3.4																										1	.1	
102																														
103	1	.7																			1	.3								
104			1	.6																										
105					1	9.2																								
106																							1	.1						
107			1	.7																										
108																												3	.7	
109	1	3.																				1	.1				1	.2		
110	1	3.8																										1	.2	
111	1	1.1																										1	.6	
112	2	20.8																												
113																														
114	2	6.5																										1	.1	
115	1	5.2	1	1.5					1	6.9																		1	.1	
116	2	4.6																										2	.5	
117																												3	.4	
118											1	.6								1	.4	1	.2							
119			1	1.7																										
120																														
121	2	7.6																		2	.7									
122													1	.3	1	.3														
123	3	4.	1	.6																										
124	1	3.2																												
125																														
126																														
127	1	3.1																										1	.6	
128			1	1.1																										
129																							1	.2						
130																				1	.2									
131	5	3.													1	.1						1	.2							
132																														
133	1	.1																												

TABLE II (continued)
STOMACH ANALYSES

Specimen number	Gambarus		Notropis		Etheostoma		Ameiurus		Rana		Lecustidae		Libellulidae		Agrionidae		Culex		Cestridae		Coleoptera		Ephemeroidea		Hirudinea		Nematoda		Fresh-water r Oligochaeta	
	Number	Volume	Number	Volume	Number	Volume	Number	Volume	Number	Volume	Number	Volume	Number	Volume	Number	Volume	Number	Volume	Number	Volume	Number	Volume	Number	Volume	Number	Volume	Number	Volume	Number	Volume
134	1	.3									1	.4															1	.2		
135	1	10.7									1	.2																		
136	1	1.8									1	.8																		
137	1	3.9									1										1	.1			1	.1				
138																														
139	1	.2													1	.3														
140																														
141	2	10.									3	.4																		
142	1	.6																												
143																													1	.3
144	1	3.	1	.4																										
145											2	.2																		
146											1	.4																		
147	1	1.2			1	8.9					2	.3			1	.2									1	.2				
148	1	3.																												
149			1	3.1																										
150							1	7.3																						
151	2	8.1																												
152	1	6.8									1	.3													1	.1				
153	1	1.1																												
154	1	1.7	1	3.5																										
155	1	6.9									2	.5																		
156	2	5.8																			1	.1								
157			1	.7							1	.4																		
158			1	1.3															1	.1										
159																														
160	1	5.2									1	.4																		
161							1	8.2			1	.1													1	.1				
162			2	1.9																										
163	5	19.9																												
164	1	.7									2	.3																		
165	1	.4	1	1.1																								1	.3	
166			1	1.5																										
167																														
168											1	.2																		
TOTALS	1156	451.5	40	38.4	4	36.8	3	32.4	4	32.	83	24.8	7	2.8	6	2.1	3	.3	4	.8	19	5.8	6	1.2	23	2.4	3	.3	3	.9

TABLE III
AVERAGES AND TOTAL OF DATA ON FISH

Specimen	Number found	Volume	Coefficient of frequency	Average volume per specimen	Average expectancy per stomach in cubic centimeters
Cambarus	156	451.5	.929	2.84 c.c.	2.738 c.c.
Notropis	40	38.4	.238	.96 c.c.	.228 c.c.
Ethiostoma	4	38.8	.024	9.2 c.c.	.221 c.c.
Ameirus	3	32.4	.018	10.8 c.c.	.194 c.c.
Rana	4	32.0	.024	8.0 c.c.	.192 c.c.
Locustidae	83	24.8	.494	.3 c.c.	.148 c.c.
Agrionidae	6	2.1	.036	.35 c.c.	.013 c.c.
Culex	3	.3	.018	.1 c.c.	.002 c.c.
Oestridae	4	.8	.024	.2 c.c.	.005 c.c.
Coleoptera	19	5.8	.113	.31 c.c.	.035 c.c.
Ephemeridae	6	1.2	.036	.2 c.c.	.007 c.c.
Libellulidae	7	2.8	.04	.4 c.c.	.016 c.c.
Hirudinea	22	2.4	.131	.11 c.c.	.014 c.c.
Oligochaeta	3	.9	.018	.3 c.c.	.005 c.c.
Nematoda	3	.3	.018	.1 c.c.	.002 c.c.
TOTALS	363	632.5	2.16	1.75 c.c.	3.820 c.c.

TABUL III

AVARAGES AND TOTAL OF DATA OF THIS

Species	Number of Individuals	Volume Coefficient of Specimens	Average Volume Coefficient of Specimens	Average Volume Coefficient of Specimens
Campylura	150	481.5	.020	.020
Neotoma	40	30.5	.025	.025
Ethiostoma	4	10.5	.024	.024
Ameletus	3	30.5	.010	.010
Rana	4	30.0	.024	.024
Loxostomus	27	30.5	.024	.024
Aglyptinus	8	27	.020	.020
Gulax	3	3	.010	.010
Oestridae	4	3	.004	.004
Colaptes	10	8.8	.010	.010
Ephemeridae	9	1.5	.003	.003
Libellulidae	7	8.8	.04	.04
Hirudines	20	8.4	.021	.021
Oligoneura	3	3	.010	.010
Nematoda	3	3	.010	.010
TOTALS	303	688.0	0.10	0.10

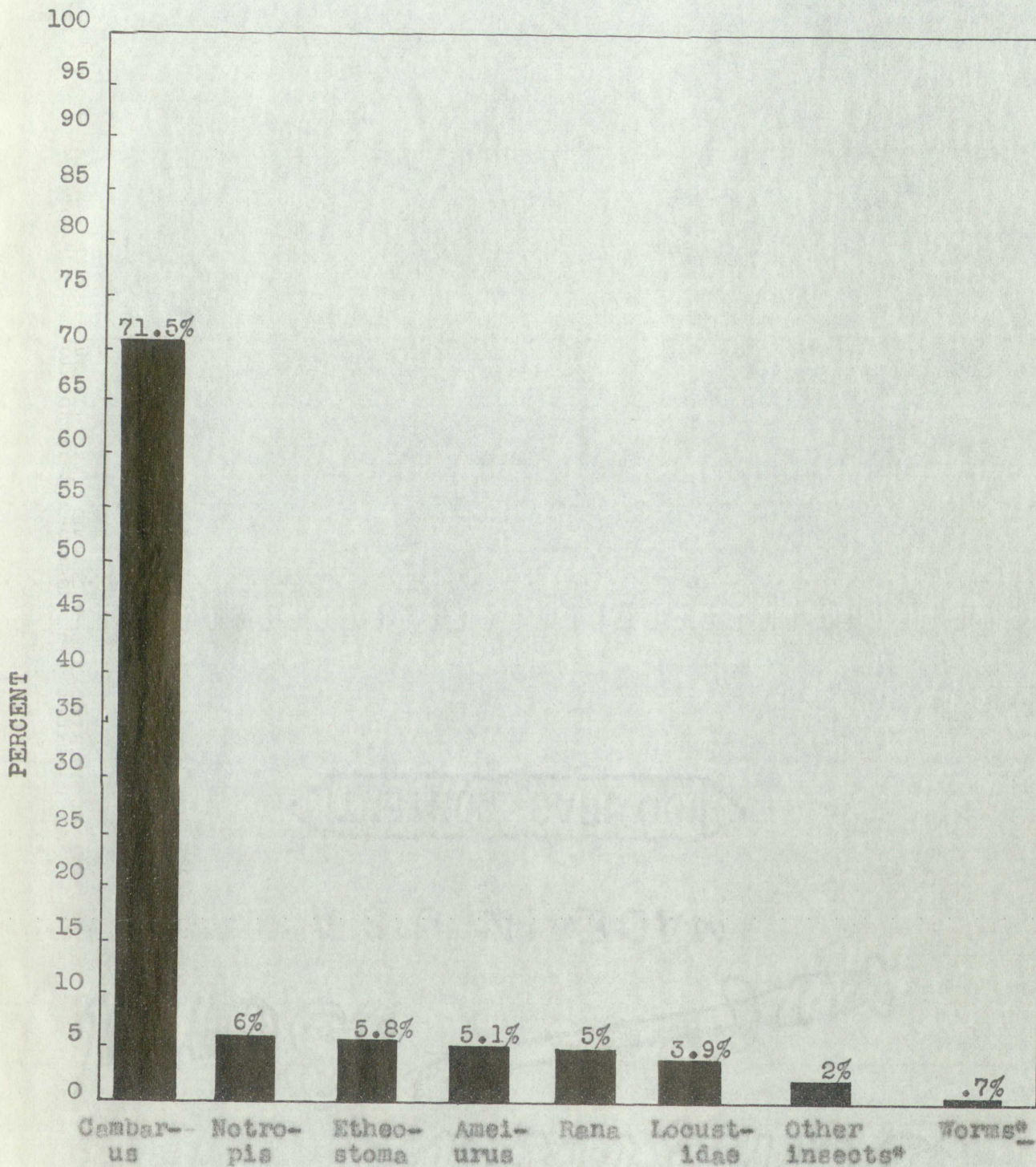
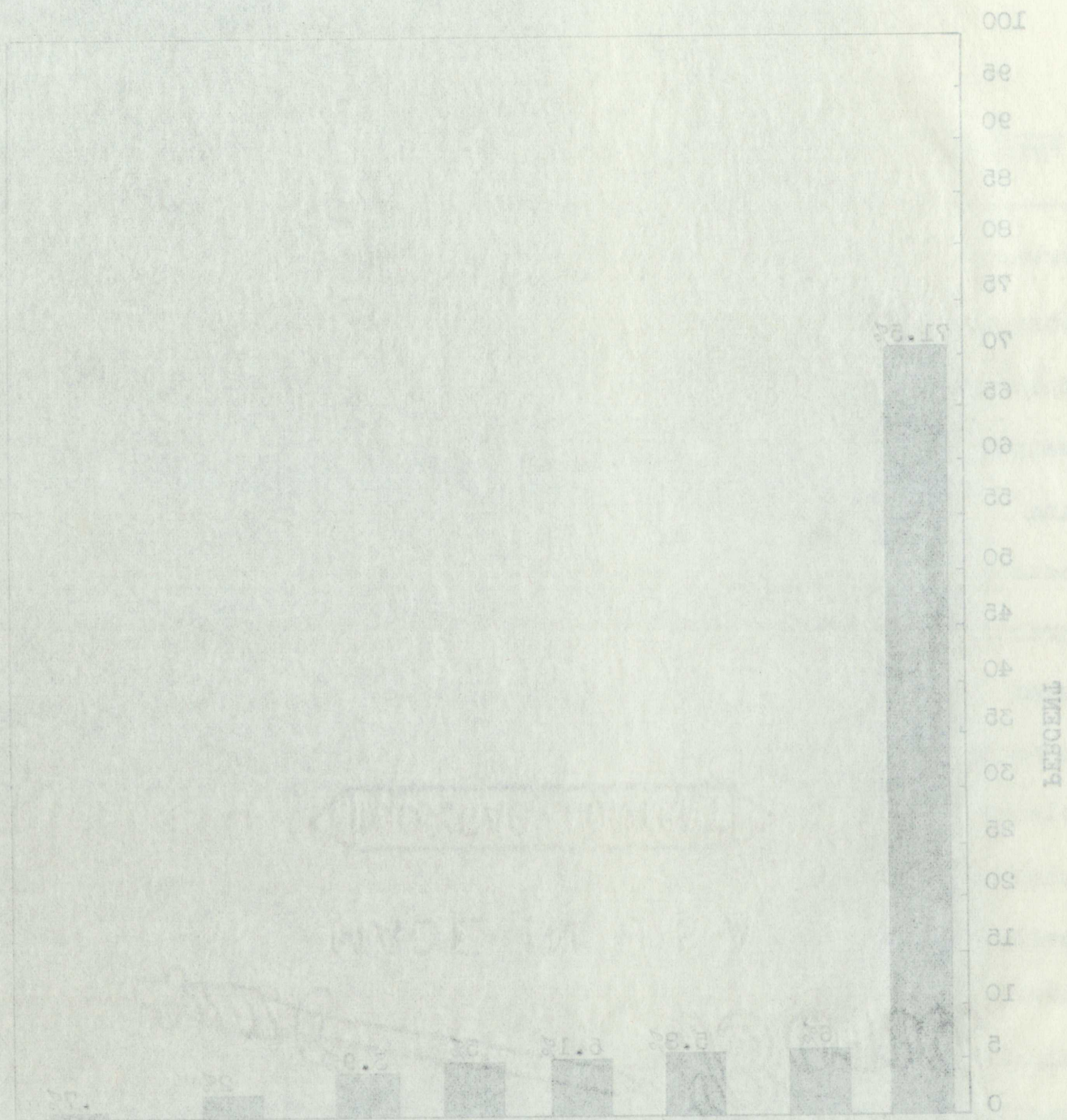


FIGURE 1

PERCENT OF STOMACH CONTENTS BY VOLUME

* Includes Odonata, Ephemerida, Diptera, and Coleoptera

† Includes Hirudinea, Fresh-water Oligochaeta, and Nematoda



* Includes Caucasians, Negroes, and Coloreds
 † Includes Caucasians, Negroes, and Coloreds

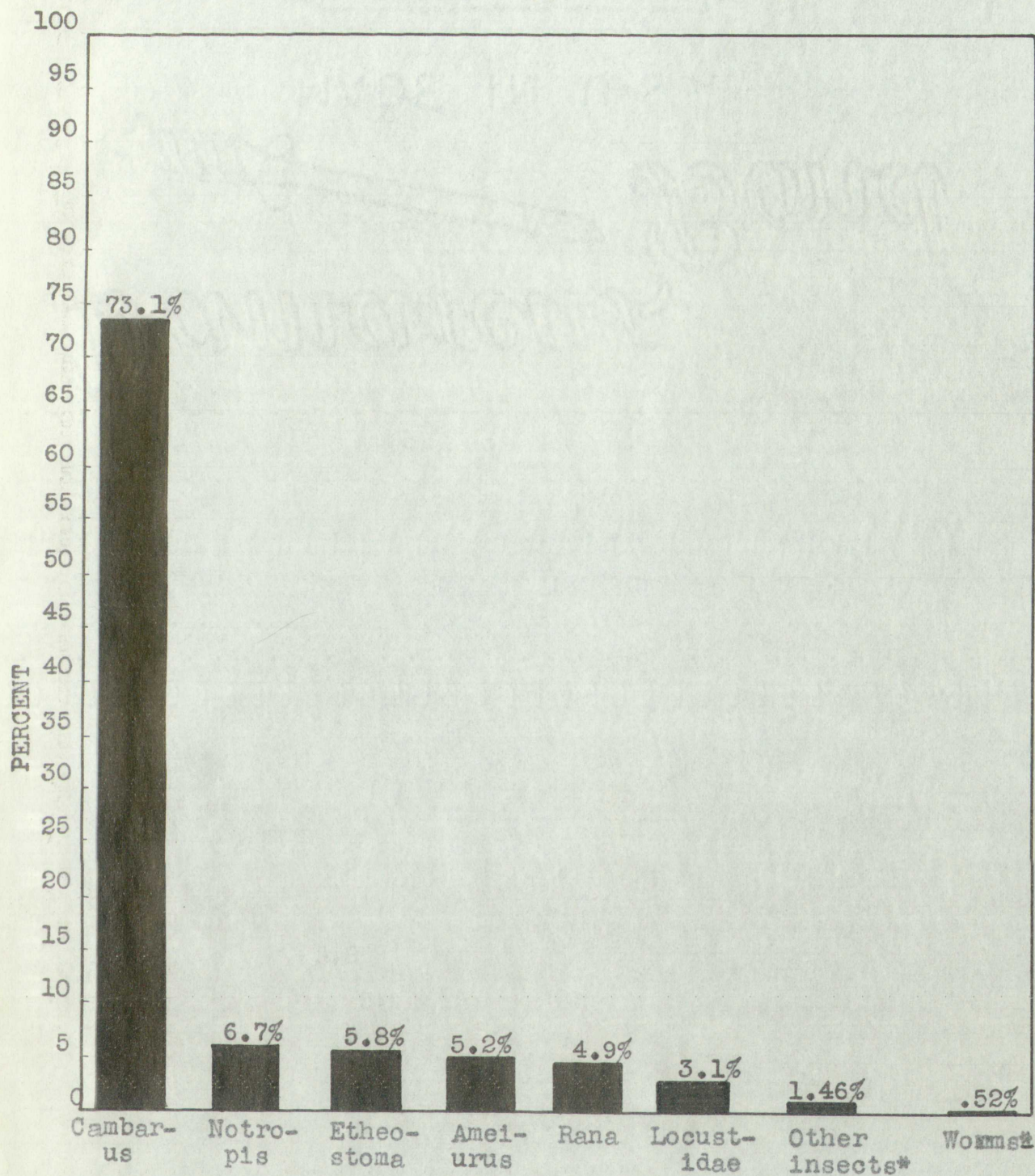


FIGURE II

PERCENT OF STOMACH CONTENTS BY WEIGHT

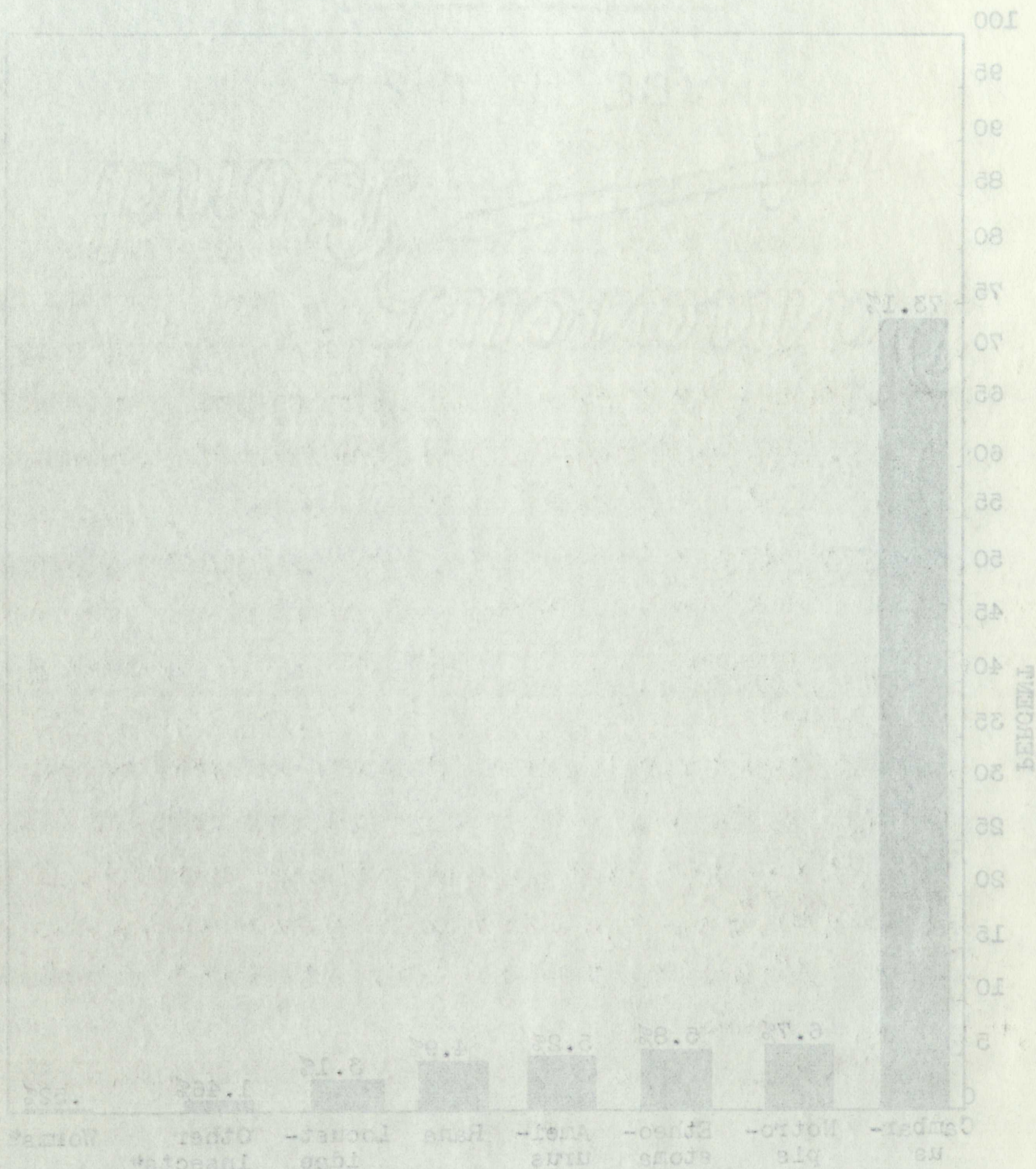
* Includes Odonata, Ephemerida, Diptera, and Coleoptera

† Includes Hirudinea, Fresh-water Oligochaeta, and Nematoda

* Includes Odonata, Ephemeroptera, Diptera, and Coleoptera
 * Includes Hymenoptera, Fresh-water Oligoneura, and Metachloa

PERCENT OF STOMACH CONTENTS BY WEIGHT

FIGURE 11



CHAPTER IV

SUMMARY OF FINDINGS

According to the data collected, mature Micropterus dolomeiu fed principally on crayfish of the Genus Cambarus. The combined fishes on which Micropterus dolomeiu fed made up only one-sixth of the total food eaten. All other food groups were comparatively unimportant, representing approximately one-tenth¹² of the total volume and weight of the contents.

The varied character of the food of Micropterus dolomeiu indicated little selection except within food groups. The combined Cambarus and fishes represented ninety percent of the total weight¹³ of the food.

The mature Micropterus dolomeiu were collected entirely by¹⁴ hook and line fishing. This fact is important since the fish taken in this manner were definitely feeding. In contrast to this type of study an investigation should be made of similar size groups that were not feeding. This could be accomplished only through the use of seines.

The fish that were collected represented all normal size groups over ten inches. The collections were attempted at different times during the day, but the late afternoon and early evening fishing produced over eighty percent of the fish

¹² Figure I and II, pps. 18, 19, in this study.

¹³ Table II, pps. 12, 13, 14, 15, 16 in this study.

¹⁴ Table I, pps. 10, 11 in this study.

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collected.

This type of investigation in itself is of little practical value if it is not subsequently followed by other investigations similar to the one just completed. This would increase the scope of the food study of Micropterus dolomeiu to include more varied local and climatic conditions.

Further studies should be made of the food of the smaller size groups of the Micropterus dolomeiu. Availability of food in the streams should be investigated. Recommendations should be made wherever necessary to modify the streams or lakes so as to produce or restock them with the essential food of Micropterus dolomeiu. The enemies of these fish including turtles, kingfishers, and herons should be reduced to a minimum. Illegitimate seining should be eliminated by more complete supervision by authorities.

If the small-mouthed black bass, Micropterus dolomeiu, is to be successfully propagated in its natural habitat, it must be assured of a readily available supply of food for all size groups.

15

Table I, pps. 10, 11 of this study

15

collected.

This type of investigation is known as a "field study".

practical value of the study is that it provides a means of

investigation similar to those that would be conducted in the

industry and scope of the field study is determined by the

include some varied field and office work.

Further studies should be made of the field study in the

size groups of the industrial group. Studies should be made

in the future should be made of the industrial group. Studies should be

made wherever necessary to study the effects of the study on the

process of research. The study should be made of the industrial group.

Conclusion. The results of the study show that the industrial group is

larger, and hence should be included in the study. The study

should be eliminated by the industrial group and the study

authorities.

If the small-sized study is made, the industrial group should

is to be considered in the study. The study should be made of the

must be assigned of a study and the study of the industrial group.

size groups.

16

Table 1, page 15, of the study

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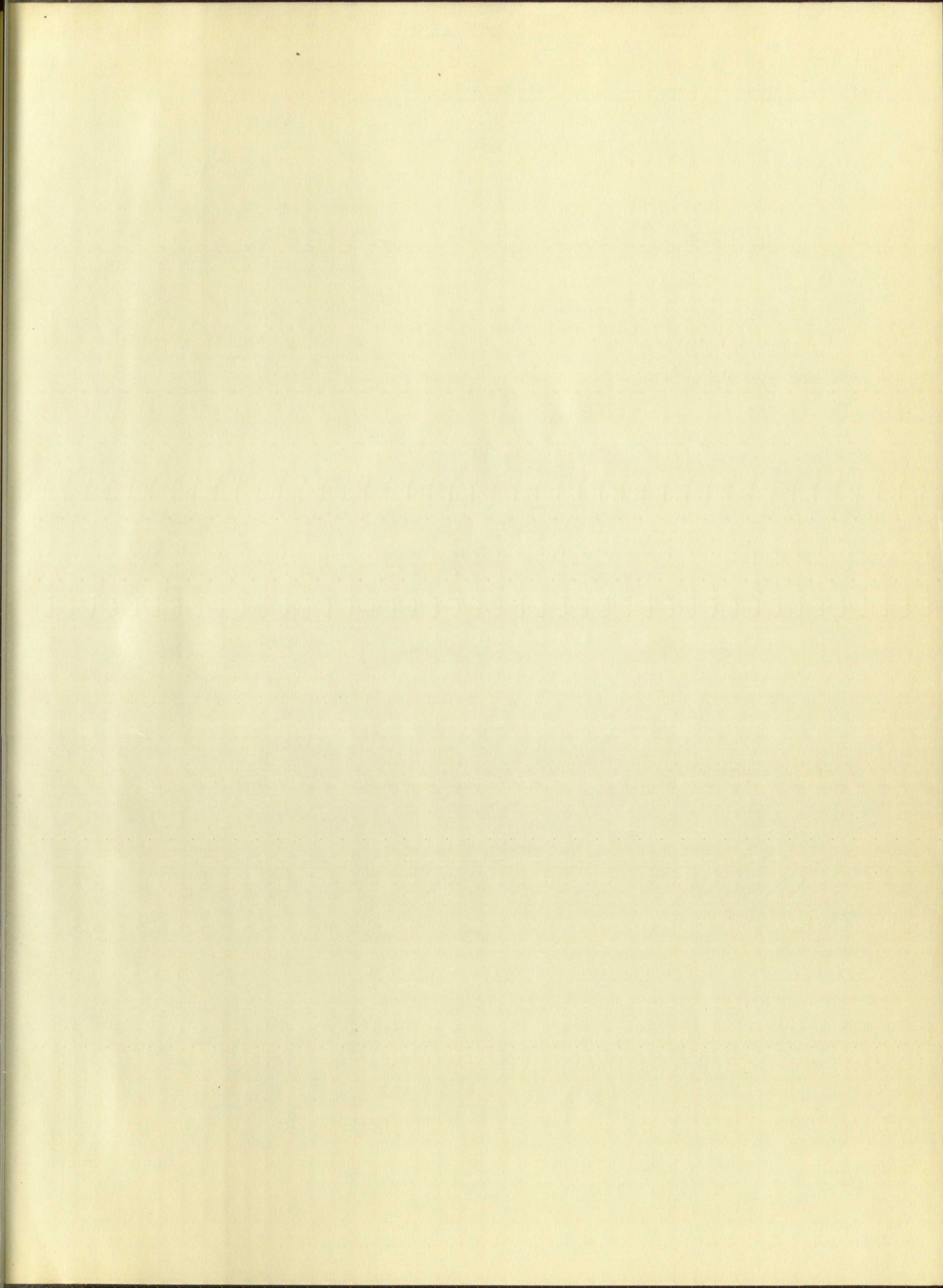
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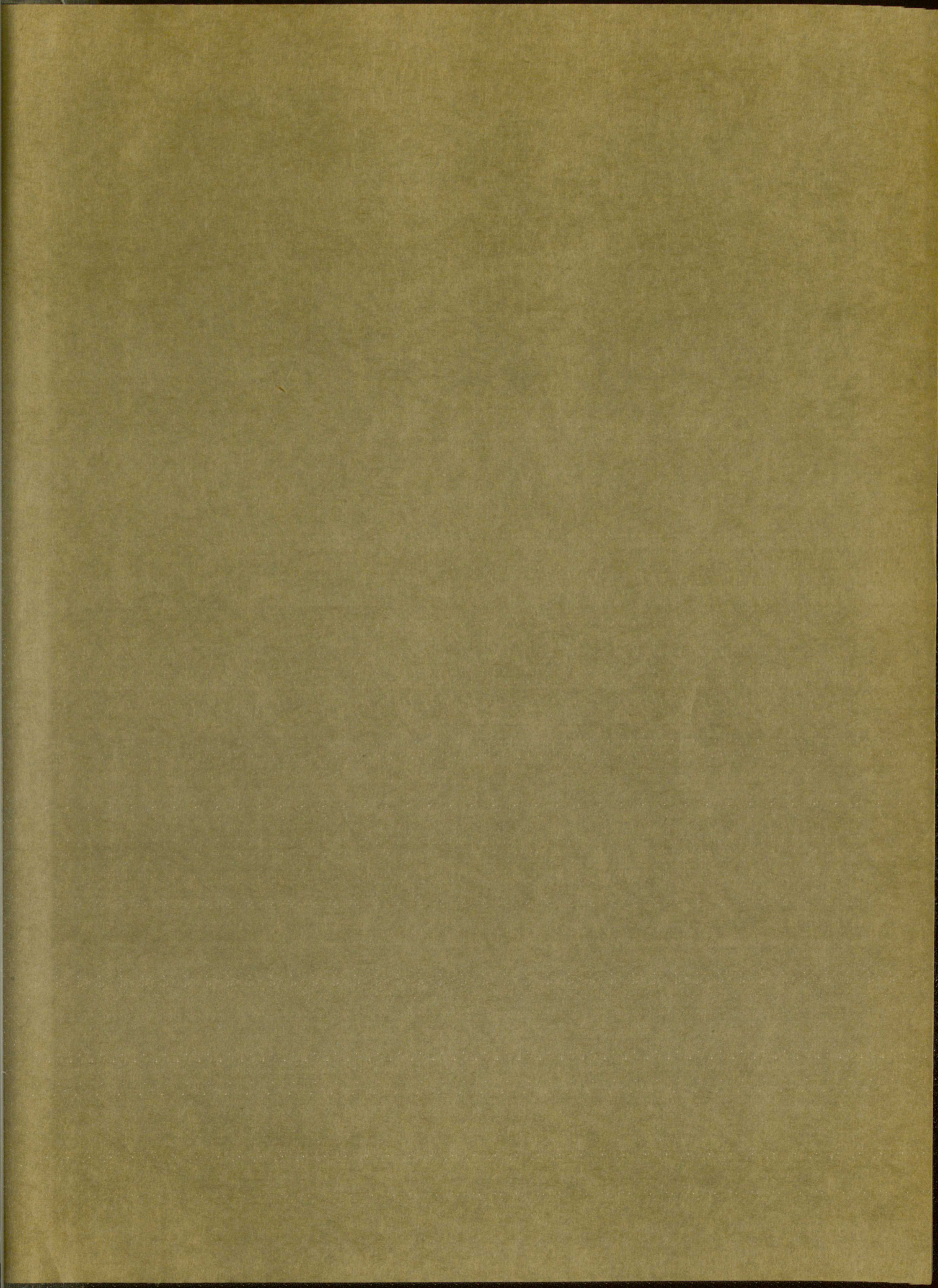
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Paradise

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