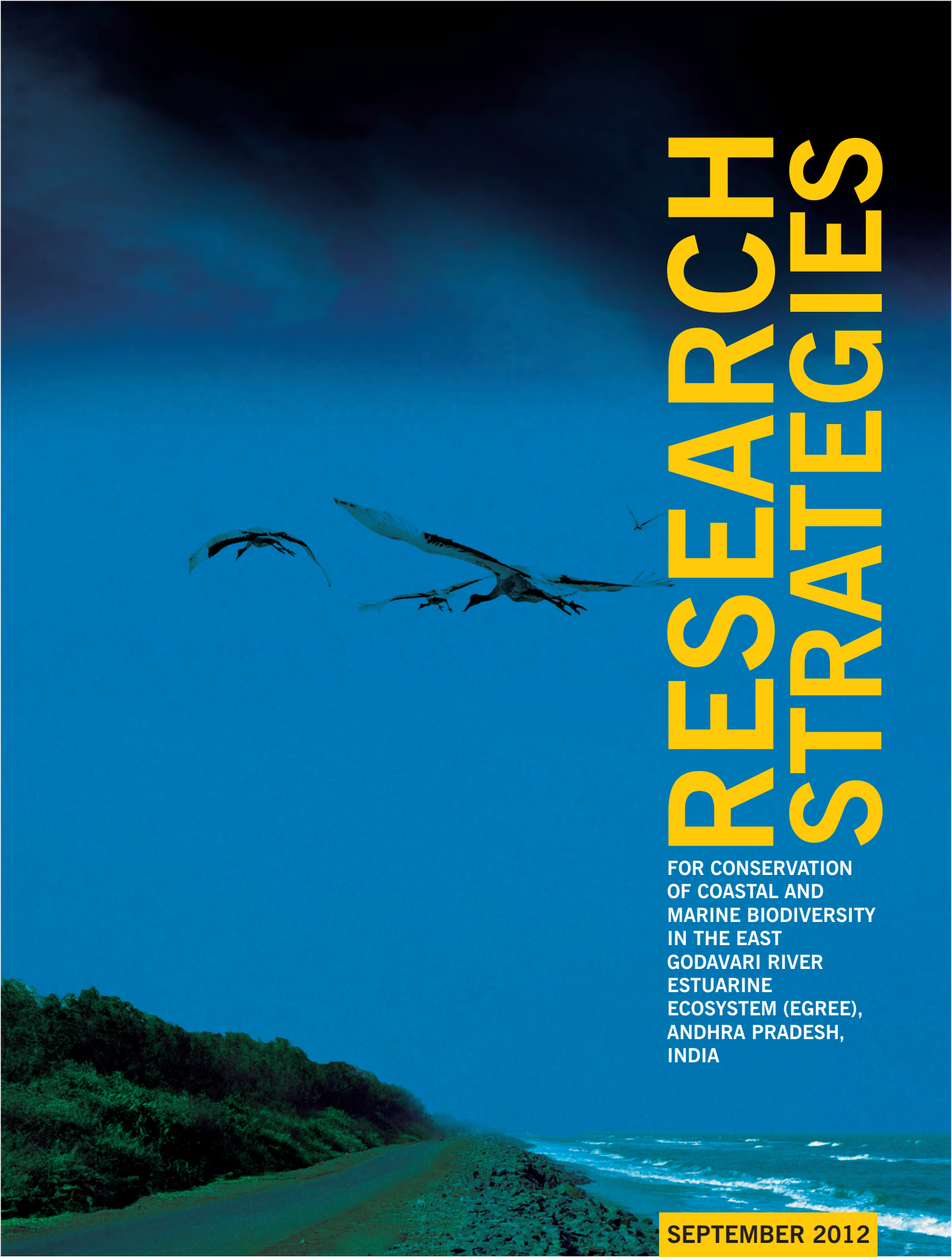

RESEARCH STRATEGIES

FOR CONSERVATION OF COASTAL AND MARINE BIODIVERSITY IN THE EAST GODAVARI RIVER ESTUARINE ECOSYSTEM (EGREE), ANDHRA PRADESH, INDIA

SEPTEMBER 2012

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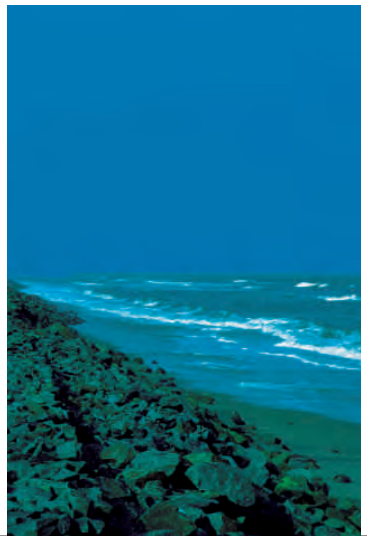

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

Supported under the GEF-UNDP-GoI Project -Mainstreaming Coastal and Marine Biodiversity Conservation into Production Sectors in the East Godavari River Estuarine Ecosystem, Andhra Pradesh, India

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CONTENTS

PREFACE

The East Godavari River Estuarine Ecosystem (EGREE) in Andhra Pradesh is the second largest area of mangroves along India's east coast. In recognition of its national and global biodiversity significance, a part of the EGREE is notified as Coringa Wildlife Sanctuary, which is one of the Marine Protected Areas in India. In addition to the biodiversity significance, EGREE holds enormous economic significance on account of the presence of a large number of important production sectors such as fisheries, aquaculture, salt pans, oil and gas exploration, factories, tourism and ports. Further , local communities are dependent on the mangroves and marine resources for earning livelihoods. All these have cumulatively impacted the overall ecoological integrity and consequently socio-economic well-being of the people who are part of the EGREE expanse.

It is felt that the existing institutional arrangements for sustainable management of the resources in the region are inadequate and there is an urgent need for developing an intergrated, cross sectoral planning framework that is based on validated scientific information. The GEF-UNDP-GoI Project-"Mainstreaming Coastal and Marine Biodiversity Conservation into Production Sectors in the East Godavari River Estuaine Ecosystem", Andhra Pradesh, India is an endeavor in this direction and aims to mainstream biodiversity ariconservation into the production sectors operating in the Godavari region. Setting up a mechanism for mobilizing and using validated scientific information in decision making is one of the important components of this project.

I am happy to note that under the project, the Wildlife Institute of India has now completed a research gap analysis and prioritizes about 58 research programmes that need to be undertaken in the Godavari region as part of the knowledge Management System of the project. I am sure that this commendable initative shall prove to be milestone for the long term sustainable managemnet of the Godavari region.

Jagdish Kishwan
Addl. Director General of Forests (WL)
Government Of India
Ministry Of Environment And Forests
Paryavaran Bhawan, CGO Complex, Lodhi Road,
New Delhi-11003

FOREWORD

The Godavari delta on the east coast of India is an important component of India's coastal and marine heritage. The region is unique in its biological diversity. It also generates significant ecological services to sustain fisheries, livelihoods and sequestering carbon. Over the years, the Godavari region has witnessed rapid economic changes and the emergence of large scale industrial production sector. This trajectory of developmental activities has raised concerns about the environmental sustainability of the region; both for human and natural systems.

Mainstreaming Coastal and Marine Biodiversity Conservation into Production Sectors in the East Godavari River Estuarine Ecosystem, Andhra Pradesh is a joint initiative of the Government of India, Global Environment Facility and UNDP, designed to respond to this situation. It aims to enhance the capacity of institutions to implement biodiversity-friendly sector plans, improve livelihoods and promote sustainable resource use while mainstreaming biodiversity conservation into the production activities of the region through cross-sectoral planning.

Such a transformation in biodiversity governance requires an enabling policy environment, cross-sectoral action and informed decision making. A key element for this change process is the availability of evidence and knowledge base. Analyzing existing information and identifying areas for further enquiry are the starting points for this change process. Two key research priorities identified in this publication are i) evaluating the economic value of ecosystem goods and services of Godavari ecosystem and ii) studying the impacts of climate change on the Godavari delta.

Coastal and marine conservation is one of the high priorities of the Convention on Biological Diversity (CBD) as elucidated in its Strategic Plan for Biodiversity for the period of 2011-2020. As India is poised to host the eleventh Conference of the Parties to the CBD in October, 2012, this publication is highly timely and relevant.

Srinivasan Iyer
Assistant Country Director, UNDP India.

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ACKNOWLEDGEMENT

The Wildlife Institute of India (WII) has associated with the United Nation Development Programme (UNDP) since 1980s in the field of wildlife conservation in India. WII is playing advisory roles in the conservation and management of coastal and marine ecosystems in the country. We wish to thank UNDP, Ministry of Environment and Forests, Government of India; and Forest Department of Andhra Pradesh for this opportunity to develop the research strategies for conservation of coastal and marine biodiversity in the East Godavari River Estuarine Ecosystem (EGREE), Andhra Pradesh, India.

We wish to place on record our gratitude for the trust with which Dr. Jagdish Kiswan, ADG(WL), MoEF, GoI; Sh Hitesh Malhotra, PCCF, AP; Sh S.V. Kumar, PCCF(WL), AP and UNDP entrusted the work to the Wildlife Institute of India and Sh P. R. Sinha, Director and Dr. V.B. Mathur, Dean, WII; Sh A.K. Sinha, CCF (Elleru) provided their unflinching support and guidance throughout the preparation of this report.

In the process of the development of this report, the authors have interacted and gathered information and suggestions from many individuals and organizations foremost among them are Sh A.V. Joseph, Dr. S.N. Jadhav, Dr. Shaktikant Khanduri, Dr. Manoranjan Bhanja, Sh Kanwarjit Singh, Smt Prakriti Srivastava, Sh Prabhat Tyagi, Sh Srinivasan Iyer, Dr. Ruchi Pant, Smt Lianchawii Chhakchhuak, Sh Kona Ravi Kumar, Sh Satyaranjan Behera, Sh K.A. Narasimham, Sh T. Rajyalakshmi and many others.

The development of the report necessitated interaction with a large number of professionals in various institutions foremost among which are Andhra University, Zoological Survey of India, MSSRF, CMFRI, Department of Marine Living Resources, College of Science & Technology, WWF-Andhra Pradesh, CIFT, Institute of Wood Science and Technology, State Institute of Fishery Technology, P.R. College, M.S.N. College, IISER-Kolkata, Department of Ports, National Institute of Hydrology, District Industrial Centre, Department of Social Welfare of Andhra Pradesh, Irrigation Department of Andhra Pradesh, DRDA, ASHRAM, etc. We thank all of them.

Authors

WORKSHOP RECOMMENDATIONS

FOR CONSERVATION OF COASTAL AND MARINE BIODIVERSITY IN THE EAST GODAVARI RIVER ESTUARINE ECOSYSTEM (EGREE)

In a major step towards achieving enhanced cooperation among stakeholders in conducting research for conservation of biodiversity and sustainable development in the East Godavari River Estuarine Ecosystem(EGREE), the Wildlife Institute of India, jointly with UNDP-GEF Coastal and Marine Programme, Government of Andhra Pradesh and the Ministry of Environment and Forests, Government of India, hosted the National Consultation cum Stakeholders Workshop to identify and prioritize the research gaps in coastal and marine biodiversity conservation in the EGREE region on 8 May 2012 at Kakinada, Andhra Pradesh. Scientific experts, biodiversity managers, officials from various state and central government organizations, officials from various NGOs, etc. attended the workshop.

Participants of the workshop stressed the importance of research in conservation of coastal and marine biodiversity in the EGREE and its surrounding regions for their survival as well as for the welfare of people who also depend on the ecological services of the EGREE for their livelihoods.

It was emphasized that the role of indigenous knowledge and academic excellence in the region is essential in developing a knowledge base.

A total of 58 research programmes were identified and prioritized into three categories. These research programmes are expected to help coastal and marine spatial planning, development of an integrated management plan for the region, restoration of threatened species and their habitats in the region, improving the livelihoods of local communities, gaining a better understanding of the biodiversity value and ecological services of the EGREE, preparing a plan with respect to climate change and other potential future threats, etc.

It was also recommended that capacity be built in the local institutions and that these local institutions and local youth should be involved in various research activities in the region to the extent possible. In this connection, it has been recommended that the Wildlife Institute of India coordinate the research capacity building programmes in the region so that most of the identified research gaps can be filled by these institutions. Further, it was recommended that the corporate bodies in the region come forward to help carry out both short and long terms research activities in the EGREE in collaboration with local and national research institutions and jointly with the Andhra Pradesh Forest Department and the proposed EGREE Foundation.

BACKGROUND

India has a coastline of about 7512 km length extending over 13 maritime states and union territories. There are a number of coastal and marine ecosystems alowqng this coastline, and these support a wealth of nationally and globally significant biodiversity. These ecosystems support almost 30% of the human population, which is dependent on the rich exploitable coastal and marine resources. The coastline of the Bay of Bengal and Arabian Sea continues to be a rich fishing ground of the South Asian region, and India is one of the world's largest contributors of marine produce. Coastal and Marine ecosystems such as estuaries, coral reefs, marshes, lagoons, sandy and rocky beaches, mangrove forests and seagrass beds are all known for their high biological productivity and provide a wide range of habitats for the aquatic flora and fauna. They also provide important food resources and critical services to human beings. Therefore, the sustainability of these fragile ecosystems should be our primary concern.

SO FAR, WE HAVE LARGELY LOOKED AT THE MARINE BIODIVERSITY AS A SOURCE OF COMMERCIAL PRODUCTS INSTEAD OF APPRECIATING ITS ECOLOGICAL VALUES, WHICH HAS RESULTED IN OVEREXPLOITATION, AND SEVERAL SPECIES ARE ON THE VERGE OF EXTINCTION. MOREOVER, HUMAN ACTIVITIES SUCH AS DESTRUCTIVE FISHING, SHIPPING, COASTAL DEVELOPMENT AND DISCHARGE OF UNTREATED EFFLUENTS FROM INDUSTRIES HAVE CAUSED CONSIDERABLE DAMAGE AND POSE A SEVERE THREAT TO THE COASTAL AND MARINE BIODIVERSITY. IN ADDITION, GLOBAL WARMING AND CLIMATE CHANGE POSE MAJOR CHALLENGES TO THE MARINE BIODIVERSITY.

Coringa Wildlife Sanctuary

The East Godavari River Estuarine Ecosystem (EGREE), encompassing the Godavari mangroves, is the second largest area of mangroves along the east coast of India. The area is rich in floral and faunal diversity and offers significant ecological and economic benefits such as shoreline protection, livelihood sustenance and provision of carbon sink services. It is an Important Bird Area (IBA), with a recorded population of 236 bird species, of which 50 are migratory. In recognition of the

significance of its national and global biodiversity significance, a part of the EGREE area is gazetted as Coringa Wildlife Sanctuary (CWLS). The area is also of enormous economic significance. The last few decades have witnessed rapid economic changes and the emergence of large scale production activities in the EGREE. The main production sectors operating in the landscape/seascape are fisheries; aquaculture; salt production; manufacture of products such as fertilizers, edible oil and rice products; oil and gas exploration; tourism and ports. Local villagers depend on the mangroves and marine resources. The activities in the area are impacting the overall ecological integrity of the EGREE, particularly the mangrove ecosystems: there are associated impacts on the livelihoods of the local people. In this connection, the UNDP-GEF intervention aims to mainstream biodiversity conservation into the production activities of the EGREE through (1) cross-sectoral planning in the EGREE that mainstreams biodiversity conservation considerations; (2) an enhanced capacity of institutions to implement biodiversity-friendly sector plans; (3) improved livelihoods and sustainable natural resource use. It is anticipated that by the end of the project, production activities in at least 80,000 ha of the EGREE will mainstream biodiversity conservation objectives, thereby improving the conservation prospects of several globally significant species, apart from contributing to the socio-economic well-being of the region.

The National Project Steering Committee (NPSC) has been constituted under the chairmanship of the Additional Director General of Forests (Wildlife), Ministry of Environment and Forests,

Eco-tourism in the Coringa mangrove forests

Jelly fish processing unit near Kakinada Bay

OBJECTIVES OF THE WORKSHOP

The main objective of the consultation cum stakeholders workshop was to identify the gap areas in research so that steps could be initiated to conduct important research programmes on a priority basis to strengthen the conservation and management of the coastal and marine biodiversity along with sustainable development in the EGREE. The specific objectives of the workshop were the following:

a. Identification of gaps in research in coastal and marine biodiversity
b. Prioritization of research activities
c. Identification of institutions to plug research gaps.

THRUST AREAS

A. LANDSCAPE/SEASCAPE/ECOSYSTEM LEVEL RESEARCH
B. HABITAT LEVEL RESEARCH ON COASTAL AND MARINE BIODIVERSITY
C. SPECIES LEVEL RESEARCH ON COASTAL AND MARINE BIODIVERSITY
D. MONITORING AND RESTORATION ECOLOGY
E. SOCIO-ECONOMIC AND POLICY LEVEL RESEARCH
F. INTEGRATING PRODUCTION SECTOR INTO BIODIVERSITY CONSERVATION

Operation of shore seine in EGREE

METHODS

After a brief introduction to the workshop, a keynote address (presentation) titled 'Preliminary Review of Research Activities in the EGREE: Gaps and Way Forward' was provided. After the keynote address, six groups comprising 6-10 participants each were formed for group work on respective thrust areas to achieve the workshop objectives. After the discussions, each group made a presentation addressing the research gaps of its thrust area (see Research Matrix Table). Later, the research gaps were prioritized. Then a panel discussion was held under the chairmanship of the Principal Chief Conservator of Forests (Wildlife), Government of Andhra Pradesh.

PROCEEDINGS OF THE WORKSHOP

The workshop was conducted in four sessions. Each session was chaired by an eminent expert. Details about the session's chairs and the programme are provided in Appendix I.

Dr. K. Sivakumar, Scientist E, Wildlife Institute of India, welcomed all the participants and resource persons and briefed them about the background of the workshop. He stressed the importance of research in conservation of the coastal and marine biodiversity in the Godavari river estuarine ecosystem and its surrounding regions for their survival as well as for the welfare of people who depend on the same habitat for their livelihood. He provided an overview of the workshop and highlighted the commitment of the UNDP-GEF Coastal and Marine Programme for the conservation of the estuarine ecosystem in the region.

Sh. A.V. Joseph, Additional Principal Chief Conservator of Forests, Andhra Pradesh, emphasised the need for ensuring the ecological integrity of the EGREE project zone so that the dependent livelihood opportunities of these systems are maintained compatibly. He also underlined the need to conserve the dwindling coastal and marine biodiversity in India, especially in Andhra Pradesh. He described various conservation measures taken by the Government of Andhra Pradesh to safeguard the coastal and marine ecosystem but expressed the opinion that they should be strengthened further in the current situation.

Prof. B.C. Choudhury, from the Wildlife institute of India, visualized the EGREE project as the beginning of a larger Godavari Delta eco-compatible land use planning process, keeping the biodiversity conservation concern as the main plank in the developmental sectors. He emphasized the role of indigenous knowledge and academic excellence in developing a knowledge base for the region and using it appropriately for development and conservation to go hand in hand.

Dr. S. K. Khanduri, Inspector General of Forests (WL), Ministry of Environment and Forests, Government of India, formally inaugurated the workshop. Dr. Khanduri, lauded the objectives of the workshop and said that he expected a model knowledge management system to be established under the UNDP-GEF EGREE project, which could potentially be replicated in other landscape level programmes that have been planned across the country. He stated that with appropriate scientific information, further research and education, combined with adequate financial resources, our coastal and marine biodiversity would be conserved. He also emphasized the importance of the involvement of the local community in safeguarding this vulnerable coastal ecosystem. At the end, he formally declared the workshop opened, wished the participants a successful workshop and invited Dr. Sivakumar to start the next session.

Mr. Tarun Kathula from UNDP-India proposed a vote of thanks in which he thanked all dignitaries and participants of the workshop.

ANALYSIS OF RESEARCH GAPS IN COASTAL AND MARINE BIODIVERSITY CONSERVATION IN GODAVARI ESTUARINE ECOSYSTEM

Chairperson - Dr. Manoranjan Bhanja, APCCF

Dr. K. Sivakumar first introduced the objectives and methods to be followed to identify the research gaps in this workshop and then made a presentation titled 'Preliminary Review of Research Activities in the EGREE: Gaps and Way Forward'. So far, 688 research publications covering various taxa and aspects of the Godavari Delta have been collected and are available with the Wildlife Institute of India. These are based on work carried out by 17 institutions and universities from India, 18 international institutions and five non-governmental organizations of India.

Dr. Sivakumar listed the roles expected of research in efficient conservation of biodiversity in the Godavari Delta while safeguarding the livelihoods of people in the region. He requested the participants to suggest appropriate research activities to achieve the followings:

Fleet of fishing trawlers in EGREE

- MAINTAINING/RESTORING THE GOODSAND ECOLOGICAL SERVICES OF THE EGREE
- SPATIAL PLANNING OF THE GODAVARI ESTUARINE LANDSCAPE AND SEASCAPE
- REVIEWING DEVELOPMENTAL PLANNING AND IMPACT ASSESSMENT IN THE GODAVARI DELTA
- INTERVENING IN THE ENVIRONMENTAL MANAGEMENT PLANS OF THE DEVELOPMENT SECTORS
- ENSURING THE FLOW REGIME OF THE RIVER ITSELF FOR MAINTENANCE OF DOWNSTREAM ECOLOG
- REVIEWING THE MANAGEMENT PLANS OF THE FOREST AND WILDLIFE SECTOR
- DEVELOPMENT OF A GODAVARI DELTA VISION AS A LONG TERM PLAN
- PLANNING FOR EXPECTED IMPACT OF CLIMATE CHANGE
- ENHANCEMENT OF SOCIO-ECONOMIC CONDITIONS OF LOCAL COMMUNITIES ALONG WITH BIODIVERSITY CONSERVATION IN THE CHANGING CLIMATE REGIME

He emphasized the point that various biological aspects of the Godavari estuarine ecosystem have been studied in the past but there are still several gaps in research into coastal and marine biodiversity conservation in the Godavari Delta region, which need to be prioritized. He also stated that the major requirements for marine biodiversity conservation research in the EGREE involve (a) coordination among all the organizations/ institutions that work for conservation of coastal and marine biodiversity, development of the industrial sector and welfare of coastal communities in the EGREE and (b) documentation and creation of a database of information obtained through research into marine biodiversity, These are required urgently.

Later, Dr. Sivakumar listed various gaps in research into coastal and marine biodiversity conservation in the EGREE, based on a preliminary review carried out by the Wildlife Institute of India.

ECOSYSTEM LEVEL RESEARCH GAPS

1. Long term monitoring studies on the dynamics of the coastal geomorphology in connection with ongoing developmental activities and climate change in and around the EGREE
2. Assessment/estimation of coastal marine habitat lost or being lost to (mangroves, sand dunes, mud-flats, etc).
3. Impact of climate change on the coastal and marine biodiversity and its habitat in the EGREE
4. Linkages/connectivity among habitats/ ecosystems
5. Reduction in freshwater flow and sediment influx and its linkages with estuarine and mangrove systems
6. Role of bio-shield in enhancing species diversity
7. Assessment of impact of Invasive species in the ecosystem
8. Inventorization of biodiversity of estuaries
9. Identification and conservation of important coastal and marine biodiversity areas of the EGREE for spatial planning
10. Experimental studies in estuaries and mangroves
11. Economic valuation and ecological services
12. Development of landscape level management plan for the EGREE
13. Impact of pollution and its linkages with the industrial sector in the EGREE

HABITAT LEVEL RESEARCH GAPS

1. Restoration of entire mangrove communities instead of selected mangrove species
2. Inter-tidal mud-flats-their ecological significance
3. Long term monitoring of mangroves
4. Inventorying seagrasses and lesser known mangrove associates
5. Documentation of biodiversity in intertidal zone and rocky shorelines
6. Coastal lagoon ecology and biodiversity
7. Habitats of threatened animals

SPECIES LEVEL RESEARCH GAPS

1. Strengthening of taxonomic capacity in the region
2. Preparation and implementation of species recovery plan-locally achieve recovery of

certain threatened species such as horseshoe crabs and otters in the EGREE

3. Periodic assessment of threatened and endemic species in the EGREE
4. Ecological studies of endemic and threatened species of invertebrates and Prochordates groups
5. Identification of indicator species in different habitats and monitoring them
6. Marine mammals
7. Coastal and oceanic birds
8. Ecological studies on marine reptiles
9. Long term monitoring of and ecological studies on lesser known fish species
10. Studies on wildlife diseases in certain threatened species

RESEARCH GAPS IN SOCIO-ECONOMIC STUDIES

1. Working models for ecological benefits versus economic benefits in a dynamic marine ecosystem need to be established whenever and wherever they are required. A model prepared by MSSRF with respect to mangroves needs to be reviewed. The same model may be repeated with appropriate changes, if any.
2. Impact of climate change and other economic developments in the demography of coastal communities of the EGREE
3. Determination of socio-economic dependency of user communities on coastal and marine resources versus other resources
4. Documentation, promotion and extension of eco-compatible alternate livelihood options-identification of various stakeholders and assessment of the impact of their activities on the ecological resources in the EGREE
5. Development of empowerment mechanisms and models of community based institutions involved in resource management
6. Collection of data on fishing communities based on fishing villages and Panchayat Raj Institutions (PRIs)
7. Documentation and analysis of the impacts of infrastructure projects (ports, power plants, etc.) on the communities and their livelihoods

RESEARCH GAPS IN THE MONITORING, RESTORATION AND OTHER ASPECTS OF ECOLOGY

1. Status and trends of contaminants in coastal waters
2. Environmental factors, such as winds, sea level and temperature
3. Changes in the abundance over various life stages of invertebrates and fish
4. Fluctuations in the abundance of otters, turtles and seabird species
5. Biological input of organics and faecal coliforms
6. Effect of commercial vessel traffic and recreational activities
7. Natural and anthropogenic impacts
8. Interactions of fisheries with mammals and turtles
9. Pesticide usage, sewage discharge, dredge spoil disposal
10. Recurring road repair debris side-casting along the coast
11. Strengthening silviculture technology for endemic and threatened mangrove species
12. Development of restoration technology for endangered habitats
13. Impact of advances in fishing technology on biodiversity
14. Development of technology to minimize by-catches
15. Development of better technology to monitor the benthic and pelagic biodiversity

RESEARCH GAPS IN THE PRODUCTION SECTORS

1. Assessing the carrying capacity with respect to industries without compromising the other ecological services of the EGREE
2. Identification of exclusive industrial zone with environment management plan and best practice guidelines
3. Identification of compatible industries in the region
4. Economic services of industrial sector in the EGREE and their impact on the local economics
5. Identification and promotion of eco-friendly industries in the EGREE
6. SEA and CIA studies

THE CHAIRPERSON, DR. M. BHANJA, APPRECIATED THE EFFORTS TAKEN BY THE UNDP-INDIA AND THE WILDLIFE INSTITUTE OF INDIA TO FILL THE RESEARCH GAPS IN THE REGION AND GAVE SEVERAL VALUABLE SUGGESTIONS TO ENHANCE THE KNOWLEDGE MANAGEMENT SYSTEM OF THE EGREE. HE EMPHASIZED THE IMPORTANCE OF IDENTIFICATION AND MONITORING OF BIO-INDICATOR SPECIES IN THE GODAVARI ESTUARINE ECOSYSTEM. HE ALSO HIGHLIGHTED THE URGENT NEED TO FIND THE REASONS FOR THE DECLINE IN THE RESOURCE GENERATING SYSTEM OF THE ESTUARINE ECOSYSTEM. HE SUGGESTED THAT THE CARRYING CAPACITY OF THE REGION BE STUDIED BY LINKING THE PRODUCTION SECTOR WITH RESOURCE AVAILABILITY. HE ALSO EMPHASIZED THE NEED TO CARRY OUT A STUDY ON SEDIMENT AND ENVIRONMENTAL FLOWS FROM THE GODAVARI RIVER AND THEIR ECOLOGICAL RELEVANCE TO THE EGREE. GENETIC MAPPING OF THREATENED SPECIES, RECLAMATION OF AFFECTED AREAS AND INTER-SECTORAL COORDINATION AMONG VARIOUS STAKEHOLDERS WERE ALSO SUGGESTED BY HIM.

Later, six groups were formed to discuss the research gaps and their prioritization:
(a) the ecosystem level, (b) the habitat level, (c) the species level, (d) the socio-economic level, (e) monitoring and restoration ecology level and (f) research gaps in production sectors.

Ecosystem level research
The members of this group included Shri A.V. Joseph, Dr. Manoranjan Bhanja, Dr. Thulsi Rao, Dr. Farida Tampal, Dr. M. Balaji, Dr. P. Sathiyaselvam, Mr. P.V. Ramana Kumar, Dr. K. Balaji and Mr. C.H. Vijayakumar.
Discussant - Dr. Thulsi Rao

Habitat level research
The members of this group included Prof. M.S. Chakravarthy, Prof. M. Venkaiah, Prof. P.S. Rajasekhar, Dr. T. Rajyalakshmi, Dr. S.Z. Siddiqui, Shri S. Basheer Ahmed, and Shri M. Anant Raju.
Discussant - Dr. S.Z. Siddiqui

Species level research
The members of this group included Dr. K. Narasimham, Dr. G. Maheswarudu, Dr. D. Srinivasa Rao, Dr. C. Annapurna, Dr. A. Chandra Sekhar Reddy, Dr. P. Ram Mohan Rao, Dr. D. Padmavathi, Dr. B. Tripathy and Dr. P. Bhadury.
Discussant - Dr. P. Bhadury

Socio-economic level research
The members of this group included Dr. Shaktikant Khanduri, Dr. T. Sathyanarayana, Dr. S. Angeli, Mrs. Arathy Ashok, Mr P. Muralidhar, Mrs. P. Usha, Mrs. A Varalakshmi and Mr. V. Paramesh.
Discussant - Mrs. P. Usha

Monitoring and restoration ecology
The members of this group included Shri. Kanwarjit Singh, Shri. A.K. Sinha, Shri. Satyaji Rao, Shri. P.V.S. Machiraju, Dr. Raghavendra Rao and Shri. R. Ramasubramanian.
Discussant - Shri. A.K. Sinha

Research gaps in production sectors
The members of this group included scientists from CIFT (Dr. M.M. Prasad, Dr. G. Rajeshwari, Shri. G. Sriharibabu, Shri Jesmi Debbasma, Shri Arathy Ashok) and others.
Discussant - Dr. Raghu Prakash

Fisheries is the major production sector in the EGREE

PRIORITIZATION OF RESEARCH GAPS

Chairperson - Dr. Manoranjan Bhanja, APCCF

Dr. S.N. Jadhav, APCCF and Member Secretary of Andhra Pradesh State Board of Biodiversity, chaired Technical Session II, on identification of research gaps by the various thematic groups. The recommendations of all the groups have been listed in the Research Matrix Table. All the groups presented the results of their group's discussion and listed the research gaps after prioritization.

A heronary in EGREE

DURING THE DISCUSSION, IT WAS POINTED OUT THAT THERE IS A NEED FOR A SPECIAL STUDY ON THE PARTICLE SIZE OF SEDIMENTS, WHICH WILL GIVE A DEEPER UNDERSTANDING OF THE HABITAT. STUDYING THE LIVELIHOOD ASPECTS OF THE LOCAL PEOPLE WAS STRESSED. FURTHER STUDIES ON THE IMPACT OF CLIMATE CHANGE, ECONOMIC EVALUATIONS OF ECOSYSTEM SERVICES, ESTUARINE INTERTIDAL ECOLOGY AND MONITORING OF THREATENED TAXA WERE ALSO EMPHASIZED. A SUGGESTION WAS MADE TO STUDY THE ECOLOGICAL FOOTPRINTS OF THE PRODUCTION SECTOR. THE IMPACT OF SAND MINING ON THE COASTAL AREAS AND DEPOSITION AND REMOVAL OF SAND WAS ALSO POINTED OUT IN RELATION TO WATER FLOW ISSUES.

It was also suggested that habitat studies, especially of mangroves and their freshwater requirements in the ecosystem, be carried out. In the Coringa mangroves, the freshwater drainage is getting reduced, which is affecting the mangrove ecosystem. It was pointed out that there is no water left for irrigation in the Godavari basin, and this indicates that problems will be faced in relation to water in the near future.

The need to find an indicator species to recognize species level declines was discussed. It was suggested that bar coding of DNA needs to be carried out; however, there are some limitations involved.

A suggestion to maintain a Biodiversity Atlas was also made. Carrying out studies on lesser known taxa, especially reptiles, was also prescribed. Similarly, research on birds was also emphasized. It was suggested that a proper checklist be maintained of the birds of the East Godavari area. Studies related to pollinators in the EGREE were also stressed. These pollinators may act as indicators of mangrove ecosystems as the status of pollinators indicates the productiveness of an area. A question was raised regarding the need for species restoration and endemism. It was suggested that there is a need to remove alien species and to monitor them constantly. Individual studies on species and monitoring of changes occurring in the keystone species were suggested. Studies based on GIS databaseof species was also suggested. Finally, more studies on indicator species were emphasized.

During the discussions of this technical session, **Dr. Jadhav** described the various steps taken by the State Biodiversity Board of Andhra Pradesh to integrate various stakeholders in biodiversity conservation to ensure that both people and biodiversity are benefitted by the suggested conservation efforts. He stressed the importance of involving the people in the conservation programme.

PANEL DISCUSSION

Chairperson - Shri S.V. Kumar, PCCF (WL)

Finally, a panel discussion was conducted to conclude the prioritization of research activities in the EGREE, under the chairmanship of Shri S.V. Kumar, PCCF (WL), Government of Andhra Pradesh. Dr. S.K. Khanduri, IGF (WL), Ministry of Environment and Forests; Prof. B.C. Choudhury, Wildlife Institute of India; Dr. K.A. Narasimham and Dr. T. Rajyalakshmi Sasibalan participated in the panel discussion. All the panel members appreciated the UNDP-GEF Coastal and Marine Programme, the Wildlife Institute of India and the participants and their contributions in identification of research gaps in the EGREE. The Chairman and all the panel members emphasized the importance of prioritized research activities in achieving the objective of the UNDP-GEF Programme, i.e. mainstreaming biodiversity conservation into the production sectors.

EGREE is rich with molluscan diversity

DURING THE PANEL DISCUSSIONS, THE CHAIRMAN ACCEPTED THE VIEW EXPRESSED BY THE PARTICIPANTS THAT THERE IS A NEED TO BUILD CAPACITY IN THE LOCAL INSTITUTIONS AND INVOLVE LOCAL YOUTH IN VARIOUS RESEARCH ACTIVITIES IN THE REGION AS MUCH AS POSSIBLE. THE PANEL MEMBERS ALSO FELT THAT THE CORPORATES IN THE REGION SHOULD COME FORWARD TO HELP CARRY OUT LONG TERM RESEARCH ACTIVITIES IN THE EGREE. AT THE END, WHILE THANKING THE WILDLIFE INSTITUTE OF INDIA FOR ORGANIZING THIS WORKSHOP, SHRI S.V. KUMAR, PCCF(WL), WELCOMED ALL PARTICIPANTS TO CARRY OUT PRIORITIZED RESEARCH ACTIVITIES SO THAT THE CONSERVATION PROGRAMME OF THE GODAVARI DELTA WOULD BE SUCCESSFUL. AT THE END, A RESEARCH FRAMEWORK FOR THE EGREE WAS DEVELOPED WITH ADDITIONAL INPUTS FROM THE REVIEW OF THE LITERATURE CARRIED OUT BY THE WILDLIFE INSTITUTE OF INDIA.

Mushrooming of aquaculture farms in the estuarine ecosystem

RESEARCH FRAMEWORK FOR EGREE

OVERALL, THE RESEARCH PROGRAMME IN THE EGREE INTENDED TO FOCUS ON BROADENING OUR SCIENTIFIC UNDERSTANDING OF THE MARINE ECOSYSTEMS AND DEVELOPING RESEARCH PROGRAMMES THAT WILL ENHANCE OUR UNDERSTANDING AND PROVIDE MANAGEMENT WITH THE SCIENTIFIC INFORMATION NECESSARY TO TAKE INFORMED DECISIONS. IN THIS CONNECTION, IT IS IMPORTANT TO ESTABLISH THE RESEARCH AND MONITORING COMMITTEE (RMC) UNDER THE UMBRELLA OF THE PROPOSED EGREE FOUNDATION TO COORDINATE ALL RESEARCH AND MONITORING ACTIVITIES IN THE EGREE. IT IS EQUALLY IMPORTANT TO ESTABLISH AN IN-HOUSE RESEARCH AND MONITORING FACILITY WITHIN THE EGREE FOUNDATION. A RESEARCH OFFICER WITH ADEQUATE SUPPORTING RESEARCH STAFF AND FACILITIES NEED TO BE PROVIDED FOR THIS IN-HOUSE RESEARCH AND MONITORING FACILITY. IN-HOUSE RESEARCH AND MONITORING SHOULD FOCUS ON LONG TERM MONITORING OF HABITAT AND CERTAIN THREATENED TAXA SUCH AS OTTER ETC.

LONG TERM RESEARCH PROGRAMMES

Inventorization

This must be carried out with a view to continuously inventory the biotic and abiotic components of the integrated landscape of the Godavari estuarine ecosystem. Information will be collected on meteorology, land use practices and the distribution and status of threatened species using remotely sensed satellite information supported by ground truthing: the status of the intertidal zone and its biodiversity; identification of invasive species and their impacts in the region; estuaries and mangroves and their biodiversity, including impacts of climate change; sand dunes and sandy beaches and their biodiversity, including impacts of climate change and land based anthropogenic activities fluvial origin and their impacts on biodiversity; land-use changes driven by land-use changes and anthropogenic and developmental activities and their impacts on important habitats; climate change and its possible impacts; identification and mapping of pollutant sources and their impacts on the ecological processes and biodiversity using indicator species; the importance of the flow of water and sediments from the Godavari River into the estuary.

Monitoring

Effective management requires an understanding of long term changes in the status of the resources and their environment. Long term monitoring is a way to detect and document these changes in environmental quality, ecology and human activities and determine if changes in management strategies are needed. The primary purpose of the monitoring programme will be to detect changes, determine their causes, whether natural or anthropogenic, and develop and evaluate management strategies. Overall, the monitoring programme will assist in our understanding the general health of the EGREE. This programme should include pollution monitoring studies and studies

Fishing is the livelihoods of many in EGREE

monitoring the population dynamics of species in all habitats within the EGREE. Identified indicator species and critical habitats need to be monitored to detect possible changes. Changes in the relative distribution of these species could indicate natural or anthropogenic threats to EGREE resources. Monitoring the natural functions of the land- sea interface, as well as human interruptions of these functions, will improve our understanding of the relationships between ocean and terrestrial ecosystems. The results of the monitoring programme will be useful to basic scientific research and to the goals of academics, education and applied management.

Examples of environmental factors to be monitored include: (1) status and trends of contaminants in the EGREE; (2) environmental factors, such as the wind, sea level and temperature (collected by coastal stations, offshore data buoys and satellites); (3) changes in abundance of invertebrates and fish in various life stages; (4) fluctuations in the abundance of otters, turtles and seabird species in the EGREE; and (5) biological input of organics and faecal coliforms.

Certain activities and their effects, both individually and cumulatively, should be monitored. These include: (I) commercial vessel traffic; (2) recreational activities; (3) commercial fishing and nature observation activities; (4) natural and anthropogenic (e.g., sand mining) erosion and sedimentation; (5) interactions between fisheries and mammals/turtles, such as incidental catches of whales, turtles and other mammals in fishing nets; (6) pesticide usage; (7) sewage discharge; (8) dredge spoil disposal; (9) monitoring the socio-economic profile of people in the EGREE in relation to changes in the biodiversity profile of the EGREE; and (10) recurrence of road repair debris being side-cast along the coast. Another important component of the monitoring programme is the assessment of the effectiveness of management strategies. Once a new management strategy (implemented by the UNDP Programme) has been put in place, in response to a change detected in the environment or in the use of the EGREE, monitoring must continue to determine whether the management strategy has the desired effect. In fact, in most cases, each new management strategy will require the design and implementation of specific monitoring activities to augment the long term monitoring programme envisioned by this UNDP-GEF-GoI Coastal and Marine Programme in the EGREE.

It is important to identify 'long term monitoring plots with standardized methodology' in the EGREE for long term monitoring of the above-mentioned biodiversity. Identification and establishment of non-violate vegetation preservation plots for long term monitoring is also required.

Economic Valuation Including Ecological Services

of mangroves and estuarine ecosystem in the region is urgently required: the roles of mangroves, estuaries, seagrass beds and intertidal zones as breeding and nursery grounds of various fauna (temporally as well as spatially); the temporal and spatial distribution patterns of migratory fauna in the coastal and marine environment; identification of foraging and breeding grounds of migratory fauna, including determination of the migratory paths, through the use of advanced technology; documentation of changes in the demographic profile in the region and the pressure they exert on the ecological setting.

Restoration Ecology

Studies to restore degraded mangroves, the intertidal zone and sea turtle nesting habitats; restoration of mangroves with special reference to endemics; stock enhancement of commercially important but native fishes which will help local communities, who can later go for harvesting these resources in a sustainable manner.

Local fish market cum fish landing centre

Socio-Economic

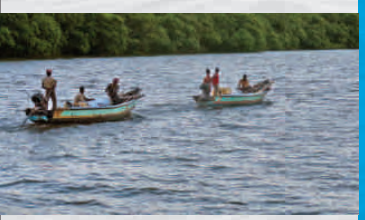
Determination of the socio-economic dependency of user communities on coastal and marine resources versus other resources; documentation, promotion and extension of eco-compatible alternate livelihood options; identification of various stakeholders and assessment of the impact of their activities on the ecological resources; gender issues involving resource use and management; development of empowerment mechanisms and models of the involvement of community based institutions in resource management.

Policy Research

Evaluating the efficacy of international, national and state policies and legal instruments in resource management in the EGREE; and mechanism of networking various governmental, nongovernmental and communities based institutions in participatory management.

Modelling

Three types of modelling activities, numerical simulations, ecosystem models and statistical models, will be used to interpret data, guide field programmes, test hypotheses and predict potential outcomes from proposed uses and thereby influence management decisions. Modelling efforts will be based on the information gathered from the baseline, monitoring and experimental studies. As more information is gathered in these endeavours, the models will be continuously modified and refined. Modelling efforts can be used to analyse the causes and consequences of ecosystem changes and predict the effects of new and more intense human activity in the area. Unlike the monitoring programme, some of these studies may be predictive, short term and directly targeted to an immediate management issue. Examples of modelling studies include (1) determining and predicting the effects of boating activity on sea turtles and marine mammals; (2) predicting the flow of an inadvertent discharge (such as a fuel spill) into the EGREE; (3) modelling the transport of sediments in the EGREE; and (4) estimating the impact of the loss of kelp habitats on higher trophic levels. These types of models are useful for determining effective management strategies. Once strategies are in place, monitoring information will determine their effectiveness and be used to refine the model.



Fishing is the livelihoods of many in EGREE

SHORT TERM RESEARCH

THE PROPOSED EGREE FOUNDATION SHOULD TAKE UP UNDER ITS RESEARCH AND MONITORING PROGRAMME SPECIFIC PROBLEMS POSED BY THE LOCAL POPULATION AND TRY TO FIND OUT SUITABLE SOLUTIONS. THESE SOLUTIONS WILL HELP ATTAIN HIGHER STANDARDS OF LIVING AND MAY PROVIDE AVENUES FOR GAINFUL EMPLOYMENT TO LOCAL PEOPLE. FOR EXAMPLE, A SHORT TERM STUDY ECONOMIC IMPACT ASSESSMENT OF LAND USE PATTERN CHANGES ALONG THE SAND DUNE HABITAT MAY BE CARRIED OUT.

IN-HOUSE RESEARCH AND OUTSOURCED SPECIALIZED RESEARCH

The Research and Monitoring Committee (RMC) of the EGREE Foundation should be directly involved largely with monitoring programmes and facilitate the research by other institutions, other than monitoring. If necessary, other institutions can also be involved in the monitoring programme. The Research Officer(s) of the EGREE Foundation, who has (have) a strong research background in marine biology, and his/her team members need to be continuously sent to refreshment courses either in India or outside India for updating their knowledge, especially in monitoring the marine biodiversity of the EGREE and its ecological services to the local communities. The RMC of the EGREE Foundation should not expect to conduct all kinds of marine research programmes by its own. The EGREE Foundation can outsource certain research programmes that are very important for the conservation of biodiversity and its dependent communities to

various concerned research institutions mentioned in the Research Matrix Table or toany other professional institutions.

COORDINATION, DOCUMENTATION AND DATABASE OF RESEARCH INFORMATION AND POSTING ON WEB PAGE

One of the important activities of the RMC of the EGREE Foundation is coordination with all other research institutions, documentation of all the research findings and maintenance of a database and sharing this database with the outside world by posting its own web page, www.egreefoundation.org.

COMPILING RESEARCH RECOMMENDATION FOR IMPLEMENTATION FOR MANAGEMENT

The RMC has to also compile all the research recommendations in a simple manner so that everyone can understand them. The RMC should take the responsibility of monitoring the success of implementation of the various research recommendations made by the RMC to the EGREE. The RMC should also review the progress of the implementation programme of the EGREE Foundation every year in its Research Advisory Committee meetings.

CAPACITY BUILDING FOR IN-HOUSE RESEARCH AND MONITORING

The RMC should regularly conduct training programmes related to marine biodiversity and monitoring their habitats, management of marine protected areas, etc. The field staff of the RMC should be trained regularly so that they will facilitate various research programmes in this region. The RMC should seek the help of the best resource persons available in India and abroad for its training programmes. The expenses incurred in conducting such training programmes may be met by the EGREE Foundation, Ministry of Environment and Forests, Government of India, Forest Department of the Government of Andhra Pradesh and other international and national donor agencies.

COMMUNITY INVOLVEMENT IN RESEARCH AND MONITORING

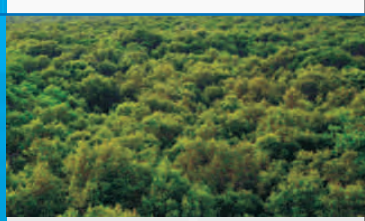
It is important that the RMC make all efforts to appoint local people as the field staff of all the projects, which could send the message to the local communities that they are also part of all the activities of the EGREE Foundation in the EGREE. All the research activities of the RMC should be made known to the local communities. The findings of all the research activities which are related to the local communities need to be shared with them.

ANNUAL RESEARCH SEMINAR

THE EGREE FOUNDATION WILL CONDUCT AN ANNUAL RESEARCH SEMINAR (ARS) FOR PRESENTATION AND REVIEW OF THE RESEARCH ACTIVITIES UNDERTAKEN BY ALL ORGANIZATIONS AND INDIVIDUALS. ALL THE MEMBERS OF THE RESEARCH ADVISORY COMMITTEE ARE EXPECTED TO PARTICIPATE IN THIS TWO DAY SEMINAR. NEW PROPOSALS MADE BY ANY ORGANIZATIONS INCLUDING THE RMC OF THE EGREE FOUNDATION NEED TO BE REVIEWED AND APPROVED ONLY DURING THE ARS. ALL EXTERNALLY FUNDED RESEARCH PROPOSALS WHICH HAVE ALREADY BEEN PEER REVIEWED BY THE FUNDING AGENCIES ARE TO BE RATIFIED WITH THE CONDITION THAT THEY MUST MAKE A PRESENTATION ON THEIR RESEARCH PROGRESS AND MUST PROVIDE ANNUAL AND FINAL COMPLETION REPORT COPIES TO THE EGREE FOUNDATION.

PRIORITIZED RESEARCH GAPS AND RESEARCH MATRIX FOR THE EAST GODAVARI RIVER ESTUARINE ECOSYSTEM

Sl.No.	Research Programme	Activities
1	Development of integrated landscape level management plan for Godavari Delta	1. Assessment of biodiversity profile and identification of threats 2. Spatial planning and setting ecological boundaries of the operational area 3. Zonation of the operational area into wilderness, buffer and tourism zones 4. Identifying degraded and fragile ecosystem 5. Identifying better ecological restoration plans
2	Impact of climate change on the coastal and marine biodiversity and its habitat in the EGREE	1. Assessing and predicting the impact of climate change on biodiversity, community structure and ecosystem unctioning in the EGREE 2. Assessing and predicting the impact of climate change on the distribution pattern and community structure of primary producers, mangroves,reptiles, birds and mammals with special reference to threatened species in the EGREE 3. Assessing and predicting the impact of climate change on the socio-economic and demographic profile of coastal communities in the EGREE 4. Preparing a long term 'Conservation and Preparedness Plan' to safeguard the marine biodiversity and coastal communities of the EGREE from the adverse impacts of climate change
3	Economic valuation and ecological services	1. Identification of knowledge, innovations and practices of indigenous and local communities 2. Identification of impacts of developmental activities on ecosystem goods and services 3. Evaluation of negative and positive impacts using tools of market and non-market valuation 4. Economic analysis of conservation-development of scenarios using multiple criteria assessment and cost benefit analysis 5. Ranking of scenarios and identification of options for conservation and sustainable development



A TOTAL OF 58 RESEARCH PROGRAMS HAVE BEEN IDENTIFIED AND PRIORITIZED IN THREE CATEGORIES BASED ON GROUP DISCUSSIONS AND PANEL DISCUSSIONS DURING THE STAKEHOLDERS WORKSHOP. THESE RESEARCH PROGRAMS HAVE ALSO BEEN IDENTIFIED BASED ON INTENSIVE 'REVIEW OF LITERATURE' AVAILABLE FOR THE REGION.

Thrust Area	Priority	Term	Potential Funding Agencies	Potential Institutions
Ecosystem	I	Short term	EGREE-UNDP/APFD	APFD with WII/AU
Ecosystem	I	Short term	EGREE-UNDP	WII
Ecosystem	I	Short term		WI-SA/WII/IIE

4	Biodiversity Atlas of EGREE	1. Biodiversity assessment and inventorization 2. Assessment of threat status of different groups of animals and plants 3. Preparation of distribution maps with demographical profile of threatened species in the EGREE 4. Preparation of atlas of threatened species and habitats of the EGREE
5	Impact of pollution from industrial sector in the EGREE	1. Listing the industries around the landscape and finding out the effluents released 2. Analysis of samples of contaminated soil and water 3. Laboratory analysis of affected plants/animals to determine the concentration of toxicants
6	Long term monitoring studies on dynamics of coastal geomorphology in connection with ongoing developmental activities and climate change in and around the EGREE	1. Collection of available data on various aspects of coastal geomorphology and analysis in GIS domain to record the changes 2. Identification of drivers which might have changed the geomorphology and develop ecological modelling for expected future changes 3. Quantification and determination of importance of sediment and freshwater flow 4. Continuation of studies for comparison with data available for previous years
7	Impact of changes in freshwater flow and sediment influx and its linkages with the estuarine and mangrove systems	1. Collection of available data on freshwater flow, sediment influx and tidal amplitudes 2. Collection of data on land use and infrastructure development in the upstream areas
8	Identification and determination of the status and distribution of indicator species in different habitats of the Godavari estuarine ecosystem	1. Identification of bio-indicators to monitor the health of habitatsterm 2. Assessment of status and distribution of the identified bio-indicators
9	Restoration of entire mangrove communities instead of selective mangrove species	1. Development of restoration technique for recovery of mangrove communities through polyculture instead of monoculture 2. Initiating immediate restoration of degraded mangrove habitats using existing baseline data
10	Intertidal mudflats-their ecological significance	1. Avifaunal diversity assessment in the intertidal mud-flat habitats 2. Assessment of other intertidal fauna in the EGREE 3. Composition habitat evaluation of mud-flats; bionomics and hydrological intervention for development/protection of mud-flats
11	Long term monitoring of mangroves	1. Identification and marking of long term monitoring plots 2. Long term evaluation/monitoring of mangrove habitats for sustainable resource management
12	Ecology of lesser known habitats such as seagrass beds and lagoons in the EGREE	1. Preparation of exhaustive inventory of seagrasses/mangroves/lagoons/associates urgently 2. Analysis of linkages between lesser known habitats and other major habitats of the EGREE with respect to production as well as ecological services
13	Coastal lagoon ecology and biodiversity	1. Ecological aspects and biodiversity of Pandi Lagoon of the EGREE vis-a-vis local livelihood issues
14	Habitats of threatened animals	1. Identification and assessment of status of critical habitats of threatened species 2. Suggestions for habitat restoration

Ecosystem	I	Short/long term	APFD/MoEF/DST	AU/IISER/WWF/ ZSI/BSI/CMFRI
Ecosystem	I	Long term		AU/WWF/CMFRI
Ecosystem	I	Long term		NIOT/NIO/AU
Ecosystem	I	Long term		NIH/NIOT/IIT/AU
Habitat	I	Short term		WII/AU/IISER/WWF/APFD
Habitat	I	Long term		MSSRF
Habitat	I	Short term		AU/ZSI/CMFRI
Habitat	I	Long term		MSSRF/AU
Habitat	I	Short term		CMFRI/ZSI/BSI/WII/ APFD/AU/WWF
Habitat	I	Short term		CMFRI/ZSI/BSI/WII/ APFD/AU/WWF
Habitat	I	Short term		WII/WWF/AU

15	Status, distribution and community structure of primary producers, especially plankton	1. Species inventory 2. Diurnal and seasonal variations in productivity
16	Ecology of jellyfish communities	1. Species identification and biodiversity 2. Biology and exploitation/Production
17	Ecological monitoring of benthic fauna in connection with climate change and various other developmental activities	1. Documentation of nematodes and copepods 2. Documentation of polychaetes and molluscs 3. Temporal trends of benthic organisms 4. Application of modern tools (e.g. bar coding) to speed up biodiversity assessment
18	Prawns and crabs (mud crabs)	1. Species identification, including preparation of atlas 2. Biodiversity assessment of prawns and crabs
19	Molluscs and shellfish	1. Species identification and preparation of atlas 2. Economic assessment of molluscs and shellfish 3. Collection of data on the fisheries and population dynamics 4. Suggestions for rational exploitation 5. Use of mussels and oysters as sentinels to monitor aquatic pollution
20	Finfish	1. Inventorization and preparation of atlas 2. Study of individual species' life cycles 3. Larval identification and density 4. Recording endangered species in the EGREE 5. Documentation of migratory species (e.g. economically important ones such as the hilsa) 6. Alien and exotic species 7. Seasonal and annual variations in abundance of fish fauna 8. Developing hatchery technology for the economically important fishes including migratory ones 1. Designating and delineating Marine Protected Areas (MPAs) along the oastline 2. Stock enhancement based on long term studies including endangered species 3. Bar coding of finfish 4. Study of recruitment dynamics of juveniles of finfish and shellfish
21	Reptiles	5. Assessment and monitoring of reptiles in the EGREE with special reference to sea turtles 6. Suggestions to improve the conservation of sea turtles in the EGREE 7. Long term monitoring of nesting habitat and populations of sea turtles in the EGREE
22	Birds	1. Species inventory of mangrove associated birds 2. Monitoring terns and gulls 3. Atlas preparation 4. Population assessment
23	Mammals	1. Ecology and behaviour of otters in the EGREE 2. Long term monitoring of otters in the EGREE 3. Otter recovery programme in the EGREE 4. Assessment and long term monitoring of other mammals in the EGREE
24	Invasive species	1. Ecology and impact of invasive species in the EGREE 2. Suggestions to manage invasive species in the region

Species	I	Short term	IISER/ZSI/AU
Species	I	Short term	CIFT/CMFRI/CASMB
Species	I	Long term	IISER/CASMB/
Species	I	Short term	CASMB/CMFRI/ZSI
Species	I	Short term	CASMB/CMFRI/ZSI
Species	I	Long term	CFLR/CMFRI/ZSI/ AU/SIFT/CIFT/ APFD/SFD
Species	I	Short/long term	APFD/AU/WII/CMFRI
Species	I	Short/term	WII/AU/WWF
Species	I	Short/long terms	WII
Species		Short/term	WII

25	Diseases/surveillance	3. Identification of pathogens affecting biota of the EGREE 4. Temporal trends in pathogenicity
26	Status and trends of contaminants in coastal waters	1. Identification of different pollutants and their sources in the EGREE 2. Mapping the impact zone of existing pollutants 3. Suggesting measures to eliminate/minimize pollution in the EGREE
27	Monitoring pollution	1. Establishing independent monitoring mechanism at various strategic points to find contaminants continuously 2. Monitoring pesticide usage, sewage discharge, organic pollutants, faecal coliforms, agricultural runoff, industrial effluent discharge, dredge spoil disposal, etc.
28	Monitoring various trophic levels of mangrove habitats	1. Quantification of litter fall through outsourced agencies 2. Estimation of carbon sequestration in mangroves in the EGREE
29	Monitoring seawater intrusion through aquifers and backwaters, and natural disasters such as tsunamis and cyclones	1. Review of existing groundwater monitoring network 2. Additional monitoring network 3. for aquifers, rivers and coastal areas 4. Evaluation of groundwater utility and well census 5. Modelling sea Water intrusion
30	Strengthening the silviculture technology for endemic and threatened mangrove species	1. A study on the phenology and reproduction of endemic and threatened mangrove species in the EGREE 2. Development of a technology to propagate these species in the EGREE
31	Impact of advances in fishing technology on biodiversity	3. Identification and development of efficient but eco-compatible fishing technology in the EGREE
32	Assessment of socio-economic conditions in the EGREE with special reference to traditional communities practicing fishing, agriculture, etc.	1. Survey of demography 2. Assessment of dependency level 3. Preparation of working model (micro plan)
33	Sectoral study	1. Harmonizing different production sectors such as fisheries aquaculture, agriculture and allied activities, and industries in spatial planning and monitoring
34	Assessing the carrying capacity of industrial development without compromising other ecological services of the EGREE	1. Identifying the production sector in the geographic scope of the EGREE project 2. Production sectors and their impacts 3. Assessing the potential resource 4. Assessing the need 5. Identifying the industries and determining the sustainable limit 6. Standardization of the carrying capacity 7. Calculating MSY/fleet optimization/resource exploitation 8. Studying land use patterns 9. Crop pattern 10. Water use 11. Assessing the carrying capacity of industries without compromising other ecological services of the EGREE 12. Following up action plan and monitoring the process/making changes if needed, based on the performance

Species	I	Short/long term	IVRI/APAH
Monitoring and restoration ecology	I	Short/long term	SPCB/CBPC/AU/CIFT
Monitoring and restoration ecology		Short/long term	SPCB/CBPC/AU/CIFT
Monitoring and restoration ecology	I	Short/long term	MSSRF
Monitoring and restoration ecology	I	Short/long term	NIOT/NIO
Habitat ecology	II	Short term	MSSRF/CASMB/AU
Production sector	I	Short term	CIFT/SIFT/CMFRI/AU/WII
Socio-economic	I	Short term	AU/WWF/ASHRAM/CZM
Socio-economic	I	Short term	AU
Socio-economic	I	Short/long term	CMFRI/CIFT/AU

35	Identification of exclusive industrial zone with environment management plan and best practice guidelines	1. Identifying the area based on need/resource availability/ strategic environmental assessment 2. through study on ecological feasibility of individual EMPs 3. Make a road map/develop best practice guidelines 4. Identify the best exclusive industrial zone
36	Economic services of industrial sector in the EGREE and impacts on local economics	1. Identify the economic services 2. Impact on livelihood 3. Impact on social status 4. Impact on livelihood of local individual/society/at national level
37	Identifying and promoting eco-friendly industries in the EGREE	1. Identify eco-friendly industries 2. Eco-liability/responsibility 3. Mitigation plans 4. Promoting eco-friendly industries in the EGREE
38	SEA and CIA studies	1. Assessing the cumulative effects of the production sectors on the ecosystem and 2. Mitigation methods 3. Policy framework to be implemented 4. Reduce the impact of production sectors on biodiversity without affecting the extent of production
39	Assessment of coastal marine habitat loss being lost	1. Identification of the study areas within the landscape using GIS technologies 2. Analysis of the time series data of the satellite imagery of the identified sites 3. Grazing impacts under different management arrangements
40	Studying the awareness level among village level institutions such as PRIs/ SHGs/EDCs on biodiversity conservation vis-à-vis livelihood opportunities	1. Identifying the key village level institutions through the random sampling method 2. Use of questionnaire survey method for biodiversity components used in their livelihood activities
41	Linkages/connectivity among habitats/ ecosystems	3. Data from short-term and long -term projects will be utilized for understanding the linkages between habitats and ecosystems
42	Human influence on biodiversity and measures of conservation and sustainable	1. Forces driving human impact on biodiversity 2. Property rights in use of biological 3. Impact on access to information and intellectual resource rights 4. Consequences of increasing demand for resource
43	Documentation of biodiversity in rocky intertidal shoreline	1. Distribution and diversity of rocky intertidal shoreline fauna
44	Effect of commercial vessel traffic and recreational activities	2. Assess the impact of vessel traffic and recreational activities
45	Development of better technology to monitor the benthic and pelagic biodiversity	3. User friendly technology to monitor the benthic and pelagic biodiversity
46	Documentation of habitat level biodiversity	1. Resource base 2. Paradigm change 3. Biodiversity manuals with multi-disciplinary approach
47	Collecting economic studies/ documentation at national level	1. Analyse the GDP contribution for designing the national policy

Production sector	I	Short term	AU/NIO/CASMB/WII
Production sector	I	Short term	AU/IIT
		Short term	AU/IIT/IIM
Production sector	I	Short term	IMT/IIM/AU/NIO/CASMB
Ecosystem	II	Short term	NIOT/AU
Ecosystem	II	Long term	WWF/ASHRAN/CZM
Ecosystem	II	Long term	CASMB/CMFRI/AU
Ecosystem	II	Long term	
Habitat	II	Short term	
Habitat	II	Short term	
Species	III	Short term	
Socio-economic	II	Short term	
Socio-economic	II	Short term	

48	GMP(Good Management Practices)	1. Collection of case studies(country/state/district/ITK level) 2. GMP (modified) 3. Group activity in homogenous groups
49	Empowerment mechanism (Resource Management)	4. Capacity building, skill up gradation, Value Addition in the field of Aqua, Agri/Horti etc
50	Food security	1. Edible varieties to be identified with nutritional value/ balanced diet 2. Identify suitable vegetable varieties for backyard cultivation 3. Schemes to support income generative standards
51	Production sectors	1. EIA studies 2. Impact studies and habitat degradation 3. Depletion of natural resources 4. Hampering livelihoods
52	Island villages	1. Assessment of Resource base
53	Fishing gear	1. Monitoring impacts and regulation of fishing and aquaculture
54	Natural calamities	1. Resources (fauna/flora/groundwater/salinity)
55	Impact of existing tourism at landscape and seascape levels in the Godavari Delta	1. Identifying existing tourism areas 2. Type of facilities created by the host agencies 3. Assessing tourist footfalls and the carrying capacity of the site 4. Understanding the waste management systems offered in the tourism areas
56	Bioshield-enhancing species diversity	1. Developing different bio-shield models to reduce the impacts of different natural calamities 2. Development of reclamation models for recalcitrant sites 3. Developing species recovery plans for the RET species. The impact of cultural values on the biodiversity of the EGREE area
57	Long term monitoring of environmental	1. Long term monitoring of environmental factors such as wind, sea level rise and temperature
58	Policy level research	1. It is important to have a national policy on the coastal and marine environment 2. The efficacy of international, national and state policies and legal instruments in resource management in the coastal and marine environment needs to be assessed. 3. Mechanism of networking various governmental, non-governmental and communities based institutions in the participatory management of coastal and marine resources. 4. Identify various components that need to be part of a national or state level policy for restoration and rehabilitation of communities affected by conservation initiatives, natural disasters, etc.

Socio-economic	II	Short term	
Socio-economic	II	Short term	
Socio-economic	II	Short/long term	
Production sectors	II	Short/long term	
Production sectors	II	Short term	
Production sectors		Short term	
Production sectors	II	Short term	
Ecosystem	III	Short/long term	APTD/APFD/WWF/CEE
Ecosystem	III	Short term	AU/NIOT/MSSRF/ NIO/CMFRI/ APFD/MOEF
Monitoring ecology	III	Long term	IMD/APFD
Policy research		Short term	

ACRONYMS

APAH	Andhra Pradesh Animal Husbandry Department
APCCF	Additional Principal Chief Conservator of Forests.
APFD	Andhra Pradesh Forest Department
APTD	Andhra Pradesh Tourism Department
AU	Andhra University
BSI	Botanical Survey of India
CASMB	Centre for Advanced Studies in Marine Biology
CBD	Convention of Biological Diversity
CEE	Civil and Environmental Engineering
CFLR	Centre for Fisheries Living Resources
CIFT	Central Institute of Fisheries Technology
CMFRI	Central Marine Fisheries Research Institute
CoP	Conference of the Parties
CWLS	Coringa Wildlife Sanctuary
CZM	Coastal Zone Management
DST	Department of Science and Technology
GEF	Global Environment Facility
GIS	Geological Information System
GoI	Government of India
IBA	Important Bird Area
IDB	International Day for the Biological Diversity
IG (WL)	Inspector General of Wildlife
IGCMP	Coastal and Marine Programme
IIE	Institute of International Education
IIM	Indian Institute of Management
IISER	Indian Institute of Science Education and Research
IIT	Indian Institute of Technology
IMD	India Meteorological Department
IMT	Institute of Management Technology
IVRI	Indian Veterinary Research Institute
KMS	Knowledge Management System
MOEF	Ministry of Environment and Forests
MSSRF	M.S. Swaminathan Research Foundation
NGO	Non -governmental Organizations
NIH	National Institute of Hydrology
NIO	National Institute of Oceanography
NIOT	National Institute of Ocean Technology
PCCF (WL)	Principal Chief Conservator of Forests.
RMC	Research and Monitoring Committee
SIFT	State Institute of Fisheries Technology
SPCB	State Pollution Control Board
UNDP	United Nations Development Programme
WII	Wildlife Institute of India
WI-SA	Wetland International - South Asia
WWF	World Wide Fund for Nature
ZSI	Zoological Survey of India

WORKSHOP AGENDA

FOR CONSERVATION OF COASTAL AND MARINE BIODIVERSITY IN THE EAST GODAVARI RIVER ESTUARINE ECOSYSTEM (EGREE)

APPENDIX I

09.00 - 09.30	Registration
09.30 - 09.35	Welcome: Dr. K. Sivakumar, Wildlife Institute of India, Dehradun
09.35 - 09.45	Opening remarks: Prof. B.C. Choudhury, Wildlife Institute of India, Dehradun
09.45 - 09.55	Inaugural address: Mr. A.V. Joseph, IFS, Addl. Principal Chief Conservator of Forests, Andhra Pradesh
09.55 - 10.05	Address of Chief Guest: Dr. Shaktikant Khanduri, IFS, Inspector General of Forests (WL), Ministry of Environment and Forests, Government of India
10.05 -10.15	Vote of thanks: Mr. Tarun Kathula, Project Officer, UNDP

Technical Session I

Chairperson:	Mr. Manoranjan Bhanja, IFS, Addl. Principal Chief Conservator of Forests, Andhra Pradesh.
10.15 - 10.45	**Introduction to workshop objectives and methods by Dr. K. Sivakumar,** Wildlife Institute of India, Dehradun
10.45 - 11.00	Tea break
11.00 - 11.45	**Preliminary review of research activities in the EGREE: Gaps and way forward by Dr. K. Sivakumar,** WII
11.45 - 13.30	Group formation and group discussion
13.30 - 14.30	Lunch

Technical Session II

Research Gap Analysis

Chairperson:	Dr. S.N. Jadhav, IFS, Member Secretary, Andhra Pradesh State Biodiversity Board
14.30 - 15-30	Group discussion
15.30 - 15.40	Presentation by Group 1: Landscape/seascape/ecosystem level research in the EGREE
15.40 - 15.50	Presentation by Group 2: Habitat level research on coastal and marine biodiversity in the EGREE
15.50 - 16.00	Presentation by Group 3: Species level research on coastal and marine biodiversity in the EGREE
16.00 - 16.15	Tea break
16.15 - 16.25	Presentation by Group 4: Monitoring and restoration ecology in the EGREE
16.25 - 16.35	Presentation by Group 5: Socio-economic and policy level research in the EGREE
16.35 - 16.45	Presentation by Group 6: Production sectors in the EGREE

Technical Session III

16.45 - 15.30	Panel Discussion and Conclusion Prioritization of research activities in the EGREE
Members:	PCCF(WL) & Chief Wildlife Warden, Dr. S.K Khanduri, IG F(WL), Prof. B. C.Choudhury, Dr. K.A. Narasimham and Dr. T. Rajyalakshmi Sasibushan

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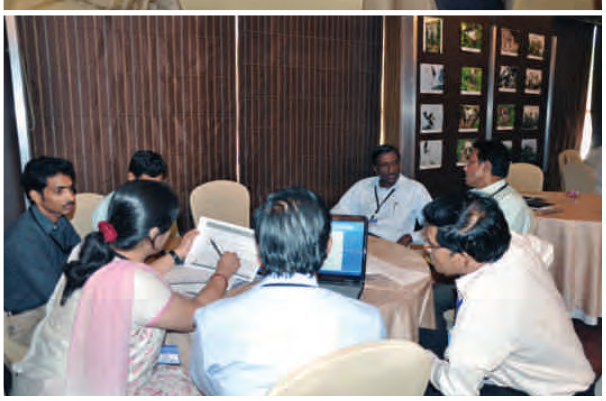
GLIMPSES OF THE WORKSHOP




kshop for Identification of
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