BIOLOGY
OF THE SNAIL
HELISOMA TRIVOLVIS
(Continuation)

By

Emile T. Abdel-Malek

Biological Station

University of Michigan

Summer 1949

CONTENTS

INTRODUCTION

The present study on the biology of Helisoma trivolvis was undertaken during the summer session 1949 in order to continue a similar study which the author had started in the summer session 1948 under the supervision of Prof. Dr. F. Eggleton.

At the beginning of the summer the objectives were to study carefully some ecological problems of the snail in the localities in which it is abundant. For this reason two localities were chosen, namely Fontinalis Run and Goose Pond in Wilderness State Park.

The question of food of planorbid snails is of special interest, however, it has not generally received enough consideration and has been described by some investigators as being largely vegetal. Special attention was therefore given to this problem.

The survey of Cheboygan and Emmet Counties which was started in 1948 was continued in the summer 1949, and additional localities for the snail are reported on.

Stress was also made on the chemical analyses of the water in the above mentioned localities.

In preparation for a future study on the Molluscan Family Planorbidae, snails were collected from several localities and fixed for anatomical and histological studies.

The pictures enclosed with this report were taken by Mr. C. Blair to whom the author is greatly indebted.

FIELD INVESTIGATIONS

a) Quantitative ennumeration of H. trivolvis and its associate snails:

Locality : Fontinalis Run — Sky : Clear

Date : July 8, 1949 — Bottle : # 1,2,3 and 4

Time : 2:oo P.M. to 4:30 P.M. — Locus Key: T37N,R2W,S11

Wind : Slight breeze

****

An area of about 300 cms. along the shore and 120 cms. from the shore was investigated. The following quantitative data were taken for the H. trivolvis and its associate snails.

H.trivovis :

Young	Medium	Adult	Shells
65	43	39	16
Average greater: 8 mm. diameter	13 mm.		19 mm.

Lymnaea megasoma: 26 adult
61 juvenile

Physa gyrina : 56 of different heights.

Planorbula armigera : 23

Gyraulus deflectus : 11

Succinia retusa : 21

Ferrisia rivolaris : 3

b) ASSOCIATE VEGETATION

Aquatic Plants :

1. Utricularia vulgaris occurs in a very large number. Young H. trivol.

were observed to be abundant on U. vulgaris. but they do also crawl on the logs.

2. Myriophyllum exalbesens
3. Ceratophyllum demersum
4. Typha latifolia
5. Nymphaea odorata
6. Nymphaea tuberosa
7. Nuphar advena
8. Anacharis canadensis
9. Potamogeton Friesii
10. Sporganium sp. (no flowers to identify species)

Some beach forms grow in furrows in some of the logs.

1. Potentilla ancirina
2. Myrica gale
3. Hypericum virginivum
4
4. Some species of grass.

c) ECOLOGY

The above mentioned area was chosen near the road at a distance of about 250 cms. north east to the bridge. The snal is very abundant in this area and also in the area continuous with it along the shore.

The shore line in this part of the Run is indefinite (Picture #1) the banks are low and not shaded (open). The bottom is formed mainly of sand which is mixed with a small amount of silt and also with decaying organic matter. Logs are abundant in this area , either submerged or floating. The logs are usually crossing each

other and the snails are found in the water in the meshes. The place is not very deep (Picture # 2), it has a depth of 20 cms. to 80 cms. The part of the Run continuous with the area investigated contains many logs along the shore. These logs are present together with a dense vegetation formed mainly of Typha latifolia. Snails are found usually crawling on the logs immediately under the surface of the water in such away that they can be easily seen. This observation made it necessary to take all the samples for the chemical analyses immediately under the surface.

Snails are never found far from the shore. They are not also found under the bridge or immediately on either side of it. This may be atributed to the fact that men are working on the road, they take water out of the Run by pumping it. They usually refill the tank every half an hour. This process of pumping the water makes it difficult for the snails under investigation to survive in this place. The snails prefer usually more or less stagnant water i.e. water in which the water movements arevery much reduced.

The part of the Run between the bridge and Burt Lake (Picture# 3) is about 20 meters in length and 4 to 5 meters in width. The banks here are high and bordered with logs and shrubs. The logs are either erect, floating or submerged. Some logs are also partly submerged in the center of the Run. In this part of the Run, the snails are found crawling on the logs which are situated on the banks or those which are partly submerged in thecenter of the Run.

The reason why the water movements in Fontinalis Run are very

much reduced is due mainly to the fact that the Run is slightly higher in level than the lake (Picture # 3). For this reason water is , in most instances, not contiuous between the Run and the lake.

d) OVIPOSITION

Oviposition usually takes place on the logs. The erect stems of Sparganium sp. which are partly submerged provide also a suitable surface for oviposition. Very few egg masses are found on the lower surface of the lillie pads of Nymphaea odorata and Nuphar advena.

At the time the area was investigated few egg masses were collected. The number of the egg masses is considered to be low when compared with number of adult snails collected from the same area. The number of eggs per each egg mass varies from 12 to 24. All egg masses brought from the field contained living embryos. The egg is circular or polygonal and mostly fertile. In its early stages of development the embryo appears as a shining spot situated usually at one pole of the egg. At a later stage of development the snail was observed to be very active inside the egg. The radula, heart and the developing shell can be easily observed.

A simple experiment was done with some egg masses containing very active young snails. The snails were set loose out of the eggs, and each group of 5 was raised in a finger bowl. Out of 20 snails released in this way about 17 survived. This proves that when the snail is completely developed in the egg it can survive

outside the egg, the same as it does inside the egg. Therefore the period between the full development of the snail and its release from the egg is mainly due to the fact the snail is trying to break through the egg membrane. It seems that the snails differ in their ability to break through the egg. This may suggest one explanation to the fact that snails layed at the same time, or nearly so, do not usually hatch at the same time.

HELISOMA TRIVOLVIS AS AN INTERMEDIATE HOST FOR TREMATODE WORMS

On examination of H. trivolvis snails collected from Fontinalis Run they proved to be acting as intermediate host for some of the Trematode worms. The most importamt of these parasites is DIPLODISCUS TEMPORATUS which is a digenetic trematode of the family Paramphistomidae. On dissection of the snails they were found to contain a large number of cercariae and mother rediae. The cercariae when formed from the mother rediae emerge from the snails and can be easily seen against light. The cercariae swim freely in the water and can infect frogs which are the final host for the parasite. In Fontinalis Run the frogs are very abundant and are usually infected with the parasite. The presence of H. trivolvis in Fontinalid Run together with a large number of frogs, provides an ample chance for the parasite to complete its life cycle. Tadpoles can only be infected when they start metamorphoses.

PERIPHYTON
AS A SOURCE OF FOOD FOR
H. TRIVOLVIS

A light brownish green layer is accumulated on the surface of the logs in Fontinalis Run. A similar layer but usually of a deep green color is found on the snail's shell.This material which is accumulated on the logs and on the snail's shell is refered to as"Periphyton".

There is some controversy as to the food and the feeding habits of snails in general. The kind of food which provides normal growth of the snail has been discussed by some investigators who suggested several sources for snail food. It has been claimed that the food of the planorbid snails is largely vegetal. A thorough investigation of the periphyton deposited on the logs in Fontinalis Run seemed therefore necessary since the logs together with the periphyton provide a suitable natural habitat for the snails. It seemed also necessary to study the contents of material grasped by the snail in between the radula. The investigation was also extended to the contents of the digestive tract. The fecal material was also collected from the snails right after they were brought from the field and a complete investigation of their contents will be done later on (they are fixed in formaline) as a continuation of this study.

It is very evident , therefore, that a comparison of the contents of 1.Periphyton 2. Material in the radula. 3. Digestive tract. 4. fecal material, will demonstrate without any doubt facts concerning the source of the snail's food.

I- ORGANISMS FOUND IN THE PERIPHYTON ACCUMULATING ON THE LOGS AND ON THE SNAILS SHELL

The deep green layer on the shell is in the form of tubercles together with filamentous extensions. ~~The~~ On examination , the layer is found to be formed of.

Fresh-Water Algae
Class Chlorophyseae
Order Ulotrichates
Genus Cladophora

Cladophora is very abundant and forms colonies. From the Chlorophyseae there are also Scenedesmus and Microspora. The class Bacillariaceae (diatoms) is also represented by Navicula and Vanheurckia. Bacteria(Fungi) are of different forms/also abundant.

The above mentioned algae are also found in the periphyton on the logs together with the following :

MYXOPHYCEAE

Anabaena
Oscillatoria
Lyngbya
BACILLARIACEAE
Tabellaria
Melosira
Gomphonema
Synedra
Fragillaria
CHLOROPHYCEAE
Cosmarium
Mougeotia
Rhizoclonium
Chaetosphaeridium (epiphytic alga)
Sanidesmus
Pediastrum
Ulothrix
MOSSES
Bryum
Leptodictium

PROTOZOA

Sarcodina:

PROTOZOA (Continued)

Difflugia
Amoeba proteus
Amoeba sp.

Mastigophora
Euglena viridis

Infusoria
Vorticella
Ophridium

PORIFERA
Spicules of sponges

ROTIFERA
Euchlanis
Keratella
Scaridium

II- ORGANISMS FOUND IN THE MATERIAL GRASPED BY THE SNAIL

When collecting snails from Fontinalis Run, some of them were found grasping material between the radula teeth. This material was taken from the mouth and investigated when brought back to the lab. The following organismswere found :

FUNGI

Bacteria of different forms

MYXOPHYSEAE

Oscillatoria (abundant)
Lyngbya (abundant)
Phormidium (abundant)
Anabaena

BACILLARIACEAE

Navicula
Fragellaria
Vanheurckia
Tabellaria
Gomphonema

CHLOROPHYCEAE

Mougeotia

Cosmarium
Chaetosphaeridium
[illegible]idesmus
[illegible]otrichates

MOSSES

[illegible]ptodictium

PROTOZOA

[illegible]tiella
[illegible]hridium
Difflugia
Amoeba sp.

ROTIFERA

[illegible]ridium
[illegible]atella

III- ORGANISMS FOUND IN THE DIGESTIVE TRACT OF H. TRIVOLVIS

The snail was dissected in the field, alimentary tract opened, the contents together with the snail were fixed in 4% formaline soln. In investigation when brought back to the lab, the following organisms were found. More than 10 snails were dissected.

[illegible]

Bacteria different forms

[illegible]AE

Oscillatoria (abundant)
Lyngbya

[illegible]ACEAE
Navicula (abundant)
[illegible]llaria
[illegible]onema (abundant)
[illegible]ra (abundant)

[illegible]CEAE

[illegible]hrix
[illegible]m
[illegible]a
[illegible]rium

Scenidesmus
Mougeotia

MOSSES

Broken Leptodictium stems

PROTOZOA

Vorticella
Amoeba
Ophridium

PORIFERA

Spicules of sponges

ROTIFERA

Scaridium

Sand granules were also found in the stomack of H. trivolvis together with the above mentioned contents.

CHEMICAL ANALYSES

OF WATER OF FONTINALIS RUN AND GOOSE POND, W.P.

Physico chemical determinationsfor the water of Fontinalis Run and Goose Pond in Wilderness State Park, taken on several days are indicated on the enclosed Permanent Physico Chemical records.

A comparison of the chemical analyses of the water in the two localities in which the snails are very abundant (Fon. Run on July 15 and August 5, 1949-**-- Goose Pond on July 28,1949) will indicate a pronounced difference in pH and total alkalinity. This proves that these snails can stand a wide range of pH. Moreover if we take in consideration the chemical analyses of the water of Fontinalis Run on

August 5, 1949 it will be found that the dissolved oxygen is very low, pH is towards the acidic side and the free carbon dioxide is abundant. The reason for this pronounced change in the water as indicated by the chemical analyses on July 15, and August 5 is because the place was in a process of drying on the latter day, The level of the water went down, the lillie pads together with a part of the plant were exposed in the air. Near the shore the place was muddy with partly decayed aquatic plants causing a considerable rise in the free carbon dioxide. In a situation like this, the snails were still surviving although those in places which became completely dry and in which there was no chance of moving, the snails died.

As to the colorimetric determination of some of the dissolved elements, the following results were obtained.

	FONTINALIS RUN	GOOSE POND
Dissolved Phosphorus	.002 p.p.m.	.0015 p.p.m.
Silicate	13 p.p.m.	10 p.p.m.

LIMNOLOGICAL METHODS

PERMANENT PHYSICO-CHEMICAL RECORDS

State Michigan Sky clear Turbidity

County Cheboygan Wind Slight breeze Color

Water Fontinalis Reen Air Temperature 29°c Secchi Disk

Locus Key T 37N R 2W S11 Thermometer

Station Near the bridge Sampling Method

Date July 15 1949 Analysis Methods for PH, La Motte

Time 2 : P : M calorimeter SMWA

to 3 : P : M Records By Emile Abdel-Malek

O_2 (Volume Titrated = 204 cc. k = .9974

Assembled From Field Records Nos. 1 and 2

Depth		Temperatures			Oxygen			Carbon Dioxide							
Feet	Meters	Therm. No.	Cent.	Fahr.	$Na_2S_2O_3$	O_2 ~~cc. per L.~~ p.p.m.	KOH ~~.65~~	M.O.	ph-th	Free 6.5	Bicb:	Cb.	pH.	Cond.
	25 Cm.		26°c		6.45	6.433	.65	19.95	0.0	6.5 p.p.m.	199.5 ppm.	0.0	7.3	

U.M.B.S. Limnological Methods.
F.E./ 5-26-47. 1 M.

Permanent Phy-Chem. Records Sheet No. 1

LIMNOLOGICAL METHODS

PERMANENT PHYSICO-CHEMICAL RECORDS

State Michigan Sky Clear Turbidity

County Emmet Wind Slight breeze Color

Water Goose Pond, Wilderness Park Air Temperature 28°c Secchi Disk

Locus Key T 39N, R5W S25 Thermometer Chemical (Volume

Station Surface waters Sampling Method Judey bottle (Kemerer sampler) O_2 (Titrated = 204 ml

k = .9974

Date July 28, E 1949 Analysis Methods SMWA

Time 1 : P : M Assembled From Field Records

to 1 : 30 P.M Records By Emile Abdel-Malek Nos. 2

Depth		Temperatures			Oxygen			Carbon Dioxide						
Feet	Meters	Therm. No.	Cent.	Fahr.	$Na_2S_2O_3$	O_2 ~~cc. per L.~~ p.p.m.	KOH	M.O.	ph-th	Free	Bicb. p.p.m.	Cb.	pH.	Cond.
	0		29.5°c		7.0	6.982	0.0	10.8	.95	0.0	98.5	19.0	8.4	

U.M.B.S. Limnological Methods.
F.E.E./ 5-26-47. 1.M.

Permanent Phy-Chem. Records Sheet No. 2

LIMNOLOGICAL METHODS

PERMANENT PHYSICO-CHEMICAL RECORDS

State Michigan Sky Overcast Turbidity

County Cheboygan Wind Slight breeze Color

Water Fontinalis Run Air Temperature 28°c Secchi Disk

Locus Key T 37 N R 2W S 11 Thermometer Chemical (Volume 204 ml.

Station Near the bridge Sampling Method Judy Bottle (Kemerer Sampler) O_2 (Titrated =

(k = 1.01

Date July-August 5 1949 Analysis Methods SMWA

Time 11 : a : M Assembled From Field Records

to 12 : 00 M Records By Emile Abdel-Malek Nos. 3

Depth		Temperatures			Oxygen			Carbon Dioxide						
Feet	Meters	Therm. No.	Cent.	Fahr.	$Na_2S_2O_3$	O_2 cc. per Ltr. P.P.M.	KOH	M.O.	ph-th	Free ppm	Bicb. p.p.m	Cb. ppm	pH.	Cond.
			27.5°c		4.40	4.44	4.7	24.5	0.0	47	245	0.0	7.1	

U.M.B.S. Limnological Methods.
F.E.E./ 5-26-47. 1 M.

Permanent Phy-Chem. Records Sheet No. 3

OTHER LOCALITIES FOR THE SNAIL

Continuing the study of the snail localities in Cheboygan and Emmet Counties, Michigan, which have been started in summer 1948 (refer to the report written in 1948), the following localities were investigated and are considered to be natural habitat for the snail:

1. SEDGE POOL T37N, R3W, S21
2. BESSEY CREEK T38N, R3W, S 18 . Living snails were collected from Bessey Creek. Helisoma trivolvis was decreasing in number in this locality at the beginning of the summer. Shells are abundant. At the end of the summer the snails are again very abundant
3. CARP LAKE T39N, R4W, S15

Snails were collected from Carp Lake near the source of Carp River. Snails are found near the shore and also in some swamps extending from the lake in this area i.e. near the source of Carp River. The snails near the shore of the lake are found in a habitat similar to some extent to that in Fontinalis Run. The snails are crawling on floating or submerged logs whose surface provides a suitable substratum for periphyton.

4. SWAMPS EXTENDING FROM BLACK LAKE T36N, R1W, S21

This locality provides the same habitat for the snail as in Fontinalis Run :

a- Logs covered with periphyton, mosses are very abundant (Drepanocladus exannulatus and Leptodictium.

b- Typha latifolia together with nearly the same aquatic vegetation, found in Fon. Run , the swamps extending from Carp Lake or those extending from the Indian River.

c- Water movements are very much reduced,

5- CROOKED RIVER T36N, R4W, S2,3 and 10).

Associate Snails : same as Fontinalis Run with the exeption of Lymnaea megasoma.

Associate Vegetation :

Typha latifolia
Sparganium euricarpum
S. fluctuans
Potamogeton natans
P. Richardsonii
P. Friesii
P. pectinatus
P. angustifolius
P. zosteriformis
Naias flexilis
Vallesnaria americana
Anacharis canadensis
Scirpus validus
S. atrocinctus
S. atroverens
Lemna minor Spirodela pol-
Spirodela polyrhiza
Nymphaea tuberosa
N. odorata
Nuphar advena
Utricularia vulgaris
Megalodonta Beckii
Hippuris vulgaris
Myriophyllum heterophyllum
Chara vulgaris

The fact that Crooked river is highly polluted and at the same time rich in some planorbid forms is very important as far as the environmental conditions of members of this family are concerned.The planorbid snails can withstand unfavourable conditions and therefore can use water containing sewage as a habitat.

Helisoma trivolvis is abundant in parts of the river where the following conditions
the following conditions are prevailing:

1Where the water movements are very much reduced
2.
2. Logs with periphyton accumulated on their surface
3. Typha latifolia, Sporganium sp. together with other aquatic plants are abundant.

Other proposed Problems for research on Helisoma trivolvis:

1- Early developmental stages of the snail.

2- Morphological study of the shell from its early development to the fully formed condition, and the importance of this study from a taxonomic point of view.

FIXATION OF PLANORBID SNAILS FOR ANATOMICAL AND HISTOLOGICAL STUDIES

Before fixation the snail was narcotized through the effect of Menthol crystals. Snails were put in finger bowls, half-filled with water, menthol crystals were then added where they floet on the surface of the water. The snails were watched during the next hour and when completely narcotized were put in the fixative. The time required for narcotization of the snail, also the amount of menthol crystals to be used for the purpose, usually vary with the age of the snail and also with the species. Fixation was performed in Bouin's fluid or in Formaline. The following snails were fixed :

1- Helisoma trivolvis

2- Helisoma antrosum

3- Helisoma campanulatum

4- Planorbula armigera

Picture # 1 Fontinalis Run; east and north east to the bridge.
Area investigated (see page 2) is at the end of the arrow.

Picture # 2 : Fontinalis Run east and north east to the bridge. Notice depth of the area in which the snail is abundant.

Picture # 3 : Fontinalis Run ; part between the bridge and Burt Lake

Emile T. Abdel-Malek

Proposed Plan of Research

on

HELISOMA TRIVOLVIS

I- ECOLOGY

1- General Characters of Habitat ; pond, pool, creek, river or lake; running or stagnant water.

2- Physical Factors:

a) Depth in meters.

b) Distance from shore.

c) Shore line; condition , nature.

d) Nature and structure of substratum (bottom).

e) Presence or absence of currents in the water containing the snail.

f) Temperature (centigrade), of air and water at the cetain depth in which the snail lives.

g) Light penetration; color; turbidity and suspended matter.

h) Place and depth at which the measurements should be taken.

3- Chemical Analyses:

a) H concentration , pH value.

b) Free Oxygen (Oxygen supply).

c) Detection of Carbon Dioxide using different indicators.

(free Carbon Dioxide, Carbonate and Bicarbonate).

4- Associate ~~Habitat~~ Biota:

a) Qualitative enumeration.

b) Quantitative enumeration.

(a) and (b) for Vegetation, Phytoplankton, Bentic and Limnetic (Zooplankton) animals.

II- LIFE HISTORY

1- Type of reproduction, number of eggs (per egg mass and per season), time of laying eggs, rate of ovoposition and place of ovoposition.

2- Rate of growth.

3- Period of the life history i.e. how long does the animal live.

III- SHELL MORPHOLOGY

1- Number of coils (whorls) at different ages.

2- Size of shell: a) Diameter b) Height c) Diameter of aperture.

3- Shape of outer lip.

4- Color.

5- Any carinations?

6- Any variations in the above mentioned features.

IV- SOFT PART MORPHOLOGY

1- Color of the soft part.

2- Shape and size of the foot.

3- Length of the tentacles.

4- Shape and size of the visceral hump.

V- Comparison between Helisomes of the New World and Planorbis of the Old World in all the above respects.

VI- INFECTION

a) If we succeed in bringing infected snails (Planorbis) from Egypt, we try to infect Helisomes with the same parasite (similar work was done with negative results).

b) In case of both Helisoma and Planorbis, find out the stage at which infection with the parasite is more possible.

c) Effect of the parasite on the snail, and its life history inside it.