

In the earlier studies, the Japanese workers have described Yoshida sarcoma as a near diploid tumour with forty elements as the modal chromosome number.<sup>4</sup> They have also described the establishment of a polyploid clonal subline with 30 chromosomes as the modal number which has maintained this character for over 200 transfer generations.<sup>2</sup>

Varied events have occurred during the transplantation of this tumour since the time of its discovery. Proliferation of a single clone by the transplantation of single cell, heterotransplantation in mice, preservation of cells in the cold, regeneration from a nodule day after the death of the animal, exposure to 60° C. for half-an-hour and chemicals, have all been reported during its maintenance. Sublines of Yoshida sarcoma with large number of chromosomes with marked slow down in growth accompanied by remarkable changes in the ascites characteristics of the tumour have been obtained.<sup>5</sup>

The present study indicates that no chromosome number is absolutely predominant in any one of the transfer generations. From karyological studies it is observed that even though the modal number in the 111th generation is 40, as in the original Yoshida ascites sarcoma, it is different in its chromosomal

make-up by possessing more of the telocentrics and metacentrics whereas submetacentrics are less in number.

Variations in the modal number has occurred at the different transfer generations. The tumour appears to be undergoing a continuous change in its chromosomal constitution, though transplantation is being done in isogenic strains of rats and has not yet attained stabilization.

In spite of these chromosomal variations there has not been any noticeable difference in the character of the tumour development and its progression,<sup>6</sup> thus confirming the general observation that visible chromosomal changes may not always reflect change in biological activity.

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## BIOCHEMICAL CHANGES IN RELATION TO THE BREEDING CYCLES OF *NAUSITORA HEDLEYI* SCHEPMAN (BIVALVIA : TEREDINIDAE)

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**T**HE present study was initiated to elucidate the general biochemical make up of *Nausitora hedleyi*—a typical estuarine boring bivalve and more specifically to determine whether systematic variations of any of the constituents might be correlated with the annual reproductive cycle. The estimations have been made on entire animals only,

collected from the Cochin Backwaters for a period of twelve months. All biochemical estimations were done on material dried to constant weight. Water content, ash content, glycogen, protein, total nitrogen and non-protein nitrogen, lipids, calcium, phosphorus and chloride content were estimated. Glycogen estimation was done according to the method outlined by Mendel and Hoogland and adopted by Raymont and Krishnaswamy<sup>1</sup> and expressed as percentage of glucose in dry

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tissue. For determination of the total nitrogen content, the conventional method of micro-kjeldahl distillation as outlined by Steyermark<sup>2</sup> was followed and for lipids Soxhlet apparatus was used. The method of A.O.A.C.<sup>3</sup> was followed for the determination of salts, ash content, calcium and phosphorus.

The data representing average values are delineated in Figs. 1 and 2. The water content varied from 57.04 to 83.60%. An inverse relationship between the water content of the body and the salinity of the ambient water was evident (Fig. 1). It was also observed that the water content of the body of females was higher than that of males and that the range of fluctuation was more conspicuous in females than in males. Glycogen is an important food reserve of many marine molluscs needed for reproduction, growth and maintenance. Glycogen values were considerably high during the non-breeding months especially during February to May when they fluctuated between 33.35% and 52.22% of the dry weight of the animal (Fig. 2). From June to January the values were comparatively low. On the onset of the breeding season there was a perceivable fall in the glycogen content, probably owing to the initial mass spawning during

June. After January the values were comparatively high and reached the highest value for the year in March. The protein content was generally high during the period June to January. The total nitrogen values were apparently steady both during the breeding as well as during the non-breeding periods. The values for non-protein nitrogen indicate that in general this constituent was poor during a major part of the breeding season.

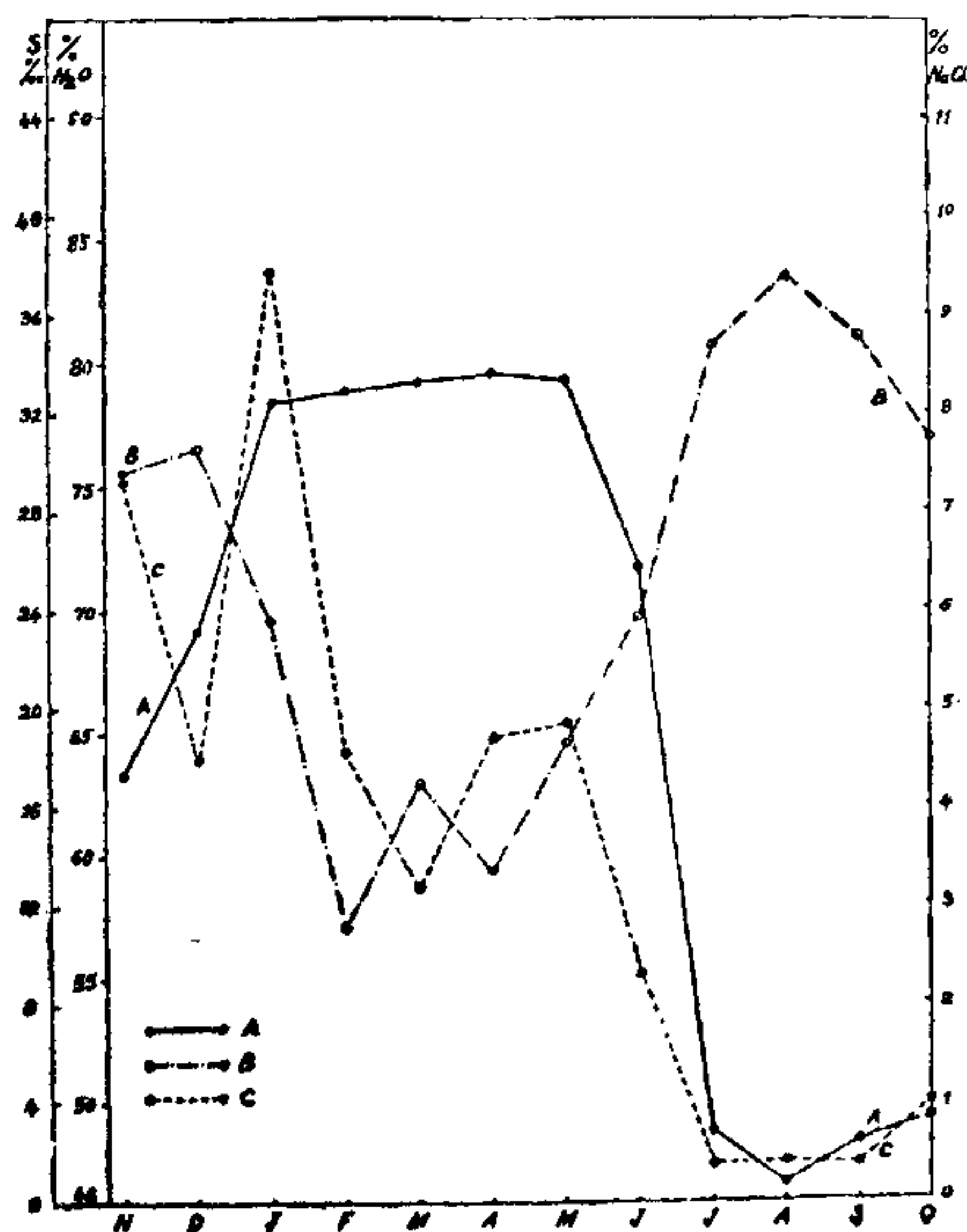


FIG. 1. Monthly variations in the average salinity of the ambient water (A) and percentages of water content (B) and NaCl (C) in the body of *Nausitora hedleyi*.

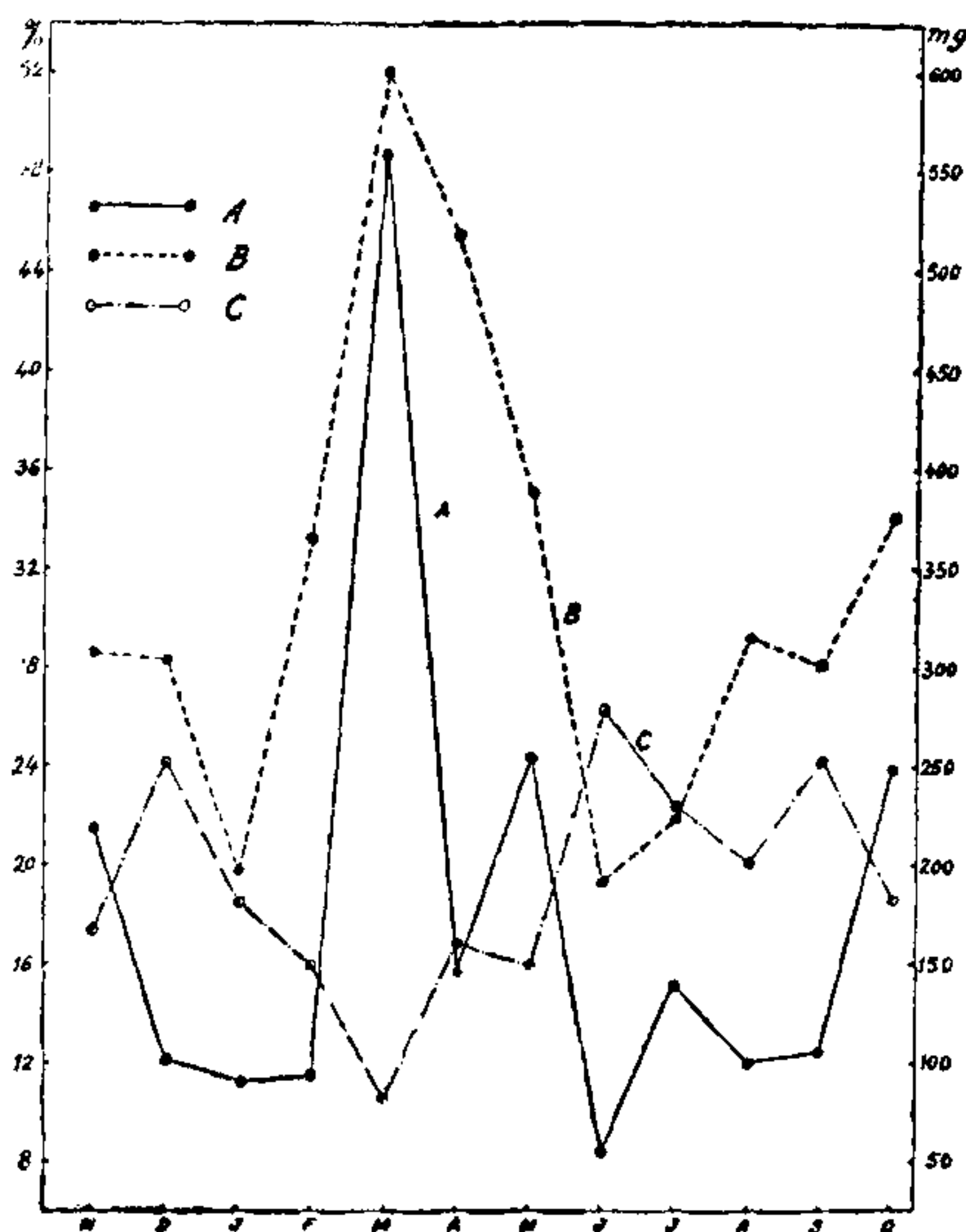


FIG. 2. Monthly variations in the average dry weight of specimens (A), percentage of glycogen (B) and protein content (C) in the body of *Nausitora hedleyi*.

To find out the relationship regarding glycogen, protein and total nitrogen content of this species to the dry weight, the specimens were arranged into groups with a weight difference of 50 mg. irrespective of any considerations of sex, time of collection or length. The average glycogen content of shipworms below 50 mg. dry weight was about 23.17% and the values showed a steady increase without appreciable fluctuations to reach a value which represented more than 50% of the entire dry weight of the animal in specimens above 400 mg. weight. In this estuarine species glycogen in terms of per cent. dry weight is higher than that in such wood boring bivalves as *Teredo pedicellata*,<sup>8,9</sup>



and *Martesia striata*<sup>4</sup> or in oysters.<sup>5</sup> The protein content of animals in the weight group 0.50 mg. was found to be highest and this constituent continued to be high until about the weight group 250 to 300 mg. with an average protein content of about 18% of dry weight. Protein had also as high a value as 23.51 in the lowest weight group. In specimens above 400 mg. this constituent was found to be even less than 50% of the protein content noticed in the smallest weight group. The total nitrogen content of animals had a similar trend to that of protein with the highest values in the smallest weight group. An inverse relationship was noticed between glycogen and nitrogen and a direct relationship between nitrogen and protein.

The lipid content expressed in terms of percentage of dry weight varied from 3.46 in June to 8.34 in November. Lipid values were comparatively low during April, May and June. A distinct correlation between lipid content and breeding period was, however, not very evident in this mollusc. In *N. hedleyi* lipids constitute only a small percentage of the dry weight unlike in forms like chitons<sup>10</sup> where this constituent was found to reach levels of 29% of the total dry weight in some organs. The percentage of salts (chlorine as sodium chloride) expressed as percentage of dry tissue showed a distinct fall on the onset of breeding season which in this case coincided with a fall in salinity of the ambient water. During the highly saline period of February, March and April the salt content of the body was curiously low. The ash content expressed as percentage of dry weight varied from 4.68 in July to 11.45 in June. This shows that there is a noticeable fall of the ash content soon after the onset of breeding. On an average the amount of ash in this species is about 8.12% of the dry tissue thus falling within the usual range noticed in mature molluscs. The calcium content of the species expressed as percentage of the ash content fluctuated between 7.1 in November and 22.48 in August. The values were comparatively high during July, August and September and were low during October and November.

A similar trend was noticed in respect of phosphorus content of this mollusc. However, the amount of phosphorus present seems to be much less than calcium. The data regarding the mineral constituents give the impression that coinciding with the period of spawning and the consequent loss of weight owing to a fall in the organic constituents, there is an apparent increase in the calcium content of the body as has been reported in the case of oysters.<sup>7</sup> From the above study of the variations in the chemical composition of *N. hedleyi* it may be seen that there are two distinct periods of variation, the first extending from June to December, which is the season when there is breeding activity and the other extending from January to May representing a period of rest. These periods are characterised by the variation in the chemical composition. In the first period the values for water content, protein, total nitrogen and in general for calcium and phosphorus are high while in the second period glycogen and non-protein nitrogen show an increase with an apparent fall in the percentage of the constituents which showed higher values during the first period. Thus an interesting correlation is noticeable with regard to the breeding season and the chemical composition in this species.

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