

SHORT COMMUNICATIONS

TABLE 2—DENSITIES OF INTERTIDAL AND SUB-LITTORAL POPULATIONS OF *Nephtys* FROM DIFFERENT PLACES

[Values, No./m², are maximum densities]

Species	Place	Density/m ²
INTERTIDAL POPULATIONS		
<i>N. caeca</i> ¹³	Port Erin-Isle of Man	20
<i>N. caecoides</i> ¹⁰	Bodega harbour, California	32
<i>N. californiensis</i> ¹⁰	Dillon Beach California	+
<i>N. cirrosa</i> ¹⁴	Exe. estuary, Devon	32
<i>N. hombergi</i> ¹⁵	Tamar estuary, Devon	100-300
<i>N. hombergi</i> ¹⁴	Exe. estuary, Devon	104
<i>N. hombergi</i> ⁸	Lynher estuary	72
<i>N. oligobranchia</i> *	Vasishtha Godavari Estuary	140
SUB-LITTORAL POPULATIONS		
<i>N. buccera</i> ¹⁶	Buzzards Bay, Massachusetts	419
<i>N. incisa</i> ⁷	Long Island Sound	1000
<i>N. incisa</i> ¹⁶	Buzzards Bay, Massachusetts	1642
<i>N. incisa</i> ¹⁷	Irish Sea	20-40
<i>N. polybranchia</i> ¹⁸	Kerala coast	50
<i>N. incisa</i> ¹⁹	Bideford River estuary N.W. Prince Edward Island	15

*Present work; other superscript numbers indicate respective references.

composition of the substratum. *N. cirrosa* inhabits clean sandy substratum while *N. hombergi* thrives on muddy sand and both are absent in substrata containing a high percentage of silt^{11,12}. *N. californiensis* and *N. caecoides* are reported to avoid fine substrata¹⁰. In the present instance *N. oligobranchia* is restricted to places with fine sand mixed with silt and clay and seems to avoid substratum containing coarse sand near the confluence.

The authors express their thanks to the management and Head of Zoology Department, Sri Y.N. College, Narsapur for facilities, and to Prof. K. Hanumantha Rao, Head of Zoology Department, for his encouragement. One of the authors (D.S.R.) is grateful to CSIR for the award of a Junior Research Fellowship during the tenure of which the present work has been carried out.

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Feeding Experiments with the Shrimp, *Metapenaeus monoceros* (Fabricius)

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Received 19 May 1978

Feeding experiments have been carried out with *M. monoceros* using 4 different compounded diets. Comparison of the results is made with those of other available data for this species. The importance of using natural feeds to obtain greater food conversion efficiencies has been indicated.

STUDIES on the cultivation of prawns have been in progress at NIO since 1975, and selection of a suitable diet is a prerequisite for such studies. Keeping this in view, earlier investigations have been concentrated on the feeding experiments with the shrimp, *Metapenaeus monoceros* using natural food (detritus) and processed and compounded diets¹⁻³. This paper forms a continuation of such a study on *M. monoceros* and also summarises some experimental results on the food conversion of the shrimp, primarily from laboratory studies.

Juveniles of *M. monoceros* were collected from Mandovi estuary, Goa and were sorted into 3 groups based on wet weight (group I: 0.5-1 g, group II: 1-1.5 g, and group III: 1.5-2 g). Each group was fed on 4 different diets, the composition of which is shown in Table 1. The volume of sea water in the experimental tanks was kept constant (7 l) and, therefore, the number of shrimps in each tank was determined in relation to the volume of sea water. Thus, group I had 15 shrimps in each tank, group II 5 and group III 2 shrimps. Standard precautions were taken to acclimatize each group of shrimp with reference to the test diet for a week before starving them for 24 hr prior to the commencement of the experiment. The experimental duration was 15 days at room temperature 27° ± 1°C. Calculations of dry weight balance indicated in Table 2 were similar to those adopted by Royan *et al.*².

The smallest shrimps (group I) showed highest relative growth rate (RGR), and K₁, K₂ and A/C were highest with Japanese (JF) food, followed by CB and WFM (Table 2). When TNAU pellet was given to this group, there was loss of weight. The consumption/unit weight/day (column 13) was

TABLE 1 — COMPOSITION (PER CENT) OF TEST DIETS USED IN FEEDING EXPERIMENTS OF *M. monoceros*

White fish meal (WFM)	Cooper No. 6 beta diet (CB)	Japanese food No. 10 (JF)	Tamil Nadu Agricultural University pellet No. 7 (TNAU)
White fish meal (87.2)	Oil (4.5)	Vitamin-free caesin (54)	Silkworm pupae (25)
Cod liver oil (2)	Protein (40)	Egg albumin (6)	Groundnut oil cake (25)
Vitamin-free mix (2.8)	Fibre (4.5)	Oil (6)	Rice bran (25)
Mineral mix (3)		Glycogen (6)	Tapioca flour (25)
Binder (5)		Salt mixture (6.5)	Plus salt and vitamin mixture
		Cellulose powder (16.8)	
		Vitamin and amino acid etc. (14.2)	

highest in the groups fed with TNAU, followed by CB, JF and WFM. Same trend is shown by group II shrimps with reference to K_1 , K_2 and relative growth rates. However, in group II, the shrimps fed with JF consumed less and converted the most whereas those fed with TNAU consumed the most and converted least. In the bigger sized shrimps (group III) A/C, K_1 , K_2 and RGR values were high while consumption was moderate with reference to Japanese food. WFM was efficient next to JF, followed by CB and TNAU.

Analysis of variance showed that between groups or between diets A/C did not vary significantly. However, K_1 and K_2 values showed significant variations (1% level), the values increased from the smaller group to the larger group. JF gave a higher K_2 value, followed by WFM, CB and TNAU, thereby indicating the superiority of JF over other diets tested.

For *M. monoceros*, feeding experiments were carried out with 16 different diets (Table 3). Among these, some were unprocessed (1 and 4); some processed (2, 3, 13 and 14) and others compounded (5-12, 15 and 16). The details of their composition is same as in earlier studies²⁻⁴. There is a wide variation in K_1 , K_2 and A/C values (0.3 to 30%; 0.4 to 38% and 64 to 93% respectively). The reported ranges of these values for the crustaceans are 4-68% (K_1); 24-71% (K_2) and 39-70% (A/C). It is interesting to note that for the shrimp, *M. monoceros* these values vary considerably which indicates that the K_1 and K_2 values are food quality dependent¹.

From the data summarized in Table 3, it appears that the shrimp is able to convert maximum of the food into body tissue when it was fed with *Artemia salina*, detritus and trash fish. Among the processed and compounded foods, the Japanese feeds (5, 6, 7 and 15) had about 60% protein and were found to be superior. This may be due to the fact that Japanese foods are well balanced and supplemented with minerals and growth promoters⁵. The low conversion values obtained with foods 8-12 and 16,

TABLE 2 — DRY WEIGHT BALANCE OF *M. monoceros* AFTER 15 DAYS OF GROWTH FED WITH DIFFERENT DIETS [The experiments were carried out at 27°±1°C and 15‰ salinity. Values are expressed in g/animal]

Food	Initial wt W_1	Final wt W_2	Weighted mean \bar{W}	Production P	Consumption C	Faecal output F	Relative growth rate RGR	Assimilation A	Metabolism R	C-(P+F)	Assimilation efficiency A/C %	Gross growth efficiency K_1 or P/C %	Net growth efficiency K_2 or P/A %	Consumption/unit wt/day C/W/15
WFM	0.1996	0.2006	0.2001	0.001	0.4653	0.131	0.0003	0.3343	0.3333	0.652	71.85	0.215	0.299	0.155
CB	0.1848	0.1921	0.1887	0.0077	0.5208	0.1432	0.0027	0.3776	0.3699	0.722	72.5	1.48	2.04	0.184
JF	0.1957	0.2292	0.2125	0.0335	0.5207	0.1178	0.0105	0.4029	0.3694	0.5389	77.38	6.43	8.31	0.163
TNAU	0.1561	0.1477	0.1519	—	0.5051	0.1762	—	0.3289	—	0.9366	65.11	—	—	0.2217
WFM	0.2386	0.2992	0.2689	0.0606	1.0097	0.2971	0.015	0.7126	0.652	6	70.58	6	8.5	0.2503
CB	0.2534	0.337	0.2952	0.0836	1.1753	0.3695	0.0189	0.8058	0.7222	0.656	68.56	7.11	10.37	0.2658
JF	0.2585	0.3653	0.3119	0.1068	0.9847	0.339	0.0228	0.6457	0.5389	0.57	65.57	10.85	16.54	0.2105
TNAU	0.2623	0.2993	0.2808	0.037	1.5325	0.5589	0.0088	0.9736	0.9366	2.41	63.53	2.41	3.8	0.3638
WFM	0.3943	0.5051	0.4497	0.1108	2.1045	0.7182	0.0164	1.3863	1.2735	5.26	65.87	5.26	7.99	0.3238
CB	0.4068	0.4995	0.4532	0.0927	2.7498	1.1171	0.0136	1.6328	1.5401	3.37	59.38	3.37	5.68	0.4045
JF	0.4434	0.6302	0.5368	0.1868	2.97	0.773	0.0232	2.197	2.0102	6.29	73.97	6.29	8.5	0.3689
TNAU	0.3919	0.4662	0.4291	0.0743	4.5147	1.6658	0.0115	2.8489	2.7747	1.65	63.1	1.65	2.61	0.7014

WFM = White fish meal; CB = Cooper beta; JF = Japanese food No. 10; TNAU = Tamil Nadu agricultural pellet No. 7.

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TABLE 3 — PERCENTAGE VALUE OF ASSIMILATION EFFICIENCY (A/C), GROSS GROWTH EFFICIENCY (K₁) AND NET GROWTH EFFICIENCY (K₂) IN *M. monoceros*

Food	Protein level	Assimilation efficiency A/C	Gross growth efficiency K ₁ or P/C	Net growth efficiency K ₂ or P/A
1 Estuarine detritus ¹	5	93.3	21.6	24.1
2 Trash fish ²	87	93.3	13.15	14.1
3 Low protein pellet ²	20	70.2	6.5	9.4
4 <i>Artemia salina</i> (adult) ²	60	79.1	30	37.9
5 JF ² 5	60	87.1	12.3	14.04
6 JF ² 7	60	84.6	16.5	19.4
7 JF ² 8	60	85.8	13.6	15.80
8 TNAU ³ 9	60	84	0.34	0.4
9 TNAU ³ 10	60	84.3	4.41	5.23
10 TNAU ³ 13	40	84.06	0.84	1
11 TNAU ³ 20	60	83.95	3.36	4
12 TNAU ³ 21	60	84.07	3.16	3.79
13 WFM*	60	69.43	3.83	5.6
14 CB*	40	66.81	3.99	6.03
15 JF 10*	60	72.31	7.86	11.12
16 TNAU 7*	50	63.91	2.03	3.21

*Present work and references 1, 2, 3 respectively.

may probably be attributed to the fact that the protein is derived from vegetable source alone and the foods need to be incorporated with growth promoters.

The 3 natural foods which gave higher conversion are incidentally cheaper. In commercial fishing, trash fish do not fetch a high price and very often they are discarded. Likewise, the adult *A. salina* which occurs abundantly in nature, merely perishes after releasing the eggs; it is also not utilized in mass culture programmes of *A. salina*. Detritus, on the other hand, in spite of its low protein content, is highly nutritive as it is rich in organic matter derived from plants and animals, enriched with microorganisms⁴. It is also known to occur abundantly in nature, especially in coastal and estuarine waters^{4,6}. Trash fish, adult brine shrimps, and detritus can be collected with relative ease, practically at no cost and with simple processing these can be used as feed for shrimps effectively. However, it would be interesting to test some of these results obtained under laboratory conditions by field trials.

The authors express their gratitude to Prof. D. J. Crisp, University College of N. Wales, Menai Bridge, UK, for planning out this work and for his valuable comments. The authors are thankful to Dr S. Z. Qasim, Director, for his suggestions to improve the manuscript. Thanks are also due to Prof. M. N. Kutty of Tamil Nadu Agricultural University, Coimbatore and to Dr C. B. Cowey, Institute of Marine Biochemistry, Aberdeen, UK, for the supply of feeds used in this study.

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Growth of the Bean Clam *Donax incarnatus* Gmelin from a Sandy Beach at Benaulim, Goa

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Received 8 May 1978; revised received 14 June 1978

Growth rate of *D. incarnatus* was determined for 1 yr in relation to ecological factors and meristic characters. Average monthly growth rate was 2.2 mm. Growth of newly settled animals was faster than the older populations. Growth was influenced by the availability of particulate organic carbon and chlorophyll *a* in the surf water. From the multiregressional analysis it was observed that 2 variables of meristic characters gave better estimates of growth than a single variable.

CLAMS of the family Donacidae occur abundantly on the surf-beaten sandy beaches along the west coast of India^{1,2} and these are valued as food by a large number of people in Goa. The abundance of *Donax incarnatus* at certain seasons of the year in some areas of the Goa coast is of the order of 7630 individuals/m² (ref. 2,3). Dimensional relationship of molluscs have been reported to vary with environmental factors^{4,5}. In the present communication an attempt has been made to describe the changes in growth of various meristic characters in relation to ecological parameters.

Animals were collected at monthly intervals for 1 yr (July 1973 to June 1974) from the exposed intertidal sandy areas of the beach at Benaulim, Goa. Data for the environmental parameters of the surf water were also collected from the sampling area. Analysis of water samples for oxygen, salinity, particulate organic carbon and chlorophyll *a* were

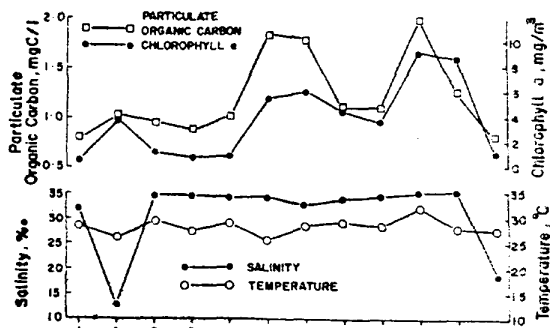


Fig. 1 — Monthly variations in salinity, temperature, particulate organic carbon and chlorophyll *a* of the surf water