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Report of an Investigation Carried on at the
Atlantic Biological Station
from June 12, to August 11, 1930

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INTRODUCTION —— There has been much confusion in the generic nomenclature of this family. At one time all the species were known as Natica, while later the terms Lunatia, Neverita and Polynices were applied to special forms. However it has been proposed to use the name Natica for those forms having a shelly operculum, Polynices for those having a corneous operculum, while Lunatia and Neverita have become subgenera of the genus Polynices.

DESCRIPTION —— Polynices heros, the round whelk, has a thick shell, ashy-white to brownish in colour. As stated above the operculum is corneous. The shell is dextral. The foot, when fully extended, may be twice the length of the shell, and the latter is frequently completely covered by the mantle, at which time the tentacles are directed anteriorly. When disturbed, the tentacles and mantle are withdrawn into the shell with great speed, while the foot follows more slowly. At the same time a great quantity of water seeps out of the shell, whose aperture is finally closed by the drawing up of the operculum. In this way Polynices heros performs that which is mathematically impossible, that is, putting the larger volume into the smaller.

HABITAT —— These forms are found in sand, or a mixture of sand and gravel, from low water line to a depth of 17 fathoms. Previously the record for the vicinity of St. Andrews seems to have been 10 fathoms, (Dotweiler, 1912), although Pratt (1927) states that they may be found to a depth of 230 fathoms.

During the summer specimens were obtained on the flats north of the laboratory; at Joe's Point; at the sandy beach on the route to

Joe's Point; in the St. Croix River between the Biological Station and Robbinston, Maine; on Navy Island in the Waweig River; Birch Cove and Tidal Cove.

Dimensions —— About 450 specimens gathered about Passamaquoddy bay were measured. The height was taken as the distance from the apex of the shell to the basal edge of the lip, measured along a line through the axis. The greatest diameter was taken to be the distance along a line drawn at right angles to the axis. The smallest specimen found measured 0.3 cm. x 0.3 cm., while the largest was 5.8 cm. x 6.0 cm.

Feeding Habits —— Observations were made on the feeding habits of Polynices both in its natural habitat and in the laboratory.

A curious groove or furrow in the sand leads to where a Polynices heros has withdrawn below the surface to feed. The food consists of clams, mussels, Buccinum or smaller Polynices. As the whelk moves along it crawls over a mussel or clam and curves the posterior part of the foot about the shell of the prey. Then it may crawl along the ground for a short distance, or immediately commence to burrow into the sand with the anterior part of the foot. It then rolls up, thus surrounding the prey with its foot, and finally secreting a mucous envelope around the enclosed animal, before boring into the shell by means of the radula extended from the proboscis. In a number of cases a stone was found surrounded by the same mucous envelope as the other molluscs which serve as food for Polynices. Apparently the whelk always burrows into the

sand before feeding, since none were found on the surface and many were located either buried or burrowing themselves with a mucous covered mollusc preparatory to eating. The time taken to bore a hole and devour the contents varied from 2 to 6 days. Those taking the longer time were occasionally seen moving around the tank with the mollusc still clasped in the foot. Clams which had been opened were eaten in 3 1/2 hours, the soft parts first, the siphons last. Some whelks commenced feeding the day following a meal while others neglected food for periods up to 2 weeks. The size of the mollusc taken as food was proportional to that of the whelk feeding upon it.

ENEMIES —— As previously mentioned the larger whelks devour smaller individuals. Both eggs and adults were preyed upon by other forms in the vicinity of their habitat. Several small animals such as Hydrachna were found destroying the eggs, while starfish eat the adult by removing the operculum. One, Asterias vulgaris, kept in the laboratory tank with the whelks took 3 days to open the operculum and devour the contents.

NATURAL ENVIRONMENTAL FACTORS —— Specimens at low tide level in the vicinity of St. Andrews were exposed for not more than 2 hours during the low spring tides. During the neap tides very few were exposed at all, being found at or below the water's edge when the tide was low. As the tide ebbed some buried themselves in the sand taking about 20 minutes to do so, while others withdrew into their shell, and a few crawled along the surface on the sand, gravel or adjacent beds of mussels.

The temperature of the water to which they are normally exposed during the summer varies from 8° to 13°C. (approximately), while the lethal temperature was found to be 38.5°C. (starting at 10°C and gradually increasing 1°C per 5 minutes). It is evident that they live well within the range possible for life.

LOCOMOTION — On a smooth surface the average rate of locomotion of the large specimens was 11.6 metres per hour, while that of the small ones (less than 2 cm. in diameter) was 5.2 metres per hour. Large and small alike travelled through sand at the rate of 0.6 metres per hour.

MIGRATION — Several experiments on migration were tried but proved unsuccessful. About 75 specimens in all were numbered by filing the shell and placed out as follows:

(1) previous habitat, would be exposed for 2 hours.

(2) transferred from Joe's Point to Brandy Cove.

(3) placed on moist sand where there would be 4 hours exposure in place of the 2 hours.

(4) placed on dry sand where there would be 4 hours exposure in place of the 2 hours.

(5) transferred from east of Joe's Point to flats east of the laboratory and there left buried in the sand.

In each case the specimens were carefully observed until the tide came in and covered them. There was no uniformity of migration or reaction; some closed their shells, others moved in shore, and others out to sea with or against the tide; while others burrowed into the sand. Within the first 24 hours only one third of them were found. After 96 hours even those left buried in the sand had disap-

peared.

ORIENTING REACTION —— When the whelk is turned ventral side up waves of contraction are sent around the foot, the anterior end of the foot being extended downward, while further waves of contraction pass around the foot producing a swaying motion. Eventually the anterior part of the foot reaches the substratum and the whelk topples over. The length of time required for this righting process is about 3 minutes.

REPRODUCTION —— Mating was observed among the whelks kept in the laboratory tanks on and after July 22. Fertilization is internal. The female moved about the tank with both shield and tentacles expanded. At this time also the males went about with the penis extended outward, which was inserted into a large space between the shield and the shell of the female. The time of copulation varied from 10 to 90 minutes. They are both polyandrous and polygamous.

The sand collars on which the eggs are found are a curiosity of the sea-beach resembling "a basin with the bottom knocked out and broken on one side." (Arnold, 1903). They vary from 4 to 14 cms. in diameter and from 1 to 4.5 cms. in height.

Rogers (1913) in "The Shell Book" P. 144 says, "The eggs are laid in a sticky mass of clear jelly which is moulded over the shell; this explains its peculiar collar shape. There is but one layer of egg cases, arranged in regular quincunx order. A layer of fine sand covers each side of the collar, making it about the

thickness of an orange peel. While this remains in the water the mucous is rubber-like, and the eggs are safely concealed under the protective film of gray sand. Cast ashore the sand collar becomes dry and brittle. Who has not seen these collars, 6 inches in diameter and open at one side, lying on the beach? It is useless to try to carry one home without having it shattered. Near hatching time the sand falls off, and the eggs become visible."

At Joe's Point one morning a round whelk was observed building a sand collar in a manner which differed from that described by Rogers (1913). It had been buried in the sand and was migrating to the surface. As it did so it secreted mucous which seemed to come from the lower surface of the foot. It moved in a circle along the sand at the rate of 1 cm. per minute. After an hour's time it was almost buried once more. The incoming tide swayed the mucous film backward and forward permitting particles of sand and debris to cling to it. Unfortunately before the process was completed the tide came in far enough to prevent further observation and could not be located the following morning.

There is a possibility that Rogers (1915) may be describing collars built by a different species. (Natica sp.).

No eggs were found in the sand collar if the capsules were not visible on the surface. If present these were usually found on the inner surface, though in a few cases they were observed on the outer surface and occasionally on both surfaces. The number of egg capsules on the sand collars varied from 2 to 538, while the number of eggs in an individual capsule varied from 35 to 85.

Embryos in various stages of development were found in these capsules, from the segmenting ovum to a tiny embryo with a shell consisting of 1 1/2 whorls. In 13 days it grew 60 μ in diameter. A more detailed report of the embryology with illustrations will follow at a later date.

BIOMETRY —— By plotting the frequency curve (see Plate I), and comparing the peaks found on it with the lines of growth on the shells the rate of growth is that shown in Plate II. In the laboratory the rate of growth in circumference varied from 0 to 1 mm. in 3 weeks. Why we have a gap between 2.4 cms. to 2.9 cms. has not yet been determined. Two explanations have been offered, first, that the two series of peaks represent two species, secondly, that specimens of that size did not happen to be found.

Some large specimens of Polynices heros showed the coloured bands mentioned by Arnold (1903) p. 367 for Polynices triseriata. Several shells when broken also exhibited the same coloured rings. These were quite evident in the apex of the shell but seemed to have worn off as the animal grew.

Several methods were tried to determine the rate of growth by the rings on the operculi but no conclusive results have as yet been obtained. It is hoped that during the winter a method of doing this may be worked out.

ACKNOWLEDGEMENT —— The writer wishes to acknowledge her indebtedness to Dr. A. G. Huntsman, Director of the Atlantic Biological Station, for his interest and helpful suggestions in this study.

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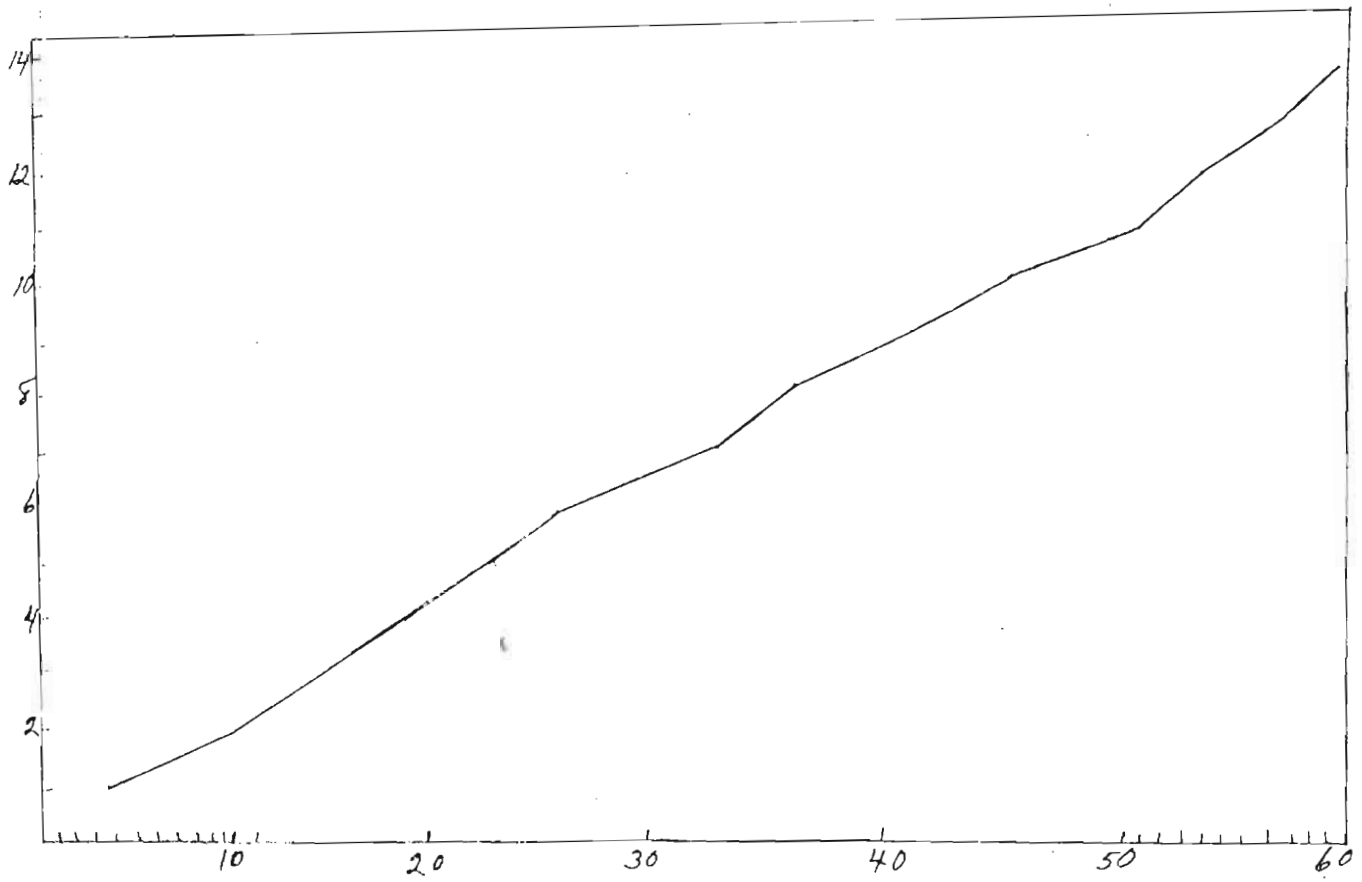
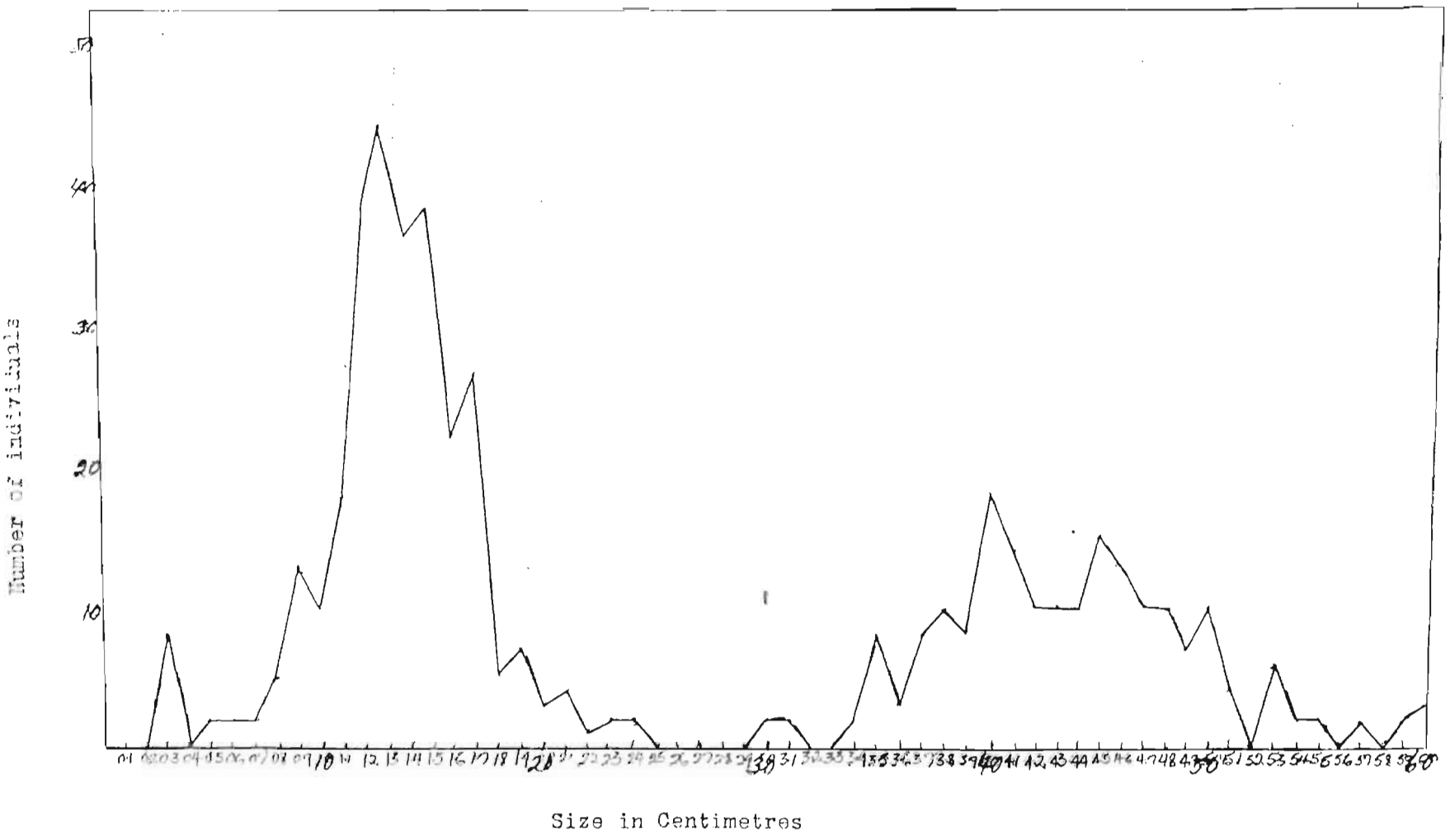
Rate of growth



Age in years

Size in Centimetres


Number of individuals
10
20
30
40
50
Size in Centimetres