Advances in Aquatic Ecology

Vol - II

Vishwas B. Sakhare

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— Volume 2 —

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Dedicated to
My Father

Shri Balasaheb Pandharinath Sakhare

Managing Director
Sagar Co-operative Sugar Factory Ltd.
District Jalna (M.S.)

Preface

The second volume of *Advances in Aquatic Ecology* is compendium of recent original research in the field of aquatic ecology. It is an assemblage of up-to-date information of rapid advances and developments taking place in the field of aquatic ecology. The book is a unique compilation of 20 chapters which discusses exhaustic studies on planktonology, physico-chemical environment, fisheries, toxicology, physiology etc. with its application oriented and interdisciplinary approach, the book would be immensely useful to students, teachers, researchers, scientists, policy makers, environmental lawyers and others interested in aquatic ecology. The chapters in the book have been contributed by eminent scientists/academicians active in the areas of aquatic ecology.

My special thanks and appreciation go to the scientists whose contributions have enriched this volume. I wish to express my sincere gratitude to Dr.Sureshji Khursale, President, Yogeshwari Education Society, Ambajogai who has been a source of constant inspiration. I am especially thankful to Dr.D.H.Thorat, Principal, Yogeshwari Mahavidyalaya, Ambajogai for his encouragement. I owe my special thanks to Dr.P.K.Joshi of Dnyanopasak College, Parbhani, Dr. Indranil Ghosh of West Bengal University of Animal and Fishery Sciences, Kolkata, Dr.Prakash Shingare of Khar Land Research Station of B.S.Konkan Krishi University, Panvel, Dr.Mamta Rawat of J.N.V.University, Jodhpur, Dr.H.M.Ashashree of Kuvempu University, Shimoga, Dr.M.Rajkumar and Surajit Das of Annamalai University, Dr.Sachin Satam of Marine Products Export Development Authority (MPEDA), Mumbai, Dr.R.J.Chavan of Arts, Commerce and Science College, Kille Dharur (Maharashtra) and Dr.K.Pazhanisamy of Government Arts College, Ariyalur (Tamil Nadu).

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Finally, I will always remain a debtor to all my well-wishers for their blessings, without which this volume would not have come into existence.

Dr. V.B. Sakhare

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ABOUT THE BOOK

The present book is compendium of recent original research in the field of aquatic ecology. It is an assemblage of up-to-date information of rapid advances and developments taking place in the field of aquatic ecology.

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The chapters in the book have been contributed by eminent scientists/academicians active in the areas of aquatic ecology.

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Dr. Vishwas Balasaheb Sakhare is presently working as Lecturer in Post Graduate Department of Zoology, Yogeshwari Mahavidyalaya, Ambajogai.A M.Sc. and Ph.D.from Swami Ramanand Teerth Marathwada University, Nanded, Maharashtra, he has published a number of research papers related to aquatic ecology and reservoir fisheries management and presented about 25 papers in different seminars and symposia. He has completed Post Graduate Course in Inland Fisheries Development and Administration from Central Institute of Fisheries Education, Salt Lake, Kolkata.

Dr. Sakhare has supervised a research project funded by University Grants Commission, New Delhi and he is a recognized Post Graduate teacher and research guide of Dr. Babasaheb Ambedkar Mararthwada University, Aurangabad and Solapur University, Solapur. He is associated with several professional bodies related with fisheries and aquatic sciences. He is recipient of fellowship of Indian Association of Aquatic Biologists (IAAB) in reorganization of the best research carried out in the area of aquatic biology. Dr. Sakhare is also working as coordinator of reference bank of IAAB. His publications includes some books like '*Ecology of Lakes and Reservoirs', 'Reservoir Fisheries and Limnology', 'Applied Fisheries', 'Aquatic Ecology'* and '*Advances in Aquatic Ecology Vol. 1'.*

Chapter 1

Biochemical Composition of Wild Copepods, *Acartia erythraea* Giesbrecht and *Oithona brevicornis* Giesbrecht from Coleroon Coastal Waters, Southeast Coast of India

M. Rajkumar, K.P. Kumaraguru Vasagam and P. Perumal

Introduction

Information on biochemical composition of copepod is of great importance in understanding the nutritive value and energy pathways in the pelagic food web. The marine copepods are considered to be "nutritionally superior" as food for marine fish and prawn larvae as they are a valuable source of proteins, carbohydrate, lipids, amino acids, fatty acids and enzymes (amylase, protease, exonuclease and esterase), all of which play an important role in larval digestion and enhance metamorphosis of larvae (Fluchter and Rembold, 1986; Munilla-Moran *et al.,* 1990; Millamena *et al.,* 1990 and Støttrup, 2000). Most of the fish and crustacean species mainly depend on zooplankton (copepods) throughout their life stages and some species even feed exclusively on copepods during their entire life. In aquaculture, larval pigmentation, growth and survival of fish are normally satisfactory only when copepods are used as live-feed. Studies on protein, carbohydrate and lipid content in the various zooplankton groups imply that these substances may have an important role in the physiological functions, metabolism, nutritive value and reproductive and energetic aspects of the marine ecosystem (Bhat and Wagh, 1992; Sreepada *et al.,* 1992; Krishnakumari and Goswami, 1993; Maruthanayagam and Subramanian, 1999; Nageswara Rao and Krupanidhi, 2001 and Ashok Prabu *et al.,* 2005).

Copepods are the most abundant and probably the most ecologically significant animals of the first consumer level of the marine plankton. In aquaculture chilled and frozen zooplankters are often used and they float, making it easier for the fish to catch (Tucker, 1992). The live-feed organisms like copepods are called "living capsules of nutrition" for fish and prawn larvae (Thakur, 1998). The high content of amino acids (Dabrowski and Rusiecki, 1983), enzymes (Lauff and Hofer, 1984) and water (Lemm, 1983) in zooplankton are all positive qualities for starting feeding by fish larvae (Holm and Moller, 1984). Free amino acids are present in the frozen fluid that surrounds the zooplankton and these form a powerful attractant and appetite stimulant for fish larvae (Dabrowski and Rusiecki, 1983; Mearns, 1986 and Tucker, 1992). Further, the nutritional quality of copepods is important in determining the survival and growth of fish larvae (Szyper, 1989). In many marine fish and shrimp hatcheries, high mortality rates during the first feeding of larvae are linked to lack of nutritionally inadequate live-food organism. Copepods have been shown to be essential diet for solving these problems.

The limited information available on biochemical composition of wild zooplankton in India is related to the general quantitative aspects of protein, fat and carbohydrate (Madhupratap *et al.,* 1979; Rosamma Stephen *et al.,* 1979; Goswami *et al.,* 1981; Sumitra Vijayaraghavan *et al.,* 1982; Krishnakumari and Nair, 1988; Nandakumar *et al.,* 1988; Krishnakumari and Achuthankutty, 1989;

Bhat and Wagh, 1992; Ingole and Parulekar, 1995; Goswami *et al.,* 2000 and Ashok Prabu *et al.,* 2005) as well as the amino acid content of cultured copepod *Oithona rigida* (Santhanam and Perumal, 2001 and Rajkumar and Kumaraguru Vasagam, 2006).

Marine copepods have paramount ecological significance as they form pelagic food links and they constitute the largest and reliable source of protein. With all essential amino acids, they play an important role in the growth and survival in fish and crustacean larvae when used as feed in aquaculture. Amino acids are served as an energy substrate in the developing eggs and larvae of fishes. Only very limited works are available on the amino acid composition of copepods (Yurkowski and Tabachek, 1979; Dabrawski and Rusiecki, 1983 and Santhanam and Perumal, 2001). Hence in the present study, we focused on the seasonal variations in the biochemical composition *viz*., protein, lipid, carbohydrate, moisture, ash contents and amino acid profiles of two wild copepods the calanoid copepod *Acartia erythraea* and the cyclopoid copepod *Oithona brevicornis* collected from 4 locations Bay of Bengal, Coleroon mouth, Coleroon estuary and Vettar backwaters.

Materials and Methods

Study Area

The river Coleroon, a branch of the river Cauvery, originates from Brahmagiri of the Western ghats and after meandering for over a distance of 760 kms, forms a very fertile delta in Nagapattinam District in Tamil Nadu before it debouches into the Bay of Bengal at a place called Pazhayaru (Lat. 11° 21' N; Long. 79° 50' E) on the south east coast of India. Pazhayaru is one among the three major fishing harbours in Tamil Nadu. It contributes a good quantity of seafood for the state. The river Coleroon flows into the Bay of Bengal at about 10 kms south of Parangipettai. The average width of the Coleroon-estuary varied from 420 meters in mouth region to 100 meters in upstream and the average depth near the mouth was about 7 meters and 1 or 2 meters in the tidal and freshwater zones. The Coleroon estuary has her estuarine connections with Pichavaram mangroves in the northern side and Buckingham canal and Vettar backwaters near the mouth on the southern side. The Buckingham canal and Vettar backwaters are the two small adjacent drainage channels of paddy fields. The mouth of the Coleroon river is always open and it shows semidiurnal tide and the tidal flushing extends up to a distance of about 15 kilometers upstream.

The present study was carried out from four different environments *viz*: (*i*) The sea (*ii*) Coleroon Mouth (*iii*) Estuary and (*iv*) The Vettar backwater for a period of one year (April 2004–March 2005). Station I was in 10 fathom line of Bay of Bengal and the Station II was in the mouth of the Coleroon river. This station is highly influenced by freshwater inflow during northeast monsoon (October-December). The mean salinity was 33 per cent. The bottom is characterized by sand. Station III was situated near the mouth region of the estuary. The bottom was characterized with mud deposits. Station IV was located at about 1.5 km from the Station II, which is highly influenced by freshwater through the adjacent Vettar backwater. The Vettar backwater has also got connection with two channels *viz.,* 'Chinna Vettar' and 'Semmangadu channel' (Figure 1.1).

Collection

Copepod (zooplankton) samples were collected from the study areas by horizontal-surface towing of a plankton net (0.35 cm mouth diameter), made up of bolting silk cloth (No 10: mesh size 158 μm) for 30 minutes. The copepod samples were immediately transported to laboratory and

thoroughly rinsed to reduce the contamination from other zooplankters. From the samples, the copepods were identified under the microscope using the key of Kasturirangan (1963). The copepod samples were sorted out through the microscopical investigation and they were analyzed biochemically. After recording biomass (displacement volume), the samples were cleared of debris, washed with distilled water. Half of each sample was preserved for taxonomical studies and the rest was fresh dried (60°C) until constant weight was obtained. Triplicate analysis was made and the average value taken.

Figure 1.1: Map Showing the Study Area

Isolation

After the collection, the zooplankton was screened to isolate the size fraction containing dominantly adult and later stage copepodites of *A. erythraea* and *O. brevicornis*. The zooplankton samples were first screened coarsely through a 500 µm mesh to remove the larvae of fish and prawn. Then they were rinsed for 2 hours in a zooplankton washer (Schipp *et al.,* 1999) fitted with a 190µm mesh screen used to remove smaller zooplankters such as rotifers, copepod nauplii and barnacle nauplii. The vigorous rinsing was made continuously for 2 hrs, after which most of the rotifer contamination was reduced and the rinsing was done periodically to reduce rotifer numbers. After rinsing, the remaining adult copepods were used for biochemical composition.

Biochemical Composition

Triplicate analysis was made and the average values were taken. Proximate composition were analysed for their protein, dry matter, ash content following (AOAC, 1995). Carbohydrate and lipid were analysed following Dubois *et al*. (1956) and Folch *et al*. (1956) respectively.

Amino Acid Estimation

The protein bound amino acids were separated from free amino acids by using 6 per cent TCA solution (Finn *et al.,* 1995). Amino acids were analysed after sealed tube hydrolysis with 6N HCL for 22 h at 110°C (Spackman *et al.,* 1958 and Finlayson, 1964). After hydrolysis, the acid was evaporated in vacuum oven and the sample was kept in a NaOH desiccator to remove traces of acid. The residue was brought into 1 ml of sample diluent (pH 2.20). Amino acids were analysed using the

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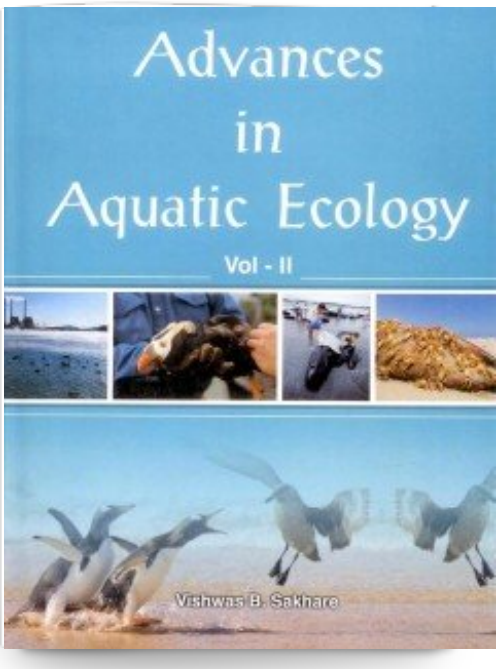

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