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NATURAL HISTORY OF GONIOBASIS LIVESCENS (MENKE)

IN DOUGLAS LAKE MICHIGAN

1941 Report

by

Ralph O. Cooper

Introduction

The report of this year covers to a large degree the same types of study as carried on in previous years. The statement in the 1937 report to the effect that Goniobasis livescens is an inhabitant of the sandy shoals of Douglas Lake where the descent into deep water is quite abrupt and in some places quite close to shore needs no alteration. However this is not to be construed as meaning/<sup>that</sup>all portions of the lake where the shores fit the above description are inhabited by the snails. The question of migration has always been one of the major phases of research on this snail and the migration toward Station 7 this year has been an item in the work demanding more than usual attention. The study of migration has in itself been an interesting feature but has opened up the way for other important features not accomplished in other periods of study.

Equipment

Equipment was the same as that used in previous work, except a one fourth square meter unit sampler area borrowed from Mr. Hatchett. Other equipment consisted of Tyler screens, a dustpan shaped screen sampler for field use, medium and fine mud screens, glass bottomed bucket, vernier caliper, and microscope with ocular micrometer, and the usual field bottles and materials for transporting specimens.

## Explanation of terms

Four terms which best describe certain groups of snails need explanation:

Micro-snails refers to those snails small enough to be measured best with the microscope and ocular micrometer. They ranged from 0.72 mm to 2.5 or 3.0 mm.

Juveniles is purely an arbitrary term used to designate the range of snails between the micro- snails and a group beginning at 10.0 mm approximately. They appear to be second year individuals.

Adults is a loose term referring to those snails more than the approximate length of 10.0mm. The term is not intended to imply that the snails are adults either chronologically or physiologically. It is also a term of convenience.

The term mossbacks is a descriptive term used to designate individuals which have accumulated a considerable coating of marl, indicative of individuals which have not been active enough to keep the shell polished by movement.

## Distribution

Goniobasis continues to occur in all the regions previously report, and has spread to a noticeable degree in both directions from the regions previously discussed. In Station 3 the snail has not previously made much progress although in nearby Station 4 they have occurred in great abundance. As the little bay called Station 3 is well protected from the strong winds beyond Grapevine Point, it would appear to be a good situation. During the summer of 1941, however, the snails have occupied most of the beach in spite of more than the usual amount of winds from the north and northeast. No particular study was made of the region of Station 3 and no worthwhile theory is advanced for the spread

into this region.

The other region of apparently successful migration is that indicated in blue of Station 7 on the map inclosed. By 1938 the snails seemed successfully established upshoal as far as the site of the pitcher pump beyond Old Log Lab. By 1939 they had reached a position opposite the path leading to Old Mess Hall of the former camp. No records are available for 1940, but by the close of this season they are to be found in limited numbers as far toward Big Shoal as the first prominent point beyond the site of the old camp, commonly named Children's Point. This is a distance of approximately 200 yards, and on much less secure footing than farther downshoal toward the present camp.

The common reference to the failure of the snails to spread upshoal because of loose sandy footing seems to have little to back it up. Present evidence seems to indicate that they succeed very well until such seasons as the one of 1941 when an unusual amount of beach building occurs. This will be discussed more under the heading of The fate of snails. Certainly loose footing has nothing to do with oviposition and prosperity of micro-snails. Well toward the point of disappearance the loose sand coated in places with flocculent marl snails of 2 - 3 mm. were to be seen in considerable numbers, even though adults were sparsely present and only at the declivity edge. The small snails occupied shoal regions ten or more meters from the declivity.

An attempt was made to secure data which would cast some light upon the size and age of snails which were to be found in the regions covered by migrations of the past few years. Two methods were tried. In the first the total population was removed from regions one meter square and five meters apart, such transect regions paralleling the face of the declivity.

The transect intervals began in an undisturbed area between Cort cabin and Old Log Lab. Numerous snails were buried so deeply that the unit sampler had to be cleaned out to a depth of two inches or more. The amount of time and labor involved indicated that the task would be greater than time permitted to sample the entire shore line to the vanishing point. A series of five such transect intervals of one square meter gave results as follows:

		median length
I	92 snails	14.9 mm
II	63 "	14.9
III	118 "	14.9
IV	90	14.9
V	69	14.7

Thus far no evidence was available to indicate whether or not the tendency was toward a population of larger or lesser snails predominated as the point of disappearance was reached.

The method was changed following a disturbance due to rough water. Continuous transects the width of the sampler (approximately one third meter) and ten meters long were next taken to get enough snails to have numbers comparable to those taken in the square meter intervals. Whereas in previous samplings 90 or more snails had been taken, only a dozen or few were taken by the same method before changing the plan of sampling. Results of the second method as far as carried out are given :

Transect	Number of snails	median length
I	145	16.3 (19% dead)
II	93	15.3 ( 7.5% dead)
III	128	15.3 (4.7% dead)
IV	40	15.5 (2.5% dead)
V	52	16.5 none dead

No information is available to account for all the dead snails,

unless it is a question of their becoming too deeply buried.

In the latter/<sup>two</sup> samplings ~~no~~ no snails might be classed a juveniles, eg., snails between 3.0 mm and 10.0mm in length. Other samplings showed that juveniles had been represented in the populations.

Other weather conditions again disturbed the population and as time was getting short general observations were relied upon from a point opposite Old Mess Hall on to the point of vanishing. At the point first mentioned small snails of 2.0 mm were found on the loose sand. Random sampling of the immediate territory showed miniature snails to be present for a distance of eight meters or more from the face of the declivity. Chief point of emphasis on this work is that in previous summers, due to faulty sampling, or some other personal error no such miniature snails had been found at any point of the shoal east of the boat house. Such sized snails had been found in April of 1941, five days after the ice had left the shores. \* While the finding of such snails had little to do with the study of size and the vanishing point as originally undertaken, it did seem to cast some definite light upon the unsolved question of oviposition.

The question of securing a large population of all size groups from the same area had always been a pressing one since the problem was begun, and until this time no location had been found in which all such groups could be had. If the 'micro-snails were plèntiful, as in Station 4, the juveniles and adults were very scarce or vice versa. Further attempts at statistical samplings upshoal were given up and general observations relied upon for sizes. As the point of disappearance was approached medium sized snails seemed to give way to larger sizes, suggesting remnants of a former population or very active wanderers among the larger groups. The most gratifying part of the work lay in finding miniature snails

\* Private correspondence, F.E. Eggleton, April 28, 1941

on the loose flocculent marl at some distance from the declivity. This will be treated further under the topic of oviposition.

#### Distributional changes

Confusion might easily result in thinking of the snails as uniformly plentiful on the shoals where they occur most abundantly. Furthermore abundance may vary in a large degree from one week to another for any given area. Also they may remain more constant from season to season than is generally believed. With the vast amount of beach building that is going on the regions of greatest abundance in some ins near the water's edge, while in others it is at the edge of the declivity. Today, August 19th, the advancing edges of the encroaching sand abound in all sized snails in the region of the Old Lab Shoal. Given a few days of offshore wind and these regions would soon become almost deserted, if the snails follow their usual pattern of behavior.

The finding of snails in large numbers by Mr. Riggs of the Biological Station \* just previous to the freezing over of the lake and again at the water's edge as soon as the ice had left the shore the following spring does not seem to bear out the theory of migration into deep water during the winter and return to the shoals when the water again becomes habitable for them. Also the finding of the snails in large numbers in all sizes in four feet of water and some distance from the declivity within five days after the ice went out does not add much to the theory of migration to deeper waters with the onset of winter. Probably the best explanation is that they remain in the narrow layer of water between the ice and the sand.

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\*\* Both refer to private correspondence.

There may be a tendency for undercurrents to work them away from shore as the fall storms make for greater wave action but this is purely a matter of conjecture.

Present evidence seems to bear out that the so-called "swarm" period of late summer is not a change in total numbers but rather a concentration into certain regions due to changes in water level and beach building action.

#### Oviposition

As in past years all attempts at finding eggs of *Goniobasis* proved futile. Apparent egg masses on sticks, stones, clam shells were observed in aquaria from time to time. In all cases what appeared to be egg masses when brought into the aquaria, soon disintegrated or proved to be eggs of other species, or even insect eggs.

In past seasons when miniature snails were eventually found they appeared in great numbers in such places as the soft sands of Station 4. Not until this season had they been found in the regions of Station 7, probably due to faulty sampling. The finding of miniatures in significant numbers in the upshoal regions of Station 7 on August 8th was particularly significant in the light it cast upon places of oviposition. With no stones, logs, or other substantial substratum the question of necessity of stones and logs for oviposition seems to be pretty definitely ruled out. Only two other probabilities suggest themselves, viz., vegetation down the face of the declivity and clam shells, which in this instance were sparsely scattered. There seems to be much evidence in support of the writer's belief that the eggs are deposited in the loose sand. The findings of Van Cleave and Jewell \*, viz, that eggs are laid singly or in pairs, seem to support the belief that eggs are deposited in the loose sand.

\* Nautilus 44: 115

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Since the young snails were found quite far from the declivity, even to the water's edge in such places as Station 4, the belief that eggs are laid over wide areas and not localized to solid substratum, seems pretty well founded.

Chart I shows snails of less than 1.0 mm in length occurring in all four collections between the dates of July 17 and August 14. However, since such length snails are found but sparingly in any of the collections in proportion to the total numbers taken, it would appear that the principal oviposition occurs early, probably before the beginning of the session. Such small individuals seem to have hatched from a few eggs laid after the principal oviposition. Thus there is no evidence of two or more broods during the season, but rather one large brood followed continuously by late hatching snails.

The conclusion drawn from the work of migration and oviposition in the region of Station 7 is that if the snails fail to spread farther or fail to maintain themselves in the region over which they have spread, it will not be because of solid substratum for oviposition, but will be due to other factors, such as the effects of beach building as seen this summer.

#### Growth and life span

Studies of growth and life span finally took three principal forms as follows:

I Three collections of miniature snails were taken in the loose flocculent marl covered sand in Station 4 on July 17, July 26, and August 14 respectively. Another group of miniature snails which were a part of a total collection taken between Welch and Eggleton docks were considered in connection with the three groups



mentioned . Each collection was measured with the microscope and ocular micrometer. Medians were computed by the formula :

$$M = A \text{ plus } i \left( \frac{\sum fd'}{n} \right) . \text{ Results indicated are :}$$

Collection	Median length in mm.	Time lapse	Growth	Av. daily growth from period to period	Av. for total time.
July 17	1.247	----	-----	-----	-----
July 26	1.415	9 days	0.168	0.0186	-----
Aug. 9 *	1.65	14 "	0.235	0.017	-----
Aug. 14	2.616	5	0.966	0.062	0.048

It appears that the last figure of 0.048 is a significant figure meaning that average gain is almost 0.05 mm per day, an average gain of a mm in between twenty and twenty five days. If this figure is within any reasonable range of the actual gain, it certainly appears that the snails falling within the range of 0.72mm ( smallest) to 2.5 mm in any collection may safely be considered as first year individuals.

Another point stands out quite clearly if these figures are within a reasonable range of accuracy in respect to the total juvenile population. Once a length of 1.5 mm - 1.75 mm is attained, growth is quite rapid from there on. Two theories present themselves regarding this growth curve:

- 1- The snails have reached a stage of development in which the ability to assimilate vastly more food is possible.
- 2- Since Goniobasis livescens seems to be a feeder upon marl forming organisms it may be possible that much more and possibly more desirable food is available later in the season than when the snails are quite small. This point is, however , one of conjecture. Dr. Welch states that to his knowledge there is no data on the rate of marl formation

\* From the collection between Welch and Eggleton docks.

in such regions as the broad shoals of Station 7.

II An attempt was made beginning July 7 to take populations as nearly identical as possible from a given area to be used as a basis for growth and life span studies of "adults". At a point midway between Cort cottage and Old Log Lab a continuous transect sixty meters in length and approximately one third meter wide was taken parallel to the declivity. In this area of twenty square meters 1320 snails were taken. Chart II shows the size distributions. Another transect parallel to the first and just a little more shoreward was taken on July 22 and 23, with 867 live and 112 dead snails. Dead specimens are not included in the graph. Since numbers are not comparable, no definite conclusions can be drawn, but by use of medians obtained by the formula previously stated (page 9\*) it was found that an average daily growth of 0.031 mm occurred. This would seem to indicate that growth was still quite active in a group which on the first thought might be counted a static population. Should this lead have any worthwhile value, further checking might alter the present conclusion of a three year growth period.

Weather conditions so altered the region that further measurements were not obtained. It did not appear wise to include the 1447 "juveniles" and "adults" obtained in the collection taken by the Welch-Eggleton docks.

III The need for study of a complete population from one specific locality has been pressing during previous seasons, but not until August 8 had such a location been found. In other attempts to obtain such a population, "miniatures" were out of all reasonable proportions to the larger snails or the reverse situation obtained. On August 9 an area of eight square

meters was depopulated and 1162 snails collected, an average of 208- snails per square meter. The collection was taken in an area one meter wide and eight meters long, paralleling the face of the declivity between Welch and Eggleton docks of camp shoal in Station 7. Chart III shows the distribution, with groups including all snails within a 0.5 mm interval. The small snails of this group were used in Chart I also. While the chart is not trimodal it appears that snails ranging from 3.5 mm - 4.00 mm up to those of 8.0 mm - 10.0mm are quite likely second year snails. This is substantiated by the finding as previously mentioned of 2.0 - 4.0 mm snails on the shoal within five days after the ice went out. They certainly are too large for first year snails if the growth rates as indicated in the discussion of Chart I have any significance. High mortality of miniatures and sizes below 10.0 mm probably accounts in part for the failure of the curve to show distinct trimodal character. For snails above 20.0 mm little information has been obtained to indicate whether or not they are large third year individuals or fourth year individuals still growing a little. It is in this group that marl encrusted snails "mossbacks" occur most frequently.

#### The fate of snails

The season of 1941 has been very good for studying the fate of snails. Mortality seems to be particularly high in miniatures. but juveniles and the size known in this paper as adults also seem to suffer disastrous conditions, as evidenced in the second transect taken for snails charted in Chart II. One experiment was made and a number of observations made.

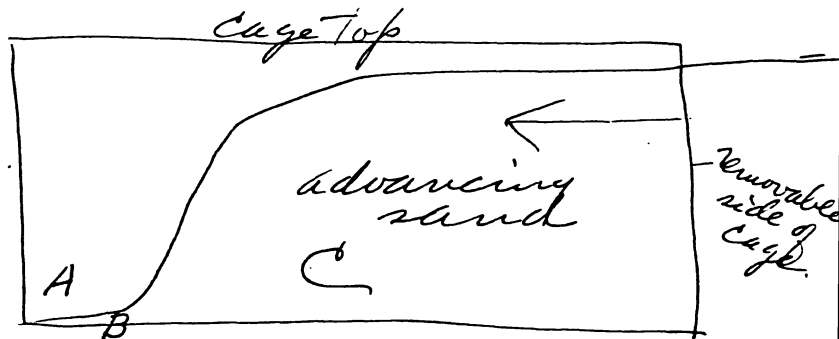
On August 5 a square cage of approximately one meter sides was fastened at the <sup>leeward</sup> edge of the drifting sand beaches built up

on the shoals of Station 7. The cage was made of wood frames covered with galvanized screen wire. One hundred twenty five (125) snails were placed on the cage on August 5th. In period of windy weather the side of the cage nearest the advancing sand was removed allowing free entrance of the drifting sand. The water on the the advancing sand was only ankle deep when the cage was placed into water almost knee deep at the edvancing edge of the sand. In times when there was little wave action the side was replaced on the cage. At no time was the top of the cage below water line by several inches.

Immediately following periods of wave action, as for instance when the wind died away during the night, the snails would advance over the face of the sand and head toward the declivity for some little distance( a yard or more) before beginning to scatter fan shape. This was observed enough times to be sure of the statement. In times of severe sand deposition most of the snails appeared to be entirely quiescent, with only an occasional one trying to advance into the oncoming sand. Mortality was quite high, even among the snails which were not buried. A longitudinal view of the encroaching sand at the time of removing the cage on August 19 is sketched below.

Records obtained from three portions of the cage as indicated by letter s are as follows:

A. Not buried	Alive	38
	Dead	<u>11</u>
		49
B. Buried in shallow sand	Alive	7
	Dead	<u>11</u>
		18
C Buried deeply	Alive	7
	Dead	<u>9</u>
		16
Accounted for		83
Missing		<u>42</u>
Total		125



There seems to be little interpretation of the above data. A few of the snails might have escaped at times when the cage was open, but the very definite pattern of behavior with the coming of quiet water seems to indicate that forty two is too large a number of snails to have escaped. As for the eleven dead unburied snails, it certainly does not seem like a question of food, for at almost any time after the sand reached a height of half the depth of the cage, a fine loose marl drift made its way through the mesh of the cage. An explanation of the eleven buried in very shallow loose sand in "B" part of the cage is not forthcoming. Live ones in part C of the drift were found to be buried much deeper. All told the experiment showed more in an incidental way than from the results obtained with the imprisoned snails. In screening the sand from A and B parts of the cage numerous miniature snails were found, apparently having been swept across the top of the drifting sand from the region near the declivity, a distance of fifty feet or more. In the cage with the snails were *Helisoma* sp., colonial protozoa, dragon fly larvae, *Campeloma*, ~~and~~ Chironomous larva, and Mayfly larvae, all apparently drifted in with the advancing sand. Sampling at the edge of the drifting sand outside the cage gave comparable results for small snails and other organisms mentioned.

Thus it appears that in times of beach building, and especially where beach pools are built, many of the snails both large and small are lost, buried too deeply or die in the stagnant water of the pool.

Samplings near the boat slip showed numerous miniature and juvenile snails to be buried a foot or more above water's edge along a "windrow" of bits of wood and other debris. It appears

that when wave action on the soft sands of the shoals become sever enough to disturb the equilibrium of the snail it contracts the foot and is quiescent, rolling about from one ripple trough to another, ready victim of being buried by advancing sand shoals as have built up the beach in many places this year. This may be one good reason for the lack of complete establishment up the shoal.

As far as this season is concerned, temperature can be ruled out as a lethal factor. The highest record of surface temperature as recorded by the Limnology Department was 84 degrees C. Quiest waters near the shore were of course higher, yet snails were observed living normally very near the waters' edge on the hottest days. Prolonged high temperatures might show different results.

#### Plantings

On August 1st 1320 snails were planted at the angle between the shoal fo Station 7 and Big Shoal in one and one fourth meters of water. The first day they scattered in all directions and when the place was visited a few days later not a snail was visible, nor were any found in random screen samples. Apparently they scattered widely and becoming quiet were buried in loose sand, but there was no indication that enough sand had moved into the area to bury them completely. Snails used for measurements were used and there is the possibility that they may have died from too crowded condition in the aquaria. Freshly collected snails should be used for all planting experiments.

Plantings made in Lancaster and Munro Lakes in 1939 showed no indications whatever of success.

### Summary

*Goniobasis livescens*(menke) is maint/aining itself and spreading rapidly up the shoal toward Big Shoal, but may not be able to maintain its hold if beach building continues for a few seasons as it has this.

All available evidence points to a principal oviposition early in the season with a dwindling oviposition throughout the summer.

All available evidence points to oviposition of single eggs or clusters of a very few in the loose sand.

Snails less than 3.0Ø mm in length are probably in one season's growth span, although late hatched individuals may not attain that length until the second season.

Evidence continues to point to a three year growth span, with probably at least one year more before death by natural causes.

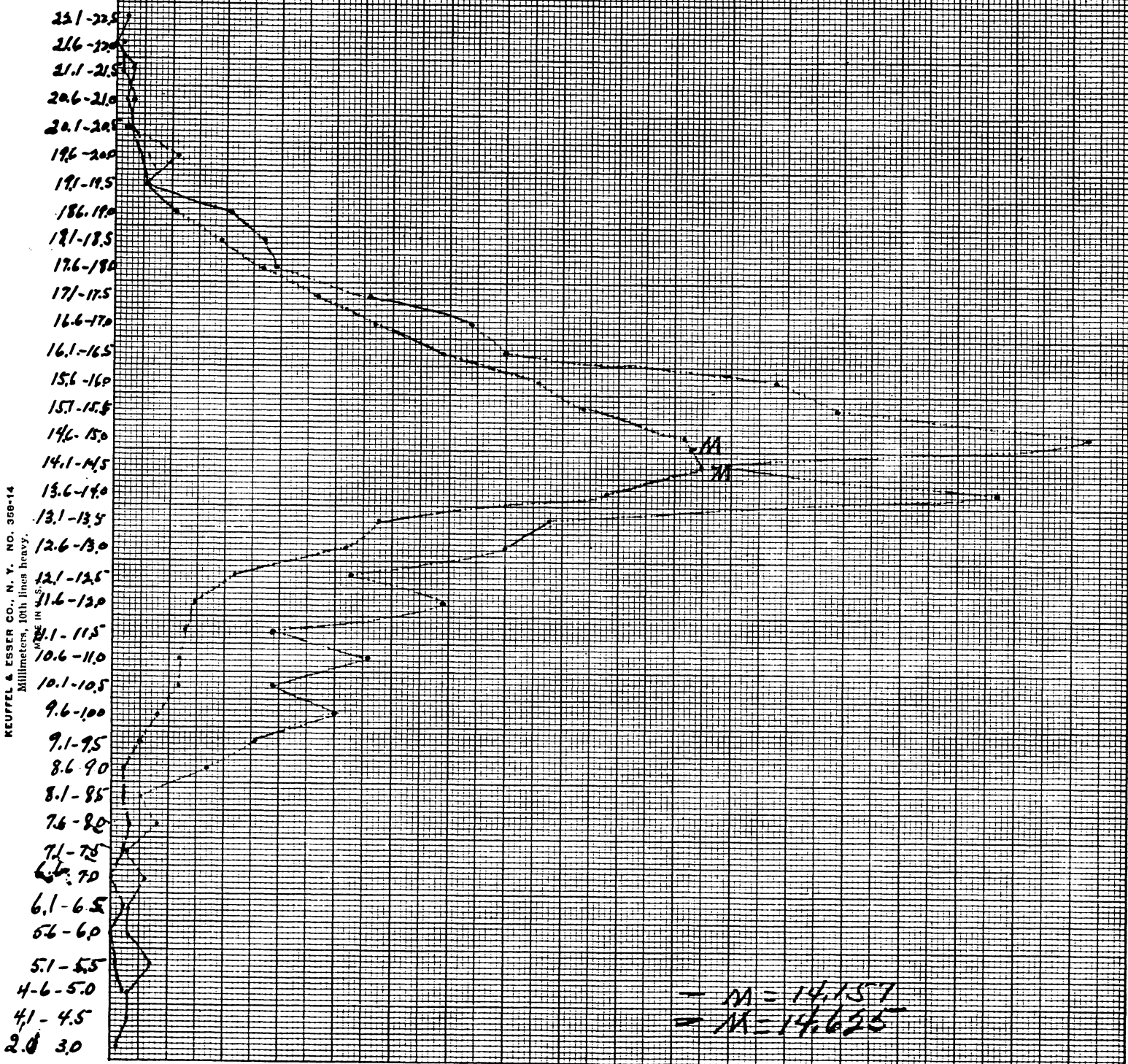
Growth span of second season snails is not definitely known but appear to range approximately from 3.0 mm - 10.0 mm.

Snail mortality is very high among all three length groups, but especially so in small and medium lengths in time of severe beach building as this season.

Combined graph of transects I (July 7, 1941)  
 and II (July 22-24, 1941) log lab shoal  
 Station # 7

— Pencil for July 7  
 — Red for July 22-24

Chart II



KEUFFEL & ESSER CO., N. Y. NO. 368-14  
 Millimeters, 10th line heavy.

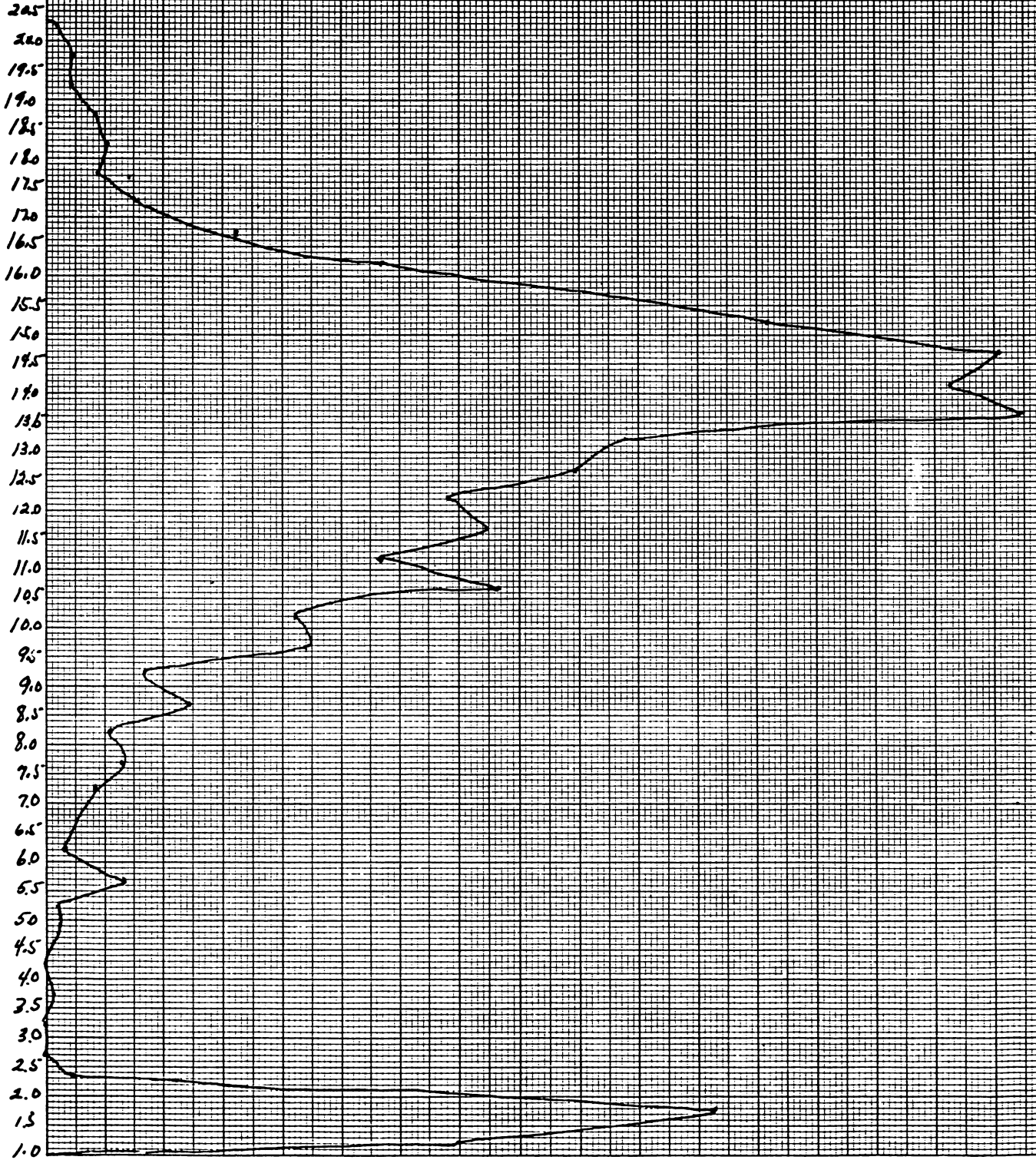


Length  
in mm.

Chart of total population collected August 9, 1941  
at region of Welch-Eggleston locks

Station 7

CHART III



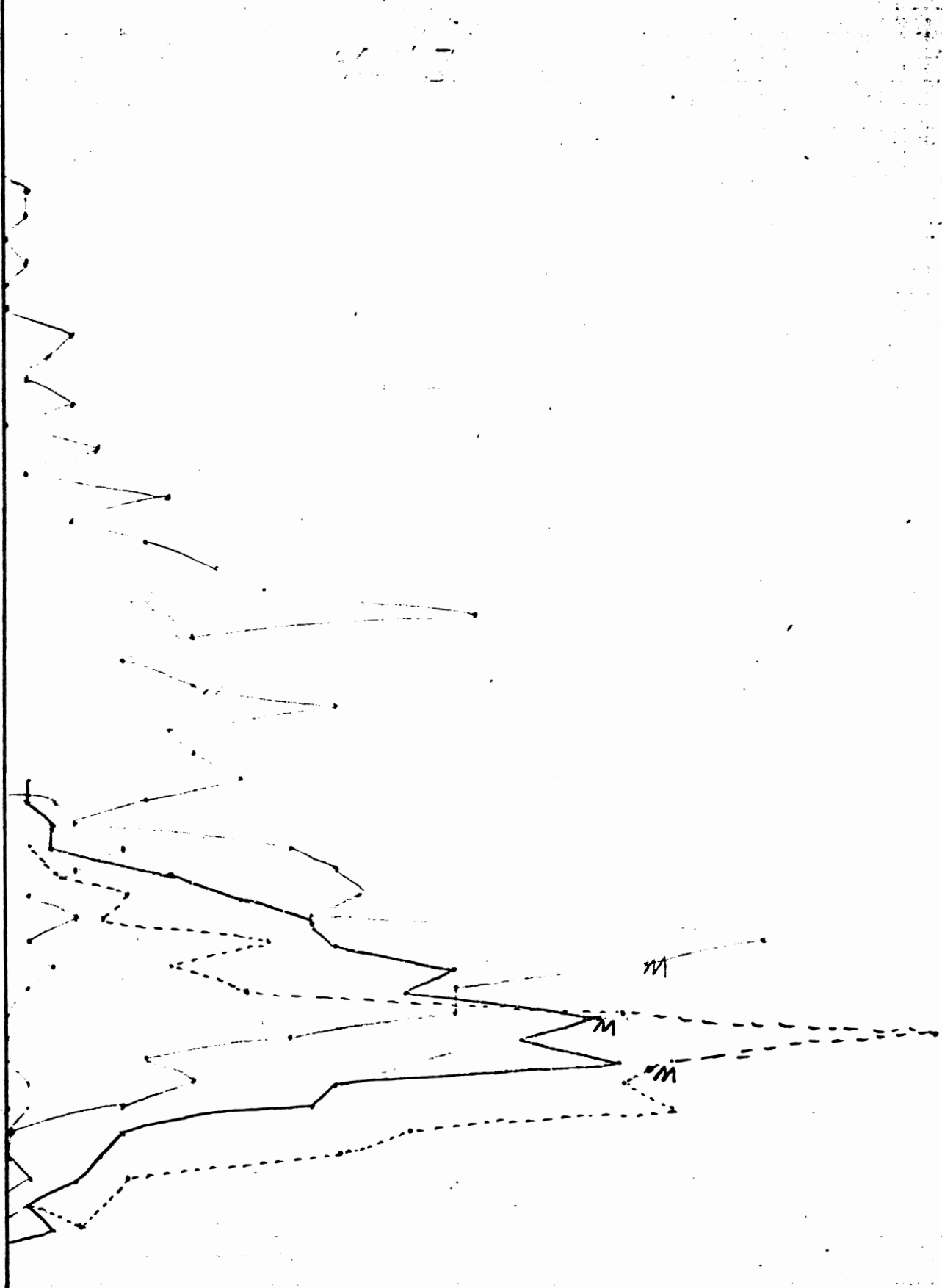
# Chart I

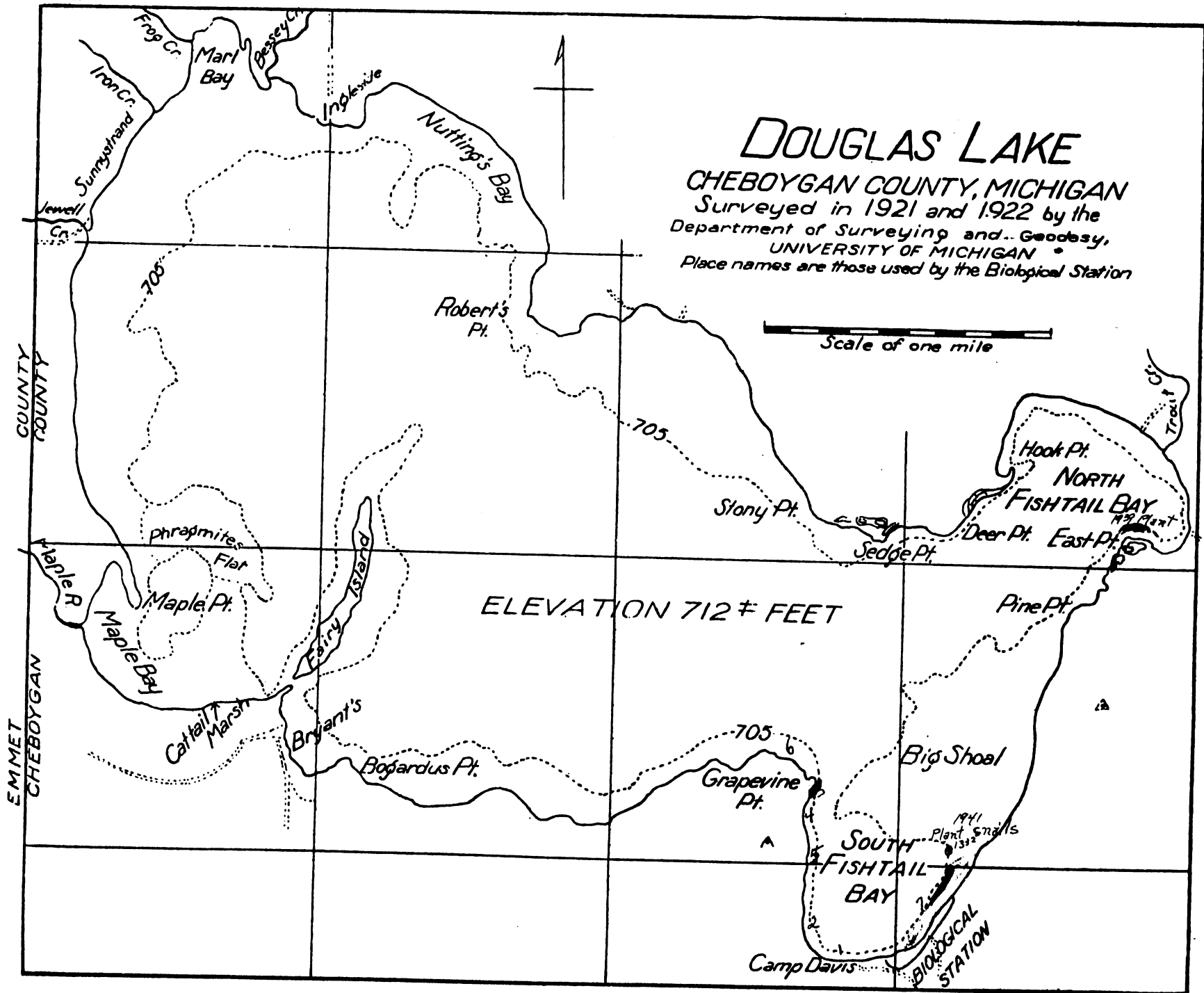
Combined graph of measurement of miniature snails  
from Stations 4 and 7 under dates of July 17, July 26,  
Aug. 9, and Aug 14, 1941

Key : July 17 ■ July 26 ■ Aug 9 ■ Aug.14 ■

Length in  
M.M.

- 4.48
- 4.40
- 4.32
- 4.24
- 4.16
- 4.08
- 4.00
- 3.92
- 3.84
- 3.76
- 3.68
- 3.60
- 3.52
- 3.44
- 3.36
- 3.28
- 3.20
- 3.12
- 3.04
- 2.96
- 2.88
- 2.80
- 2.72
- 2.64
- 2.56
- 2.48
- 2.40
- 2.32
- 2.24
- 2.16
- 2.08
- 2.00
- 1.92
- 1.84
- 1.76
- 1.68
- 1.60
- 1.52
- 1.44
- 1.36
- 1.28
- 1.20
- 1.12
- 1.04
- .96
- .88
- .80
- .72





CHEBOYGAN COUNTY

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