in the clams\textsuperscript{16}. Similar striking changes in carbohydrate levels in molluscs have already been reported\textsuperscript{2,5,17}.

In the present study an important relationship was observed between carbohydrate and protein in both the species. The sum of carbohydrate and protein (C + P) was nearly constant always. The average values of (C + P) in \textit{V. cyprinoides} and \textit{M. casta} were 80.91 and 81.81 respectively. A significant negative correlation (\( \rho = -0.95, P = 0.001 \)) was observed between carbohydrate and protein in both the species. The respective linear relations were:

\textit{V. cyprinoides}: \( Y = -1.0276 X + 83.3777 \)

\textit{M. casta}: \( Y = -1.6689 X + 119.371 \)

where \( Y \) is protein (%) and \( X \) is carbohydrate (%).

\textit{Ash content}—Ash content in \textit{V. cyprinoides} was rather low compared to \textit{M. casta}. The ash content increased with increase in protein content in both the clams (Table 1). The increased ash content may possibly be due to an increased inorganic content in the body constituents.

\textit{Phosphorus}—Its content varied with season as well as with species. In general, a higher percentage of phosphorus was always accompanied by a higher percentage of lipid. Similar trend was also reported by Jafri et al.\textsuperscript{18} and Khawaja\textsuperscript{19} in some carps, cat-fishes, eels, etc. They attributed this to the formation of phospho-lipids.

\textit{Calorific values}—The calorific values (Table 1) showed little variation with season in both the species. The relative similarity in the levels of various biochemical constituents in the 2 species may point to their close similarity in physiological mechanisms as well.

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References


Length-Weight Relationship & Condition Factor of the Sciaenid Fish, \textit{Johnieops osseus} (Day)

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Length-weight relationship of \textit{J. osseus} indicated an allometric form of growth. Seasonal variations in the condition of fish could not be attributed to any particular factor.

The present observations, which form a part of the general study of the biology of \textit{Johnieops osseus} (the most abundant sciaenid of the South Kanara coast), deal with the length-weight relationship and condition factor, the information on which is meagre\textsuperscript{1-3}.

Total length and weight of 1539 fishes of all sizes, collected from trawl landings at Mangalore and Malpe during 1976-77 were recorded. Length and weight were plotted in the form of a scatter to note the relationship between the two. This suggests a relationship of the form, \( Y = A + BX \), where \( Y = \log W, A = \log a, B = b \) and \( X = \log L \). The values of \( A \) and \( B \) were estimated by the method of least squares. The length-weight relationship, computed from the above equation, for the 2 sexes at each of the locality is Mangalore—females: \( \log W = -5.3097 + 3.1877 \log L \); males: \( \log W = -5.2294 + 3.1497 \log L \) and Malpe—females: \( \log W = -5.1201 + 3.1071 \log L \); males: \( \log W = -5.0059 + 3.0468 \log L \).

Analysis of covariance applied to test the difference in the values of \( B \), for the 2 sexes at the 2 localities showed no significant difference at 5% level. Since difference was also not seen between the values of \( B \) obtained for the 2 localities, a common regression equation of \( \log W = -5.2341 + 3.1540 \log L \) was obtained for the 2 places. The \( t \) test\textsuperscript{4}, used to test the

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pattern of growth, indicated an allometric form of growth.

The relative condition factor \( K_r = \frac{W}{L^3} \) was obtained for individual fishes. Mean values of \( K_r \) for each month were calculated for immature (irrespective of sex) and mature males and females. The weighted average for the above, were also calculated. There was no difference in the condition of fish of both the sexes at either of the localities. But the condition of immature fishes was lower than that of the mature fishes.

Data on seasonal variation in condition (Fig. 1) show that in October, December and January, both immature and mature fishes show a high condition indicating that maturity and spawning may not be the factors responsible. Based on the available data, it is difficult to explain the monthly variations in the condition of fish.

Blackburn \(^5\) remarked that it is not possible to interpret the changes of condition in *Thysites atun* basing on sexual cycle or the intake of food and that it may depend on several other factors. The same opinion is also held by James \(^6\) in the case of *Eupleurogrammus intermedius*. However, Thompson \(^7\) has pointed out that high and low condition in *Pleuronec tes platessa* are found before and after spawning. Hickling \(^8\) has attributed the low and high condition in *Sardina pilchardus* as due to sexual cycle and availability of food respectively.

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**References**


**Association between the Bivalve, *Amussium pleuronectes* (Linne), & the Crabs, *Portunus hastatoides* Fabricius & *Charybdis hoplites* Wood Mason**

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The short term (April-May) association between the bivalve and the crabs, observed for the first time in Porto Novo waters, protects the juvenile crabs from heat and predation. The bivalve seems to be benefitted from the active current induced by the crabs.

Associations between crabs and bivalves are known\(^{1-5}\). Silas and Alagarswamy\(^6\) have reported the relationship between the Pinnotherid crabs and the bivalve *Meretrix casta*. Adoption of empty bivalve shells by crabs as a protective device\(^{7-10}\) and the shell selection behaviour of hermit crabs\(^{11}\) are also known.

Of the 19 specimens (juveniles) of Portunidae crabs associated with the bivalve, *Amussium pleuronectes* (Pectinidae), collected from commercial trawlers during April 1978-May 1978, 18 were *Portunus hastatoides* and 1 was *Charybdis hoplites*. In the former, 2 were females, 22-26 mm across the carapace, and the rest were males, 21-30 mm across the carapace. No berried crabs were collected. A single male of *C. hoplites* was 21 mm across the carapace.

All the crabs were found near the free edge posteriorly (Fig. 1) and never on the hinge side of the bivalve. The chelae of the crabs were protruding from the free edge of the host in all cases. The bivalve shells were 34-38 mm in width while the carapace width of

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**Fig. 1—A. pleuronectes with its associate (A) and the host with a shell removed showing its associate P. hastatoides (B)**