

Seshaiyana

ENVIS Newsletter on Estuaries, Mangroves, Coral Reefs and Lagoons

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Hello Readers,

Over the years, this newsletter has come in different dimensions covering various facets of the coastal and marine ecosystems, thereby playing an important role in the dissemination of information to the scientific community world over.

This issue carries various articles on coastal and marine sciences. The first article evaluates the suitability of the Indian Sundarbans environment for the purpose of oyster culture. The second article emphasises the prevalence of quorum sensing in a wide array of bacteria indicating its importance. The third article attempts to assess the population status of coastal plants and mangroves with the view of conserving them. The fourth article with the aesthetic sense addresses coral reefs as beautiful gardens in the sea and sea anemones as the flowers in this garden. The fifth article discusses about the significance of horseshoe crabs and their biomedical values. The sixth article reports the occurrence of an interesting fish namely sunfish in Parangipettai waters throwing light on its distribution and biology. The last article on the computational tools explains their application in drug discovery.

Other than these, items such as recent news, forthcoming research meets etc. are included. Apart from reading, the users can contribute articles to our newsletter.

Prof. T. BALASUBRAMANIAN
Prof. S. AJMAL KHAN

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Editors

Prof. T. Balasubramanian
(Director & ENVIS in-charge)
Prof. S. Ajmal Khan

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INSTRUCTIONS TO AUTHORS

Seshaiyana welcomes original articles, snippets and cartoons in the area of coastal wetlands, preferably, estuaries, mangroves, coral reefs and lagoons. The newsletter accepts popular/research articles, reviews, news and notes. Details of forthcoming seminars/symposia/trainings/workshops will also be considered for publication.

The articles should not exceed five typed pages in double space.

Line drawings and cartoons should be clear for good reproduction.

References should be limited and cited in the text by name and year. Council of Biological Editors' style manual may be referred to for listing references at the end.

Articles should be sent to:

The In-Charge
ENVIS Centre
Centre of Advanced Study in Marine Biology
Parangipettai - 608 502
Tamilnadu, India

OR

E-mail your articles
(as attached files in MS-Word 6.0)
to
cdl_aucasmb@sancharnet.in
casmb@envis.nic.in

Editor's desk invites reader's views, suggestions and constructive criticism on *Seshaiyana*.

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Please help to keep information abreast.

Front cover photo : A coral species *Acropora abrotanoides*

QUALITY OF EDIBLE OYSTER WITH RESPECT TO COLIFORM LOAD: A REPORT FROM INDIAN SUNDARBANS

Introduction

The Indian Sundarbans is one of the most biologically productive, taxonomically diverse, mangrove dominated ecosystem of the tropics (Mitra *et al.*, 1992), which has been declared as the World Heritage Site in 1987 by UNESCO. The deltaic lobe is a unique genetic reservoir sustaining a wide spectrum of commercially important finfish and shellfishes. It is however, a tragedy that such a rich reservoir of natural resources is encircled by poverty stricken island dwellers, most of whom are living below poverty line. Man-resource conflict is thus inevitable in this zone. In recent times, thrust has been given to the culture of edible oyster, *Saccostrea cucullata* as an alternative livelihood option for the local people (Mitra and Banerjee, 2005) with the aim to divert them from illegal intrusion into the forest area in search of wood, honey, fish, shrimp seeds, wax etc. In this context, it is extremely important to evaluate the quality of meat of these commercially important bivalve species in terms of coliform load. Need for such study arises mainly due to discharge of anthropogenic wastes into coastal areas as a result of which the zone becomes vulnerable in terms of microbial load (Glasoe and Christy, 2004). The microbes from the ambient media often get accumulated in shellfish because of their filter feeding behaviour. Under favourable conditions, a single large oyster may filter up to 5 litres of water per hour. Such a species is thus an effective filter device of particles that enter the estuarine environment through urban, industrial and municipal wastes (Pommeypuy, 1996).

Considering this property of oyster, the Council of the European Communities has given directions for production and marketing of healthy live bivalves (91/492/EEC). Under these directives, all Member States are required to classify their shellfish harvesting areas into one of three categories according to the level of fecal indicators present in shellfish samples.

No such classification exists for Indian coastal and estuarine shellfish culture area, and the present study is an attempt to evaluate the suitability of the Indian Sundarbans environment for the purpose of oyster culture.

Materials and methods

The present investigation was carried out during the month of April, 2007 at three different stations namely Namkhana, Frazergaunge and Sajnekhali. The sampling stations were selected based on the magnitude of anthropogenic pressure. Station 1 (Namkhana) is situated in the western sector of Sundarbans, which is not only an important fish landing station, but also receives the wastewater from Kolkata and nearby Haldia port-cum-industrial complex. Station 2 (Frazergaunge) is also an official fish landing station of the state of West Bengal, but the water of this station receives the discharge of several hotels and tourism units located along the Bakkhali area. Station 3 (Sajnekhali) is situated in the eastern sector of Indian Sundarbans, which is noted for its wilderness. Anthropogenic stress is minimum in this sampling station owing to the presence of mangrove forest, being protected and monitored by West Bengal Forest Department.

For microbial analysis, water samples were collected from these stations during high tide using water sampler and the sediment samples were collected with the help of the pre-sterilized Peterson grab. The water samples were immediately transferred in to sterile bottles. The central portion of the sediment samples was aseptically taken and put into sterile polythene bags and transported to the laboratory under ice-frozen condition for bacteriological examinations. Oyster samples were collected from the intertidal zone of the selected sampling stations for carrying out microbial load analysis in terms of total coliform and fecal coliform.

For bacterial analysis, the flesh of the oyster samples were accurately weighed and blended with 0.1% peptone buffer besides 3% NaCl diluent for 1 minute. Different dilutions (10^{-1} - 10^{-3}) were made. 1 ml of each dilution was added separately in test tube containing Lauryl-Sulphate Tryptone broth. Total sets were incubated at 37°C for 24 hours and the results were expressed from MPN index per gram basis. Water and sediment samples, were also analyzed according to the standard methods described in APHA 20th Edition, 2001.

Results and discussion

The results indicated maximum coliform load in oyster flesh, water and sediment collected from Namkhana region (Tables 1 and 2). The station-wise order of microbial contamination was Namkhana > Frazergaunge > Sajnekhali. This spatial variation may be attributed to the degree of anthropogenic stress: Namkhana and Frazergaunge, being the fish landing sites constantly exposed to wastes of complex nature. In addition to decomposed fish products, these stations are also contaminated with sewage from surrounding market place, residential plots and tourism units. Sajnekhali, on the other hand is a wildlife sanctuary with minimum environmental stress. The area sustains unique mangrove vegetation, which acts as the agent of bioremediation.

As per the directive of European Council, the shellfish harvesting area may be demarcated in to categories A, B and C on the basis of fecal indicators in shellfish flesh samples. Shellfish from Category A can be directly taken to the market. They must meet a standard of not more than 230 *Escherichia coli* per 100 gm shellfish flesh (or 300 FC/100 gm) as well as other standard for specific pathogens (such as *Salmonella*), chemicals and algal biotoxins. Shellfish from Category B must be purified before being taken to the market and shellfish from Category C must be placed again in clear water for two months prior to marketing (Pommepuy, 1996). As per this standard, the coliform load (60 and 47 times more) in the shellfish tissues sampled from Namkhana and Frazergaunge showed alarming levels. Hence, oyster harvested from here should be properly deputed before being taken to the markets. Again these places may not be suitable for oyster culture. Oyster being an edible product needs continuous monitoring with respect to coliform load to overcome the barrier of consumer acceptability, which may otherwise pose an adverse effect on the human health (consumers). The third station may be used for oyster culture.

The ability to produce, transport and market healthy disease-free shellfish is crucial to the success of the Indian oyster industry. Under such circumstances, results of the present work may serve as baseline information for initiating oyster culture in the maritime state of West Bengal.

Table 1. Total coliform load in water, sediment and oyster samples collected from sampling stations during April 2007

Sl. No.	Stations	Oyster flesh (MPN/gm)	Sediment (MPN/gm)	Water (MPN/100ml)
1	Namkhana	140+	30	1800+
2	Frazergaunge	110	24	1600
3	Sajnekhali	46	9.5	350

Table 2. Total fecal coliform load in water, sediment and oyster samples collected from sampling stations during April 2007

Sl. No.	Stations	Oyster flesh (MPN/gm)	Sediment (MPN/gm)	Water (MPN/100ml)
1	Namkhana	140+	30	1800+
2	Frazergaunge	110	24	1600
3	Sajnekhali	46	9.5	350

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A. Mitra¹, H.K. Jana², B.R. Pati³, K. Banerjee¹ and K.C. Mondal³

¹Department of Marine Science
University of Calcutta
35, B. C. Road, Kolkata - 700 019

²Department of Microbiology
Panskura Banamali College
Purba Midnapore, Midnapore

³Department of Microbiology
Vidyasagar University
Paschim Midnapore, Midnapore

QUORUM SENSING – BACTERIAL COMMUNICATION SYSTEM

Introduction

The ability of bacteria to sense a species – or mixed population – specific cell density and subsequently to react with control measures resembles a polling procedure. In such a process votes are counted and once a predefined number of votes (a ‘quorum’) have been reached, consequent activities will follow. Therefore, this type of regulation is now commonly termed ‘quorum sensing (QS) regulation’ (Podbielski and Kreikemeyer, 2004). It is a mechanism in which bacteria coordinate the expression of certain genes in response to their population density by producing, releasing and detecting small signal molecules.

This process relies on the production of a low-molecular-mass signal molecule (often called autoinducer), the extracellular concentration of which is related to the population density of the producing organism. Cells can sense the signal molecule allowing the whole population to initiate a concerted action once a critical concentration (corresponding to a particular population density) has been reached. Quorum sensing is characteristic of both gram-negative and gram-positive bacteria which use different signal molecules-intact and modified peptides, amino acids, and similar amino compounds to measure their population density. Cell-cell communication using N-acylhomoserine lactone (AHL) signal is one of the known mechanisms by which bacteria can communicate with each other and is a widespread phenomenon in gram-negative bacteria (Daniels *et al.*, 2004). QS plays the key role in bacterial interactions with higher organisms (symbiosis and pathogenesis in animals and plants) and, consequently, in infection processes and diseases.

Quorum sensing regulation

Quorum sensing-controlled behaviors are those that only occur when bacteria are at high densities. QS is unproductive when undertaken by a single bacterium but becomes productive due to the simultaneous action of a group of bacterial cells.

QS-regulation appears to be a consequence of interbacterial communication by

which bacteria of one or even different species learn about their current population density and react in a defined way to that information. QS-regulation can broadly be described as a three step process (Fig. 1). In the first step, the signaling molecules are produced either by employing the intracellular machinery and subsequent outward-bound transport or by secreting a protease and subsequent cleavage from bacterial or even adjacent host structures. The signaling molecules may stay bound to the bacterial surface or could be released to the environment. In the second step, the signaling molecules accumulate outside the bacteria either due to the continuous production of a growing number of bacteria, a decrease in available space even without further production a signaling molecules, or due to the vicinity of an impermeable structure in combination with a low level production of the molecules. In the third step, the signaling molecules reach a threshold level, at which it is sensed at the bacterial surface or after passive or active passage through the cell membrane by intracellular receptors. As a consequence, specific regulators will be activated starting their quorum sensing control of gene expression.

While gram-negative bacteria can employ five or more different chemical classes of signaling molecules, gram-positive cocci predominantly use special oligopeptides for specific signaling. QS-regulators effects on virulence factor expression have been described in *Staphylococcus aureus*, *Streptococcus mutans* and *Enterococcus faecalis* in these bacteria, QS-regulation appears to be crucial for displaying tissue invasiveness and/or biofilm formation.

Sensing of the signaling molecules can start as soon as the molecules are modified and/or exported from the producing bacterium. However, it is only when the extracellular or, after re-uptake, intracellular concentration of the molecules reaches a pre-defined threshold level, that sensing of these compounds results in regulatory cascades that can affect the expression of a few or several hundred genes.

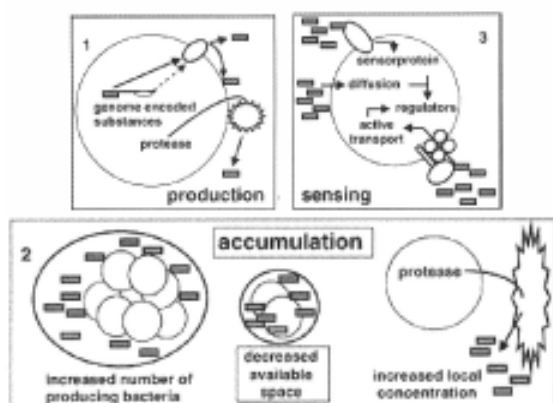


Fig. 1. The three steps in quorum sensing regulation

QS – systems in marine bacteria

The *lux* system of quorum sensing was first described in the regulation of bioluminescence in marine bacterium *Photobacterium* (formerly *Vibrio*) *fischeri* (Nealson *et al.*, 1970). This system regulates the intensity of bioluminescence depending on the density of a growing population: cells are nonluminous at a low density (lag phase) and glow when a critical density (quorum) is reached. The luciferase operon in *P. fischeri* is regulated by two proteins, *luxI*, which is responsible for the production of the N-acyl-homoserine-lactone (AHL) autoinducer and *luxR*, which is activated by this autoinducer to increase transcription of the luciferase operon (Engebrecht *et al.*, 1983; Engebrecht and Silverman, 1984).

In seawater, *P. fischeri* cells are commonly fewer than 100 per ml and do not glow. Expression of the *lux* genes and, consequently, bioluminescence are activated at a high (more than 10^8 cells/ml) population density, which occurs in rich culture media and in the light organs (photophores) of various marine animals (fish, squids, and other animals that provide a natural habitat for this symbiotic marine bacterium).

In addition to luminous bacteria, *luxI-luxR* quorum-sensing systems have been found in nonluminous bacteria *Serratia marcescens*, *Citrobacter freundii*, *Enterobacter agglomerans*, *Proteus mirabilis*, *Erwinia*

herbicola, pathogenic *E. coli* strains, etc. A quorum-sensing system has also been detected in *E. coli* K12 and in *Salmonella typhimurium*: its *sdiA* codes for a transcriptional activator, but the nature of AI is still obscure. As for N-AHLs, more than 40 such compounds are known, differing in the structure of the acyl group (hydrocarbon chain from C4 to C14, a keto or oxy group in position 3, etc.).

P. fischeri possesses the *ainS-ainR* system in addition to the classical *luxI-luxR* system. The product of *AinS*, *AinS*, synthesizes N-octanoyl L-homoserine lactone (OHL), or AI-2. However, AI-2 is less effective, since bioluminescence only slightly increases in *P. fischeri luxI* mutants at a high population density. QS is involved in formation of specific swarmer cells in *Proteus*, *Serratia*, *Vibrio*, *Chromobacterium*, *Bacillus*, *Clostridium*, and, to a lesser extent, in *S. typhimurium* and *E. coli* which are able to attach and to colonize various surfaces in soil, plants, insects, fish, and mammals (including humans). Swarmer cells are elongate, multinuclear, hyperflagellated (having many lateral flagella), and able to rapidly move on a solid substrate. However, *swrI* (a *luxI* analog) stimulates movement of swarmer cells only in *Serratia liquefaciens*, with N-butanoyl - L-homoserine lactone (BHL) acting as a low-molecular-weight AI.

The quorum-sensing system of *Pseudomonas aeruginosa* draws particular attention because this species is a human pathogen. This bacterium also has two systems of the *luxI-luxR* type: the *las* system (*lasR-lasI*, 3OC12-HSL acting as AI) controls synthesis of various virulence factors (proteases *lasA* and *lasB*, exotoxin A), and the *rhl* system (*rhlR-rhlI*, C4-HSL acting as AI) controls rhamnolipid synthesis, production of type IV pili, biofilm formation, etc. The quorum-sensing system acts as a cascade.

Phenotypes that are controlled by a quorum sensing system include luminescence, conjugation, nodulation, swarming, sporulation, biocorrosion, antibiotic production and most importantly biofilm formation and the expression of virulence factors such as lytic enzymes, toxins, siderophores and adhesion molecules (reviewed by Defoirdt *et al.*, 2004).

Table 1. Quorum-sensing system of various bacteria (after Zavidgelsky and Manukhov, 2001)

Species	Function	System	N-AHL acting as AI
<i>Photobacterium fischeri</i>	Bioluminescence	<i>luxI-luxR</i>	N-(3-oxohexanoyl)-L-homoserine lactone (OHHL), AI-1
<i>Vibrio harveyi</i>	Bioluminescence	<i>ainS-ainR</i> <i>luxL, luxM</i> <i>luxR, luxN</i> <i>luxS-luxQ</i>	N-octanoyl-L-homoserine lactone (OHL), AI-2 N-(3-hydroxybutanoyl)-L-homoserine lactone (HBHL), AI-1 AI-2 (unidentified)
<i>Erwinia carotovora</i>	Production of antibiotic carbapeneme Production of hydrolases (pectinases, cellulases etc.)	<i>carI-carR</i> <i>ecaI(expI)-ecaR(expR)</i>	N-(3-oxohexanoyl)-L-homoserine lactone (OHHL)
<i>Agrobacterium tumefaciens</i>	Production of factors for conjugal transfer of Ti plasmids	<i>traR-tral</i>	N-(3-oxooctanoyl)-L-homoserine lactone (OOHL)
<i>Pseudomonas aeruginosa</i>	Production of virulence factors (toxin A, elastase) Production of virulence factors and secondary metabolites (rhamnolipids)	<i>lasI-lasR</i> <i>rhlI-rhlR</i>	N-(3-oxododecanoyl)-L homoserine lactone (OdDHL, 3OC12-HSL) N-butanoyl-L-homoserine lactone (BHL, C4-HSL)

Applications of bacterial QS

a) Novel therapeutics:

The high specificity of the initial signal sensing and the importance for expressing special virulence traits make this type of gene expression promising for the development of novel therapeutics. The options for such therapies are critically discussed based on practical experiences with interference in *S. aureus* QS-regulation (Podbielski and Kreikemeyer, 2004).

Any type of virulence regulator could be an attractive target for new drugs to fight bacterial infections. Such an approach could have specific advantages:

- i) QS-regulation is species or even strain specific, thus any interference should selectively inhibit the pathogen but not the innocent bystander flora.
- ii) QS-regulation can be completely blocked without affecting bacterial viability and growth kinetics and so an interference should exert less selective pressure for the development of resistance mutations compared with antibiotics.
- iii) In some pathogens, QS-regulation controls biological functions like the internalization into eukaryotic cells. Thus

administering a substance that interferes with the QS-regulated eukaryotic cell internalization could be a supplement for conventional therapy with antibiotics that exclusively act outside the eukaryotic cells (e.g. β -bactams, aminoglycosides).

b) Strategy to fight infections in aquaculture

Disease outbreaks caused by pathogenic bacteria are considered to be one of the largest constraints to the development of aquaculture sector. So far, antibiotics and disinfectants have only had limited success in the prevention or cure of diseases in aquatic systems. Moreover, the frequent use of biocides, especially in subtherapeutic doses, is leading to the rapid development of resistance. Therefore, there is an urgent need to develop alternative ways to control infections caused by bacterial pathogens in aquaculture. Many of these pathogens are found to control virulence factor expression by a cell-to-cell communication system. Hence, disruption of bacterial quorum sensing has been proposed as a new anti-infective strategy and so also several techniques that could be used to disrupt quorum sensing (Defoirdt *et al.*, 2004). These techniques comprise :

- i) The inhibition of signal molecule biosynthesis.

- ii) The application of quorum sensing antagonists (including naturally occurring as well as synthetic halogenated furanones, antagonistic quorum sensing molecules and undefined exudates of higher plants and algae).
- iii) The chemical inactivation of quorum sensing signals by oxidized halogen antimicrobials.
- iv) Signal molecule biodegradation by bacterial lactonases and by bacterial and eukaryotic acylases and
- v) The application of quorum sensing agonists.

Quorum sensing system is found in a still growing list of bacteria that are pathogenic to plants, animals and humans. The list includes (but is not restricted to) the aquatic pathogens *Aeromonas hydrophila*, *A. salmonicida*, *Vibrio anguillarum*, *V. harveyi*, *V. parahaemolyticus*, *V. vulnificus* and *Yersinia ruckeri*. These quorum sensing pathogens probably increase their chances to infect their host successfully by delaying virulence factor production until the population density is large enough to overwhelm the host's immune system (Donabedian, 2003). It has been shown that inactivating the quorum sensing system of quorum sensing pathogens can result in a significant decrease in virulence factor expression (Swift *et al.*, 1999) and in a decrease of virulence as such. As the importance of quorum sensing in virulence development of pathogenic bacteria became clear, disruption of quorum sensing was suggested as a new anti-infective strategy (Finch *et al.*, 1998).

The details of quorum sensing and its importance in bacterial physiology have yet to be fully elucidated. The importance of quorum sensing, however, cannot be ignored. The prevalence of quorum sensing in a wide array of bacteria is an indication of its importance.

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Surajit Das, P.S. Lyla and S. Ajmal Khan
 Centre of Advanced Study in Marine Biology
 Annamalai University
 Parangipettai – 608 502, India

ASSESSMENT OF POPULATION STATUS OF COASTAL PLANTS AND MANGROVES USED IN TRADITIONAL MEDICINE OF ORISSA COAST FOR CONSERVATION

The economical uses of mangrove products are enormous and varied. The mangrove extracts are being traditionally used in folklore or bush medicine and these practices continue to this day (Saxena and Brahmam, 1994-96; Kathiresan *et al.*, 1995; Bose *et al.*, 1998). Probably due to unregulated tourism and population pressures, vast areas of mangrove forests are either being disturbed or cleared globally and the state of Orissa is not an exception (Banerjee, 1992). As a result, it is afraid that the scope of traditional medicinal uses of mangroves would be lost if the magnitude of forest destruction outstrips its sustainable use. The Bhitarkanika mangrove sanctuary of Orissa with its unique species diversity faces steady but gradual depletion of mangrove population in general and medicinal species in particular. Therefore scientists, conservationists and foresters alike have

underlined the need for threat assessment for sustained conservation action on medicinal plants including mangroves of Orissa coast (FRLHT CAMP-Workshop.Oct., 2007, unpublished report). In this context, an exercise was initiated to evaluate population status of traditionally used medicinally important mangroves and coastal plants of Orissa coast with special reference to Bhitarkanika sanctuary (672 sq. km) lying between lat. 20° 4'- 20° 8' N and long. 86° 45'- 87° 5' E. This part of core mangrove forest (around 200 sq. km.) is reported to have maximum species diversity (Mishra *et al.*, 2005).

In addition to the recent field studies, data on IVI (Importance Value Index), % population etc. are also obtained from various sources and recalculated comparing earlier reports in accordance with following methods.

Table 1. Population status of selected coastal plants and mangroves found in Bhitarkanika sanctuary

S. No.	Species	Local name	Record A		Record B		Record C		Record D		Average value	
			IVI	%	IVI	%	IVI	%	IVI	%	IVI	%
1	<i>Aegiceras corniculatum</i> (AgC)	Kharsi	9.72	3.00	15.8	4.99	6.87	2.29	10.71	3.57	10.78	3.46
2	<i>Amoora cucullata</i> (AC)	Uanra			20	6.32	4.03	1.34	7.66	2.55	10.56	3.40
3	<i>Bruguiera gymnorhiza</i> (BG)	Bandari	20.41	6.30	13	4.11	5.34	1.78	2.33	0.78	10.27	3.24
4	<i>B. sexangula</i> (BS)	Bandari			26.2	8.28					26.20	8.28
5	<i>Cerbera manghas</i> (CM)	Pani amba			12.2	3.85	1.83	0.61	4.32	1.44	6.12	1.97
6	<i>Cynometra iripa</i> (CI)	Singada			20.3	6.41	32.46	10.82	21.15	7.05	24.64	8.09
7	<i>Excoecaria agallocha</i> (EA)	Guan	32.18	9.93	35.4	11.18	56.64	18.88	54.49	18.16	44.68	14.54
8	<i>Heritiera fomes</i> (HF)	Sundari			38.6	12.19	121.8	40.60	95.47	31.82	85.29	28.21
9	<i>H. littoralis</i> (HL)	Dhala sundari					4.83	1.61			4.83	1.61
10	<i>Kandelia candel</i> (KC)	Sindhuguan	20.39	6.29			2.47	0.82	4.29	1.43	9.05	2.85
11	<i>Lumnitzera racemosa</i> (LR)	Churanda	2.78	0.86							2.78	0.86
12	<i>Thespesia populnea</i> (TP)	Habali							0.83	0.28	0.83	0.28
13	<i>Xylocarpus granatum</i> (XG)	Shishumar	14.22	4.39			3.2	1.07	7.02	2.34	8.15	2.60
14	<i>X. moluccensis</i> (XM)	Pitamari	5.11	1.58			0.77	0.26	3.29	1.10	3.06	0.98

Source: Records A & B = Banerjee and Rao, 1990; Records C & D = Mishra *et al.*, 2005

Table 2. Coastal and mangrove plant parts used in traditional medicine

Sl. No.	Botanical Name	Common name	Ver. Name	Medicinal part & Uses
1	<i>Aegiceras corniculatum</i>	Black mangrove	Kharsi (O,B),halsi (H), narikandam (Tam), dudumara (Tel)	Leaves-boil-earache; flowers-honey
2	<i>Amoora cucullata</i>		Uanra (O)	Bark, seeds-dysentery
3	<i>Bruguiera gymnorrhiza</i>		O-bandari, kekra; B-kankra	Bark-astringent; malaria; fruit-astringent
4	<i>B. sexangula</i>		Bandari (O)	Bark-anti cancer; root & leaves- in burns
5	<i>Cerbera manghas</i>	Dog bane	O-pani amba; B-dhakur; Tam-kodal- ma	Bark-purgative; Fruit-narcotic, poisonous; seeds-illuminant
6	<i>Cynometra iripa</i>		O-singara	Seed-oil-skin diseases
7	<i>Excoecaria agallocha</i>	Blinding tree	Guan (O), genwa (B), Kampetti (Tam), thilla(Tel)	Leave-epilepsy, ulcers; root-hand & feet swelling
8	<i>Heritiera fomes</i>	Looking glass tree	Sundari (O,B)	Bark-healing wound & cut;seeds-edible
9	<i>H. littoralis</i>	Looking glass tree	H, O, B- dhala sundari	Seeds-diarrhoea, dysentery
10	<i>Kandelia candel</i>		O-sindukua; B-goria; Tam-thuvar- kandu; Tel-kandigala	Bark-diabetes
11	<i>Lumnitzera racemosa</i>		O-tunda; B-kripa; Tam-tipparathai	Stem-itches and herpes
12	<i>Thespesia populnea</i>	Tulip tree	Habali (O), paraspipul (B), parsipu (H)	All parts-skin diseases, dysentery, migraine
13	<i>Xylocarpus granatum</i>	Puzzle fruit tree	H-pussur; O-susumara; B-dhundul	Bark-astringent, dysentery, diarrhoea, febrifuge seed-ointment for itch
14	<i>X. moluccensis</i>		Pitamari (O), dhundul (B)	Bark-astringent, dysentery

Major Source: Bose *et al.*, 1998

1. Quadrat method : (Mishra *et al.*, 2005) size- 10m X 10m, through 1 km each along tidal line from the riverbank.
2. Line transect method : (Banerjee and Rao, 1990) based on nearly complete species representation, the length of the transect was determined.

On the basis of relative frequency, abundance and density,the IVI and % population of 14 nos. of medicinal mangrove plants were

calculated and presented in Table 1. Medicinal importance and the plant parts used in traditional medicine are summarized in Table 2.

In this study, except *H. fomes*, *E. agallocha* , *B. sexangula* and *C. iripa*, all other 10 medicinal mangrove species exhibited very less population which may be considered for conservation prioritization to arrest further possibility of depletion.

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U.C. Basak

Scientist

Regional Plant Resource Centre

Bhubaneswar-15, Orissa

Email:uc_basak07@yahoo.co.in

Red devils

Flotillas of jumbo squid are invading the length of the eastern Pacific Ocean, and the voracious predators may be upsetting ocean ecosystems and threaten fisheries, scientists warn. These squids are nicknamed red devils for their powerful arms and tentacles, razor sharp beaks and insatiable appetites. These squid are spreading like wild fire to all areas of the oceans. They are found off the coast of Alaska, California and Chile. They travel in packs of thousands or more and consume everything in their paths. Researchers are worried that they will greatly effect the marine environment. For more information log on <http://news.nationalgeographic.com/news/2007/03/070330-giant-squid.html>

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The In-charge
ENVIS Centre
Centre of Advanced Study in Marine Biology
Annamalai University
Parangipettai - 608 502
Tamil Nadu, India

SEA ANEMONES: FLOWER'S OF CORAL PARADISE?

Coral reefs are having impressive biodiversity, productivity and scenic beauty. In this ecosystem one beautiful creature which is getting nourishment is known as the flowers of coral paradise i.e., sea anemones. They occur at different depth of oceans but particularly abundant in coastal water especially in coral reef system. Many are beautifully colored (red, pink, brown, green, violet etc.) and look like a flower. The oral or feeding end is equipped with many extensions called tentacles. The sea anemones are closely related to corals and do not have skeleton. Sea anemones are a rich source of biologically active polypeptides with diverse pharmacological applications.

Habitat

There are more than 1,000 sea anemone species found throughout the world oceans at various depths upto 3650 m (Fautin and Barber, 1999), although the largest and most varied occur in coastal tropical waters. They live attached to firm objects in the seas, usually the sea floor, rock or coral, but they can slide around very slowly.

Anatomy

Sea anemones come in many shapes and sizes. They have a columnar body with a single body opening, the mouth, which is surrounded by tentacles. Structurally the sea anemone is known as a polyp. The body wall consist of an outer layer of epidermis and an inner layer of gastrodermis; between these two is a gelatinous, noncellular layer known as the mesoglea. The body wall is organized into a muscular column with a top that has a mouth (the oral disc) and a bottom (the pedal disc) that holds onto the substratum. Within the column is a sac like digestive cavity, called the coelenteron or gastro vascular cavity, which has the mouth as its only opening. There is no anus hence the undigested particle also gets rejected through the mouth. The coelenterons of sea anemone is divided into pie shaped sections by muscular mesenteries, some of which attach both to the top (oral) and bottom (pedal) discs. There is no right or left side on a sea anemone-it has radial symmetry. The tentacles protect the anemone and catch food; they are studded with microscopic stinging cells (cnidocytes) or

cnidoblasts. They can have a range of 10 to hundreds of tentacles. A primitive system, without centralization and a true brain, allows mechanical reactions to any stimulation. Some anemones are tiny, but most vary in length from one to several inches (2.5-10cm); the genus *Stoichactis* in the Great Barrier Reef off the coast of Australia may reach 3 feet (90 cm) in diameter at the expanded oral end.

Feeding

Sea anemones are carnivorous and eat fish, mussels, zooplankton (like copepods other small crustaceans, tiny marine larvae) and worms. They catch food using the tentacles, which have poisonous stinging cells. They use nematocysts for capturing prey, as well as for defense purposes against predators and in interspecies aggression (Ayre, 1982; Norton, 1991). Each cnidoblast contains a small vesicle filled with toxins actinoporins, an inner filament and external sensitive hair. When the hair is touched, it mechanically triggers the cell explosion, the extrusion of the filament that injects a dose of poison in the flesh of the aggressor or prey. The poison is actually a mix of toxins including neurotoxins, which serve to paralyze and capture the prey (Liao *et al.*, 2001), which is then moved by the tentacles to the mouth for digestion inside the central cavity.

Predators

Predation on anemone is greatly reduced due to the relationship with the guest anemone fish, apart from that anemone sting deters potential predators. The anemones receive protection in the presence of anemone fish. It has been documented that in the absence of a Host/guest fish, the anemone maybe attacked by butterfly fish or even turtles (Marine Bio, 1998). Their predators include the grey sea slug and the Tompot Blenny.

Reproduction

The sexes are separate and both sexual and asexual reproduction may occur. In sexual reproduction males release sperm which stimulates females to release eggs, and fertilization occurs. The eggs or sperms are ejected through the mouth. The fertilized eggs develop into planula, which finally settles down

somewhere and grows into a single anemone (Holts and Beauchamp, 1993).

They can reproduce asexually by budding, binary fission and pedal laceration. Asexual reproduction involves pulling apart into two halves, or in some species, small pieces of the pedal disc break off and regenerate into a small anemone (Singer, 1971). Laceration is a process of fragmentation of the basal disk, or by pulling itself into two parts.

Mutualism

Many sea anemones form symbiosis with certain single celled green algal species which reside in the gastrodermal cells of the animal body. These algae may be either zooxanthellae, zoochlorellae or both (Baldauf and Muller Parker, 2003). The sea anemone benefits from the products of the algae's photosynthesis, namely oxygen and food in the form of glycerol, glucose and alanine; the algae in turn are assured a reliable exposure to sunlight, which the anemones actively maintain.

Some sea anemones form symbiotic relationship with crabs, shrimps and clown fish. Anemones will either attach or be attached to the shell of a hermit crab (by the crab's own volition), providing additional protection for the hermit crab (*Eupagurus*) and allowing the anemone to eat scraps when the crab feeds. Anemone-dwelling crab *Allopetrolisthes spinifrons* (Porcellanidae) prefers different types of sea anemones (Baeza and Stotz, 2003). A similar relationship can be formed between a sea anemone and clown fish. The clown fish benefits from this symbiotic relationship because it is protected by the anemone. In open waters these fish are more susceptible to predators and are poor swimmers. In addition, anemones provide protection for the nests (Fautin and Allen, 1992). The anemones are observed to generally do better with a host fish and may also benefit possibly from fish consumption of parasite and increased water circulation from fanning (Fautin and Allen, 1992). The anemone benefits because the anemone gets food scraps from the clown fish. Anemone fishes are protected from the sting of the anemone by their mucus. There is a period of acclimatization that must occur before the fish is immune to the anemone sting. This involves a process in which

the fish swims around the anemone rubbing its belly and ventral fins on the ends of the tentacles. Sea anemone secretes mucus to capture the prey and to escape from predator. It releases mucus which contains the neurotoxin that paralyzes the prey or predator (Fautin and Allen, 1992).

Dominant species

Aquarium shops sell the following species of sea anemones along with clown fishes: *Heteractis magnifera*, *H. aurora*, *H. crispa*, *H. magnifica*, *Stichodactyla mertensii*, *S. haddoni*, *Stoichactis giganteum*, *Entacmaea quadricolor*, *Anthopleura elegantissima*, *Actinia bermudensis* etc. In Indian waters very few species of sea anemone are dominant like *Heteractis magnifica*, *H. crispa*, *S. gigantea*, *Stichodactyla haddoni*, *S. mertensii* and *Entacmaea quadricolor*.

Conclusion

Coral reefs are beautiful gardens in the sea and sea anemones are the flower of coral reef. Due to their miraculous symbiotic relationship with several organisms, they attract the researchers towards themselves. They also act as indicators of the healthy aquatic environment. Sea anemones are beautiful and diverse organisms which populate the world's oceans from the tropics to the poles. Although sea anemones are among the simplest of animals, they possess one of the most complex structures in the animal kingdom: the nematocysts or stinging capsule. In many areas, overexploitation of anemones with colour fishes for the aquarium trade has been reported. This is posing a serious threat. Other threats include habitat degradation due to water pollution, storms, and dynamite fishing in coral reef systems.

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- Subodh Kant Setu and T.T. Ajith Kumar**
Centre of Advanced Study in Marine biology
Annamalai University
Parangipettai 608 502, India

OBITUARY

Prof. T. Kannupandi, Former Director & ENVIS In-charge expired on 14.11.2007. Editors and Staff of ENVIS convey their heartfelt condolences to the bereaved family members.



HOW DOES THE HORSESHOE CRAB PROTECT PUBLIC HEALTH?

Horseshoe crabs are among the world's oldest and most fascinating creatures. The earliest horseshoe crab species inhabited Earth at least 200 million years before the dinosaurs arrived or about 400 million years ago (Botton and Ropes, 1987). True crabs classified as decapod crustaceans, have five pairs of legs the first pair being chelate. But horseshoe crabs have seven pairs of legs under their helmet-like shells; five of these seven pairs of legs are equipped with claws.

The battle over this ecologically, economically, and medically important species has become one of the most debated environmental issues in the eastern hemisphere (India, Malaysia, Indonesia, Philippines, Japan and North America) in recent years. It was founded on the belief that developing effective management strategies requires an understanding of all three dimensions of the horseshoe crab issue: fisheries, shorebirds, and biomedical companies.

Importance of horseshoe crabs

Biomedical

Today horseshoe crabs are important to people for their use in medicine. For over fifty years scientists have used horseshoe crabs in eye research. Scientists can easily study large eyes and optic nerve (the nerve that sends signals from the eye to the brain) of the horseshoe crabs. Scientists have learned a great deal about how human eyes function from research on horseshoe crab eyes.

Horseshoe crabs find use in the biomedical industry for the production of *Limulus* Amebocyte Lysate (LAL). *Limulus* is the generic name of the horseshoe crab, amebocyte is the blood cell that contains the active components. LAL, a clotting factor in the horseshoe crab's blood, is invaluable to the biomedical industry. LAL enables the health-care industry to detect bacteria in human blood, to test the purity of clinical drugs, and to verify the purity of all prosthetics before implantation.

LAL is used for detecting the presence of endotoxins pathogenic to humans in pharmaceutical, medical, and dental products (Mikkelsen, 1988; Novitsky, 1991). The

horseshoe crab plays a vital role in the life of anyone who has received an injectable medication. An extract of the horseshoe crab's blood is used by the pharmaceutical and medical device manufacturing industries to ensure that their products, e.g. intravenous drugs, vaccines, and medical devices, are free of bacterial contamination.

Chitin

Chitin of horseshoe crab has received a lot of attention from scientists because it is nontoxic and biodegradable. Contact lenses, skin creams, and hair sprays can also be manufactured from chitin. Chitin can be used to remove lead and other harmful chemicals from wastewater. Chitin joins the fight against fat when added to foods. It has the ability to bind with fats and then pass them through the body without being absorbed. In addition, chitin from the crab's shell is incorporated into sutures and bandages to decrease the healing period for wounds

Chitosan

When chitin is processed, another substance, chitosan, is produced and it can be used as a raw material to manufacture a variety of important products. Chitosan uses include promoting the healing of ulcers and lesions; serving in antibacterial action; acting as an antacid; helping to control high blood pressure; and in treating and preventing irritable bowel syndrome. Besides absorbing fat to promote weight loss, chitosan also inhibits "bad" cholesterol uptake and boosts "good" cholesterol. Lastly, chitosan can be made into string used to suture surgical wounds and in wound dressings. People are less likely to experience an allergic reaction to the chitosan-based stitches, which dissolve slowly, and the dressings actually promote healing.

Bait

Studies have shown that a novel chemical cue in horseshoe crab eggs may mediate this predator-prey interaction. Originally suspected to be a compound ubiquitous in the tissue of horseshoe crabs, it is now known that the chemical attractant is concentrated within the horseshoe crab eggs. In laboratory assays, an extract prepared from horseshoe crab eggs was

to be more attractive than either muscle or reproductive tissue from adult horseshoe crabs.

Horseshoe crab harvest increased dramatically in the nineties. In 1996, 5,153,630 pounds of horseshoe crabs were landed compared to 908,130 pounds in 1990 (ASMFC, 1999). Increases in horseshoe crab harvest are due to stricter regulations on other traditionally harvested ground fish, increasing demand for whelk and American eel, and lack of regulations in the whelk and eel fisheries (Berkson and Shuster, 1999). These commercial fisheries are economically important to coastal communities, and the total value of the eel and whelk pot fisheries is estimated at approximately \$21 million per year (Manion *et al.*, 2000).

Mechanism of protection

One may wonder why the horseshoe crabs is sensitive to endotoxin and, furthermore, how does the crab benefit from this phenomenon? As we know, seawater is a virtual "bacterial soup". Typical near-shore areas that form the prime habitat of the horseshoe crab can easily contain over one billion Gram-negative bacteria per ml. of seawater (Novitsky, 1991).

Thus, the horseshoe crab is constantly threatened with infection. Unlike mammals, including humans, the horseshoe crab lacks an immune system; it cannot develop antibodies to fight infection. However, the horseshoe crab does contain a number of compounds that will bind to and inactivate bacteria, fungi, and viruses. The components of LAL are part of this primitive "immune" system. The components in LAL, for example, not only bind and inactivate bacterial endotoxin, but the clot formed as a result of activation by endotoxin provides wound control by preventing bleeding and forming a physical barrier against additional bacterial entry and infection. It is one of the marvels of evolution that the horseshoe crab uses endotoxin as a signal for wound occurrence and as an extremely effective defense against infection. The predominant blood cell type, the amebocyte, circulates in the horseshoe crab's copper-based hemolymph (Shuster, 1978). The horseshoe crab's immune reaction includes hemolymph coagulation, cell agglutination, antimicrobial action, and phagocytic action (Iwanaga, 2002). In the presence of endotoxin, the active component lipopolysaccharide (LPS)

triggers amebocytes to exocytose granules containing a coagulogen/protease system. Polymerization of the coagulogen results in the formation of a clot (Armstrong, 1985). It is this immune response of the horseshoe crab amebocytes that led to the first formulation of LAL, and the coagulation cascade is the basis of the LAL test produced by the biomedical industry.

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Ravichandran, S. and S. Sudha
Centre of Advanced Study in Marine Biology
Annamalai University
Parangipettai – 608 502, India
E-mail : sravicas@gmail.com

OCCURRENCE OF SUNFISH *MOLA MOLA* (LINNAEUS, 1758) IN PARANGIPETTAI WATERS (SOUTHEAST COAST OF INDIA)

Parangipettai is one of the minor fish landing centres of Tamil Nadu. Every day 40 to 50 small mechanized boats (32 footers) and 25 to 35 fiber catamaran land their catches here. On March 25th 2007, a large sunfish *Mola mola* belonging to the family Molidae was landed. It was caught by the drift gill net (Mothavala-large mesh gill net) from a depth range of 400 - 500 m. This gear is used by fishermen here to catch tunas, barracuda and seer fishes. This fish was caught by a fisherman whose age was 55. He has been catching fishes since 40 years (he started fishing at the age of 15). He has not seen this fish previously and was telling that for the first time in his long fishing career, he has netted this fish. In India seven species of sun fishes have been recorded (Table 1). The sunfish belongs to the order Tetraodontiformes which houses fishes having, four fused teeth that form the characteristic beak and give the order its name (tetra=four, odous=tooth, and forma=shape).

Body measurements of *M. mola* caught in Parangipettai waters are given below:

Total length	-	1180mm
Standard length	-	990mm
Body depth	-	720mm
Eye diameter horizontal	-	60mm
Eye diameter vertical	-	60mm
Length of pectoral fin	-	130mm
Length of dorsal fin	-	720mm
Length of anal fin	-	720mm
Total weight	-	50 Kg

Why it is called sunfish?

It is popularly called as sunfish in English. It is due to its habit of sunbathing at the surface of the water. In Portuguese, French and Spanish it is called as moon fish due to its rounded shape. In German it is called as swimming head because it has no true tail. Taiwanese call it as toppled car fish for its tendency to lie on its side while sunbathing. In Taiwan's Hualien Country, sunfish is featured as the official mascot.

Distribution of sunfish

The ocean sunfish is native to tropical and temperate waters around the globe.

Body shape

Sunfish has a remarkable shape. It is flattened laterally. The pectoral fins are small and fan shaped. However, the dorsal and anal fins are lengthier. The caudal fin of the sunfish has disappeared, to be replaced by a lumpy pseudo-tail, called the clavus. The sunfish lacks a swim bladder. It is as broad as it is long, when their dorsal and anal fins are extended. It appears as though the tail end has been amputated just behind the high dorsal and anal fins. Such a body is well adapted for a more or less passive drift in ocean currents and it has been suggested that its curious shape is associated with the peculiar diving habit of this fish. The ocean sunfish *M. mola* or common mola is the heaviest bony fish in the world, with an average weight of 1 ton.

Sunfish fry resemble miniature puffer fish, with large pectoral fins, a tail fin and body spines uncharacteristic of adult sunfish.



Sunfish *Mola mola* caught in Parangipettai waters

Swimming

Ocean sunfish often swim near the surface, and their protruding dorsal fins are sometimes mistaken for those of sharks. However the two can be easily distinguished. While the shark swims by keeping the dorsal fin moving in a straight line, the sunfish on the other hand swings its dorsal fin. Even though it is believed to be a pelagic fish, it spends a large portion of their lives submerged at depths up to 591 metres occupying both the epipelagic and mesopelagic zones.

Feeding

The diet of the sunfish consists primarily of various jellyfishes. As this diet is

Table 1. Details of sun fishes recorded in Indian waters from 1953 to 2007

Name of scientists	Year	Name of species	Place	Total length (mm)	Journal etc. where published	Remarks
Kulkarni, C.V.	1953	<i>Masturus lanceolatus</i>	Mumbai	925	J. Bombay nat. Hist. Soc., 51(4): 948-950.	First record of sun fish from Indian waters
Chacko and Mathew	1956	<i>Ranzania truncata</i>	Malabar coast near Bepore	610	J. Bombay nat. Hist. Soc., 53(4): 724-725.	First record of this species
Chapgar, B.F.	1964	<i>Ranzania truncata</i>	Sassoon Dock, Bombay city	571	J. Bombay nat. Hist. Soc., (2):453-456.	-
Pradhan, M.J.	1965	<i>Ranzania truncata</i>	Bombay waters	-	J. Bombay nat. Hist. Soc., 62(1): 163-164.	-
Mohamed Zafarkhan	1975	<i>Mola mola</i>	Off Satpati, Bombay	1240	Indian J. Fish., 22(1,2): 295-296.	First record of this species
Devaraj, M. et al.	1976	<i>Masturus oxyropterus</i>	Gulf of Mannar	880	J. mar. boil. Ass. India, 18 (3): 664-665.	First record of this species
Ebenezer, I.P. and J. Jerold Joel	1984	<i>Ranzania typus</i>	Kanyakumari	616	Indian J. Fish., 31(3): 360-361.	First record of this species
Arumugam G.	1994	<i>Masturus lanceolatus</i>	Off Tuticorin Gulf of Mannar	1535	Mar. Fish. Infor. Serv., T&E Ser., No. 128.	Largest sun fish landed in India
Chellappa, M. et al.	2005	<i>Mola mola</i>	Off Tuticorin Gulf of Mannar	-	Mar.Fish. Infor. Serv., T&E Ser. No. 188.	First Record of this species
Sandhya Sukumaran et al.	2006	<i>Ranzania laevis</i>	Rameswaram	620	Mar.Fish. Infor. Serv., T&E Ser., No. 187.	
Mohan, S. et al.	2006	<i>Mola ramsayi</i>	Chennai	835	Mar.Fish. Infor. Serv., T&E Ser., No. 189.	New record from Indian waters
Present record Murugan, S. et al.	2007	<i>Mola mola</i>	Parangipettai	1180	Seshaiyana, 15(2).	First record in Parangipettai waters

nutritionally poor, they consume large amounts of other organisms also like salps, comb jellies, zooplankton, squids, crustaceans, small fishes, fish larvae and eel grass to develop and maintain their large body. So it feeds from the surface to deep water, and occasionally down to the seafloor in some areas.

Reproduction

Females of this species can produce more eggs (more fecund-300 million eggs) than other known vertebrates. The breeding behaviour is largely unknown.

Life span

Ocean sunfish may live up to ten years in captivity. Longevity in the wild is not known.

Interaction with Man

Despite its size, sunfish is a docile, largely a sluggish and stupid fish and pose no threat to human divers.

Exploitation

The fin is tough and leathery. Underlying the skin is a layer of hard gristly material some two or three inches thick-ample compensation for any loss of power. Despite its large size, the yield of edible is low, roughly 20% of the body

weight because of the large cartilaginous skeleton. The flesh of the ocean sunfish is considered a delicacy in some regions, the largest markets being Taiwan and Japan. All parts of the sunfish are used in cuisine and some parts of the fish are used in traditional medicine. In other parts of the world, the sun fish is accidentally but frequently caught in drift gillnet fisheries. It is making up nearly 30% of the total catch of the swordfish fishery in California. The by-catch rate is even higher for the Mediterranean swordfish industry, with a 71% to 90% of total catch.

Aquaria having sunfish

Some Asian aquaria display sunfish particularly in Japan. The Kaiyukan aquarium in Osaka, Japan is one of few aquaria with sunfish on display, where it is reportedly as popular an

attraction as the larger whale shark. The Lisbon Oceanarium in Portugal is another aquarium where sunfish is showcased in the main tank.

Conclusion

Sunfish is an interesting fish. However they are caught very rarely in India. It may be due to fewer numbers in the waters despite the fact they are the most fecund animals among fishes. Information on their distribution, abundance and population dynamics will go a long way in the protection of this very interesting and important fish. Such studies have to be initiated.

S. Murugan, P.S. Lyla and S. Ajmal Khan

Centre of Advanced Study in Marine Biology
Annamalai University
Parangipettai - 608 502, India

COMPUTATIONAL TOOLS AND THEIR APPLICATION IN MARINE BIOACTIVE COMPOUNDS

Research activity in the field of marine toxins or bioactive substances in marine organisms has increased rapidly in recent years leading to the development of new biochemical resources which prevent food poisoning thereby takes care of human welfare. In the marine environment, there is highest structural diversity of bioactive pigments which differ from one another in functional aspects, distribution and structural diversity.

Computational biology provides an integrative methodology for identifying and characterizing pathways that are critical to the study of changes involved in cancer, discovering new targets within the context of biological networks and assessing both on and off target effects of therapies. Network biology, a distinct research area within systems biology, addresses the aspect of topology and seeks to identify organizational rules underlying large scale topologies of cell networks that can provide insights in to pathway and network function. For example, protein networks contain highly connected hub-proteins that have been shown to correlate with evolutionarily conserved proteins and in yeast it is encoded by essential genes. Another challenge is to understand how representations of signaling networks can be expanded to include other regulatory networks eg. metabolic, gene expression and cytoskeletal networks and how cell signaling networks can be

integrated into larger networks of interacting cells, tissues and physiological systems.

Protein structure prediction

A protein sequence is a linear heteropolymer, meaning simply that it is an unbranched chain of molecules with each "link" in the chain made up by one of the twenty amino acids. Proteins perform the vast majority of the biochemical reactions required by living organisms (playing various catalytic, structural, regulatory, and signaling roles required for cellular development, differentiation, replication, and survival). To understand protein function at the molecular level, it is important to study the structure adopted by a particular sequence. In particular, serious difficulties present themselves when one attempts to predict the folded structure of a given protein sequence. Efforts are on to use computational methods for predicting protein structure based only on sequence information (Nagano, 1973). To analyse primary structure Compute pI/ MW can be used.

The main types of secondary structures that are examined for sequence variation are α helices, β - strands and coils (Chou and Fasman, 1974).

Widely used methods for protein secondary structure prediction are (I) Chou-

Fasman Method, (II) GOR Method and (III) SOPMA- <http://pdil.ibcp.fr/>

One of the important advances in 3D prediction in recent years has been the development of mean force potentials. Before this structure prediction was done with 'physical' potentials, i.e., bonds, angles, torsion angles and vanderwaals as well as electrostatic non-bonded terms which describe the internal energy of the molecule. The tool used for tertiary structure prediction is : Swiss-Pdb viewer <http://www.expasy.ch/spdbv/mainpage.html>

Comparative modelling

This is commonly referred to as homology modeling. It is useful when a 3D structure of a sequence that shares substantial similarity to the protein sequence of interest is available. The two sequences are aligned to identify segments that share sequence similarity. The multiple sequence alignment tool used is: Clustal W- <http://www.ebi.ac.uk/Tools/clustalw/index.html>

Microarray

Gene expression, defined by steady state levels of cellular mRNA, has emerged as the first aspect of gene function amenable to genome scale measurement with readily available technology. It is now possible to carryout massively parallel analysis of gene expression on tens of thousands of genes from a given sample (<http://cmgm.stanford.edu/pbrown/:brownlab>).

Docking

It is used to predict the binding orientation between a small molecule and drug candidates, in order to predict the affinity and activity of the small molecule. Hence docking plays an important role in the rational design of drugs (Kitchen *et al.*, 2004). Given the biological and pharmaceutical significance of molecular docking, considerable efforts have been directed towards improving the methods used to predict docking. Important docking tools have been given below:

- Autodock-<http://www.scripps.edu/mb/olson/doc/autodock/>
- Dock - <http://dock.compbio.ucsf.edu/>
- Hex - <http://www.csd.abdn.ac.uk/hex/>

Drug discovery

In drug development, QSAR (Quantitative structure activity relationship) can be used to

determine how the structural features of a molecule are related to biological activity. Structure based drug design or structure based virtual screening usually involves explicit molecular docking of molecules in to the binding sites of targets (or receptors). It predicts a binding mode of the compounds and measures, or rather "scores", the quality of the intermolecular interactions.

A pipeline of computational analysis can be envisaged that starts from dynamic modeling of cellular behaviours based on detailed map of molecular interactions and other types of analysis to identify regions of the parameter space that control cell behaviour in a specific manner. Such analyses shall be done for models of tumor cells and normal cells so that the selectivity of drugs can be examined. When promising sets of perturbations are identified, a possible list of lead compounds shall be used to select specific perturbations that can be introduced by the available drugs. Although the ideas presented on how computational analysis of system-level dynamics can be used for drug discovery are still speculative, it is already clear that this is going to be a major enterprise that requires the integration of various aspects of system biology and drug discovery, as well as a new way of looking at the discovery of drugs from marine bioactive compounds for various diseases.

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**D. Rajamani Karthikeyan,
S.T. Somasundaram, P. Anantharaman
and T. Balasubramanian**
Centre of Advanced Study in Marine Biology
Annamalai University
Parangipettai – 608 502, India

RECENT NEWS IN BRIEF

"Extinct" river dolphin spotted in China

A confirmed sighting of a baiji dolphin just months after it was declared "extinct" has prompted scientists to launch an against-all-odds plan to save the last of the rare Chinese river dwellers. A team of marine-life scholars led by Wang Ding, a scientist at China's Institute of Hydrobiology, examined digital video footage recently taken along the eastern section of the Yangtze River. The video provides evidence of the survival of the baiji, or whitefin dolphin, the team confirmed. For more information log on <http://news.nationalgeographic.com/news/2007/08/070831-baiji-dolphin.html>

Bangladesh : wildlife conservation need of the hour

Ex-situ conservation is the conservation of biodiversity away from its natural habitat. Viable populations of many organisms can be maintained in cultivation or in captivity. Plants may also be maintained in seed banks and germplasm collections; similar techniques are under development for animals (storage of embryos, eggs, sperm) but are more problematic. The maintenance of biological diversity at all levels is fundamentally the maintenance of viable populations of species or identifiable populations. This can be carried out either on site or off site. The maintenance of wildlife diversity on site may be designated as conservation of wildlife diversity in-situ. The maintenance of a significant population of the world's biological diversity at present only appears feasible by maintaining organisms in their wild state and within their existing range. The term wildlife covers all living organisms ranging from microbes to higher animals (microbes, plants and animals) and the term conservation of wildlife is synonymously used with the conservation of biodiversity.

Conservation is imperative : In Bangladesh, wildlife may be put under 'double sided' characters. One side is the 'species richness'; another side, the population size of the existing species is very small almost in all cases. This characteristic bears hopefulness in the way that if the species richness is preserved immediately then the biodiversity could be used both for the economic benefit and environmental soundness. But the low population size per species is risky for the species to be extinct as maximum species are at the stage of seriously "threatened" status. This is the negative side of the double sided characteristics. For more information log on <http://www.thedailystar.net/2007/08/03/d708031801124.htm>

A warming climate can support glacial ice

New research challenges the generally accepted belief that substantial ice sheets could not have existed on Earth during past super-warm climate events. The study by researchers at Scripps Institution of Oceanography at UC San Diego provides strong evidence that a glacial ice cap, about half the size of the modern day glacial ice sheet, existed 91 million years ago during a period of intense global warming. This study offers valuable insight into current day climate conditions and the environmental mechanisms for global sea level rise. The new study in the Jan. 11 issue of the journal *Science* titled, "Isotopic Evidence for Glaciation during the Cretaceous Supergreenhouse," examines geochemical and sea level data retrieved from marine microfossils deposited on the ocean floor 91 million years ago during the Cretaceous Thermal Maximum. This extreme warming event in Earth's

history raised tropical ocean temperatures to 35-37°C (95-98.6°F), about 10°C (18°F) warmer than today, thus creating an intense greenhouse climate.

The presence or absence of sea ice has major environmental implications, specifically in terms of sea level rise and global circulation patterns. As humans continue to add large amounts of carbon dioxide and other greenhouse gases that accelerate the heating of the atmosphere and oceans, research on Earth's past climate conditions is critical to predict what will happen as Earth's climate continues to warm. For more information log on http://www.aquanet.com/index.php?option=com_content&task=view&id=1682&Itemid=2

“Super suckers” slurp invasive algae off reefs

In the battle against an exotic seaweed, biologists are employing a rather unusual solution: underwater vacuum cleaners. The cleaners-called Super Suckers-suck up tons of gorilla ogo, invasive algae that are killing coral reefs, sea grass beds, and fouling beaches in Hawaii. At a recent scientific conference in Japan, biologists announced the arrival of “Super Sucker Junior,” a smaller and more versatile unit that can operate in shallower waters and be easily transported between islands.

Sucking it up : Each Super Sucker consists of a powerful pump and a tube for suctioning algae from beneath the ocean surface to the deck of a barge. Divers in the water operate the 100-foot-long (30-meter-long) suction hose, feeding in gobs of algae by hand after first shaking loose any marine organisms that may be attached. “They literally suck the algae off the reef,” Hauk said. Workers on the barge further screen the collected algae for any accidentally collected marine life. The nutrient-rich algae are then packed into bags for use as fertilizer. The Super Suckers can remove up to 800 pounds of algae per hour and restore hundreds of square feet of reef in a day, Hauk said. “When you pull the algae off, there is often live coral underneath that is fighting to survive,” Hauk said. “You feel like you are saving the reef one [coral] colony at a time.” The Super Sucker project is a joint effort by The Nature Conservancy, the University of Hawaii, and the state's Department of Land and Natural Resources. For more information log on <http://news.nationalgeographic.com/news/2007/07/070730-super-sucker.html>.

Alien competitors : In Hawaii and elsewhere, scientists have noticed high-diversity coral communities shifting to algae-dominated reefs with greatly reduced species diversity. The problem posed by gorilla ogo and other invasive algae in Hawaii has been growing in magnitude for a number of years, experts say, and now has become dire. “The algal invasion poses the largest current threat to the health of reefs in Hawaii,” said Cynthia Hunter, a marine biologist at the University of Hawaii. Thick coatings of algae can kill corals by blocking them from sunlight and flows of fresh seawater. Some species have been particularly affected, Hunter said, including a species of rice coral that is now rapidly disappearing. Algae also fill in the cracks and crevices that make coral reefs a safe haven for fish and other forms of marine life. Even larger animals such as sea turtles may be excluded from their normal resting areas. “Removing the algae recreates the three-dimensional nature of the coral reef, and recreates homes used by all types of fish and invertebrates,” said Brian Hauk, a director of the Super Sucker project with Hawaii's Department of Land and Natural Resources. Gorilla ogo is just one of five exotic algae that now threaten Hawaii's reefs. Only one of the invaders arrived by accident-probably on the hull of a ship.

INFORMATION, NEWS AND NOTES



UPCOMING RESEARCH MEETS

- ✉ 16 - 30 May, 2008. Sixth All India Summer Research Training Programme on Molecular Techniques. Contact: Dr. A. Mohankumar, School of Biological Sciences, Sengunthur Arts and Science College (Campus), Tiruchengode - 637 205. Mobile : (0) 98427-91195; E-mail: moniver@satyam.net.in
- ✉ 19 - 21 May, 2008. Seventh International Conference on Environmental Problems in Coastal Regions including Oil and Chemical Spill Studies – Coastal Environment 2008. Contact: Jenna Solanki, Conference Secretariat Coastal Environment 2008, Wessex Institute of Technology, Ashurst Lodge, Ashurst, Southampton, SO40 7AA. Phone: 44 (0) 238 029 3223; Fax: 44 (0) 238 029 2853; E-mail: jsolanki@wessex.ac.uk; <http://www.wessex.ac.uk/conferences/2008/coast08/index.html>
- ✉ 22-27 June, 2008. Environmental Sciences : Water, Holderness School, Holderness, NH. Contact: <http://www.grc.org/programs.aspx?year=2008&program=envsci>
- ✉ 25-29 August, 2008. Fourth International Symposium on GIS/Spatial Analyses in Fishery and Aquatic Sciences, Rio de Janeiro, Brazil. Contact: <http://www.esl.co.jp/Sympo/4th/index.htm>
- ✉ 11-15 October, 2008. 4th National Conference on Coastal and Estuarine Habitat Restoration, Rhode Island, USA. Contact: E-mail: conference@estuaries.org; Website : <http://www.estuaries.org/?id=138>.
- ✉ 22-24 October, 2008. 4th Congress of the Mexican Limnological Society. Contact: E-mail: congreso_limnologia2008@yahoo.com.mx; Website: http://www.uv.mx/citro/congreso_limnologia2008
- ✉ 1-5 December 2008. 4th International Symposium on Deepsea Corals, Victoria University of Wellington, New Zealand. Contact: <http://coral2008.niwa.co.nz/>
- ✉ 20 - 24 May, 2009. 2nd International Marine Conservation Congress, Washington, DC, UCA. Contact: E-mail: John.Cigliano@cedarcrest.edu; IMCC2009@conbio.org; Website: <http://wwwz.cedarcrest.edu>.

Over the years, the ENVIS Centre has brought out several publications on coastal environment. These publications are highly commended by the scientists, policy makers and planners of various prestigious institutions and agencies. These are found to be highly useful to the researchers in the field of Marine Science, helping them to get an update of the research findings from the Indian coasts.

Considering the overwhelming demand from the researchers and students for these publications and our inability to send them free of charges, the Centre has fixed a nominal price for ENVIS publications. Users interested can write to the following address to receive the publications.

The In-charge, ENVIS Centre
Centre of Advanced Study in Marine Biology
Parangipettai - 608 502
Tamil Nadu, India
E-mail: cdl_aucasmb@sancharnet.in; casmb@envis.nic.in

ENVIS PUBLICATIONS

Booklet on Coral Reefs

Coral reefs are distinct and unique habitats found mostly in clear shallow waters in the warmest part of the world. The majority of coral reefs are found within tropical and sub-tropical countries. In some developing countries, food from reefs provides about 25 per cent of the total food supply and 60 per cent of the total protein intake. In India, the reefs are distributed along the east and west coasts at restricted places. There are 4 major coral reef areas here namely Andaman and Nicobar Islands, Gulf of Mannar, Lakshadweep Islands and the Gulf of Kachchh. The total area of coral reefs in India is estimated to be 2273.8 sq km. Coral reefs stabilize the shoreline changes, save people living in the coastal areas from natural calamities, and prevent soil erosion. Reef sponges have been used for producing antiviral drugs to treat HIV and herpes. Chemicals from multiple reef species may be able to help fight cancer. This booklet written in a simple manner enables people in common walks of life and students to learn about the importance of coral reef ecosystem and to understand how healthy coral reefs are valuable to the people, plants, and animals that depend on them.

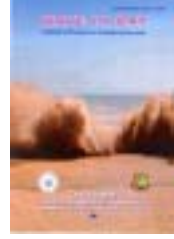
Pages: 54, Rs.25/-



Wave in Bay (Impact of Tsunami on Coastal Resources)

The earthquake, measuring 9.3 on Richter scale, that occurred on 26th December 2004 with its epicenter at Banda Aceh, Sumatra, Indonesia caused a huge tsunami that claimed nearly 2.5 lakhs human lives and displaced millions of people in 13 southeast Asian countries. The word 'Tsunami' has now become part of the common parlance. Considering the impact of tsunami on the coastal environment, the ENVIS Centre at the Centre of Advanced Study in Marine Biology, Annamalai University has brought out this publication. It gives information on the impact of tsunami on the coast and their resources.

Pages: 129, Rs.150/-



பவளப்பாறைகள்

பவளப்பாறைகள் தன்னகத்தே பல்வேறு விலங்குகளையும், தாவரங்களையும் உள்ளடக்கிய விந்தையான இயற்கை செழிப்பு மிக்க, உற்பத்திதிறன் மிகுந்த சூழலாக திகழ்கிறது. இயற்கை பேரழிவுகளான புயல், சூறாவளி, ஆழிப்பேரலை மற்றும் மண் அரிமானம் போன்றவைகளிலிருந்து கடற்கரையை பாதுகாக்கிறது. மேலும் பல லட்சம் மக்கள் பவளப்பாறைகளின் ஆதாரங்களை நம்பி வாழ்கின்றனர். அதுமட்டுமல்லாமல் பவளப்பாறைகளில் வாழும் தாவரங்கள் மற்றும் விலங்கினங்களிலிருந்து பெறப்படும் வேதிப்பொருட்கள் பல்வேறுவகையான நோய்களுக்கு மருந்து தயாரிக்கப் பயன்படுகிறது. வண்ணமயமான உயிரிகளை கொண்ட இச்சூழல் சுற்றுலாப்பயணிகளை அதிகம் கவர்ந்திழுக்கும் இடமாகவும், நீர்விளையாட்டுகளுக்கு ஏற்ற இடமாகவும் விளங்குகிறது. இந்நூல் பவளப்பாறைகளின் வகைகள், பயன்கள், அவற்றிற்கு ஏற்படும் தீங்குகள் மற்றும் பாதுகாப்பு முறைகள் பற்றி பொதுமக்களிடமும், மீனவர்களிடமும் விழிப்புணர்வை ஏற்படுத்த எழுதப்பட்டுள்ளது. ஆகவே இக்கருத்துக்களை கவனத்தில் கொண்டு இம்மையம் ஒரு கையேட்டினை வெளியிட்டுள்ளது. இக்கையேடு அனைத்து மக்களும், மாணவச் சமுதாயமும் எளிதில் புரிந்துகொள்ளும் வகையில் வடிவமைக்கப்பட்டுள்ளது.

Pages: 52, Rs.25/-

