

The Ohio Naturalist,

PUBLISHED BY

The Biological Club of the Ohio State University.

Volume XIV.

MARCH, 1914.

No. 5.

TABLE OF CONTENTS.

DRAKE—The Food of <i>Rana Pipiens</i> Schreber.....	257
STERKI—Ohio Mollusca, Additions and Corrections.....	270
Field Manual of Trees.....	272
SEWELL—Soil Bacteria.....	273
Plant Life and Plant Uses.....	278
McAVOY—Meeting of the Biological Club.....	279

THE FOOD OF RANA PIPIENS SHREBER.

CARL J. DRAKE.

The frogs, *Rana pipiens* Shreber, dissected for this paper were collected on the peninsula of Cedar Point, Ohio, at various times during the day and evening, between August eighth and August twenty-second inclusive. My notes are entirely derived from the two hundred and nine specimens collected here in the low, wet depressions between the sand dunes, in the weeds and grasses southeast of the Lake Laboratory, and one evening under the electric lights at the Summer Resort.

The object of this paper is to determine the food of our common leopard frog, *Rana pipiens* Shreber, and its relation to nature in the neighborhood of its habitat. Owing to the fact that the frog's skin must always be kept moist in order that cutaneous respiration may take place, its habitat is always in close proximity to water, or among wet weeds and grasses. Water also affords the means of escaping from its enemies; one who walks along the margin of a pond or stream will notice that a frog when startled almost invariably makes a jump for the water. In this way the creature has a ready mode of escaping, not only from man, but from any other creature which might easily overtake it in an open field.

The frog's food consists of almost any kind of an animal small enough to be seized and swallowed. It has an instinct to snap at all moving objects that come sufficiently near, and will not take dead or motionless animals. Only living and moving creatures are devoured. The frog's tongue is the only organ used for seizing food. It is soft, extensile, attached in front, but free behind,

LOT I.

Frog Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45				
Animals	6	5	3	†	2	1	8	2	7	7	3	1	5	4	1	10	1	2	10	5	2	1	4	2	3	12	8	3	7	5	7	3	4	4	5	3	4	3	4	5	4	2	1	5	4				
Mollusca							3												1																														
Crayfish																																															2		
Spiders	1		1				2		3	3										4		1	1		1	7	6	1	3	2	1		2	3		2	3	2	3	2	2				1	1			
Insects	5	5	2		2	1	3	2	4	4	3	1	5	4	1	10	1	2	9	1	2		3	2	2	5	2	2	4	3	6	3	2	1	5	1	1	1	1	3	2				4	3			
Ephemeridae							1					2	4												2																								
Zygoptera																			2																														
Aceridae			2				1								1																																		
Gryllidae		1						1																																								1	
Gerridae							1		1							6	1	2			2																												
Membracidae		1																																															
Caterpillars	4									1	1													1	1			1	1	1	1	2	1	1												3	2		
Coleoptera	1			2	1		1	2	3	1	1	1	4		3			7	1		2	1	2	3		1	3	2	3		1	1	1		3	1		1	1	1	1					1	1		
Carabidae	1			1								1	1	4		2		4	1		2																												1
Coccinellidae					1							1																																					1
Staphylinidae																							1																										
Spondylidae				1																																													
Rhynchophora								1	2	3						1		3						2	3		1	3	2	1	1	1		2	1		1	1	1	1									
Beetle Larvae																																																	
Formicina	1	2														1																																	
Ichneumonidae																												1																					

† This stomach was entirely empty.

† This stomach contained sand only.

Collected Aug. 8, 1913, between 2:00 p. m. and 6:00 p. m., also between
8:00 p. m. and 10:00 p. m.

and covered with a sticky secretion which adheres firmly to the food seized. So rapid is the protrusion of this weapon that a careful watch is necessary in order to see the animal feed.

The material contained in the stomachs examined can be divided into two classes, animal and foreign. All the evidence indicates that the presence of substances other than those of an animal nature is merely incidental, and due to the mode and conditions of feeding.

FOREIGN MATTER. Nothing can be more natural, since the frog captures the greater part of its prey on the ground by means of its tongue, than that a small amount of foreign substance should be swept into the mouth along with the animals upon which it feeds. In the stomachs examined, this foreign substance

LOT II

Frog Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Animals	5	8	9	3	2	12	7	6	6	9	6	2	9	2	3	6	18	11	8	7	2
Mollusca		1	1														2	1	1	1	
Isopoda							1		1	1										1	1
Spiders	2	2	4	1		4	2	3		2	4		4	1	1	3	4	4		1	
Insects	3	5	4	2	2	8	4	3	5	6	2	2	5	1	2	3	12	6	6	4	2
Acrididae																				2	
Gerridae	1															1	1			1	3
Membracidae									1				1							1	
Caterpillars		2	2	1	2	4	2			5	2	1	2	1				5			1
Coleoptera	2	3	2	1		4	2	3	4	1		1	2		1	2	11		2	1	1
Carabidae						1				1					1	2	3				1
Staphylinidae		1															2				
Rhynchoptera	2	2	2	1		3	2	3	4			1	2				3		2		
Beetle Larvae																	3				
Formicina																	1				
Bembecidae																		1			

Collected Aug. 11, 1913, between 2:00 p. m. and 3:30 p. m.

consisted of vegetable and animal matter. Very little vegetable matter was found. In four stomachs, it consisted of bits of rotten wood, in eight stomachs, seeds of *Washingtonia claytoni* Britton, in two stomachs, pieces of linden leaves (*Tilia americana* L.), and in two stomachs, a little *spirogyra*, the latter being found in stomachs containing aquatic insects. The mineral matter, which consisted of pebbles and sand, composed the greater part of the foreign material. Four small pebbles were found in four stomachs, and about fifteen per cent of the stomachs contained sand, three being completely filled with the latter only. Almost invariably, in the stomach containing sand, the frog had been feeding or preying on animals found on the ground. As the frog swallows its prey entire and the stomach does the whole process of trituration, it is probably that the sand aids in grinding the animals, especially insects like beetles with hard chitinous bodies.

LOT III.

Frog Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		
Animals	4	2	7	4	4	1	3	5	5	5	3	2	3	1	5	7	2	4	7	4	3	4	8	10	3	†	6	5	6	8	2		
Mollusca			1		1				1												1		3							2			
Isopoda																							1			2				1			
Spiders	1		4	2				2		2	1	2						2	3			1				2	1	1					
Insects	3	2	2	2	3	1	3	3	4	3	2		3	1	5	7	2	2	4	4	2	3	8	5	3		2	4	3	7	2		
Pentatomidae			1																														
Membracidae								2							2																		
Chrysalis					1																												
Caterpillars	2	1		1	1	1	1			1	2		1	1	1	2	1			1	2	2	1	1			1		4	1			
Coleoptera	1	1	1	1	1		2	1	1	1	2		2		4	1			2	3		1	6	3	3		2	3	3	3	1		
Carabidae			1	1	1			1							4								3		1		3		3				
Coccinellidae											1													1	1								
Staphylinidae										1																					1		
Chrysomelidae							1																		1								
Rhynchophora	1						1		1		1								2			1	2	2			1						
Beele Larvae	1																						1				1		3				
Formicina									2									1	1	2			1	1									
Bembecidae															2		1																

† This stomach was entirely empty.

Collected Aug. 12, 1913, between 2:00 p. m. and 4:30 p. m.

Since the greater number of stomachs contained no sand, and since, as a rule, sand was found only in stomachs containing ground animals, I am inclined to think that its ingestion was merely incidental.

LOT IV

Frog Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Animals	2	1	1	2	1	†	4	2	3	2	2	2	3	4
Spiders		1	1	1	1		2	1	3	2		2	1	3
Insects	2			1			2	1			2		2	1
Acrididae													1	1
Membracidae				1							1			
Caterpillars	2						1							
Coleoptera							1				1		1	
Cicindelidae											1		1	
Rhynchophora							1							
Pompilidae								1						

† This stomach contained sand only.

Collected Aug. 13, 1913, between 4:00 p. m. and 5:00 p. m.

LOT V.

Frog Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Animals	6	7	3	5	6	6	5	5	4	5	2	2	5	3	3	1
Mollusca					2			1								
Myriapodo														2		
Spiders	3	4	2	3	2		1		2	2	2		1			1
Insects	3	3	1	2	2	6	4	4	2	3		2	4	1	3	
Acrididae		1						1						1		
Caterpillars		1			1	3	1	1	2			1			1	
Diptera					1											
Coleoptera	2	1	1	1		1	2	3		3		1	2		2	
Carabidae		1		1			1	1								
Cicindelidae						1				1						
Rhynchophora	2		1				1	2		2		1	2		2	
Formicina	1			1	2											
Bembecidae													2			

Collected Aug. 15, 1913, between 10:30 a. m. and 1:00 p. m.

ANIMAL MATTER. The frog's food consists of mollusks, crustaceans, myriapods, spiders, and insects; in fact any sort of living creature is acceptable to it as both sense of taste and of smell are apparently obtuse. In a few stomachs, a small amount of

LOT VI.

Frog Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	
Animals	2	2	3	3	1	3	1	†	5	4	2	2	3	†	3	9	2	4	4	4	2	3	3	2	†	2	5	
Mollusca										1												1				1		
Spiders	1		1	2	1	3			3			1						2	2			2		2			1	
Insects	1	2	2	1			1		2	3	2	1	3		3	9	2	2	2	4	2		3				1	4
Acrididae	1											1																
Grullidae												1						1										
Membracidae							1								1												1	
Neuroptera																			1									
Caterpillars																							2					
Diptera													1															
Coleoptera		2	1	1					2	3	1		2		2	9	1	2		4	2		1				2	
Cicindelidae																9				4								
Carabidae		2		1					2	1								1	1									
Rhynchophora			1							2	1		2		2				1			2		1			2	
Ichneumonidae																					1						1	
Vespidae				1																								

† This stomach contained sand only.

Collected Aug. 16, 1913, between 11:00 a. m. and 2:30 p. m.

partially digested animal matter was present that could not be placed in its proper phylum and I will make no further reference to it.

ACKNOWLEDGMENT. I wish to express here briefly, my sincere appreciation to those who have very kindly assisted me in the determination, as follows: Prof. W. M. Barrows and Mr. W. J. Kostir of Ohio State University, the spiders and the Orthoptera; Prof. Stephen R. Williams of Miami University, the Myriapoda; Mr. Chas. Dury, the Rynchophora; and to Doctors Harriet Richardson, A. K. Fisher, and J. C. Crawford of the National Museum, Washington, D. C., the Isopoda, the Lepidopterous larvæ, and the Hymenoptera.

LOT VII.

Frog Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Animals	6	†	5	5	2	13	7	5	5	3	5	2	4	2	3	2	7	2	2	†
Mollusca										1										
Isopoda	6												2							
Spiders			3	2	2	3		2	2	1	2				1	1	2	1	1	
Insects			2	3		10	7	3	3	2	2	2	2	2	2	1	5	1	1	
Grullidae			1																	
Acrididae										1			1	1						1
Caterpillars						7	2						1	1	1		2			
Diptera									1										1	
Coleoptera				2		2	5	3	2	1		2			1	1	3			
Carabidae						1	3	2		1					1		3			
Cicindelidae							1	1	1			2								
Coccinelidae						1			1											
Cerambycidae							1													
Rhynchophora				2												1				
Tenthredinidae			1																	
Formicina			1			1				2										

† This stomach contained sand only.

Collected Aug. 18, 1913, between 10:00 a. m. and 1:00 p. m.

MOLLUSCA..... 29

Gastropods furnished three per cent of the entire number of animals and were found in ten per cent of the stomachs examined. In a few stomachs, the digestive fluids had dissolved the shell beyond recognition. The species that could be identified were:

<i>Limacida</i>	3
<i>Zonitoides arboreus</i> Say.....	3
<i>Strepomatida</i>	5
<i>Goniobasis informis</i> Lea.....	5
<i>Limneacida</i>	11
<i>Galba humilis modicella</i> Lea.....	4
<i>Physa heterostropha</i> Say.....	7
Gastropoda, not further identifiable.....	10

LOT VIII

Frog Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35			
Animals	3	1	6	†	12	17	3	2	8	6	4	5	5	†	9	3	8	10	10	1	2	24	1	4	3	30	2	6	6	4	3	4	3	7	7			
Mollusca					1																	1																
Isopoda					10	1		2				4						2				22			27													
Myriapoda					1																																	
Spiders		1		1			2	4	2	1	2				1	6	6	5		1	1				1		1		2						2			
Insects	3	6		11	5	2		2	4	3	3	1			8	3	2	2	5	1	1		1	4	2	3	1	6	4	4	3	4	3	7	5			
Zygoptera				1																																		
Blattidae							1													1							1											
Malonectidae										1																												
Butterfly																					1																	
Caterpillars	2	2		1								1							2																			
Diptera				1																						1												
Coleoptera	1	1		6	5	1		1	3	3	3				7	3	2	2						1	3	2	2			2	4	3	4	3	7	5		
Cicindelidae				2	1					3	1				5										2							2						
Carabidae				3			1									2	2											1	2					2	3	3		
Hydrophilidae																																			1			
Staphylinidae					1																					1												
Coccinellidae																								2												2		
Erotylidae																										1												
Elateridae	1																																					
Spondylidae																	1																					
Cerambycidae																																			3			
Tenebrionidae			1																																			
Rhynchophora				4	1					3	2				2	1	1								1	1				1	2		2			4		
Formicina				2																								1										
Bembecidae			3					1							1											1			1									

† This stomach was entirely empty.

‡ This stomach contained sand only.

Collected Aug. 22, 1913, between 9:30 a. m. and 2:00 p. m.

CRUSTACEA.....	87
<i>Astacida</i>	2
Only two crayfish were found, these were in a large frog caught in Beimiller's Cove.	
<i>Cambarus</i> sp.....	2
<i>Isopoda</i>	85
Members of this suborder, commonly called "sow bugs," form about ten per cent of the animals, twenty-seven being in a single stomach.	
<i>Oniscida</i>	85
<i>Porcellio scaber</i> Latreille.....	2
<i>Porcellio rathkei</i> Brandt.....	47
<i>Isopoda</i> , not further identifiable.....	36
MYRIAPODA.....	3
<i>Lithobius forficatus</i> L.....	2
<i>Geophilus rubens</i> Say.....	1
ARACHNIDA.....	249
Spiders were found in one hundred and nineteen stomachs and constitute about twenty-seven per cent of the entire number of animals. Their bodies are so extremely soft and fragile that in many stomachs they were ground up beyond specific recognition and only a few specimens could be identified.	
<i>Theraphosida</i>	1
<i>Atypus milberti</i> Walck.*.....	1
<i>Clubionida</i>	1
<i>Trachelas tranguilla</i> Hentz.....	1
<i>Lycosida</i>	6
<i>Lycosa</i> sp. ♂.....	2
<i>Lycosa</i> sp. ♀.....	1
<i>Lycosa</i> sp. ♂ (young).....	1
<i>Pardosa</i> sp. (young).....	2
<i>Epeirida</i>	3
<i>Metepaira labyrinthea</i> Hentz ♂.....	2
<i>Meta menardi</i> Latreille ♀.....	1
Spiders, not further identifiable.....	238
INSECTA.....	563
Insects composed over sixty per cent of the total number of animals and were present in the stomachs of one hundred and seventy-eight frogs. Twenty-five per cent of the frogs had eaten nothing but insects. They are represented by nine orders: Ephemeraida, Odonata, Orthoptera, Hemiptera, Neuroptera, Lepidoptera, Diptera, Coleoptera, and Hymenoptera.	

* Ohio Nat., 14: 251.

Ephemera	9
Only nine mayflies were found; these were in the stomachs of four frogs taken one evening under the electric lights at the Summer Resort.	
<i>Ephemera</i>	9
<i>Hexagenia</i> sp.....	9
Odonata (Zygoptera)	4
<i>Agrionida</i>	4
<i>Argia</i> sp.....	4

SUMMARY

Lot Number	1	2	3	4	5	6	7	8	Total
Stomachs Examined	45	21	31	14	16	27	20	35	209
Animals	187	141	133	29	68	74	80	219	931
Mollusca	4	7	9		3	3	1	2	29
Crayfish	2								2
Isopoda		5	4				8	68	85
Myriapoda					2			1	3
Spiders	58	42	25	18	23	21	23	39	249
Insects	123	87	95	11	40	50	48	109	563
Ephemerae	9								9
Odonata	4							1	5
Orthoptera	7	2		2	3	4	5	3	26
Hemiptera	15	10	5	2		3		1	36
Neuroptera						1			1
Lepidoptera	24	30	30	3	11	2	14	9	123
Diptera					1	1	2	11	15
Coleoptera	57	43	49	3	19	35	22	74	302
Hymenoptera	7	2	11	1	6	4	5	10	46

Orthoptera	26
<i>Blattida</i>	3
<i>Blattella germanica</i> Linn.....	1
<i>Periplaneta americana</i> Linn.....	1
<i>Ischnoptera pennsylvanica</i> DeG.....	1
<i>Acridida</i>	17
<i>Melanoplus differentialis</i> Uhler.....	2
<i>Melanoplus femur-rubrum</i> DeG.....	12
<i>Conocephalus (Xiphidum) sp</i>	3
<i>Gryllida</i>	6
<i>Gryllus pennsylvanicus</i> DeG.....	6

Hemiptera	36
<i>Notonectidæ</i>	1
<i>Notonecta undulata</i> Say.....	1
<i>Gerridæ</i>	20
<i>Gerris marginatus</i> Say.....	20
<i>Pentatomidæ</i>	1
<i>Cosmopela cornifex</i> Pen.....	1
<i>Membracidæ</i>	14
<i>Ceresa bubalus</i> Say.....	14
Neuroptera	1
<i>Myrmeleonidæ</i>	1
<i>Myrmeleon immaculatus</i> De Geer.....	1
Lepidoptera	123
<p>Insects of this order were found in the stomachs of seventy-three frogs, consisting of one imago, one chrysalis, and one hundred and twenty-one caterpillars. These larvæ were eaten indiscriminately and constitute one of the most important foods. Such hairy caterpillars as the larvæ of the Tiger-moths and Fall Web-worms were present in several stomachs. Frogs taken at night or in the morning contained such nocturnal larvæ as cutworms (<i>Agrotinæ</i>).</p> <p>Lepidopterous larvæ are so easily digested that in many stomachs they were ground up beyond specific recognition and could not be identified beyond the family.</p>	
<i>Pyromorphidæ</i>	1
<i>Harrisina americana</i> Guer.-Men.....	1
<i>Pyralididæ</i> , not further identifiable.....	9
<i>Geometridæ</i> , not further identifiable.....	14
<i>Notodontidæ</i>	28
<i>Datana ministra</i> Drury.....	16
<i>Datana</i> sp.....	12
<i>Noctuidæ</i>	39
<i>Apatela</i> sp.....	5
<i>Agrotinæ</i> (cutworms).....	11
<i>Arsilonche albovenosa</i> Goeze.....	2
<i>Catocala</i> sp.....	7
<i>Plusiodonta compressipalpis</i> Guenee.....	2
<i>Noctuidæ</i> , not further identifiable.....	11
<i>Arctiidæ</i>	28
<i>Hyphantria cunea</i> Drury.....	1
<i>Arctiidæ</i> (chrysalis).....	1
<i>Arctiidæ</i> , not further identifiable.....	11
<i>Sphingidæ</i>	1
<i>Hemaris thysbe</i> Fahr.....	1
<i>Hesperiidæ</i>	2
<i>Eudamus tityrus</i> Fabr.....	2
<i>Nymphalidæ</i>	1
<i>Euvanessa antiopa</i> Linn. (Adult).....	1

Diptera	15
<i>Tipulidæ</i> , not further identifiable (larvæ).....	1
<i>Muscidæ</i>	12
<i>Chrysomyia macellaria</i> Fabr.....	4
<i>Musca domestica</i> Linn.....	8
Dipterous larvæ, not further identifiable.....	2
Coleoptera	302
The beetles found, belonged to fourteen different families and were present in the stomachs of one hundred and thirty-five frogs, eleven being found in a single stomach. They constitute thirty-three per cent of the whole number of animals and fifty-four per cent of the insects.	
COLEOPTERA GENUINA	176
<i>Carabidæ</i>	89
Carabids were found in fifty-two stomachs, composing about ten per cent of the animals. Because of their predaceous habits, these insects form a constant food for frogs.	
<i>Omophron americanum</i> Dej.....	2
<i>Bembidium variegatum</i> Say.....	5
<i>Callida punctata</i> Lec.....	4
<i>Calathus gregarius</i> Say.....	5
<i>Platynus rubripes</i> Zimm.....	3
<i>Chlaenius sericeus</i> Forst.....	1
<i>Chlaenius impunctifrons</i> Say.....	1
<i>Harpalus pennsylvanicus</i> Dej.....	68
<i>Cicindelidæ</i>	44
<i>Cicindela punctulata</i> Oliv.....	16
<i>Cicindela hirticollis</i> Say.....	5
<i>Cicindela repanda</i> Dej.....	23
<i>Hydrophilidæ</i>	1
<i>Hydrophilus triangularis</i> Say.....	1
<i>Staphylinidæ</i>	8
<i>Creophilus villosus</i> Grav.....	8
<i>Coccinellidæ</i>	13
<i>Hippodamia 13-punctata</i> Linn.....	4
<i>Coccinella novemnotata</i> Herbst.....	1
<i>Megilla maculata</i> DeG.....	8
<i>Erotylidæ</i>	1
<i>Languria mozardi</i> Lat.....	1
<i>Elateridæ</i>	1
<i>Alaus oculatus</i> Say.....	1
<i>Spondylidæ</i>	2
<i>Parandra brunnea</i> Fab.....	2
<i>Cerambycidæ</i>	4
<i>Leptosylus parvus</i> Lec.....	4

<i>Chrysomelidæ</i>	2
<i>Calligrapha scalaris</i> Lec.....	1
<i>Diabrotica 12-punctata</i> Fabr.....	1
<i>Tenebrionidæ</i>	1
Only one of the darkling beetles was found. This has been pronounced by Mr. Dury as being a new record for Ohio.	
<i>Paratenetus gibbipennis</i> Mots.....	1
<i>Staphylinidæ</i> (larvæ).....	4
<i>Creophilus villosus</i> Grav.....	4
Beetle larvæ, not further identifiable.....	6
RHYNCHOPHORA	126
Weevils were taken from seventy different stomachs. The habit of these insects of dropping to the ground when disturbed gives the frog a chance to capture them.	
<i>Otiorhynchidæ</i>	120
<i>Otiorhynchus oratus</i> Linn.....	120
<i>Calandridæ</i>	1
<i>Sphenophorus costipennis</i> Horn.....	1
<i>Curculionidæ</i>	5
<i>Sitones hispidulis</i> Linn.....	5
Beetle larvæ.....	10
Hymenoptera	46
<i>Tenthredenidæ</i>	1
<i>Cimbex americana</i> Leach.....	1
<i>Pompilidæ</i>	1
<i>Priocnemis alienatus</i> Smith.....	1
<i>Ichneumonidæ</i>	5
<i>Compoplex</i> sp.....	1
<i>Glypta</i> sp.....	1
<i>Itoplectis annulipes</i> Br.....	2
<i>Itoplectis conquisitor</i> Say.....	1
<i>Bembecidæ</i>	13
<i>Microbembex fascicta</i> Fabr.....	13
<i>Vespidæ</i>	1
<i>Halictus sparsus</i> Robt.....	1
Formicina (Hymenoptera).....	25
<i>Componotus</i> sp.....	5
Formicina, not further identifiable.....	20

TABLES. In the tables, the frogs are grouped into eight lots as collected and are numbered in the order of dissection. Under each frog's number, the animals found in its stomach are placed in their respective classes.