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Mangrove Ecosystems

International Training Course on Mangrove Biodiversity and Ecosystems

Centre of Advanced Studies in Marine Biology
Annamalai University, India

BACKGROUND: Coastal ecosystems (e.g., coral reefs, mangroves, and wetlands) are some of the world's richest storehouses of biological diversity and primary productivity. It is estimated that about half the world's coastal ecosystems face a significant risk of degradation from human activities, those in South and Southeast Asian perhaps among the most threatened.

This course focuses on mangrove ecosystems with particular emphasis on the methodology for assessing, monitoring and conserving biodiversity. It is taught by a multidisciplinary team of lecturers and through hands-on involvement of the participants.

COURSE SYLLABUS

OBJECTIVES: Primarily to build the capacity of professionals and institutions in developing countries to undertake monitoring, research and conservation of critical ecosystems within mangrove forests. This is achieved through training of young professionals in the scientific methodology and description of latest research work on related subjects. A secondary objective is to promote and encourage development of a network of professionals from developing countries working in this field.

The course has also been developed as an open course ware as part of an open learning initiative with UNU, Tokyo and is available at: http://ocw.unu.edu/

Further information can be found in a background Paper *Training and Capacity Building for Managing Our Mangroves Resources - UNU's Role to Meet Regional Challenges* (pdf 23.1KB).

To apply for the course please complete the ***Application Form*** and email OR send scanned copies to:

Dr. K. Kathiresan
Professor, CAS in Marine Biology
Annamalai University, Parangipettai
608 502, Tamil Nadu, India
Telephone: 91-4144-43223(Off), 238419 (Res.)
Mobile: 91 - 9442068003
E-mail: kathirsum@rediffmail.com; kathiresan57@gmail.com

FELLOWSHIPS: A limited number of fellowships are available to qualified **candidates from developing countries only**. These **fellowships will be granted on a competitive basis** and will cover the entire expenses of the workshop, including economy excursion airfares via the most direct route for candidates from outside India. Candidates from India will be reimbursed for train tickets via the most direct route. In order to apply for a fellowship, please complete the section called 'Justification for UNU Fellowship'.

PARTNERS:

UNESCO SACEP

Last updated: November 2011

INTERNATIONAL TRAINING COURSE ON

'MANGROVE BIODIVERSITY AND ECOSYSTEMS'

Course Report

October 05 - 19, 2011

T. Balasubramanian
Co-ordinator

K. Kathiresan
S. Ajmal Khan
Organisers

Sponsored by

United Nations University-
Institute for Water, Environment & Health
Canada

South Asia Co-operative
Environment Programme
Sri Lanka

Organised by

Annamalai University
Faculty of Marine Sciences
Centre of Advanced Study
in Marine Biology
Tamil Nadu, India

CONTENTS

I. INTRODUCTION
1. Rationale of course
2. Objectives of course
3. About the present course
4. Genesis and development of course

II. PRE-TRAINING COURSE ACTIVITIES
1. Initiation of 11th course
2. Selection of participants
3. Arrival of participants
4. Preparation of course manual

III. TRAINING COURSE ACTIVITIES
1. Inaugural function
2. Proceeding of course
3. Valedictory function
4. Rotary function
5. Leaving of participants

IV. SALIENT FEATURES OF COURSE

ANNEXURE I
An Institutional Contractual Agreement

ANNEXURE II
Course announcement at website

ANNEXURE III
List of selected candidates

ANNEXURE IV

Invitation for Inaugural function

ANNEXURE V

Registration form for participants

ANNEXURE VI

Schedule of training course

ANNEXURE VII

A list of rapporteurs

ANNEXURE VIII

Daily report by participants

ANNEXURE IX

Invitation for Valedictory function

ANNEXURE X

Invitation for Rotary function

ANNEXURE XI

Data sheets for field studies prepared by participants

1. INTRODUCTION

1. Rationale of course

Mangroves are among the world's most productive ecosystems of great ecological and economic significance. They continue to disappear leading to loss of biodiversity and fishery productivity. Hence, there is an imperative need to protect, conserve and develop the mangrove ecosystems and their biodiversity, especially in South and Southeast Asian countries. These regions are in shortage of trained manpower to manage the coastal resources. Bearing this in mind, UNU-INWEH-UNESCO initiated a training programme on "Biodiversity in Mangrove Ecosystems" by the year 2000.

2. Objectives of course

The objective of the training course is to build the capacity of professionals and institutions to undertake monitoring, research and management of mangrove ecosystems, in developing Asian countries such as China, Bangladesh, Sri Lanka, Philippines, Vietnam, Indonesia, India etc. This is achieved through training of young professionals in research methodology and latest trends in research on the conservation of biodiversity in mangrove ecosystem. A secondary objective set for the training is to promote and encourage development of network of professionals from developing countries, working in mangrove ecosystems. It is expected that the trained people will disseminate their knowledge to other respective institutions and countries (Zafer Adeel, 2003).

3. About the present course

This course was held successfully for the Eleventh time during October 05-19, 2011 for 15 days at the Centre of Advanced Study in Marine Biology, Annamalai University, India with the financial assistance of United Nations University (UNU) Institute for

Water, Environment & Health, Canada (INWEH) and South Asia Co-operative Environment Programme (SACEP).

The training course was comprised of lectures and demonstrations, as well as group discussions. The technical sessions covered various aspects of mangrove ecosystems. The participants were made in involve themselves in the workshop by following two approaches : (1) by presenting a status report of the mangroves in their respective countries / regions and / or related topics; and (2) by conducting the proceedings, recording the minutes and submitting the reports by the participation arranged to teach taxonomy, and management strategies.

Dr. K. Kathiresan and S. Ajmal Khan, Professors of the Centre have made all the arrangements of the training course and Dr. T. Balasubramanian, Dean and Professor of the Centre co-ordinated the programme with the help of faculty members of the course.

4. Genesis and development of the course

The training course was first endorsed at the UNU workshop in Okinawa during the year 2000. A preliminary workshop at Annamalai University was conducted in March 2000. A memorandum of understanding was signed by UNU, UNESCO and Annamalai University in August 2000, and all Contractual Agreement was signed later in November 2001. All the efforts for signing these contracts were made by Dr. Zafer Adeel of UNU, Dr. Miguel Clusener-Godt of UNESCO and Dr. AN. Subramanian of Annamalai University. After signing the contracts, the first training course was held during March 5-19, 2001 and the second one during February 4-18, 2002.

The course was evaluated in Tokyo during 9th July 2002 by a panel of mangrove experts who appreciated the initiative and its impact. A number of improvements in the course design and implementation have also resulted de to this evaluation (Zafer

Adeel, 2003). This meeting inducted Prof. K. Kathiresan, as one of the organizers of the training course, based on his expertise in the subject of the training course. As suggested in the meeting Prof. K. Kathiresan thoroughly changed the syllabus of the course towards the management aspects of biodiversity conservation in mangrove ecosystems. With this revised syllabus, the third training course was organized during March 10-24, 2003, the fourth training course during May 31-June 14, 2004, the fifth course during June 14-28, 2005, the sixth training course during June 1-15, 2005, the seventh one during November 12-26, 2007, eighth one during November 3-17, 2008, and the ninth one during November 2-16, 2009, tenth one during October 1-15, 2010. The present – Eleventh training programme was held from October 5-19, 2011.

A second review meeting for the International course on successfully conducted at Nagaoya, Japan on 17th October 2010 for the purposes: (i) to review the achievements of Annamalai University in covering the International Mangrove Biodiversity course, (ii) to suggest ways for improving the focus and implementation of the course, (iii) to consider expansion of the curriculum, (iv) to explore possible new venue(s) for delivering the course, (v) to discuss possible partnerships, and (vi) funding options for the future. Prior to this external review, and internal review was conducted on site from 10 to 15 October 2010 by Ms. Hanneke Van Lavieren UNU-INWEH at Annamalai University, India.

An Agreement of Cooperation was signed among the United Nations University (UNU), Institute for Water, Environment & Health (INWEH) and the Annamalai University (copy of the documents enclosed – **Annexure I**).

II. PRE – TRAINING COURSE ACTIVITIES

1. Initiation of the 11th course

The Eleventh course was initiated with the announcement for the submission of applications given in the UNU website during May 2011 (Annexure II). The interested applicants submitted their applications to Dr. K. Kathiresan, Organiser of the training course, as directed in the advertisement. The last date stipulated for the submission was August 5, 2011.

2. Selection of participants

Dr. K. Kathiresan, compiled the applications received within the deadline, and prepared a list of applicants. He further discussed with Dr. S. Ajmal Khan and Dr. T. Balasubramanian and short-listed the eligible candidates based on their qualifications, age, experience in the field of mangroves, and research publications. The short list along with soft copies of 72 applications was sent to Ms. Hanneke Van Lavieren, UNU-INWEH, Canada for necessary action.

The selection committee constituted a review panel in Canada. The panel reviewed the documents of applicants for their educational qualification and background, relevant research and teaching experience, capability to train others in academic or community settings, and gender and geographic balance. The following candidates were approved by the Panel because they met the selection criteria:

1. Ms. Swati Sappal (INDIA)
2. Dr. T. Ganesh (INDIA)
3. Mr. Mali Mukeshkumar (INDIA)

4. Dr. C. Ravinder Singh (INDIA)
5. Mr. P. Ragavan (INDIA)
6. Mr. Agus Ariyanto (INDONESIA)
7. Mr. Minh Nguyen Van (VIETNAM)
8. Mrs. Khodeeyoe Pornchai (THAILAND)
9. Ms. Kanchana Peeris (SRI LANKA)
10. Ms. Eni Hidayati (INDONESIA)
11. Dr. Zannatul Ferdoushi (BANGLADESH)
12. Md. Masud Rana (BANGLADESH)
13. Mrs. Supe Gerlyn (PHILIPPINES)
14. Mr. Shahzad Sadiq (PAKISTAN)
15. Ms. Wong Yun Yun (MALAYSIA)
16. Md. Mahbubul Hassan (BANGLADESH)*
17. Mrs. Prapapron Whaiprib (THAILAND)*
18. Dr. Liao Yan (CHINA)

* if budget permitting

All the selected candidates were informed of their selection with fellowship. However, Ms. Wong Yun Yun (MALAYSIA), Mr. Shahzad Sadiq (PAKISTAN), Mrs. Supe Gerlyn (PHILIPPINES), Dr. Liao Yan (CHINA), Md. Mahbubul Hassan (BANGLADESH) and Mrs. Prapapron Whaiprib (THAILAND) could not participate in the programme due to the non-availability of Visa. Mr. Bipinkumar Khokhariya of Gujarat Forest Department was included under recommendation of the Ministry of Environment & Forests (Govt. of India), with intimation to Ms. Hanneke van Lavieren. Thus 13 selected candidates were able to participate in the course (List of Participants: **Annexure III**).

3. Arrival of participants

Pre-paid ticket advices were sent to all the selected foreign participants, and the Indian participants were asked to make their own arrangements for travel by train and to reimburse the cost upon arrival.

Seven foreign participants arrived in the Chennai Airport. They were picked up at the airport by teacher volunteers of Centre of Advanced Study in Marine Biology. All of them were transported to Chidambaram by taxis. They were then provided with accommodation at the University Guest House at Annamalai Nagar in Chidambaram.

4. Preparation of course manual

A great effort was made to prepare the course manual, comprising of information related to the syllabus content in the following titles:

No.	Title	Author
	Why This Course?	Zafar Adeel
	Why This Centre?	T. Balasubramanian
1	**Introduction**	
	Marine Environment	AN. Subramanian
	Waves and Tides	M. Natarajan, K. Mohan & T. Balasubramanian
	Understanding Biodiversity	L. Kannan
2	**Diversity Assessment Methods**	
	Biodiversity Values	S. Ajmal Khan
	Methodology for Assessment of Biodiversity	S. Ajmal Khan
	Pre- treatment of Data for Biodiversity	S. Ajmal Khan

	Assessment	
	Assessment of Marine Ecosystem Health	S. Ajmal Khan & P.S. Lyla
	IUCN Conservation Status Assessment	K. Kathiresan
	The Barcode of Life Initiative	Dirk Steinke, S. Ajmal Khan & S. Rajagopal
	Molecular Tools for Assessing Genetic Diversity	S.T. Somasundaram & M. Kalaiselvam
	DNA Markers for Understanding Mangrove Genetics	M. Thangaraj, S. Kavitha, Ashish Kumar Banoda & K. Kathiresan
	Genetic Diversity in Mangrove Animals – Case Studies	S. Ajmal Khan, A.R. Nazar & P.S. Lyla
3	**Mangrove Ecosystems**	
3.1	Distribution of Mangrove Ecosystems	K. Kathiresan
3.2	Ecology and Environment of Mangrove Ecosystems	K. Kathiresan
3.3.	Biology of Mangroves	K. Kathiresan
3.4.	Methods of Studying Mangroves	K. Kathiresan
3.5.	Importance of Mangrove Ecosystem	K. Kathiresan
3.6.	Bioprospecting Potential of Marine Invertebrates	M. Arumugam & T. Balasubramanian
4.	**Biodiversity in Mangrove Ecosystems**	
4.1.	**Floral Diversity**	
	Marine Viral Diversity	M.A. Badhul Haq & K. Kathiresan
	Bacteria and Fungi	A. Purushothaman & S. Jayalakshmi
	Actinomycetes	K. Sivakumar
	Phytoplankton	P. Sampathkumar & G. Ananthan
	Seaweeds	P. Anantharaman & L. Kannan
	Seagrasses	L. Kannan & T. Thangaradjou

	Mangroves	K. Kathiresan & N. Rajendran
	Salt Marsh and Other Coastal Flora	K. Kathiresan & T. Ramanathan
4.2.	**Faunal Diversity**	
	Zooplankton	P. Perumal & M. Rajkumar
	Nematodes	M.A. Sultan Ali & S. Ajmal Khan
	Polychaetes	P. Murugesan & S. Ajmal Khan
	Amphipods	P.S. Lyla & S. Ajmal Khan
	Biodiversity of brackishwater amphipods (crustacean) in two estuaries, southeast coast of India: Case study	P.S. Lyla & S. Ajmal Khan
	Prawns and Shrimps	P. Soundarapandian & N. Rajendran
	Brachyuran Crabs	S. Ajmal Khan & S. Ravichandran
	Brachyuran crabs in mangroves : a case study	S. Ajmal Khan, S.M. Raffi & P.S. Lyla
	Insects	K. Balasubrahmanyan, M. Srinivasan & K. Kathiresan
	Molluscs	A. Shanmugam & S. Rajagopal
	Molluscs in Mangroves : a Case Study	A. Shanmugam & S. Vairamani
	Fin Fish	V. Ramaiyan & M. Kalaiselvam
	Mudskippers	V. Ravi & S. Rajagopal
	Ornamental Fish	K. Raja, T.T. Ajithkumar & T. Balasubramanian
	Parasitic Fauna of Fishes	N. Veerappan & A. Selvamathi
	Wood-borers	L.N. Santhakumaran
	Reptiles	M. Srinivasan & S. Bragadeeswaran

	Birds	AN. Subramanian, A. Sethuraman & K. Sampath
	Mammals	AN. Subramanian, A. Sethuraman & S. Murugan
	Bycatch Resource	S.M. Raffi
5.	**Threats to Mangroves**	
	Degradation and Destruction of Mangroves	K. Kathiresan
	Water Quality	T. Balasubramanian & S. Vijayalakshmi
	Persistent Chemicals	AN. Subramanian
6.	**Policy and Sustainable Management of Mangroves**	
6.1.	**Conservation and Management Strategies**	
	Restoration Technologies	K. Kathiresan
	People's Participation	K. Kathiresan
	Alternate Livelihood : a Case Study	A. Gopalakrishnan
	Backyard Hatchery for Marine Ornamental Fish: An Alternate Livelihood	T.T. Ajith Kumar & T. Balasubramanian
	Application of Remote Sensing & GIS	S. Ramachandran
	Management of Mangroves & Climate Change	K. Kathiresan
6.2.	**Global Policies**	
	Role of Institutions	K. Kathiresan
	Conservation Strategies in Different Countries	K. Kathiresan

III. TRAINING COURSE ACTIVITIES

1. Inaugural function

The inauguration of the course was held at 8.30 a.m on 5th October 2011 at the Vice-Chancellor's Bungalow, Annamalai University (Invitation : **Annexure IV**). The participants registered for attending the programme (**Annexure V**).

The meeting was presided over by Prof. Dr. M. Ramanathan, Vice-Chancellor, Annamalai University. Prof. T. Balasubramanian welcomed the gathering. Prof. K. Kathiresan proposed a vote of thanks to all those who helped in the conduct of the programme especially Dr. Zafer Adeel and Ms. Hanneke Van Lavieren of UNU-INWEH and SACEP. The Vice-Chancellor inaugurated the programme and wished all the best for the participants.

2. Proceedings of the course

The schedule of the training course is given in **Annexure VI**. The proceedings of the course were recorded by the participants. Each participant served as a rapporteur on any one the days of course (a list of Rapporteurs **Annexure VII**).

Daily the programme started at 9.30 a.m in the Display Hall, CAS in Marine Biology, at Parangipettai and the sessions extended up to 5.30 p.m. An hour was spent on lunch and 2 tea breaks (1/2 hour each) and the remaining hours were usefully spent on the following components:

1. Listening top the speech by resource persons
2. Field / Lab demonstration by resource persons
3. Presentation by participants of status and / or daily report

4. Discussion followed by speech / presentation / demonstration
5. Internet browsing
6. Field visits :

Pichavaram mangrove forests (about 30 km away on road from the course site)

Vellar estuarine mangrove forest (three days) (around the course site)

Pondicherry, where a mangrove forest has been developed on degraded coast (60 km away on road from the course site)

Pazhayar, where an integrated farming of mangroves, crabs, fishes and prawns is being practiced (30 km away from the course site)

Killai where a mudcrab fattening is being practiced by womenfolk dependent on mangrove resources (5 km away from the course site)

Lectures were given by experts of the centre as well as by retired Professors. Special lectures were also delivered by invited guest speakers. Importance was given to the interaction of the participants by sharing their views among themselves and with the staff of the centre. Apart from the lectures given by the staff, participants gave speeches on the status of mangroves in their country / region followed by a thorough discussion especially for evolving management strategies. Manuscripts of their speeches were obtained and the copies were given to all the participants prior to their speech.

The practical classes were held in a sequence, so as to train the candidates in the methodologies for working in mangroves. They were first taken to the field to show and operate the shallow water sampling devices of water, sediment, plankton, benthos etc., in the water bodies of Vellar estuarine mangrove forests. The operation of the various instruments used for measuring various physico-chemical parameters were shown in the field as well as in the laboratory. The participants were trained in calculating the forest structure in terms of complex index, leaf area index, net canopy

photosynthesis, underground and above ground of tree biomass and their carbon stocks.

The microbiology of mangrove environment was explained. The isolation, enumeration and identification of some microbes were demonstrated in the microbiology laboratory of the Centre. The participants were taken to the nearby nursery plantations of mangroves and were shown the practices aimed at rehabilitation of degraded mangroves.

Experts on plants and various groups of animals accompanied the participants to the mangrove forests at Pichavaram, Pondicherry, Pazhayar and Vellar estuary, and they explained taxonomy, identification, collection and preservation of mangrove flora and fauna.

The participants were taken to various aquatic biotopes such as estuary, backwater, mangroves, and coastal areas of Bay of Bengal (sandy shores) to enlighten them on the differences in various aquatic biotopes and to train them in the sampling strategies of these areas. The participants were made to collect samples at these places and to learn the subtle differences in the flora and fauna of these places.

The participants were also given hands on training in the calculation of various diversity indices using the data they collected during this training course. They were given individual computers and familiarized in the calculation of univariate, graphical and multivariate tools used extensively in biodiversity research.

3. Plantation work

The participants evinced great enthusiasm in planting mangrove species along the Vellar estuary. This plantation programme was conducted by the organizers as well as with participation of many research scholars of CAS in Marine Biology.

4. Valedictory function

The valedictory function was held at the Auditorium, Faculty of Marine Sciences, Annamalai University (Invitation : **Annexure IX**). Prof. S. Ajmal Khan welcomed the gathering. Prof. T. Balasubramanian, Dean of the Centre presided over the function. Dr. E. Vivekanandan, Principal Scientist and Officer incharge of Central Marine Fisheries Research Institute (Indian Council of Agriculture Research), Chennai delivered the valedictory address. Prof. K. Kathiresan proposed a vote of thanks especially to the UNU-INWEH for funding support continuously for the past 11 years. During the valedictory address, Dr. Vivekanandan emphasized the importance on three aspects: (1) economic valuation of biodiversity and coastal ecosystems, (2) Climate change effects on coastal resources and (3) coastal restoration and rehabilitation for ecological and economic sustainability. He also advised the participants to focus on the three aspects in their countries and in collaboration with the other participants of the programme.

While expressing impressions, both the foreign and Indian participants felt highly satisfied with the course that was more of field and discussion-oriented. They felt that this approach will be of immense help to them for managing the coastal resources in their respective countries.

5. Rotary function

The Rotary Club of Chidambaram Mid-Town honoured the scientists from India and abroad in its meeting held on 18th October 2011, arranged by Dr. K. Kathiresan who happened to be a Rotary member of the Club (**Annexure X**). Family members of the Rotary club interacted with the participants across the dining table. The participants introduced themselves, their countries, culture and specialties. They all together performed cultural programmes such as dancing, singing and reciting music. The

performance was excellent and the audience gave a thunderous applause at the end in appreciation of the participants. The Rotary family members also joined with them in performing their cultural activities.

6. Leaving of participants

The training course came to a successful close on the evening of 19th October 2011. All the Indian and foreign participants left Chidambaram. The Organisers gave a warm send-off to the participants. This was a momentous event when the participants hugged each other and their eyes welled with tears. Teacher volunteers accompanied the participants to the airport and railway station in Chennai.

IV. SALENTS FEATURES OF COURSE

1. Participants selected for this training course were mostly from mid-professional stage, belonging to 10 different disciplines as given in the following tables.

Age groups (Years)	No. of participants
20-30	7
31-40	5
41-50	1

Discipline	No. of participants
Agriculture	1
Biotechnology	1
Biology	1
Botany	2
Ecology	1
Environmental Sciences	1
Fisheries	1
Forestry	2
Marine Biology	2
Watershed Management Hydrology	1

2. The course was conducted for a total period 96 hours within 15 days period, as shown in the table given below.

Course component	Hours
Lecture	35
Lab work / Demonstration	21
Field work	24
Group discussion	7
Internet browsing	7 ½
Status reporting	13
Daily reporting	7 ½
Total	115

Daily working hours 7.7 hours

3. Participants presented their reports of their respective countries or regions followed by a thorough discussion
4. One participant was a rapporteur for each day of the 15-day long course. The rapporteur was responsible to regulate and record the proceedings and to report the proceedings in next day morning before the start of that day's technical session.
5. Group discussion was given top priority for sharing research experiences, case studies, success stories, management aspects, and strategies for future plan.
6. Much of practical knowledge through field – oriented approach was at main focus.
7. A retired Professor of rich expertise was invited as a resource person and five scientists from different fields were also invited as resource persons.
8. The course sharply focused on conservation and management of biodiversity of mangrove ecosystems through 'Training the trainers' approach.
9. Biodiversity was studied to identify some 200 biological species of the following 19 groups of organisms:

    - Bacteria
    - Fungi
    - Phytoplankton
    - Seaweeds
    - Seagrass
    - Saltmarsh vegetation
    - Mangroves
    - Zooplankton
    - Polychaetes
    - Nematodes
    - Stomatopods
    - Amphipods and Isopods
    - Prawns and Shrimps
    - Crabs

- Insects
- Mollusks
- Fin fishes
- Snakes
- Birds
- Mammals

10. Participants were taught with methods of analyzing vegetation characteristics and assessing biodiversity of flora and fauna in the field. They asked to make all calculations to determine the attributes of vegetation structural characteristics.
11. Biodiversity assessment was taught to the participants using the Primer software package. The participants were given hands on training for using the software.
12. Participants were trained on GIS analysis of mangrove areas of Pichavaram using the remote sensing imageries for different years.

Annexure I

United Nations University
Institute for Water, Environment and Health
175 Longwood Road South, Suite 204
Hamilton Ontario L8P 0A1
Canada

Institutional Contractual Agreement

Organizational Unit	Contract ID	Amendment #
UNU-INWEH	613UU-00000000000000000000000181	1

Contract entered into between the United Nations University and Name (hereinafter referred to as the Contractor)

Name : Annamalai University

Address : Academic Division
Parangipettai, Tamil Nadu 608502
India

Telephone : 414/424-3223
Fax : 414/424-3555
Email :

Terms of Reference or Work Assignment
Project # & Name: 00064305 - MangBiod

Amendment #1:

add "Production of training manual." to the work assignment and amend Annex1 to total USD 17,000 by adding item 11 - production of training manual at a cost of USD 2,000.

Original Terms of Reference:
To hold the eleventh UNU-INWEH–UNESCO international Course: "Biodiversity in Mangrove Ecosystems at the Centre of Advanced Studies in Marine Biology, Annamalai University, India, from 5-19th October 2011 (as per the agreement of Cooperation between UNU-INWEH and Annamalai University). The course focuses primarily on mangrove ecosystems while maintaining an integrated approach towards management of coastal ecosystems. Annamalai University will be responsible for course implementation, including review and prioritization of applications, making travel arrangements for participants, providing local logistics (accommodation, transport, food etc.) and organization of lectures and field work. A tentative budget is attached as Annex 1 to this contract. At the conclusion of the course, Annamalai University shall submit a final report and financial statement (with original receipts for all expenditures).

Duration of Contract
This contract shall commence on 30-Jun-2011 and shall expire on the satisfactory completion of the services described above, but not later than 30-Nov-2011, unless sooner terminated under the terms of this contract. This contract is subject to the conditions attached.

Consideration
As full consideration for the services performed by the Contractor under the terms of this contract, the United Nations University shall pay the Contractor upon certification that the services have been satisfactorily performed.

Currency :	USD
Fee:	0.00
Expenses:	17,000.00
Total Amount:	17,000.00

The fee is payable on satisfactory completion of the contract. For payment in installments, certification of satisfactory performance at each phase is required. Expenses, as agreed, are reimbursed upon submission of receipt as evidence of payment.

Schedule and Conditions of Payment
amendment #1:
Revise the amount of payment #2 from USD 4,000 to USD 6,000

Original Schedule and Conditons of Payment:
1. USD 11,000 - upon contract signature. The unused portion of these advanced funds, if any, is to be returned to UNU-INWEH.
2. USD 4,000 - upon submission of 1) final report and 2) a certified financial statement with copies of substantiating original receipts.

United Nations University
Institute for Water, Environment and Health
175 Longwood Road South, Suite 204
Hamilton Ontario L8P 0A1
Canada

Institutional Contractual Agreement

Organizational Unit	Contract ID	Amendment #
UNU-INWEH	613UU-00000000000000000000000181	1

Acknowledgement
I acknowledge that I have read and accept the conditions set out on the attached.

REGISTRAR
ANNAMALAI UNIVERSITY

Signature of Authorized Representative of Contractor

Date

Certifying Officer
Dr. Richard Thomas, Officer in Charge, on behalf of the United Nations University

Signature

Date

ANNEXURE II

COURSE ADVERTISEMENT IN WEB SITE

Mangrove Ecosystems

11th International Training Course on
Mangrove Biodiversity and Ecosystems

Centre of Advanced Studies in Marine Biology
Annamalai University, India

5-19th October 2011

BACKGROUND: Coastal ecosystems (e.g., coral reefs, mangroves, and wetlands) are some of the world's richest storehouses of biological diversity and primary productivity. It is estimated that about half the world's coastal ecosystems face a significant risk of degradation from human activities, those in South and Southeast Asian perhaps among the most threatened.

This course focuses on mangrove ecosystems with particular emphasis on the methodology for assessing, monitoring and conserving biodiversity. It is taught by a multidisciplinary team of lecturers and through hands-on involvement of the participants.

COURSE SYLLABUS

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The course has also been developed as an open course ware as part of an open learning initiative with UNU, Tokyo and is available at: http://ocw.unu.edu/
Further information can be found in a background Paper *Training and Capacity Building for Managing Our Mangroves Resources - UNU's Role to Meet Regional Challenges* (pdf 23.1KB).

To apply for the course please complete the ***Application Form*** and email OR send scanned copies to:

Dr. K. Kathiresan
Professor, CAS in Marine Biology
Annamalai University, Parangipettai
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FELLOWSHIPS: A limited number of fellowships are available to qualified candidates from developing countries only. These fellowships will be granted on a competitive basis and will cover the entire expenses of the workshop, including economy excursion airfares via the most direct route for candidates from outside India. Candidates from India will be reimbursed for train tickets via the most direct route. In order to apply, please complete the section on 'Justification for UNU Fellowship' on page 4 of the application form.

ANNEXURE III

LIST OF PARTICIPANTS

UNU-INWEH INTERNATIONAL TRAINING COURSE ON

"MANGROVE BIODIVERSITY AND ECOSYSTEMS"

OCTOBER 05-19, 2011

Sl. No.	Name & Address	Brief Biodata
1	**Ms. Swati Sappal** M.Sc., Environmental Science 202, Chandrabhaga Hostel, Jawaharlal Nehru University, New Delhi 110 067 INDIA Mobile : +91 9953300452 E-mail : swati.sappal@gamil.com	Qualification : M.Sc., Subject : Environmental Science Age : 24 Gender : Female
2	**Mr. Mali Mukeshkumar** Junior Research Fellow. GEER Foundation, Indroda Park, P.O. Sector – 7, Gandhi Nagar – 382 007 INDIA Mobile : +91 9979415094 E-mail : mukesh_mali@hotmail.com	Qualification : M.Sc., Subject : Botany Age : 26 Gender : Male
3	**Dr. C. Ravinder Singh** Lecturer Vivekanandha College, Thiruchengode, Namakkal, Tamil Nadu INDIA Mobile : +91 9597992543 E-mail : chinnaravinder@yahoo.co.in	Qualification : Ph.D. Subject : Biotechnology Age : 31 Gender : Male

4	**Dr. T. Ganesh** Assistant Professor Dept. Ocean studies & Marine Biology Pondicherry University Port Blair Campus Port Blair INDIA Mobile : +91 9679515929 E-mail : tganesh.es@gmail.com	Qualification : Ph.D. Subject : Marine Biology Age : 37 Gender : Male
5	**Mr. P. Ragavan** Junior Research Fellow Anifpdcl, HADDO Vanivikas Bhavan, Port Blair – 744 102 INDIA Mobile : +91 9476030770 E-mail : van.ragavan@gmail.com	Qualification : M.Sc., Subject : Marine Biology Age : 25 Gender : Male
6	**Mr. Bipinkumar Khokhariya** Junior Research Fellow GEER Foundation, Indroda Park, P.O. Sector – 7, Gandhi Nagar – 382 007 INDIA Mobile : +91 9033283020 E-mail : bipinkhokhariya.geer@gmail.com	Qualification : M.Sc. Subject : Botany Age : 27 Gender : Male
7	**Md. Masud Rana** Assistant Conservation of Forest Coastal Forest Division, Ministry of Environment & Forests, Bhola BANGLADESH Mobile : +88 01816573740 E-mail : masudacf@yahoo.com	Qualification : M.S. Subject : Forestry Age : 32 Gender : Male

8	**Mr. Agus Ariyanto** Forest Ecosystem Controller East Java Nature Resources Conservation, Perumahan Graha Makmur Nomor 02 Ji. Makmur, Sudimoro Betro, Kecamatan Sedati Kabupaten Sidoarjo, Jawa Timur INDONESIA Mobile : +62 89667771777 E-mail : agoesgecko@gmail.com	Qualification : M.S. Hut., Subject : Forest Age : 28 Gender : Male
9	**Mr. Minh Nguyen Van** Lecturer Organization Department, Hoa Lu University Ninh Nhar Street, Ninh Binh City VIETNAM Mobile : +84 912850854 E-mail : nvminh.dnb@moet.edu.vn	Qualification : M.Sc., Subject : Mangrove Ecology Age : 32 Gender : Male
10	**Mrs. Khodeeyoe Pornchai** Researcher Marine & Coastal Resources Research Centre, The Central Gulf of Thailand PO 71 Chumphon 86000 THAILAND Mobile : +66851289751 E-mail : khodeeyoe@hotmail.com	Qualification : B.Ag., Subject : Agriculture Extension Age : 43 Gender : Female
11	**Ms. Kanchana Peeris** Demonstrator University of Kelaniya, Pius Watte, Millawa, Kurunegala SRI LANKA Mobile : +94 723613911 E-mail : kanchana2224@yahoo.com	Qualification : B.Sc., Subject : Biology Age : 27 Gender : Female

12	**Ms. Eni Hidayati** Lecturer Universitas Samawa, Jl.Kbayan Gang Tambora 2 No. 46, Sumbawa Besar, NTB, INDONESIA Mobile : +62 87780135045 E-mail : enihidayati@gmail.com	Qualification : M.Sc., Watershed Subject : Management Hydrology Age : 26 Gender : Female
13	**Dr. Zannatul Ferdoushi** Assistant Professor Dept. Fisheries Management , Faculty of Fisheries, Hajee Mohammad Danesh Science & Technology University, Dinajpur BANGLADESH Mobile : +880 1712159970 E-mail : zannatul99bd@yahoo.com	Qualification : Ph.D., Subject : Fisheries Age : 35 Gender : Female

ANNEXURE IV

ANNAMALAI UNIVERSITY

SACEP

FACULTY OF MARINE SCIENCES
CENTRE OF ADVANCED STUDY IN MARINE BIOLOGY

UNU-INWEH INTERNATIONAL TRAINING COURSE ON "MANGROVE BIODIVERSITY AND ECOSYSTEMS"

5th OCTOBER 2011

Time : 8.30 a.m

Venue : V.C Bungalow, Annamalai University

PROGRAMME

Welcome Address	:	**Prof. T. Balasubramanian** Dean, CAS in Marine Biology Annamalai University
Introductory Remark	:	**Prof. S. Ajmal Khan** CAS in Marine Biology Annamalai University
Inaugural Address	:	**Prof. Dr. M. Ramanathan** Vice Chancellor Annamalai University
Vote of Thanks	:	**Prof. K. Kathiresan** CAS in Marine Biology Annamalai University
National Anthem		

All are cordially invited to attend the function

Prof. K. Kathiresan
Prof. S. Ajmal Khan
Organisers

Prof. T. Balasubramanian
Co-ordinator

ANNEXURE V

UNU-INWEH INTERNATIONAL TRAINING COURSE ON "MANGROVE BIODIVERSITY AND ECOSYSTEMS"

(OCTOBER 05-19, 2011)

REGISTRATION FORM

NO.	PHOTO	NAME & ADDRESS	SIGNATURE
1		**Ms. Swati Sappal** M.Sc., Environmental Science 202, Chandrabhaga Hostel, Jawaharlal Nehru University, New Delhi 110 067 INDIA	5/10/11
2		**Dr. T. Ganesh** Assistant Professor Dept. Ocean studies & Marine Biology, Pondicherry University Port Blair Campus Port Blair, INDIA	05/10/11
3		**Mr. Mali Mukeshkumar** Junior Research Fellow. GEER Foundation, Indroda Park, P.O. Sector – 7, Gandhi Nagar – 382 007 INDIA	5/10/11.
4		**Dr. C. Ravinder Singh** Lecturer Vivekanandha College, Thiruchengode, Namakkal, Tamil Nadu INDIA	5/10/2011
5		**Mr. Bipinkumar Khokhariya** Junior Research Fellow GEER Foundation, Indroda Park, P.O. Sector – 7, Gandhi Nagar – 382 007 INDIA	5/10/11

6		**Mr. P. Ragavan** Junior Research Fellow Anifpdcl, HADDO Vanivikas Bhavan, Port Blair – 744 102 INDIA	P. Ragavan 5/10/2011
7		**Mr. Agus Ariyanto** Forest Ecosystem Controller East Java Nature Resources Conservation Perumahan Graha Makmur Nomor 02 Ji. Makmur, Sudimoro Betro, Kecamatan Sedati Kabupaten Sidoarjo, Jawa Timur, INDONESIA	
8		**Mr. Minh Nguyen Van** Lecturer Organization Department, Hoa Lu University Ninh Nhar Street, Ninh Binh City VIETNAM	
9		**Mrs. Khodeeyoe Pornchai** Researcher Marine & Coastal Resources Research Centre, The Central Gulf of Thailand PO 71 Chumphon 86000 THAILAND	Khodeeyoe
10		**Ms. Kanchana Peeris** Demonstrator University of Kelaniya Pius Watte, Millawa, Kurunegala SRI LANKA	K. Peeris

11		**Ms. Eni Hidayati** Lecturer Universitas Samawa Jl.Kbayan Gang Tambora 2 No. 46, Sumbawa Besar, NTB, INDONESIA	
12		**Dr. Zannatul Ferdoushi** Assistant Professor Dept. Fisheries Management , Faculty of Fisheries, Hajee Mohammad Danesh Science & Technology University, Dinajpur BANGLADESH	
13		**Md. Masud Rana** Assistant Conservation of Forest Ministry of Environment & Forests Coastal Forest Division, Bhola BANGLADESH	

ANNEXURE VI

SCHEDULE FOR TRAINING COURSE

UNU-INWEH INTERNATIONAL TRAINING COURSE ON

"MANGROVE BIODIVERSITY AND ECOSYSTEMS"

OCTOBER 5-19, 2011

Sponsored by

United Nations University (UNU)
Institute for Water, Environment & Health (INWEH), Canada
South Asia Co-operative Environment Programme (SACEP), Sri Lanka

Organised by

ANNAMALAI UNIVERSITY
Faculty of Marine Sciences
Parangipettai - 608 502
Tamil Nadu, India

05.10.2011 (Wednesday) (Rapporteur: Ms. Swati Sappal)	
08.30 - 09.00 a.m	Registration
09.00 - 10.00 a.m	Inauguration by the Vice-chancellor, Annamalai Univeristy
11.00 - 11.30 a.m	Why This Centre? *Prof. T. Balasubramanian*
11.30 - 12.00 noon	Why This Course on Biodiversity? *Prof. S. Ajmal Khan*
12.00 - 12.30 p.m	Why This Course on Mangroves? *Prof.K. Kathiresan*
12.30 - 02.00 p.m	Lunch
02.00 - 03.00 p.m	Visit to Library, Museum, Instrumentation facility and Environmental Information System for Mangrove Research *Dr. S. Murugan, Dr.R.Kumaran & Dr. E. Karthikeyan*
03.00 - 04.00 p.m	An Introduction to Biodiversity *Prof. L. Kannan*
04.00 p.m	Daily Report by Rapporteur

06.10.2011 (Thursday) (Rapporteur: Mr. Mali Mukeshkumar)	
09.30 - 10.30 a.m	Mangroves: Definition, Distribution, Ecology & Biology *Prof. K. Kathiresan*
10.30 a.m - 12.30 p.m	Field Studies on habitat characteristics of mangrove forest along the Vellar Estuary *Prof. K. Kathiresan,Dr. A. Saravanakumar & Dr. S.Kumaresan*
12.30 -2.00 p.m	Lunch
02.00 - 3.00 p.m	Physical environment of mangrove ecosystem

	Prof. M. Natarajan
03.00 - 04.30 p.m	Practical: Measurement of currents, waves and topography of intertidal zone *Dr. R. Venkatachalapathy,* *Er. K. Mohan & Mr. N.Kumaresan*
04.30 - 5.30 p.m	Practicals: Survey of intertidal zone *Er.K.R. Venkatasan & Er. R.Velappan*
05.30 p.m	Daily Report by Rapporteur

07.10.2011 (Friday) (Rapporteur: Dr. C. Ravinder Singh)	
07.30 a.m - 12.30 p.m	Field studies on mangroves of Pichavaram: species identification, adaptive features & restoration strategies *Prof. K. Kathiresan, Dr. A. Saravanakumar, Dr. D.Annadurai & Dr. S. Ravichandran*
12.30 - 2.00 p.m	Lunch
02.00 - 04.30 p.m	Analysis of vegetation characteristics along the Vellar estuary: Practicals *Prof. K. Kathiresan & Dr. A. Saravanakumar*
04-30 - 05.30 p.m	Presentation by *Mr. P. Ragavan*
05.30 p.m	Daily Report by Rapporteur

08.10.2011 (Saturday) (Rapporteur: Dr. T. Ganesh)	
09.30 - 10.30 a.m	Importance & Methods of Assessing the Coastal Biodiversity *Prof. S. Ajmal Khan*
10.30 - 11.30 a.m	Genetic diversity: Molecular tools: Demonstration *Dr. S.T. Somasundaram, Dr. M. Kalaiselvam, Dr. T.Ramesh & Dr.M.Thangaraj*
11.30 a.m - 12.30 p.m	Presentation by *Dr. C. Ravinder Singh*
12.30 - 02.00 p.m	Lunch

02.00 - 04.00 p.m	Practical on biodiversity assessment *Prof. S. Ajmal Khan*
04-00 - 05.30 p.m	Presentation by *Ms. Swati Sappal*
05.30 p.m	Daily Report by Rapporteur

09.10.2011 (Sunday) (Rapporteur: Mr. Agus Ariyanto)	
9.30 - 10.30 a.m	Barcoding *Prof. S. Ajmal Khan*
10.30 - 11.30 a.m	Seagrass: Theory & Practical *Dr.T. Thangaradjou*
11.30 a.m - 12.30 p.m	Seaweed: Theory & Practical *Dr. P. Anandaraman & Dr. S. Vasuki*
12.30 - 1.30 p.m	Presentation by *Mr. Mali Mukeshkumar*
1.30 - 02.00 p.m	Daily Report by Rapporteur
02.00 - 02.30 p.m	Lunch
2.30 p.m onwards	Sunday holiday

10.10.2011 (Monday) (Rapporteur: Mr. P. Ragavan)	
09.30 - 10.30 a.m	Microbial diversity in mangroves: Theory and methods of isolation, enumeration, identification & preservation *Dr. S. Jayalakshmi*
10.30 - 11.30 a.m	Fungal diversity *Dr. M.Kalaiselvam*
11.30 a.m - 12.30 p.m	Actinobacteria *Dr. K. Sivakumar*
12.30 - 01.30 p.m	Lunch
1.30 -2.30 p.m	Plankton collection in Vellar estuary *Dr. P. Sampathkumar, Dr. G. Anandan, Dr. K. Ramamoorthy & Dr.V. Ashok Prabu*

02.30 – 03.30 p.m	Plankton: Theory *Dr. P. Sampathkumar*
03.30 - 04.30 p.m	Plankton: Collection & identification practical *Dr. P. Sampathkumar, Dr. G. Anandan, Dr. K. Ramamoorthy & Dr.V.Ashok Prabu*
04.30 - 05.30 p.m	Presentation by *Dr. T. Ganesh*

11.10.2011 (Tuesday) (Rapporteur: Mr.Minh Nguyen Van)	
09.30 - 10.30 a.m	Meiofauna in mangrove habitat *Prof. Olivia J. Fernando*
10.30 a.m -12.00 noon	Nematodes: Theory & Practicals *Dr. M.A. Sultan Ali &* *Prof. S. Ajmal Khan*
12.00 noon - 01.00 p.m	Polychaetes: Theory & Practicals *Dr. P. Murugesan*
01.00 - 02.00 p.m	Lunch
02.00 - 03.00 p.m	Amphipods: Theory & Practical *Dr. P.S.Lyla* & *Prof. S. Ajmal Khan*
03.00 - 04.00 p.m.	Prawn & shrimps: Theory & Practical *Dr.P. Soundarapandian & Mr. S.Sudhakar*
04.00 - 05.00 p.m	Presentation by *Dr. Zannatul Ferdoushi*
05.00 p.m	Daily Report by Rapporteur

12.10. 2011 (Wednesday) (Rapporteur: Ms. Kanchana Peeris)	
09.30 - 10.30 a.m	Crabs: Theory *Prof. S. Ajmal Khan*
10.30 - 12.30 p.m	Identification of crabs: Practicals *Prof. S.Ajmal Khan, Dr. S. Ravichandran, Dr. S.M. Raffi & Dr. S.Saravanan*
12.30 - 02.00 p.m	Lunch

02.00 - 03.00 p.m	Molluscs: Theory *Prof. A. Shanmugam*
03.00 - 04.30 p.m	Molluscs: identification Practicals *Dr. A. Shanmugam,* *Dr. D. Annadurai, Dr. S. Arularasan & Dr.S. Vairamani*
04-30 - 05.30 p.m	Presentation by *Ms. Eni Hidayati*
05.30 p.m	Daily Report by Rapporteur

13.10.2011 (Thursday) (Rapporteur: Dr. Zannatul Ferdoushi)	
09.30 - 12.30 p.m	Finfishes *Prof. V. Ramaiyan, Dr. M. Kalaiselvam, Dr. V. Ravi, Dr. S. Murugan, Dr.P.Vijayanand & Dr.A. Sundaramanickam*
12.30 - 01.00 p.m	Elasmobranchs *Dr. V. Ravi*
01.00 - 02.00 p.m	Lunch
02.00 - 03.00 p.m	Mudskippers *Dr. V. Ravi*
03.00 - 04.30 p.m	GIS Application in Mangrove Resource Assessment & Management: Practical demonstration *Dr. T. Thangaradjou*
04.30 - 05.30 p.m	Presentation by *Mrs. Khodeeyoe Pornchai*
05.30 p.m	Daily Report by Rapporteur

14.10.2011 (Friday) (Rapporteur: Ms. Eni Hidayati)	
09.30 - 10.30 a.m	Fish parasites *Prof. N. Veerappan*
10.30 - 11.30 a.m	Coastal herbal diversity *Dr. T. Ramanathan*
11.30 -12.30 p.m	Reptiles *Prof. M. Srinivasan & Dr.S. Bragadeeswaran*

12.30 - 02.00 p.m	Lunch
02.00 - 03.30 p.m	Biodiversity of birds *Dr. K. Sampath*
03.30 - 04.30 p.m	Presentation by *Ms. Kanchana Peeris*
04.30 - 05.30 p.m	Presentation by *Mr. Agus Ariyanto*
05.30 p.m	Daily Report by Rapporteur

15.10.2011 (Saturday) (Rapporteur: Md. Masud Rana)	
09.30 - 10.30 a.m	Aquarium keeping of fish biodiversity: Theory & Demonstration *Dr. T.T. Ajithkumar, Dr. M. Arumugam, Dr. K. Raja & Dr. R. Rajasekaran*
10.30 - 12.00 noon	Economic valuation of mangroves *Prof. N. Ramgopal*
12.00 - 01.00 p.m	Threats to mangroves *Prof. T. Balasubramanian*
01.00 - 01.30 p.m	Lunch
01.30 - 5.30 p.m	Visit to ecofriendly mangrove aquaculture farm at Pazhayar *Dr. P. Mayavu, Dr.G. Sankar, Dr.R. Balasubramanian, Dr. A. Gopalakrishnan, Dr. M.A. Badhul Haq, Mr. K.Sakkaravarthi, Mr. T.M. Vasanthan & Mr. Elanzhian*
05.30 p.m	Daily Report by Rapporteur

16.10.2011(Sunday) (Rapporteur: Mr. Bipinkumar)	
10.00 a.m - 05.00 p.m	Demonstration of a success story of Mangrove Restoration in Degraded Areas in Pondicherry Union Territory *Prof. K. Kathiresan & Prof. S. Ajmal Khan*
05.00 p.m	Daily Report by Rapporteur

17.10.2011 (Monday) (Rapporteur: Mrs. Khodeeyoe Pornchai)	
09.30 - 10.30 a.m.	Ecofunctions & Economic values of mangroves *Prof. K. Kathiresan*
10.30 - 11.30 a.m	Aquaculture: A Tool for Biodiversity Conservation & Eco friendly Aquaculture *Prof. S. Rajagopal*
11.30 - 12.30 p.m	By catch resources *Dr. S.M. Raffi*
12.30 - 01.30 p.m.	Lunch
01.30 - 2.30 p.m	Presentation by *Md. Masud Rana*
02.30 - 03.30 p.m	Conservation strategies, Polices & management options *Prof. K. Kathiresan & Mr. P. Madeswaran*
03.30 - 04.30 p.m	Presentation by *Mr. Bipinkumar*
04.30 - 5.30 p.m	Presentation by *Mr.Minh Nguyen Van*
05.30 p.m	Daily Report by Rapporteur

18.10.2011 (Tuesday) (Rapporteur: Mr. Mali Mukeshkumar)	
09.30 - 10.30 a.m.	Mangrove Plantation by Participants Along the Vellar Estuary *Prof. K. Kathiresan & S. Ajmal Khan*
10.30 - 11.30 a.m	Interactive discussion with research scholars of Prof. K. Kathiresan working on mangroves *Dr. N. Sithranga Boopathy, P. Senthil Raja, R. Anburaj, V. Gomathi, N. Asmathunisha, K. Saravanakumar, G. Abirami, S. Anandhan & Sunil Kumar Sahu*
11.30 - 12.30 p.m	Propagation techniques of Mangroves: Demonstration *Prof. K. Kathiresan*
12.30 - 02.00 p.m	Lunch
02.00 - 03.00 p.m	Crab fattening: an alternate livelihood

	Prof. S. Ajmal Khan & Dr. A. Gopalakrishnan
03.00 - 04.00 p.m	Interaction with stakeholders of mangrove management *Prof. K. Kathiresan & Dr. A. Gopalakrishnan*
04.00 p.m	Daily Report by Rapporteur
06.00 p.m	Visit to Mangrove Temple at Chidambaram & Rotary Meeting for Cultural Exchange of Participants

19.10.2011 (Wednesday) (Rapporteur: Ms. Swati Sappal)	
09.30 - 10.30 a.m	Climate change and fisheries *Dr. E. Vivekanandan*
10.30 a.m - 11.30 p.m	Fisheries management *Dr. E. Vivekanandan*
12.30 - 1.30 p.m	Valedictory Function – Impressions by Participants – Future Plan of Work by Participants on Conservation & Management of Mangroves
01.30 - 02.30 p.m	Lunch
02.30-3.00 p.m	Daily Report by Rapporteur

ANNEXURE VII

LIST OF RAPPORTEURS

UNU-INWEH INTERNATIONAL TRAINING COURSE ON "MANGROVE BIODIVERSITY AND ECOSYSTEMS"

OCTOBER 5-19, 2011

NO.	DATE	RAPPORTEURS
1	05.10.11	Ms. Swati Sappal
2	06.10.11	Mr. Mali Mukeshkumar
3	07.10.11	Dr. C. Ravinder Singh
4	08.10.11	Dr. T. Ganesh
5	09.10.11	Mr. Agus Ariyanto
6	10.10.11	Mr. P. Ragavan
7	11.10.11	Mr.Minh Nguyen Van
8	12.10.11	Ms. Kanchana Peeris
9	13.10.11	Dr. Zannatul Ferdoushi
10	14.10.11	Ms. Eni Hidayati
11	15.10.11	MD. Masud Rana
12	16.10.11	Mr. Bipinkumar Khokhariya
13	17.10.11	Mrs. Khodeeyoe Pornchai
14	18.10.11	Mr. Mali Mukeshkumar
15	19.10.11	Ms. Swati Sappal

ANNEXURE VII

LIST OF RAPPORTEURS

UNU-INWEH INTERNATIONAL TRAINING COURSE ON "MANGROVE BIODIVERSITY AND ECOSYSTEMS"

OCTOBER 5-19, 2011

NO.	DATE	RAPPORTEURS
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5	09.10.11	Mr. Agus Ariyanto
6	10.10.11	Mr. P. Ragavan
7	11.10.11	Mr.Minh Nguyen Van
8	12.10.11	Ms. Kanchana Peeris
9	13.10.11	Dr. Zannatul Ferdoushi
10	14.10.11	Ms. Eni Hidayati
11	15.10.11	MD. Masud Rana
12	16.10.11	Mr. Bipinkumar Khokhariya
13	17.10.11	Mrs. Khodeeyoe Pornchai
14	18.10.11	Mr. Mali Mukeshkumar
15	19.10.11	Ms. Swati Sappal

ANNEXURE VIII

DAILY REPORT BY PARTICIPANTS

UNU-INWEH INTERNATIONAL TRAINING COURSE ON

"MANGROVE BIODIVERSITY AND ECOSYSTEMS"

OCTOBER 5-19, 2011

Sponsored by

United Nations University (UNU)
Institute for Water, Environment & Health (INWEH), Canada
South Asia Co-operative Environment Programme (SACEP), Sri Lanka

Organised by

ANNAMALAI UNIVERSITY
Faculty of Marine Sciences
Parangipettai - 608 502
Tamil Nadu, India

FIRST DAY REPORT

(October 5, 2011)

(Rapporteur: Ms. Swati M. Sappal)

9:00 – 9:30 AM: Inauguration by the Vice-chancellor, Annamalai University

All the participants along with the Course Co-ordinator Prof. T Balasubramanian and Course organiser Prof. K. Kathiresan meet revered Vice Chancellor Prof. Dr. M. Ramanathan of Annamalai University. All participants introduce themselves and have a healthy discussion with honourable Vice chancellor regarding their work and research interests.

10:00 – 10:30 AM: Why this Centre? (Talk by Prof. T. Balasubramanian)

The course started with an informative talk about the History of the Centre for Advanced study in Marine Biology and how this place was a perfect venue for hosting this training course. It was very motivating to know the strong academic history behind laying the foundation of this specialised centre and how this centre have excelled over the past with the focussed and targeted research it has carried out in the field of Marine Biology and Biodiversity conservation. The un-tiring and endless efforts of the various distinguished faculties of this Centre towards building a strong network for the conservation of Coastal resources, Biodiversity and ecosystems was also praiseworthy. Apart from the strong academic expertise that has been highlighted, the centre's unique location with an easy access to different biotopes like estuarine systems, mangrove ecosystems, backwaters etc. make it an ideal site for carrying out such a focussed training program on understanding the Coastal Ecosystems Biodiversity.

10:30 – 11:30 AM: Why this course on Biodiversity? (Talk by Prof. Ajmal Khan)

This was again a very enlightening presentation by Prof. Ajmal Khan on the various ecosystems functions and biodiversity values. The talk laid emphasis on Why there is an utmost need for the conservation of Coastal Biodiversity?? How there is an intricate link established between various species and their Interdependence was highlighted. Human rely on coastal biodiversity for their life and livelihood. Biodiversity links to 100% of food value for Humans. Fish is the most abundant species found in the coastal ecosystems like mangroves and has a high nutritional quality. It not only provides a nutritional diet for humans but also

is a source of various microelements like P, K, Fe, I, F, Zn and Cancer fighting elements Se which are required for a healthy body. Fish diet also relieves stress and has a good medicinal quality. Thus Human existence and well being is very closely and intricately related to coastal biodiversity for which fish is just one small example. Apart from the dietary function the coastal biodiversity is also a very good economic asset for every country. Coastal biodiversity provides 100% contribution in fodder for livestock, 100% for spices and aromatics, 90% of fibres and rayon in textile industries come from biodiversity, 84% of fuel in India is derived from biodiversity, 70% of modern medicines also find their sources in coastal biodiversity. Thus knowingly and unknowingly Humans rely on Coastal Biodiversity for the well being and are directly benefited by it. Furthermore, Biodiversity has various support functions, Indirect Economic values, Optional value, Scientific value, Socio cultural Value, Potential value, Recreational value, Aesthetic value etc. To summarise it can be said that coastal biodiversity is a Gift of Nature to Humans, where Man is the beneficiary and Biodiversity is the benefactor and it is sad to know that in the present scenarios the beneficiary is negatively affecting the benefactor posing an alarming threat to biodiversity.

Thus the need of the hour is the Conservation and sustainable use of Coastal Biodiversity so that both the Beneficiary and the benefactor can exist in harmony without having any negative impacts on each other.

11:30 – 11:45 AM: Tea Break

11:45 – 12:30 PM: Visit to the Research lab working on the Project "DRUGS FORM THE SEA" and Saraswati Puja

All the participants were acquainted with the ongoing research projects at the CAS Marine Biology out of which one was DRUGS FROM THE SEA. It was very interesting to know the various medicinal values of the coastal flora and fauna. Several species of organisms like Molluscs, Echinoderms, Sea snakes were successfully bred in the lab conditions and were used for inventing several classes of drugs like Anti microbial, Anti venoms, Analgesics. Several success stories have been documented in the form of various publications by CAS marine biology indicating the tremendous importance of coastal biodiversity as potent drugs.

12:30 – 1:30 PM: Why this course on Mangroves? (Talk by Prof. K. Kathiresan)

It was a though provoking and knowledge enhancing talk by Prof. K. Kathiresan on the importance of Coastal Environment. Costal ecosystems are very productive, biologically diverse and valuable resources. But present day exploitation is posing severe threats to these repositories. It's a vicious cycle of exploitation which creates the need for more thus adding more pressure to the already stressed coastal ecosystems. . Mangroves are one such very important coastal ecosystem which are fast disappearing and with the present rate of degradation it is estimated that the mangrove ecosystems will be lost in the coming 100 years. Asian countries have the most luxuriant mangrove ecosystems with Indonesia being No. 1 on the list. There are various negative impacts of mangrove destruction thus mangrove ecosystems conservation needs special attention. There can be various reasons for mangrove degradation which can be summed up as

- Unsustainable aquaculture activities(like in Philippines, Bangladesh, Sri Lanka)
- Sewage disposal into mangrove ecosystems like in Mumbai, India
- Over fishing (India, Bangladesh, Sri Lanka)
- Over harvesting of Mangroves for timber
- Over grazing
- Alteration of water flows
- Altered and heavy sedimentation
- Climate change (Temperature rise, Heat waves and cyclones, Sea level rise)
- Sea water inundation and intrusion leading to species compositional changes
- Poor regeneration of mangrove seedlings

Thus seeing the present status of world mangroves this program was specially designed and formulated keeping the following objectives in mind:

- To promote better understanding of Coastal biodiversity
- To build up man power and to raise awareness towards coastal ecosystem conservation
- To promote capacity building
- To exchange ideas and build up a global network towards mangroves and coastal biodiversity conservation

1:30 – 2:15 PM: Lunch

2:15 – 3:30 PM: Visit to Library, Museum, Advanced Instrumentation Facility and Environmental Information System (ENVIS) for Mangrove Research

Participants were introduced to the institutional repository of Coastal fauna preserved in the Centre's Museum. There were demonstrations of the advanced instrumentation facility available at CAS Marine biology. As well there was a visit to the ENVIS centre for mangrove research and well equipped Centre's Library.

3:30 – 4:30 PM: An Introduction to Biodiversity (Talk by Prof. L. Kannan)

This was a very knowledgeable and helpful talk delivered by Prof. L. Kannan on the basics of Understanding Biodiversity. Biodiversity means Biological diversity and means the variability among living organisms from all sources including terrestrial, aquatic and marine ecosystems. Biodiversity is a very vast topic and can be various types. Biodiversity can be within species, between species and of ecosystems. also there are other kinds of Biodiversity as well like

- Genetic Diversity i.e. variation of genes within species. It can be further classified as Higher and Lower
- Species diversity i.e. number of species found in a given area
- Phyletic Diversity i.e. diversity within a phyla
- Functional Diversity
- Community and Ecosystem Diversity
- Habitat Diversity which further comprises of Alpha, beta and gamma diversity

Thus considering the importance of different diversity and its varied functions there is an urgent and imperative need for developing the existing biodiversity for a better and a sustainable future.

4:30 – 4:45 PM: Daily Report

4:45 – 5:00 PM: Tea break

Signature

(Ms. Swati M. Sappal)

SECOND DAY REPORT

(October 6, 2011)

(Rapporteur: Mr. Mali Mukeshkumar)

First I thank to Dr. K. Kathiresan, Dr. Natarajan, Dr. Venkatachalpathy and his team gave valuable information on Mangroves. They gave to us huge information about important of mangroves and mangrove habitat. We gained lot of knowledge related to Coastal physiography through the practical and theory.

We had two sessions, practical and theory by resource person as well as research scholars. Dr. Kathiresan delivered the first lecture on conservation. He gave the exact definition for mangrove forest, distribution, ecology and biological applications, mangrove ecosystem mangle, current status of mangrove in the world and global distribution. Also we gathered some information about types of coastal settings, ecological characteristics, morphology anatomy, pollination biology, reproduction and Mangrove establishment. Then we had visited vellar estuary for practical on Environmental parameters. We studied various parameters like pH, salinity, Eh, Temperature and collect the soil sample from six different depths for total carbon, DO, soil texture analysis and calculate the soil texture and total carbon through the standard methods.

Dr. Natarajan delivered the lecture on basic information about wind, wave, tide and water current. He explained in detailed about Wind speed, effect of wind speed and import ants of coastal environment. Also he gave basic information of Tide and its measure techniques. And we had the practical on measurement of currents waves and topography of intertidal zone by Dr. Venkatachalpathy. He nicely explained relation between mangrove environmental and meteorological parameters, elaborate definition of high tide, low tide, highest high tide, lowest low tide, amplitude, intertidal region etc. He demonstrated some instruments related to oceanography. He showed the instrument and gave the information about data receiving, data transformation and working principles of instruments. We enjoyed the whole day with scientific information.

Signature

(Mr. Mali Mukeshkumar)

THIRD DAY REPORT

(October 7, 2011)

(Rapporteur: Dr. C. Ravinder Singh)

On 7/10/2011, the program was started with Pichavaram forest visit. Prof. Dr. K. Kathiresan has explained in detailed about the Pichavaram mangroves. The practical session on analysis of mangrove habitat and soil analysis was conducted by Prof. Dr. K. Kathiresan and his research team. It was highly motivated and inspired. Participants have gathered much knowledge about the mangrove forest and soil analysis. Dr. S. Ravichandran also explained about crab and its important role in the marine environment.

At 2'0 clock we all the participants had been to Vellar estuary along with Prof. Dr. K. Kathiresan and his research team. They practically visualized various aspects of soil analysis like, pH, Salinity, temperature, carbon level and oxygen level.

Prof. Dr. K. Kathiresan delivered a talk on Pichavaram mangrove forest. He gave the perfect definition for mangroves, and he also differentiated the *R.mucronata* and *R.apiculata* and the natural hybrid *R.annamalayana*. He also discussed about the exact and simple identification tips for mangrove species. He also explained about 13 pichavaram mangrove species and 73 mangrove associates. His talk was highly enthused and it will be the great source for all the participants to identify the species. At last he gave idea about the conservation of mangrove species and its importance.

As a rapporteur, I would like to indicate the names of some important mangrove species that have been discussed by Prof. Dr. K. Kathiresan,

- *Avicennia marina*
- *Avicennia officinalis*
- *Avicennia alba*
- *Rhizophora mucronata*
- *Rhizophora apiculata*
- *R. annamalayana*
- *R. stylosa*
- *R. Lamarckii*
- *Ceriops decandra*
- *Ceriops tagal*
- *Bruguiera cylindrica*
- *B.parviflora*
- *B.gymnorrhiza*
- *B.sexangula*
- *Kandelia candel*
- *Aegiceras corniculatum*
- *Excoecaria agallocha*
- *Lumnitzera racemosa*
- *L.littorea*
- *Sonneratia apetala*

- *S.caseolaris*
- *S.alba*
- *S.griffithii*
- *Acanthus ilicifolius*
- *A.ebracteatus*
- *A.volubilis*
- *Achrostichum aureum*
- *A.speciosum*
- *Nypa fruiticans*
- *Sesuvium portulacastrum*
- *Sueada maritima*
- *S.monoica*
- *S.nudiflora*
- *Ipomea pes-caprae*

Followed by this valuable talk, Mr. Ragavan from Andaman, delivered lecture on mangroves of Andaman and Nicobar island, The whole day was enjoyed by the participants with the scientific peoples and their informative lectures.

I thank Prof. K. Kathiresan and his research team; they have taken much effort for provding hands on training.

- Mr.R.Anburaj
- Ms.V.Gomathi
- Mr.K.Saravanakumar
- Ms.N.Asmathunisha
- Mr.S.Anandhan
- Ms.G.Abirami
- Mr.Sunil Kumar Sahu
- Ms.Kayalvizhi
- Dr. N. Sithranga Boopathy

Finally the day was end up with rapporteur's report.

FORTH DAY REPORT

(October 8, 2011)

(Rapporteur: Dr. T. Ganesh)

On the 4th day (i.e. 8th October 2011) of the training course, four presentations were delivered, three in the morning session and one in the evening session including hands-on practical session by Prof. S. Ajmal Khan on Biodiversity Assessment.

1. Importance & Methods of Assessing the Coastal Biodiversity by Prof. S. Ajmal Khan

The first lecture of the day was presented by Prof. Ajmal Khan on "Importance & Methods of Assessing the Coastal Biodiversity". He started with a quote emphasizing that the more and more torture the data the more information or inferences can be derived. He explained well about reasons for valuing biodiversity with suitable example and supported theme of diversity indices are continued to be the central theme of ecology. He said that choosing of right index is important aspect. There are several indices namely biodiversity, biological and ecological indices to understand the health of ecosystem from the collected data. The assumptions of biodiversity assessment can be based on species, individuals or comparable units. Sample size is also another area, where considerable importance should be followed. Sample size can be confirmed by using rarefaction techniques. He showed several examples of ecological data, where the rarefaction curves are significantly varying based on the sample size.

Further, the importance of pre-treating the collected data was demonstrated by using different types viz., standardization, transformation (square root, fourth root, log, presence/absence), normalization (in particular environmental data). He explained how to calculate various diversity indices namely Margalef's, Shannon-Weiner, Pielou's, Brillouin, Simpson, Hill, etc. The merits and demerits of each index were taught.

Finally, Dr. Ajmal Khan was detailed the demerits of conventional diversity indices and their failure in explaining the species' phylogenetic length are relatedness in a given habitat. The importance of taxonomic-based diversity indices viz., Average taxonomic distinctness index, phylogenetic index, total taxonomic distinctness, etc. was narrated in detail.

The lecture given by Prof. Ajmal Khan was very useful to understand different diversity indices and importance of using different indices for the different datasets to understand the biodiversity of the environment.

2. Genetic Diversity: Molecular Tools by Dr.T.Somasundaram

Dr. Somasundaram lectured on different techniques of molecular tools for assessing genetic diversity. He explained role of genetic markers in the molecular techniques. Dr. Somasundaram supported the importance these techniques by resolving the following

- Ascertaining pedigrees / relatedness
- Re-description of phylogeny
- Phylogeographic patterns
- Gene flow patterns

He said that DNA markers are more useful / powerful that of protein markers and explained various nuclear DNA markers (RFLD, RAPD, AFLP, microsatellites, sNPs). The principles polymerase chain reaction (PCR) and the real-time PCR were taught

The protocol or different steps involved in RAPD and AFLP were explained with the experimental data and pictures. In addition, Dr. Somasundaram clearly detailed the methods of SNPs, mitochondrial DNA markers and DNA barcoding.

3. Role of plant biotechnology in conservation and production of medicinal properties by Dr. Ravinder Singh.

Dr. Ravinder Singh, one of the participants of the training course delivered lecture on role of plant biotechnology and production of medicinal properties. He explained various aspects in effects of hormones on callous biomass production from *Premna* sp.

4. Geochemistry of Mangrove Ecosystems by Ms. Swati Sappal

Ms. Swati Sappal, one of the participants of this training course presented an account on geochemistry of mangrove ecosystem. She explained various aspects chemical parameters influencing the distribution mangrove plants and threats due to the some of the natural calamities e.g. tsunami. She said that the tsunami caused considerable accumulation of sea-based heavy metals in the Pichavaram mangroves. This kind of studies can be carried out by using biomarkers. She

explained the importance of using biomarkers in the sea-level change and/or climate change related studies.

4. Assessment of Biodiversity by Prof. Ajmal Khan

Prof. Ajmal Khan demonstrated 'how to process data and calculate species diversity univariate and multivariate analyses by using ecology/ statistical software viz., PAST and PRIMER v.6. We were able to understand the data analysis by using mangrove data as an example. Dr. Ajmal Khan clearly demonstrated the data analysis by using PAST and PRIMER while calculating diversity indices and cluster and MDS analyses.

Signature

(Dr. T. Ganesh)

FIFTH DAY REPORT

(October 9, 2011)

(Rapporteur: Mr. Agus Ariyanto)

BARCODING AND BIOINFOEMATICS by Prof. Ajmal Khan (9.30 – 10.30 a.m)

1. Barcode is standardized approach for identifying plants and animals using minimal sequences of DNA. The primary goal is to develop an accurate, rapid, cost effective, and universally accessible DNA based system for species identifications.

2. Barcoding plays a critical role in regulating trade in endangered or protected species or products. It will also contribute importantly to the implementation of recognized need for management at an ecosystem.

3. There are some organizations that devoting the growth and use of DNA barcode such as: the consortium for the Barcode of Life (CBOL). CBOL is working with Gen Bank and its partner DNA repositories EMBL (European Molecular Biology Laboratory) and DNA Data Bank of Japan (DDBJ) to construct a global library of reference barcode sequences.

4. The Barcode is also provided important insight into evolutionary processes. The Barcode region for animals, a segment of the mitochondrial cytochrome oxidase I (COI) gene, is a sentinel for shifts in nucleotide composition and in rates of evolution across mitochondrial genome. Measures of sequences divergence in the barcode region further correlate with those in the nucleus, meaning that barcode data provide contextual information that is valuable in selecting taxa for other investigations. As a result, the immense horizontal survey of sequence diversity executed by DNA Barcoding will deliver new insights into the factors modulating rate of molecular evolution. It will also provide the most densely parameterized record of sequence information of any gene, enabling delicate investigations into pathways of COI protein evolution.

5. Methods of Barcoding assembly

   In order to examine the ever-growing number of the world's species that are included in this survey, a variety of method and technique have been employed. The act of collecting should always be accompanied by through documentation.

6. Remembering that 10-100 millions of species have not been identified, DAN Barcode is a promising tool to the identification of biodiversity, quickly and cheaply.

7. The application tool as shown by Prof. Ajmal Khan Presentation has confirmed that homo sapiens have relatively similar DNA barcode regardless where they live. That reminds us that human being (*Homo sapiens*) is only one species among 10-100 millions species on Earth. But human activities have caused a lot of species extinction.

8. DNA sequence variation can aid understanding history of animal and plant.

9. Dr. Paul D.N Hebert is a Father of Barcoding from Canadian Centre for DNA Barcoding, Biodiversity Institute of Ontario, Canada.

SEAGRASS by Dr. T. Thangaradjou (10.30 – 11.30 a.m)

1. Seagrasses are the marine flowering plant that successfully grows in tidal and sub tidal marine environment.

2. Ecological factor Important for seagrass:
   - Water depth, it is depended on light density
   - Temperature
   - Salinity

3. There are 14 genus and 72 species in the world and 6 genus, 14 species founded in India.

4. Global Seagrass Distribution :
   - Temperate North Atlantic
   - Tropical Atlantic
   - Mediterranean
   - Indo - pacific

   A half seagrass world located in tropical area

5. Description some species of seagrass

- *Enhalus acoroides, Halophila beccarii Asch, Halophila decipiens, Halophila ovalis, Halophila ovate, Thalassia hemprichii, Cymodocea rotundata, Cymodocea serrulata, Halodule pinifolia, Halodule uninervis, Halodule wrightii, Syringodium isoetifolium*

6. Importance of Seagrass;
   - Form one of the most productive ecosystems of the world
   - As primary producers
   - Seagrass meadows enhance the biodiversity and habitat diversity of coastal water. It has been estimated that over 153 species of microalgae (mostly diatoms), 359 species of macroalgae and 178 species of invertebrates are found on the seagrass as epiphytes and epizooties.
   - As Seagrass meadow also acts as nursery and foraging area for a number of commercially and recreationally important fish and shellfish and other organisms. There are about 340 animals including green turtles which directly feed on the seagrass and their epiphytes.
   - Seagrass contribute as an important carbon sink due to their slow rate of decomposition, carbon fixation of seagrass and nutrient cycling in the marine environment
   - Reduce lots of land based on pollution.
   - Seagrass improve water quality by acting as roughness elements that deflect currents and dissipate the kinetic energy of the water.
   - Seagrass are used as filling material for mattresses and shock absorbing materials for the transport of glassware.
   - Seagrass also used as raw materials in paper industry and production of fertilizer, fodder and feed. Most of the seagrass are used extensively as soil fertilizer for coconut and other plantations.
   - Seagrass are used as food by the coastal populations as the nutrient value of the flour derived from the seeds is comparable to that of wheat and rice in terms of carbohydrate and protein. E.g. *Enhalus acoroides*
   - Mangrove, Seagrass and Coral Reef act as buffers between mangrove and coral reef ecosystems.

7. Assessment of seagrass Biomass

   There are some methods for assessment seagrass:
   - Frame sampling (quadrant)
   - Coring and block cutting

- Remote sensing

Quadrant methods is widely used due to economically feasible.

8. Threats to Seagrass
   - Paper shell collection
   - Fishing on the seagrass meadows

SEAWEED by Dr. Anandaraman (11.30 a.m – 12.30 p.m)

1. The term "seaweeds" it doesn't have any taxonomic value. Seaweeds are macroscopic algae found attached to the bottom in relatively shallow coastal waters. They grow in the intertidal, shallow and deep sea areas up to 180 meter depth and also estuaries and backwaters on the solid substrate such as rocks, dead corals, pebbles, shells and other plant materials.

2. Seaweeds divided into three divisions
   - Chlorophyceae (green algae)
   - Phaeophyceae (brown algae)and
   - Rhodophyceae (red algae)

3. About 624 species have been reported in India with potential of 77,000 tons (wet weight) per annum.

4. Collection Seaweeds
   - Collection only during low tide period, variety of plants are expected
   - Idea period, Monsoon and post monsoon suitable season for collection.

5. Systematic of Seaweeds
   - Morphology
   - Development
   - Cytology
   - Life History

   Secondary Information
   - Biochemical data
   - Flagella ultra structure

6. Description of Species some species of sea weeds such as :
   - *Enteromopha clatharata*
   - *Enteromopha campressa*

- *Chaetomorpha aerea*
- *Chaetomorpha linum*
- *Chaetomorpha crassa*
- *Cladophora glomerata*
- *Dichotomosiphon tuberous*
- *Padina gymnospora*
- *Rosenvingea intricate*
- *Hypnea musciformis*
- *Hypnea cornuta*
- *Spyridia fusiformis*
- *Calaglossa leprieurii*
- *Polysiphonia platycarpa*
- *Bostrycia radicant*

6. Uses of Seaweeds
   - As a food for man
   - Seaweeds have been used for human food since ancient time
   - Seaweeds are eaten for their food value flavours and colours and texture and are typically combined with other type of food.
   - Fresh and dried and processed for human consumption
   - Cheap sources of minerals and trace element
   - Seaweeds are used as manure
   - Medical Uses, for the treatment of goiter and other glandular disease in Japan and China.
   - As Healing the wound, anti cancer, cough
   - Industrial uses of Seaweeds, Agar-agar.
   - Alternative Livelihood, recommendation for seaweeds cultivation, integrated cultivation of shrimp

7. Threats, such as trawl net operation

PRESENTATION by Mr. Mali Mukeshkumar (12.30 – 13.30 p.m)

Mr. Mali Mukeshkumar presented about mangrove in Gujarat

1. Coast line of Gujarat 1,650 km
2. Data taken from some area such as
   - Kuchch area 775 km^2
   - Saurashtra 172 km^2
   - South Gujarat 99 km^2
3. Mangroves species founded 13 species
4. Some Threat of Mangroves
   - Natural Threats, soil erosion, Algae deposition, Sand Deposition

- Anthropogenic pressure, Industrial development, Jetty and Port Construction
- Firewood Collection
- Sand Mining
- Salt pan and Aquaculture
- Water Pollution

5. The last he presented about proposal for conservation of mangrove of South Gujarat

Signature

(Mr. Agus Ariyanto)

SIXTH DAY REPORT

(October 10, 2011)

(Rapporteur Mr. P. Ragavan)

The day started with the brief introduction of Marine super star i.e Microbes by Dr. K.Kathiresan. Then Dr. Jayalakshmi delivered a lecture regarding the marine microbiology like methods of studying the marine microbes, various instruments used for sample collection, various methods of isolation and culturing methods like serial dilution pour plate, spread plate methods etc. Then she arranged a practical session in this we learned the basic of staining ie Gram staining, capsule staining, MPN etc. She also describes the methods and instrument used in culturing of anaerobic marine bacteria.

Then Dr. Kalaiselvam delivered a lecture on marine fungal diversity. In this he explained the how fungus plays an important role in biodegradation and bioremediation, commercial importance of fungus in the production of antibiotics, food, organic acids etc. He also explain the pathogenic nature of fungus in plant and animals including humans.

Then Dr. Sampathkumar explain the importance of planktonic community in marine environment by both theoretically as wells as practically. After the lunch we collected the plankton samples from Vellar estuary by planktonic net and analyzed using light microscope .we identified about 10 phytoplankton and 5 zooplanktons.

One of the participants. Dr. Ganesh from Pondicherry University, delivered a lecture on Meiofaunal diversity in Port Blair bay in Andaman and Nicobar Islands (ANI). He also describe the biodiversity richness in ANI with respect to meiofaunal diversity and lack sufficient data regarding the meiofaunal diversity in India. Dr. Sivakumar had given a wonderful lecture regarding Actinobateria in Marine important. He explains the nature and commercial importance of Actinobacteria by theoretically as well as practically. In practically session we observed the nature and characteristic of Actinomyces through microscope and learned about the how molecular tools are used in Actinobacteria identification and nomenclature. Although, most of the participants are not familiar with tiny creature of the word i.e microbes, meiofauna and Planktons, at the end of the day we were able to say something regarding microbes, meiofauna and Planktons. This is the great success of this program.

Signature

(Mr. P. Ragavan)

SEVENTH DAY

(October 11, 2011)

(Rapporteur: **Nguyen Van Minh- VietNam**)

MORNING 9h 30′

Diversity of Meiofauna Prof. Dr. Olivia J Fernando

- Macrofauna:

  Dominated by moluses & arthropods.

- Meiofauna:

- Nematoda:

  - ✓ Generally represented by Nematoda, Harpaticoda...v.v
  - ✓ More specialized- Hydrozoa, Nemertinea.v.v.

- Diversity and sediment

  - ✓ *Diversity decreases in fine sediment.*
  - ✓ *Vertical and horizontal distribution cannot be generalized.*

- Why is Meiofauna important?

  - ✓ *Trophic linkage.*
  - ✓ *Huge habitat.*
  - ✓ *Biomineralization & Rapid cycling of materials sentinels for anthropogenic inpas.*
  - ✓ *Weird phyla.*
  - ✓ *Phylogeny.*

- Meiofauna

  - ✓ *Small body size (42µm – 1mm)*
  - ✓ *90% of All species of the terrestrial environment are member of phylum arthrophora.*
  - ✓ *In the marine environment bulk of diversity is spread over many phyla*

- Macrofauna and meiofauna have a negative relationship

  - ✓ *Competition*
  - ✓ *Medation and*
  - ✓ *Amensalism.*

- Factors affecting abudance in mangrove.

  - ✓ *Nature of soil*
  - ✓ *Sediment depth.*
  - ✓ *Season.*

- ✓ *Domilat tree rabinity and tannin.*

- Seasons attributed for variation of meiofauna in mangrove.

11h Have Tea break

And then

Free Living Nematodes of Pitchavaram Mangroves Dr M.A Sultan Ali

- **HABITATS:**
  - ✓ *Intertidal shore.*
  - ✓ *Bottom mud submerged in water- rich in organic matter.*
  - ✓ *Various niches in mangroves.*
- **NICHES/SOURCES:**
  - ❖ *SEDIMENTS*
  - *Collected using*
    - ✓ *Glass Petridish.*
    - ✓ *Hand made plastic corer (3 cm in diameter and 10 cm in length.)*
    - ✓ *Any other available Grab in case of submerged mud.*
  - ❖ *Decayed parts of mangrove vegetation (roots, leaves ,etc.)*
  - ❖ *Filamentous algae from intertidal area.*
  - ❖ *Epiphytic algae from the roots of Rrhizophora.*
  - ❖ *Epiphytic algae and other detrital particles from the substrata like stones , molluscan shells etc.*
  - ❖ *NB: (Collected by simple scrapping).*

- Isolation and preservation of nematodes.

- Checklist of nematodes of pichavaram mangroves

- Predominant forms and continuous breeders :

- ✓ *Terschellingia longicaudata*
- ✓ *Paracomesoma longispiculum*
- ✓ *Desmodora (pseudochromadora) luticola*

- Patchy distribution depending on the suitability of the niches :

- ✓ *Araerolaimus longicauda*
- ✓ *Spirinia (Perspiria) striaticaudata*
- ✓ *Diplolaimella ocellata*
- ✓ *Parodontophora breviseta*
- ✓ *Metalinhomoeus longiseta*

- Factors determining the pattern of distribution :

- ✓ *Post monsoon and summer – favourable seasons.*

- ✓ *Normal life pattern seems to depend on the optimal range of temperature between (25 ^{0} - 31 ^{0} C) and salinity above 10 %*
- ✓ *Organic carbon of soil as a limiting factor (above 3 % seems to affect population growth of most of the nematodes except predominant forms.*

- <u>Different niches in mangrove ecosystem favour the life of free</u>

<u>living nematodes :</u>

- ✓ *Decayed leaves – favourable niche for Desmodorid and Comesomatid forms*
- ✓ *Decayed wood and rhizophore root system – favourable niche for Enoplid forms such as <u>Adoncholaimus</u> spp. and <u>Viscosia</u> spp.*
- ✓ *Epiphytic algae on root system – a favourable niche for Chromadorid forms as Epigrowth feeders.*

Practicals

Saw:

Vescasia sp. Dexmastoda sp. Acriolymi form. Chromatoda form.

Polychaetes : Dr P. Murugesan

Polychaetes are marine benthic invertebrates

- ✓ Benthos – the organisms which live in or on the bottom of any body of water
- ✓ Broadly benthos can be divided into
- ✓ Phytobenthos pertains to all the plants (sea grasses, Sea weeds etc.)
- ✓ Zoobenthos all animal matter inhabiting the bottom
- ✓ **Based on size Infauna still further divided into**
- ✓ **Mega fauna**
- ✓ **Macro fauna** (0.5mm size) polychaetes, amphipods, tanaeids
- ✓ **Meio fauna** (0.062mm – 0.5mm) nematodes, ostrocodes, echiurids, copepods, phoronids, gastrotrichs
- ✓ **Micro fauna** (< 0.062mm) protozoans, bacteria etc.

Collection of Polychaetes

When identification is not possible to species level….

- ✓ In some cases, only one species within a genus; this can be indicated by "sp" eg: *Capitella* sp. and if it is more than one species within a genus, indicated by "spp." *Capitella* "spp."
- ✓ Abundance / biomass determination
- ✓ Data reporting

Importance of Polychaetes

- ✓ Polychaetes serve as food for bottom feeding fin and shell fishes.
- ✓ Used as 'bait organisms' in fish angling industry.
- ✓ Important resource in aquaculture for Crustacea – since it provides correct balance of PUFA which are very much essential for maturation and egg production of shrimp brood stocks.
- ✓ Can consume as food – E.g. *Eunice viridis.*

Practicals

Saw:

Polychaete (*Cassura coasta*), *Goniada emerita, Nephtys dilranchis, Prionospia sexoculata, Jasminesia elegans*

AFTERNOON

Amphipods – Dr. Lyla

What are Amphipods?

- ✓ Amphipods are small to medium sized crustaceans.
- ✓ The word Amphipoda means two kinds of pods or limbs
- ✓ The order Amphipoda, which contains nearly 7,000 described species
- ✓ Constitute an important element of aquatic energy cycle by converting plant and animal proteins into suitable food for larger animals.
- ✓ Several qualities make amphipods - an ideal organism for metal toxicity testing because of
- ✓ its high sensitivity to metals
- ✓ its wide distribution
- ✓ Its ecological importance
- ✓ Its amenability to laboratory culture
- ✓ Short generation time
- ✓ And easy collection from natural

Lifestyle.

- ✓ Species living on seaweeds may be herbivores
- ✓ Those in mud and sand feed on bacteria on the surface of particles
- ✓ Others are scavengers on dead animals or plants
- ✓ One group of families lives in tubes spun from silk glands in their legs
- ✓ Sometimes forming colonies, these amphipods when alarmed can completely conceal themselves inside the tubes that may be 2-3 times their body length
- ✓ The only part of the body that protrudes from the tubes is the antennae that have long hairs which are thought to capture food particles.

Development.

- ✓ Development is direct.

- ✓ The ventilating current also provides for the ventilation of eggs in the marsupium.
- ✓ The marsupium of most gammarideans bears interlocking marginal setae, which aid in preventing the eggs from falling out
- ✓ Unlike crabs and shrimps amphipods are not released as zoea that develop into adults after stages of metamorphosis. Instead when released they look very much like their parents
- ✓ Some species show parental care of their young after they leave the brood

Practicals

Saw:

Grandidierella gilesi, ***Eriopisa chilkensis,*** ***Ampellica aequycornis***

Biodiversity of Mangrove Shrimps and Prawns: Dr.P.Soundarapandian

Shrimps

According to Holthuis (1980)

- ✓ 33 genera
- ✓ 2500 species
- ✓ Less than 300 species are commercially important

In India:

- ✓ 52 species , 8 are economically important
- ✓ Global distribution of shrimps and prawns in mangrove areas are 154 Species
- ✓ In India 48 species and 13 species in Pichavaram mangroves

Prawns

Sub Family Palaemoninae includes:

- ✓ 21 genera
- ✓ 300 species
- ✓ 85 species have fisheries importance

Sub Family Pontoninae includes:

- ✓ 72 genera
- ✓ 416 species

DIFFERENTIATION OF SHRIMPS AND PRAWNS

- ✓ **SHRIMP**

  Second pleura of the abdomen overlap

  Only first segment

  First three pairs of walking legs (Periopods) are chelate.

  Male – Smaller

  Female – Larger

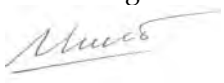
- ✓ **PRAWN**
  Overlap first and third segment
  First two pairs are chelate
  Male – Larger
  Female – Smaller
- ✓ **SEXUAL ORGANS OF PRAWN**
  Female genital pore – third pair of periopods
  Male genital pore – fifth pair of periopods
- ✓ **EGGS**

Presentation of Dr. Zannatul Ferdoushi : On Crab fattening in Bangladesh.

THE END

I LOVE MANGROVE

Signature



(Mr. Nguyen Van Minh)

EIGHTH DAY

(October 12, 2011)

(Rapporteur : Ms. Kanchana Peeris)

9.30 -10.30 a.m. – Presentation on Crabs (Theory) by Professor S. Ajmal Khan was carried out. There Diversity of Brachyuran Crabs was discussed. He explained typical characteristics of the Crabs and how to identify them as male and female by observing their dorsal side. And their distribution can be pelagic, benthic burrowing and terrestrial in mode of life. So crabs are present in all types of environments. 80% of the macro fauna of the mangrove ecosystems are occupied by crabs. Highest biodiversity of crabs has been recorded in Indonesia. There are 5 families of crabs-Grapsids, Ocypodids, Portunids, Xanthids, Gecarcinids.

In particular the sesarmids have got the extreme diversity and rich in the Indo Pacific mangrove areas. Then the role of crabs in the mangrove ecosystem was explained. As they feed on degrading leaf litter the decomposition is done by them. Also their faeces are rich with C, N, P and trace material which provide food for other organisms. Burrowing habit of these crabs helps for the aeration and oxidization of the mangrove environment. Play a major role in food chain. In Pichavaram area 5 plots has been selected and species richness was calculated.

About the five families and their species was discussed separately. Genetic diversity was discussed. There to understand flow of genes it has been collected data from different places like Kenya, Madagascar. Regarding the Biodiversity there are 38 spp., 21 genera and 5 families. Socio Economic Value was discussed as crabs have very good demand as restaurant item. Indirect economic values, Socio cultural value were discussed. And one Indian Case study on Pichavaram Mangroves and Vellar Mangroves crabs-the results as maps, abundance, tables for each species and Cluster analysis were shown.

10.30a.m.-12.00 noon - One practical class was guided by Prof. Ajmal Khan, Dr. R. Ravichandran, Dr. S. M. Raffi and Dr. S. Saravanan where we could identify the different species of crabs and their parts by ourselves.

12.00 -1.30p.m.- Theory knowledge based presentation of molluscs was done by Prof. A. Shanmugam. It was titled as Identification of Molluscs and their conservation strategies. First Brief introduction about Molluscs was given and morphology was discussed and their feeding habits types of food were mentioned. And their ecological roles like decomposition, herbivores were discussed. And Global Molluscs Diversity has been discussed. And Important of Molluscs was

mentioned – as food, as currency, as trade good etc. Two classification systems used to classify the molluscs was mentioned. Professor discussed about the classes separately. Collection of Molluscs –Qualitative and Quantitative estimation were mentioned. And Need for the conservation since the species are extinction with an alarming rate- 100- 1000 times higher rate than the evolution of human species. And Factors affecting Biodiversity - irritation and Over exploitation in some locations, human activity stress in the natural beds or habitats since increasing of the population number etc. Conservational strategies – Regulation of mesh size of the fishing nets, Issuing licence for fishing and imposing ban on fishing in the spawning season etc. Especially IUCN categories can be done for molluscs' species.

Also molluscs can be categorized according to their habitat – as infauna, Epifauna and Arboreal. Also the biodiversity measurements – Species diversity, Species richness and evenness was considered regarding the molluscs also mentioned.

1.30 -2.00p.m. - We had the lunch break.

2.00-3.00p.m. - The rest of the lecture on molluscs was done by Prof.A, Shanmugam.

3.30- 4.15 p.m. - Laboratory session on identification of molluscs –where we identified various types and species of molluscs.

4.15-4.30p.m. - We had the tea break.

4.30-5.00p.m. - The Presentation by Ms Eni Hidayati on Coral Reef Conservation education was presented.

Then the day ends with rapporteur's report.

Thank you

Signature

K. Peeris

(Ms. Kanchana Peeris)

NINETH DAY

(October 13, 2011)

(Rapporteur : Dr. Zannatul Ferdoushi)

9.30 -10.30 a.m. – Presentation on Mrs. Khodeeyoe Pornchai from Thailand. At first she presented the culture and some important information of Thailand. Then later she described the mangrove in Thailand and the aims and activities of her research centre (Pukhet Marine Research Centre). Their activities mostly focused on the biological production, total production monitoring, monitoring oceanic parameters etc. they identified 12 species of sea grasses so far. She also presented some information on the importance of mangrove, destruction of mangrove and rehabitation of mangrove in Thailand. At last she finished her presentation by a nice picture of *Avicennia marina* having 352 cm girth and 35 m length

10.30 - 11.30a.m - a presentation on finfishes by Prof. V. Ramaiyan was carried out. He is working on fish taxonomy. He focused on the method of collection and preservation of fishes for better identification. For better identification he presented some slide on key characters of fish. We learnt about the taxonomic characteristics of fish, their meristic and morphometric characters.

He also described about the key characteristics of Sciaenidae, Sillaginideae, Siganidae, Scorpaenidae, Sphyraenidae, Serranidae, Polynemidae,Mullidae, Exocoetidae, Clupeidae, Centromidae, Carangidae, Balistidae, Aridae,

At 11.30 p.m a practical session was conducted by Prof. V. Ramaiyan. We identified some fishes with their key characteristics with the help of him. Among them some clown fishes, mackerel, angel fishes, and some fishes from elasmobranch group are important.

At 12.00 p.m we had a tea break.

At 12.30 p.m a theoretical class on elasmobranch was presented by Dr. V. Ravi. He mentioned three groups of elasmobranch sharks, Ray and skates.

He also described some uses of sharks and their by products. The shark meat, fins and skin are taken as food. Beside these it has an industrial importance as aquarium live species. In India 47 species of sharks 30 species of ray and 8 species of skates are identified. He also described the differences of different kind of scales and the difference of male and female fishes of elasmobranch by showing the

photos of claspers and scale. He also showed us different forms of spines of ray fishes.

1.40-2.00p.m. - We had the lunch break.

2.00-3.00p.m.-The rest of the lecture on mudskippers was done by Prof. V. Ravi. A wonderful video on mudskippers was also shown during the class session.

We learnt about mudskippers which is mostly distribute in marine and brackish water and occasionally found in freshwater, mostly tropical and subtropical areas. We also learnt that they are the only fishes known to burrow and reside in the intertidal mudflats or mangrove swamps of the Indo-west pacific region.

At 3.00pm to 5.30pm class on GIS was carried out by Dr. T. Thangaradjou.

We learnt that GIS is a spatial data based tool which is based on without making a physical contact. It is a science of making inference of an object. He described the advantages of GIS. It is better than other method, can cover large area, a multidisciplinary utility which has digital data compatibility.

At 4.00 pm we had a tea break.

At last a practical session was carried out by Dr. T. Thangaradjou with his scholars using ERDAS IMAGINE system.

Signature

(Dr. Zannatul Ferdoushi)

TENTH DAY

(October 14, 2011)

(Rapporteur: Ms. Eni Hidayati)

On the 10th day of the training, we had 4 lectures, 1 visit to temple of Babaji, and 2 presentations from the participants. The first lecture is on fish parasites by Prof. Veerappan, the second is on coastal medicinal plants by Dr. Ramanathan, the third is on Reptiles by Prof. Srinivasan, and the fourth is on Birds by Dr. Sampath.

During the fish parasites session, we learned about what are the parasites (mainly isopods-crustaceans, worms-nematodes and acanthochepalans, mangrove gastropod-larval trematodes-vector for some tropical diseases), how to examine the parasites, and some of the ways of how parasites may do harm to their hosts. Studying fish parasites is important because several parasites found in fish can infect human as non-traditional host. These parasites may also be a good species indicator for global warming because there have been some reports indicating that increasing in temperature positively correlates with the increasing abundance of fish parasites. In addition to lectures, we also had practical session on fish parasites identification.

During the second lecture, we learned about the medicinal values of some coastal plants along the East Coast of India. Dr. Ramanathan conducted a comprehensive survey along the East Coast of India to create a database for coastal medicinal plants and to save the genetic resources. These baseline data would help in the future for conservation, development and utilization of medicinal plants in coastal areas. The survey on the coastal medicinal plants was conducted using two methods: i) collection of information from elders of fishermen communities of coastal environment through personal enquiry method and ii) collection of plants that exist in coastal areas and being identified for their medicinal values through referring to standard literatures. Awareness programs were also organized in 5 coastal villages for coastal fishermen community. During the practical session, we identified some of the medicinal plants.

Some of the medicinal values from different species are listed below:

Species Name	Medicinal Values
Avicennia officinalis	Anti –HIV, diuretic, aphrodisiac
Bruguiera cylindrica	Jaundice, antiviral
Ceriops decandra	Nasal infection and CNS stimulant, jaundice, ulcer
Excoecaria agallocha	Leprosy, analgesic, antimicrobial, antioxidant,

	dermatitis, antiviral.
Rhizophora apiculata	Diarrhea, jaundice, typhoid, antiseptic, insecticide, antiviral, antimicrobial, antifeedant.
Rhizophora mucronata	Elephantiasis, AIDS, jaundice, diabetes, anti ulcer, anti inflammation, CNS stimulant, anti pyretic activities.

There are still a lot of species explained by Dr. Ramanathan. For more detailed information, please consult Dr. Ramanathan. One thing I would like to highlight is that this topic reminds us about the importance of saving mangroves ecosystem for the sake of its potential medicinal values which are very important for human beings.

During the lecture about reptiles, we learned about the reptiles inhabiting the mangrove ecosystem. Twenty five species of reptiles were reported from south east Asian countries mangroves, while 39 reptiles were reported from east coast of India. Reptiles including crocodiles, alligators, lizards, snakes and turtles that live in mangrove systems are mostly rare and endangered. In the practical session, we visited the museum of C.A.S in Marine Sciences Annamalai University. There we learned how to identify snakes (sea snakes and terrestrial snakes).

During the lecture about birds, we learned about birds diversity and their current status, requirements for birds study, how to identify birds, usefulness of birds, conservation measures, and some theme for researches that we can take up on wetlands birds. The lecture about guide to bird identification was very informative and easy to follow.

Our visit to the Babaji Temple was a wonderful experience where we were taught how to feel the magnetic power. Then back to class, Ms. Kanchana Peeris from Sri Lanka presented about the biodiversity of mangroves in Sri Lanka and their current status. Following that, Ms. Agus Ariyanto from Indonesia presented about conservation strategies in Indonesia conducted by the government. Finally, just like the other days, the 10th day of the training was also passing by so fast with lots of knowledge being delivered to us. Thank you so much for all the speakers!

Signature

(Ms. Eni Hidayati)

ELEVENTH DAY

(October 15, 2011)

(Rapporteur: Md. Masud Rana)

Subject: Economic Valuation of Mangroves

Speaker: Prof. N. Ramgopal

Time: 9.00 a.m

Discussed matters:

- Economic Reason
- In every case have economy.
- Time allocation is the matter of valuation anything.
- Economic valuation is related to so many thing-
  - Pollution
  - Environmental protection
  - Exploration
  - Availability
  - Production
- Economic of culture
- Basic theory
  - People react to incentives/ benefits
  - Costs and benefit in economy
  - Sustainability
  - Effort to spent
  - Economic valuation
- ✓ Cost means- not only the expenditure but includes opportunity cost
- Methodology of valuation
  - Valuation- how much people are willing to pay
- Types of mangrove valuation
  - Use value and non-use value
  - Goods + services
  - Future value
  - Aesthetic value
  - Metaphor- compare to unlike things
  - Production function
  - Inputs-outputs
  - Benefit transfer method of valuation
  - Travel cost methodology
  - Revealed preference method

- Stated preference method
- Contingent method
    - DVM- Deliberating monitory valuation

Remarks: The lecture was good and enjoyable. There was no PowerPoint presentation. It is a negative side of this lecture. In future power point will b available I hope.

Subject: Video show on Eco-friendly aquaculture farm
Speaker: Dr. Elanzhian
Time: 11:00 a.m
Discussed matters:

- This is an inventory of Mr. Elanzhian
- It is an interesting model at can be replicated to any mangrove forest.

Remarks: It was a nice video.

Tea break

Subject: Aquarium keeping of fish biodiversity- theory and demonstration
Speaker: Dr. T.T. Ajithkumar
Time: 11.40 a.m
Discussed matters:

- Clown fish breeding: A livelihood option to coastal community.
- Marine ornamental fishes- living jewels of the ocean.
- Fresh water ornamental fishes.
- Marine water ornamental fishes.
- Distribution among the coast of India.
    - Andaman & Nicobar Island.
    - Lakshadweep.
    - Gulf of Manner
    - Gulf of Kutch.
- World scenario of ornamental fish trade.
- Marine ornamental fish under water.
- Destructive fishing practice for catching ornamental fishes.
    - Blasting
    - Cyanide application
    - Fishing with iron cage
    - Fishing with bamboo cage.
- Climate change-bleaching of corals causing environmental hazards.
- Prospects of ornamental fish breeding.

- Top ten marine ornamental fishes in the trade.
- Clown fishes- a success story
- Sexual maturity and spawning of clown fish
- Pair forming and spanning
- Technology delivered for different clown fishes.
- Brooders ready to spawn
- Morphological changes of eggs.
- Hatchery breed clown.
- Damsel fishes brood stock development.
- Hatchery development of damsel.
- Packing and transportation.
- Proper installment of a hatchery.
- Water quality of ornamental fish.
- Live feeds.
- Clinical treatments
- Treating infected fishes with mangroves.
- Awareness program for value of ornamental fish.
- Training on marine ornamental fish culture.
- Economics: Back yard hatchery

Practical: Hatchery centre observation of marine ornamental fishes.

Remarks: This lecture was very good and useful in practical.

Subject: Threats to mangroves.

Speaker: Prof. T. Balasubramanian

Time: 01.20 p.m

Discussed matters:

- Natural threats.
- Man made threats
- Requirements of statistics and database to mitigate threats to mangroves.
  - Chemical data
  - Pollutants data
- Monitoring program is essential
- Richness of biodiversity
- Biological parameters
- Climate change
- Developmental process

Remarks: This lecture was too short. There was no PowerPoint. This course is very important.

Then we had lunch

After lunch we had field visit to eco-friendly mangrove aquaculture farm at Palazhar. This is new approach. Then we had visit to shrimp cultivation. It was a scientific model for shrimp culture we learnt more from that field visit.

Signature

(Md. Masud Rana)

TWELTH DAY

(October 16, 2011)

(Rapporteur: Mr. Bipinkumar)

This is Mr. Bipinkumar Khokhariya rapporteur on Sunday 16/10/2011.

The day 16/10/2011 stated with Pondicherry visit with Prof. Dr. Ajmal Khan and Prof. Dr. K. Kathiresan.

- I thank Prof. Dr. K. Kathiresan for having demonstrated the success story of Ariyankuppam mangrove forest.
- The Ariyankuppam mangrove forest was artificial created by Professor and his team in the year of 1995
- Even in the polluted environment they have developed the luxuriant growth of mangrove forest.
- We really impressed with his efforts taken against to developing mangrove forest even in polluted environment.
- Followed by this, visited Auroville temple at Pondichery. After the heavy lunch, visited Pondicherry University, Dr. Ganesh, he explained about the various department and its ongoing research. As a rapporteur I thanks Dr. Ganesh also.
- And the day end up with Aanandhabhavan dinner

My special thanks to my beloved Prof. Ajmal Khan sir and Prof. K. Kathiresan and Friends.

THANK YOU

Signature

(Mr. Bipinkumar Khokhariya)

THIRTEENTH DAY

(October 17, 2011)

(Rapporteur : Mrs. Khodeeyoe Pornchai)

09.30 – 10.30 a.m. Ecological Services of mangrove by Prof. Kathiresan

Ecological Services of mangrove

1.Enrichment of biodiversity and fish production

2.Production of forest products

3.Removal of pollution

4.Coastal protection

Ecology function 1

(Nursery grounds, feeding & breed ground for crap prawns, mollusc, finfish, bird, reptiles & mammals)

- Provide 30% of all commercial fish species
- Producing annual catch of 30 million tons
- Mangroves support the fish by providing shelter, food& low predation pressure
- Mangrove helps in completing life cycle, proved with Banana prawn
- Literbag experiment for studying the change in decomposing mangrove leaves

And then he talks about Effect of Mangrove on fish resource of ecosystem

- Mangroves provide essential for microbes and microplankton
- Connectivity between coastal ecosystem increase fisheries when coral habitat in connect to mangrove the biomass of commercial fish sp in more than double in the Caribbean water

Ecology function 2

Mangrove as fodder

- 35000 kg of honey harvested from India away the honey bee by smocking of leave
- Milk in the honey from the comb

Ecology function 3 : pollution remove

- "Biofilters" 0f sediment, nutrient& pollution and explain about Carbon sequestration in ocean

Why Mangrove efficient?

- Mangrove have high levels of primary productivity than other tropical &temperate forests
- Below ground biomass is great AGB/BGB ratio 2-3 as against 4 in other forests

- Mangrove' carbon burial 50 time greater than tropical forest

Mangrove& carbon Sequestration

- Important role be to play in global carbon budgets & in the Proceed of mitigating climate change
- Mangrove restoration can be the new counter- measure of global warming
- Protect mangrove climate will be protect automatically
- Save mangrove climate will be save simultaneously

and explain for mangrove protect other marine ecosystem (Seaweed, coral reef and seagrass) and then he talk about Economic cast studies in Vietnam an in India
and he explain about Coastal Protection against wind cerrent & wave and about it's protect tsunami in 2004

09.30 – 10.30 a.m. Aquaculture: A Tool for Biodiversity Conservation & Eco friendly Aquaculture by Prof. S. Rajagopal

Biodiversity

The variability among living organism from all Sources including inter alias terrestrial marine and other Aquatic ecosystem and ecological complexes of which they are a part This includes diversity within species and ecosystem
And then he talk about Reason
In India bestowed with a rich biodiversity because of it strategle location and tropical climate

Biotops

Coast iotops likes mangroves, seagrass, coralreef, estuaries, backwater, creek, lagoon, saltbay, Island and neritic eater house avariety of organism

India status

India has more than 89 tauson species of marine organism. In the world with ashare of 7.28% and he talk about biodiversity of Mollusca, Crustaceans, Fish , in India

Threat Have

- Over fish
- Blast fishing
- Sedimentation
- Pollution
- Natural calamities
- And then he explain about
- Global climate change
- And about Coast and effect have
- Fishing and over exploitation
- The consequences of over exploitation of commercial species may lead to loss of genetic diversity

Blast fidhing this method

- Indroduced first by japaness fish
- Fillipino fishers also the introducer of

Pollution and Marine Litter

- Coastal area are effected by man
- Nutrient load

How can marine biodiversity best be conserved and managed?

- Reclamation of the habitat
- Reestablishment of the renewable resource
- Better protection of the coast outside marine protected areas in need
- The legal framworks of biodiversity conservation

He talk about Seahouse for distribution

- Seagrass and coral reef from the major habitat of pipefishes and seahouse
- All six species of pipefishes were collection from park Bay
- All the five species of seahorse could be recorded in Gulf Manna area

About Reproduction

- No sexual dimorphism in juveniles
- Adult males presence of blood pouch
- Monogamous pair bonding
- Males choos their partners
- Accepted pairs mate several time

And he show

- Stag of ovary
- Development of blood pouch
- Development of stages
- Development of eggs

Conclusion

- Aquaculture will have in reestablishment of lost species of diversity
- Aquaculture will increase the production and balance the demand and supply
- Aquaculture record the fishing pressure
- Aquaculture will improve socio economic condition of the local village

10.30 - 11.30 a.m Presentation about Status of mangrove forest in Bangladesh **by Mr. Masud Rana**

11.30 - 12.30 p.m Presentation about Determination of potential Area species suitability for mangrove restoration and conservation in Gujarat **by Mr. Bipinkumar**

02.00 -03.00 p.m By catch resources : by Dr. Raffi

Marine fisheries is sector is

- Contribute protein rich feed to the exploding populace

- Fish represent about 14 %of all animal protein and about 5 % of total protein intake
- Rate of consumption varies with in and individual country and between countries
- Employment generation
  - 8-10 million fishermen
  - Equal number of people in allied sectors
- Foreign exchange earning and nation earnings

Declining yield in fisheries in term of CPUE….A pathetic situation

- Annual fish production/active fisher
- Catch/unit effort.. declined

Reason

- Overexploitation
- Indiscriminate fishing practices
- Copture of brooder/juveniles
- Pollution
- Habitat destruction

Significance of By catch

- Annual discard from the world fisheries were estimated to approximately 20 million
- In tropical water, trawl net can catch over 400 species in their nets
- Target by catch ratio along the southwest and southeast regions of India estimate 1:4.6 and 1:1.36

Possible impacts of by catch discard

- Biological
- Ecological
- Economical

How to usd bycatch?

1. By catch resource as Export alternative
2. By catch resource for value add products
3. Product/Extraction of commercially important products/compound
   - Chitin
   - Air bladder
   - fish leather
4. Marine pharmacology

And he Explain the product made from fish

A**bout fish oil**

- Extraction quanitific and quality assessment
- Fish oil was extracted from the tissue of three low value fish

About chitin and chitosan

Was extract from shells following the method

About fish Meal and Fish bone powder

Calcium powder was extract from Sardine bone, ribbon fish

And about Awareness programme for fish

Can be done to carry out this

<u>03.00 - 03.30 p.m</u> Coastal ocean monitoring and Prediction system

Objective

- To monitor health of India coastal water
- To establish along-team database on biogeochemical
- To detect radical change in the biogeochemical of the marine system

Coastal monitoring and Prediction system

- Monitoring coastal water quality -1991
- Waste assimilative capacity
- Oil spill modelling
- Reading pollution history
- Mercury pollution

Result

Results indicated that in general, coastal waters of India show clean and healthy beyond 1 km from shore except veli and Mumbi where it extended off 5 km

Dissemination of data and information

- Data on pollution
- Dissolve oxygen
- BOD
- Ammonia , nitrate, phosphate

And location

<u>03.30 – 4.30 p.m</u> Presentation about Biodiversity in the Mangrove areas of Vietnam **by Mr. Minh Nguyen Van**

-

<u>04.30 – 05.30 p.m</u> Conservation strategies, Polices & management options by Prof. K. Kathiresan

A conception model for ecosystem degradation and restoration

- Requires physical chemical Modification
- In degrading site most significant observation High soil salinity (120/Kg.) low level of variable

Restoration of mangrove in abandoned aquaculture pond in 1989, 1993, 2004

- If the abandoned areas are drained the iron sulfides will be oxidize to sulfuric acid
- The acidity can take 5-10 year to flush out by aerate seawater
- Then only mangrove can re-establish itself
- But the stagnant cut off ponds take much longer to recover

Techniques for propagation

- Mangrove nursery
- Student planting
- Artificial create mangrove
- To restore ecosystems for essential services by 2020

Conservation & Management

Protect are the most effective conservation method for securing ecosystem service

- Only little area protect in world
- Of 80-90% of the earth outside the protect area
- Globally only 25% of mangrove in 1200 protect area

Why ecosystem restoration?

- Economic vale of global ecosystem 21-72 trillion/year
- Ecosystem restoration provide benefit/coast up to 75 in return on investment

Ways and mean

- Effective dissemination
- Enhanced Capacity development for effective nation

Global warming

If Global warming continues, no human being and no aerobic organism would survive in the next century and the earth will be the home of the thermophilic, chemophilic and anaerobes.

2 main problems to mangrove

- Sea level rise
- Horizontal migration of mangrove forest toward temperature and polar latitudes

Baseline data develop

- Forest structure
- Species richness
- Diversity of flora and fauna
- Primary production

International Protect

- Site of the international convention are of prestige
- Designation of protect

Component of management action plan

- Survey
- protection monitoring
- plantation

Community participation in coastal resource management

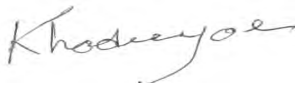
- Local government is giving
- Promoting civil society awareness and participation in decision
- Target awareness program
- School curricula

- Infrastructure facilities

Coastal livelihood

- Crab
- Seaweed
- Oyster
- Ecotourism
- Honey production
- Artemia culture

Signature



(Mrs. Khodeeyoe Pornchai)

FOURTEENTH DAY
(October 18, 2011)

(Rapporteur : Mr. Mukeshkumar Mali)

First I awfully thanks to organizing committee for given me a nice job as a rapporteur.

The day started with field demonstration about macropropagation like propagation through air layering, cutting etc., and visited mangrove nursery of CAS. Followed by this micropropagation technique with hands on training, with this we experienced about direct, indirect regeneration, callus, cell suspension culture etc.

Then had detailed discussion with scholars, they shared their research experience with the participants from across the world. In connection with this Dr. N. Sithranga Boopathy shared his experience regarding tea from mangroves and oral cancer followed by his presentation Ms. V. Gomathi explained about Thrustochytrids fungi from man environment, Unicellular cyanobacteria from mangrove by Mr. R. Anburaj, Studies on marine fungi by Mr. K. Saravanakumar, studies on silver nano particles from food material like banana and apple by Ms. N. Asmathnisha, studies on bacteriophage from mangrove environment by Mr. S. Anadhan, studies on sulphate reducing bacteria from mangrove environment by Ms. G. Abirami. Molecular studies on mangrove forest by Mr. Sunil Kumar Sahu.

Then we planted the mangrove saplings near the velar estuary, around 100 saplings planted by our participants with the right direction of Prof. S. Ajmal Khan and Prof. K. Kathiresan.

Dr. Gopalakrishnan explained about crab culture at M.G.R. Thittu, also we had the field experience about crab culturing.

And visited Lord Thillai Natarajar temple and Chidambaram Rotary club, as a todays rapporteur on behalf of the participants from across the world I thank the President and Secretary and other members of the club. The hole day we enjoyed lot.

The day ends up with rapporteur report.

Signature

(Mr. Mukesh Mali)

FIFTEENTH DAY

(October 19, 2011)

(Rapporteur: Swati Sappal)

9:30 – 11:00 AM: Impact of Climate Change on Indian marine Fisheries (Dr. E. Vivekanandan)

The start of the day was marked by the lecture on Climate Change impacts on Indian marine fisheries by Dr. E. Vivekanandan. The lecture imparted greater insights on the impacts of climate change on Coastal Ecosystems and resources with special emphasis on Fisheries, Coral Ecosystems and Mangroves. Climate change is an inevitable phenomenon. Changes in Temperature have been observed throughout the history of the existence of earth but the acceleration in these changes has only been the gift of modern day Industrialisation and developments. Rapidly increasing carbon dioxide concentrations in the atmosphere and world oceans are playing a major role in affecting the coastal resources be it positively or negatively. Three major concerns of climate change are Rise in sea surface temperatures, Ocean acidity, Sea level Rise. All of them pose a major threat to the fisheries resources of the world in general. But in certain cases climate change has also been found to be increasing the fish production and fish catch in the coastal waters like the catch and availability of Oil sardine and Indian mackerel have been increased since 1961 till date in the India coastal waters.

11:00 – 11:15 AM: Tea Break

11:15 – 12:15 PM: Fisheries Management (Dr. E. Vivekanandan)

The talk focussed on effective management of fisheries through various approaches. Several key issues were discussed as well as management approaches for better fisheries management. Some of these are discussed below.

Effort reduction can take various forms like restriction on number of fisherman, number of vessels, number of days at sea, fishing hours, Engine power, Length of net, fish hold capacity. Apart from this seasonal and spatial closure is also observed in various states of India for effective management of fisheries. Another regulation is on the mesh size of net in case of trawlers. This helps reducing the juvenile and larval catch and increases the capture of larger fishes. But this also has some limitations like under exploitation of smaller fishes. Thus arriving at an optimum size of mesh is an issue. Total allowable catch is allowing of annual catch quotas fixed for each vessel based on MSY levels. This has been

largely successful in several countries. To implement this in India, catch declaration by fisherman in logsheets should be introduced thus making it difficult to bring into practice. Monitoring control and surveillance is also one good measure. Though this method is essential but very expensive because we have to follow the fishing activity of individual boat. It needs voluntary compliance. Participatory co management will be effective and reduce the cost. Marine protected areas have been established in India where fishing is banned. Also catch of certain species is also banned. Ban on destructive fishing practices is also prohibited. Thus over the years it has been understood that conventional management methods view fish as a separate entity. Requirement is safeguarding the entire ecosystem than just concentrating on one part of it. Ecosystem based management should thus be integrated with other coastal management instruments in order for having an effective management plan. Several success stories have been witnessed for fisheries management throughout the world based on ecosystem centric approach. Participatory approach is also effective.

12:15 – 12:30 PM: Daily report by the rapporteur

12:30 – 1:30 PM: Valedictory Function- Impressions by the participants

1:30 – 2:30 PM: Lunch

Signature

(Ms. Swati M. Sappal)

ANNAMALAI UNIVERSITY

FACULTY OF MARINE SCIENCES
CENTRE OF ADVANCED STUDY IN MARINE BIOLOGY

UNU-INWEH INTERNATIONAL TRAINING COURSE ON "MANGROVE BIODIVERSITY AND ECOSYSTEMS"

VALEDICTORY FUNCTION

19th OCTOBER 2011

Time : 12.00 noon

Venue : CAS in Marine Biology Auditorium

PROGRAMME

Welcome Address	:	**Prof. S. Ajmal Khan** Organiser, CAS in Marine Biology Annamalai University
Presidential Address	:	**Prof. T. Balasubramanian** Dean & Co-ordinator, CAS in Marine Biology Annamalai University
Impressions by participants		
Valedictory Address & Distribution of certificates	:	**Dr. E. Vivekanandan** Principal Scientist & Scientist In-Charge Central Marine Fisheries Institute (Indian Council of Agriculture Research) Chennai
Vote of Thanks	:	**Prof. K. Kathiresan** Organiser, CAS in Marine Biology Annamalai University

All are cordially invited to attend the function

Prof. K. Kathiresan
Prof. S. Ajmal Khan
Organisers

Prof. T. Balasubramanian
Co-ordinator & Dean