

Ph.D. (Fisheries Resource Management)

Sr. No.	CODE	COURSE TITLE	CREDITS (28)
A. MAJOR - CORE COURSES			9
1.	FRM 601	Assessment and conservation of Aquatic Ecosystems and Biodiversity	1+2
2.	FRM 602	Application of Stock Assessment Models	1+2
3.	FRM 603	Aquatic ecosystem and productivity	1+2
A1. OPTIONAL COURSES			6
1.	FRM 604	Responsible Fisheries Management	1+1
2.	FRM 605	Data Collection and software applications in fish stock assessment	0+3
3.	FRM 606	Fisheries Governance	2+0
4.	FRM 607	Coral Reef Management	1+1
7	FRM 608	Mangrove Ecosystem Management	1+1
B. Minor courses from other disciplines			8
C. Supporting courses			5
Total Course Work Credits			28 Credits
SEMINAR			2 Credits
	Ph. D. Seminar2	0+1 each	2
Ph. D. RESEARCH			45 Credits
	(Semester III)	0+11	
	(Semester IV)	0+11	
	Semester V	0+11	
	Semester VI	0+12	
Total Ph. D. Program Credit Hours			75 Credits

Ph. D. (Fisheries Resource Management) SYLLABUS

CORE COURSES

FRM 601 **Assessment and conservation of Aquatic Ecosystems and Biodiversity** **1+2**

Objective: To enhance knowledge on assessment of aquatic biodiversity and their for conservation and restoration of ecosystems

Theory

- Unit I Measurement, Methods for sampling and analysis, scales and indices of biodiversity assessment
- Unit II Biodiversity assessment in ecosystems: Rivers, lakes, estuaries intertidal (mangrove and coral reefs) and gulf and island ecosystem
- Unit III Conservation and Restoration: Threats Declaration of Biosphere reserve, hotspot, marine protected areas, *In situ* & *ex situ* conservation, Fish passes, Environmental flows, Ganga Action Plan River management plan
- Unit IV Legal and institutional acts regimes of biodiversity: International and national Conventions and Acts on biodiversity. Institutional arrangements for biodiversity conservation (e.g. Biodiversity Boards/ Authority); Risk Assessment and Environmental Impact Assessment/ Unit VII : IUCN criteria - Red List, Wild life protection act, International treaties and conventions, , ETP species
- Unit V Valuation of biodiversity and ecosystem services

Practical

Preparation of records and inventories of biodiversity of any three critically important ecosystems based on field visits and secondary data.

How to read the RS/ GIS map

Sampling methods and data analysis using different softwares- PRIMER software application, SAS, PAST,

Draw conservation plan for given ecosystem/field site visited

Preparation of data sheet based on IUCN criteria

Using morphometric characters of flora and fauna

Identification of scheduled aquatic organisms - Predators of endangered animals. Cor on aquatic mammals, corals, seafans and other endangered aquatic Organisms, Visit to aquatic ecosystem for recording the biodiversity and richness indices, Conservation st (case studies).

Instrumentations required for biodiversity– Image analyser, PCR, EM, etc.

Suggested Readings

1. Denton, T.E., 1973. Fish Chromosome Methodology. Charles Thomas Publishers, Spring Field USA
2. Elliott A. Norse (Ed.) 1993. Global marine Biological Diversity. Inland press, Washington, D.C.383p.
3. Groombridge Brian, 1992. Global Biodiversity – Status of the Earth's Living Resources. Chapman & Hall.
4. Gunderson, D.R. 1993. Surveys of fisheries resources. John Wiley and son, Inc., New York. 248 p.

5. Khanna D.R,A.K.Chopra and G.Prasad, 2005. Aquatic Biodiversity in India , Daya Publishing House
6. Kumar. U. Biodiversity Principles and Conservation, Narendra Publishing House Publishers & Distributors.
7. Lakra W.S., Rehana Abidi,A.K.Singh, N.Sood, G. Rathore , T.R. Swaminathan, 2000. Fish Introductions and Quarantine: Indian Perspective National Bureau of Fish Genetic Resources (NBFGR), Lucknow.
8. Lambshead P.J.D., G.L.J. Paterson and J.D. Gage. 1997. Biodiversity professional version 2. by National History Museum and the Scottish association of Marine Science.uk.
9. Magurran, A. E. Ecological Diversity and its Measurement. Chapman & Hall, London, 179pp.
- 10.Mahanta P.C., L.K. Tyagi, 2003. Participatory Approach for Fish Biodiversity Conservation in North East India National Bureau of Fish Genetic Resources (NBFGR)
- 11.MoEF 2012 –economic valuation working reports
- 12.Ponniah, A.G. and A. Gopalakrishnan (Eds.)2000. Endemic fish diversity of western Ghats NBFGR, Lucknow 347 p.
- 13.Rajkumar R. and Parulekar A. H. 2001 Biology of Corals and Coral Reefs *in* The Indian Ocean – A perspective Vol II (Eds. R. Seng Gupta and E. Desa) Oxford and IBHPubl. New Delhi 467-494
- 14.. SenGupta,R and G Deshmukhe 2000 Coastal and maritime environments of Gujarat: Ecology and economics - Gujarat Ecological Society, Vadodara(India). 167p.
- 15.Wafar S, and A. G. Untawale 2001 Mangroves *in* The Indian Ocean – A perspective Vol II (Eds. R. Seng Gupta and E. Desa) Oxford and IBHPubl. New Delhi 539-562
- 16.Zoological Survey of India, 2007, National Symposium on Conservation and Valuation of Marine Biodiversity

FRM 602 STOCK ASSESSMENT MODELS IN FISHERIES

1+2

Objective: To enhance the knowledge of the application of various dynamics and holistic models used in fish stock assessment

Theory:

Unit I	Application of Biomass dynamics models: Virtual population Analysis, Beverton and Holt's, Thompson and Bell's prediction models
Unit II	Holistic models Surplus production model, swept area, productivity models
Unit III	Stock recruitment models : Biological Reference points (BRP, LRP) Ricker's model and Beverton and Holt's
Unit IV	Bio-economic modelling
Unit V	Trophic models: Ecopath with Ecosim (EwE) models; Species interaction, competition, predation and complex food webs, Prey predator model of May, Pella and Tomlinson

Practical

Data analysis using logistic and analytical models in different systems.
Data analysis using EwE
Use of softwares for population dynamics analysis
Instrumentation for Growth estimations using hard parts

Suggested Readings

1. Beverton, R.J.H. and S.J.Holt 1993. On the dynamics of exploited fish populations. Chapman and Hall, London 533p.
2. Elizabeth F. Edwards and Bernard A. Megrey, 1989. Mathematical analysis of fish stock dynamics American Fisheries Society, Maryland. 214 p.
3. Gulland, J.A. (Ed.) 1977, Fish population dynamics. John Wiley and sons, London, 372 p.
4. Nikolsky G.V. 1980. Theory of fish population dynamics. As the biological background for rational exploitation and management of fishery resources.
5. Hiborn R. and Walters C. J., 1992. Quantitative fisheries stock assessment choice, Dynamics and Uncertainty. Kulwar Academic Publishers, Boston, 570p.
6. Ricker, W.E. 1971. Methods for the assessment of fish production in freshwaters. Blackwell Scientific publishers, Oxford and IBH, Edinburg. 348p.

FRM 603 AQUATIC ECOSYSTEM AND PRODUCTIVITY

1+2

Objective: Enhance the knowledge on productivity of ecosystems

Unit I Aquatic habitat:

Climatic, Morphometric and Edaphic and Biological factors influencing productivity

Unit II: Productivity:

Primary productivity and fish production potential

Unit III Secondary productivity: Plankton, nekton, benthos and periphyton productivity

Unit IV Food web and energy transfer, trophic models

Unit V Conservation;

Habitat conservation; Spawning/ feeding ground protection, fish refugee, Gear regulation; closed seasons, closed areas riparian vegetation protection

Unit Climate change

VI: Adaptation and Mitigation

Practical:

Primary productivity measurement – Conventional and advanced methods

Species diversity indices: plankton, benthos, nekton and periphyton

Estimation of physico-chemical parameters

Estimation of SST, Chlorophyll *a* and fish production potential – marine and inland system

Instruments : Liquid scintillation, spectrophotometry, flurometer, water parameter kit

Case studies

Suggested Reading

1. Allison, E. H., Perry, A. L., Badjeck, M. C., Neil Adger, W., Brown, K., Conway, D. and Dulvy, N. K. 2009. Vulnerability of national economies to the impacts of climate change on fisheries. *Fish and fisheries*, 10(2): 173-196.

2. Badjeck, M. C., Allison, E. H., Halls, A. S. and Dulvy, N. K. 2010. Impacts of climate variability and change on fishery-based livelihoods. *Marine Policy*, 34(3): 375-383.
3. Brander, K. M. 2007. Global fish production and climate change. *Proceedings of the National Academy of Sciences*, 104 (50): 19709-19714.
4. Daw, T., Adger, W. N., Brown, K. and Badjeck, M. C. 2009. Climate change and capture fisheries: potential impacts, adaptation and mitigation. *Climate change implications for fisheries and aquaculture*, 107 pp.
5. Ficke, A. D., Myrick, C. A. and Hansen, L. J. 2007. Potential impacts of global climate change on freshwater fisheries. *Reviews in Fish Biology and Fisheries*, 17(4): 581-613.
6. Glantz, M. H. (Ed.). 2005. *Climate variability, climate change and fisheries*. Cambridge university press.
7. Glantz, M. H. 2001. *Currents of change: impacts of El Niño and La Niña on climate and society*. Cambridge University Press.
8. Kizhakudan, J. K., Mohamad Kasim, H. and Jasper, B. 2008. Experimental methods to assess the impact of climate change on plankton-Winter School on Impact of Climate Change on Indian Marine Fisheries held at CMFRI, Cochin 18.1. 2008 to 7.2. 2008.
9. Mohamed, K. S. 2008. Evidences for Climate Change-Winter School on Impact of Climate Change on Indian Marine Fisheries held at CMFRI, Cochin 18.1. 2008 to 7.2. 2008.
10. Nair V. R. Zooplankton 2001 Primary Productivity in The Indian Ocean – A perspective Vol II (Eds. R. Seng Gupta and E. Desa) Oxford and IBHPubl. New Delhi 417-450
11. Parry, M. L. (Ed.). 2007. *Climate Change 2007: impacts, adaptation and vulnerability: contribution of Working Group II to the fourth assessment report of the Intergovernmental Panel on Climate Change* (Vol. 4). Cambridge University Press.
12. Pörtner, H. O. and Peck, M. A. 2010. Climate change effects on fishes and fisheries: towards a cause-and-effect understanding. *Journal of Fish Biology*, 77 (8): 1745-1779.
13. Roessig, J. M., Woodley, C. M., Cech Jr, J. J. and Hansen, L. J. 2004. Effects of global climate change on marine and estuarine fishes and fisheries. *Reviews in Fish Biology and Fisheries*, 14(2): 251-275.
14. Salagrama, V. 2012. *Climate change and fisheries: perspectives from small-scale fishing communities in India on measures to protect life and livelihood*. International Collective in Support of Fishworkers.
15. Sharp, G. D. 2005. Climate change, the Indian Ocean tuna fishery, and empiricism. *Climate Variability, climate change and Fisheries*, 377 pp.
16. Vass, K. K., Das, M. K., Srivastava, P. K. and Dey, S. 2009. Assessing the impact of climate change on inland fisheries in River Ganga and its plains in India. *Aquatic Ecosystem Health & Management*, 12(2): 138-151.
17. Verlencar X. N. and A. H. Parulekar 2001 Primary Productivity in The Indian Ocean – A perspective Vol II (Eds. R. Seng Gupta and E. Desa) Oxford and IBHPubl. New Delhi 397-416
18. Vivekanandan, E. 2006. Impact of climate change on marine fisheries. *CMFRI Newsletter No. 112 October-December 2006*, 112: 1-4.
19. Vivekanandan, E. 2011. Marine Fisheries Policy Brief-3; Climate change and Indian Marine Fisheries. *CMFRI Special Publication*, 105: 1-97.
20. Vivekanandan, E., Hermes, R. and O'Brien, C. 2012. Climate change effects in the Bay of Bengal Large Marine Ecosystem. *Frontline Observations*, 97 pp.
21. Vivekanandan, E., Rajagopalan, M. and Pillai, N. G. K. 2009. Recent trends in sea surface temperature and its impact on oil sardine.
22. Westmacott, S., Cesar, H. S., Pet-Soede, L. and Lindén, O. 2000. Coral bleaching in the Indian Ocean: Socio-economic assessment of effects. *Essays on the Economics of Coral Reefs. HSJ Cesar (ed.)*, 94-106

OPTIONAL COURSES

FRM 604 Responsible Fisheries Management

1+1

Objectives: To enhance knowledge about compliance of FAO CCRF in Indian fisheries

Theory

Unit I Conservation and enhancement of fishery resources through responsible fishing practices, adoption of Low impact and Fuel efficient fishing practices and modified gears.

Unit II Energy conservation in fisheries: Approaches to energy conservation in fish harvesting: Fishing gear and methods, vessel technology, engines, reduction gear, propeller and nozzle; and adoption of advanced technology.

Unit III Gear selectivity, Issues of overfishing, bycatch, Discards, ghost fishing, excess fishing capacity, IUU, VMS and MCS.

Unit IV Technical Guidelines of FAO CCRF

Unit V Application of satellite technologies like GPS, GIS and RS to fisheries in resource inventory, location of PFZ and fishery forecast. Electronic Recording & Reporting system (ERS)

Practicals

Documentation of responsible fishing practices, assessment of fishing capacity, study of reliability of PFZ advisories in forecast of potential fishing zones, gear selectivity, documentation of bycatch reduction devices, Case studies & field visits related to bycatch, discards, IUU, preparation of questionnaire to determine IUU. Design of questionnaire for study of compliance of marine fisheries/fishing systems with relevant provisions of FAO CCRF.

Suggested reading

1. Bjordal A & Lokkeborg S, 1996. Longlining, Fishing News Books Ltd. London, 156p.
2. FAO Technical Guidelines for Responsible Fisheries 1996. Fishing Operations TG1.
3. FAO Technical Guidelines for Responsible Fisheries 1996. Fisheries management, managing fishing capacity TG4.
4. Graeme Macfadyen, Tim Huntington and Rod Cappell, 2009. Abandoned, lost or otherwise discarded fishing gear, FAO Fisheries Technical Paper No. 523.
5. Janardhanan Sundaresan, K.M. Santosh, Andrea Deri, Rob Roggema & Ramesh Singh., eds. 2013. Geospatial Technologies and Climate Change. 299p.
6. John F. Caddy 2007. Using questionnaires based on the Code of Conduct for Responsible Fisheries as diagnostic tools in support of fisheries management. FAO/Fish code Review No 21.
7. Larry Nielsen & David Johnson (eds), 1983. Fisheries Techniques, American Fisheries Society, Maryland, 468p.
8. Meaden, G.J. & Aguilar-Manjarrez, J., eds. 2013. Advances in geographic information systems and remote sensing for fisheries and aquaculture. FAO Fisheries and Aquaculture Technical Paper No. 552, FAO, Rome.
9. Nambudiri D.D. & K.V. Peter (eds) 2012. Advances in Harvest & Post harvest technology of fish, 372p.
10. Pascoe, S. 2003. Measuring and assessing capacity in Fisheries, FAO Fisheries Technical Paper No. 433/2.
11. Pramod, G. 2010. Illegal, Unreported and Unregulated Marine Fish Catches in the Indian Exclusive Economic Zone, Field Report, Policy and Ecosystem Restoration in Fisheries, Fisheries Centre, University of British Columbia, BC, Vancouver, Canada, 30 p.
12. Sreekrishna, Y. and Latha Shenoy, 2001. Fishing Gear and Craft Technology, ICAR, 342 p.
13. Wileman, D.A., 1996. Manual of methods of measuring the selectivity of towed fishing gears. No. 215, International Council for the exploration of the sea. 126p.

**FRM 605 DATA COLLECTION AND SOFTWARE APPLICATIONS IN FISH STOCK
ASSESSMENT**

0+3

Objective :

Students will learn the sampling designs and application of software techniques on fish stock assessment.

Practical

Collection of fishery data at landing centres and onboard fishing vessels. Documentation of craft and gear. Morphometry of fish/crustaceans/molluscs. Estimation of age, growth, mortality, population and stock parameters employing FiSAT. Length structured VPA, Thompson & Bell yield stock prediction for single and multifleet multispecies version. Beverton & Holt yield-per-recruit model; biomass-per-recruit. Relative yield-per-recruit model and yield isopleth diagram.

Suggested Reading

Gayanilo F. C. Jr., Soriano and , D. Pauly, 1995. FAO - ICLARM Stock Assessment Tools. FAO of UN, Rome

P. Sparre, 1989. Length based Fish Stock Assessment (LFSA) – FAO Technical Paper, FAO, UN Rome

FRM 606 FISHERIES GOVERNANCE

2+0

Objective: To develop critical understanding of governance in fisheries

Unit I: Overview of legislation, critical review of fisheries regulatory and developmental setup in Centre and States (spheres of responsibility and division of power); need for fisheries management; regulatory, legal and enforcement regimes. Developmental planning for fisheries; plan allocation, programs and performance of fisheries sector; regional disparities and balanced development; political economy of fisheries development
Political ecology

Unit II: Policy and regulatory environment in Marine Fisheries Sector, Inland Fisheries Sector, Brackishwater Aquaculture Sector, Freshwater Aquaculture Sector, Processing Sector, Fish Marketing and Trade policies, institutionalization of stakeholder participation and Developing policy framework for fisheries

Unit III : International policy and regulatory scenario in fisheries sector; FAO's CCCRF; UN's Law of the Sea and other conventions; treaties; WTO, SAARC, NACA,CBD, CITES, MARPOL, EU's Common Fisheries Policy,; Fisheries policy and regulation of select countries in Asian and American region; WTO and Fisheries; Subsidies and taxation in fisheries sector

Unit IV: Common Fishery policies (Rules on aquaculture and stakeholder involvement): State, National and International International regulatory and developmental instruments: United Nations Law of the Sea Historical perspectives; international negotiations and settlements over open seas, conflict management ,UN fish stocks agreement, shared stocks), FAO Compliance Agreement (1993),

Unit V: FAO Code of Conduct for Responsible Fisheries

Unit: VI Monitoring, Control and Surveillance (MCS); design considerations; operational procedures such as data collection, fisheries patrols, boarding, inspection procedures,

verification of catches, verification of position, trans-shipment, flag state responsibilities & Port State control

Unit VII: Case studies in selected states on:

1. sub-sectoral review of fisheries policy and legislative framework in selected Indian States;
2. leasing policy;
3. organisational structure, function & performance;
4. monsoon fishing ban
5. conflicting state policies
6. conflicts management on International level;
7. implications of WTO agreements for Indian and world fisheries,

Suggested reading

1. Allison, E. H. (2001), Big laws, small catches: global ocean governance and the fisheries crisis. *J. Int. Dev.*, 13: 933–950. doi: 10.1002/jid.834
2. Allison, E. H., Ratner, B. D., Åsgård, B., Willmann, R., Pomeroy, R. and Kurien, J. (2012), Rights-based fisheries governance: from fishing rights to human rights. *Fish and Fisheries*, 13: 14–29. doi:10.1111/j.1467-2979.2011.00405.
3. Jentoft S. 2006 Beyond fisheries management: the Phronetic dimension *Marine Policy*, 30 (2006), pp. 671–680
4. Jentoft S. and Chuenpagdee, R 2009 Fisheries and coastal governance as a wicked problem *Marine Policy* 33 (4): 553-560
5. Jentoft, S. T. van Son, M. Bjørkan 2007 Marine protected areas: a governance system analysis *Human Ecology*, 35 (2007), pp. 611–622
6. Kooiman, J. R. Chuenpagdee Governance and governability J. Kooiman, M. Bavinck, S. Jentoft, R. Pullin (Eds.), *Fish for life: interactive governance for fisheries*, University of Amsterdam Press, Amsterdam (2005), pp. 285–299
7. Kooiman, J. R. Pullin 2008. Assessing governability in capture fisheries, aquaculture and coastal zones *The Journal of Transdisciplinary Environmental Studies*, 7 (1) (2008), pp. 1–20
8. Thomso K. and T. Gray 2009 From community-based to co-management: Improvement or deterioration in fisheries governance in the Cherai Poyil fishery in the Cochin Estuary, Kerala, India? *Marine Policy* 33 (4): 537-543
9. Swan, J. 2000 Regional Fishery Bodies and Governance: Issues, Actions and Future Directions FAO publication 47 pp

10.

FRM 607 CORAL REEF MANAGEMENT

1+1

Objective:

To enhance the knowledge on coral reefs, their importance, conservation and restoration management

Theory

Unit I Type of coral reefs and their distribution

Unit II Origin of coral reefs – coral reefs of the world

Unit III Ecology of coral reefs; factors influencing growth; productivity of coral reefs; plants and animals associated of living reef corals and fringing reefs;

Unit IV types of corals and their Biology of corals (Nutrition, production, larval dispersal and settlement)

Unit V Bioactive substances from corals

Unit VI Economic importance of coral reefs

Unit VII Threats, Management and conservation of coral reefs and soft corals

Practical:

Identification of soft and hard corals; Survey of corals and mapping; identification of associated organisms; preparation of checklist and associated organisms of Indian coast. Predatory animals of corals, Extraction of bioactive substances from soft and hard corals. Observations of destructive methods of corals and coral reef fishes

Suggested Readings

1. Frederic M. Bayer. Manfred Gracshotf, Jakob Verseveldt.1983. Illustrated trilingual glossary of morphological and anatomical terms applied to octocorallia, E.J.,Brill, Dr.W. Backhuys Leiden 75 p.
2. Frank Talbot and Clive Wilkinson 2001. Coral reefs, management and seagrasses. A source book for managers. Australian Institute of Marine suck Australia, 193p.
3. Caroline S. Rogers et al. 1999. Coral reef monitoring manual for the Caribbean and western Atlantic. National Park service, Virgin Islands National Park.
4. Eugene Rosenberg and Yoss. Loya (Eds.) 2004. Coral Health and disease. Springer, Bartin -488p.
5. Biswas, K.P.2008. Corals of tropical oceans, Daya publishing House, Delhi. 228 p.
6. Peter Sale, Ed.2006. CORAL REEF FISHES: Dynamics and Diversity in a Complex Ecosystem, Pb Academic Press
7. P.S.B.R. James. 1986 Recent advances in marine biology. (Dr. Johnes 70th Birthday commemoration volume. Today and tomorrow printers and publishers. P. 591.
8. N.V.C. Polunin and C.M. Roberts. 1996. Reef fisheries. Chapman and Hall, London. P.477.
9. Bakus, G.J. 1994. Coral reef ecosystem. Oxford and IBH publish co. pvt. Ltd. P. 232.
10. Pillai, C.G.S. Coral reefs of India

FRM 608 Mangrove Ecosystem Management

1+1

Objective: Towards understanding and ecology restoration, conservation and importance of mangrove

Theory

Unit I Ecology of mangrove forest

Distribution, Zonation, Biogeochemical cycle

Unit II Taxonomy and phenology of mangroves and biodiversity of mangrove ecosystem

Unit III adaptation carbon and nitrogen cycle in mangrove environment; Carbon sequestration

Unit IV Valuation of mangrove ecosystem

Unit V Threats, restoration and conservation

Unit VI Sustainable management, case stud

Practical:

Visit to mangrove plots and study zonation,

Biodiversity assessment along with the ecological parameters

Observe and understand the developmental pressures

Survey the livelihood dependency on the selected site

Draw management plan based on the observations and information

Suggested Readings:

1. Dodd, R.S. & Ong, J.E. (2008) Future of mangrove ecosystem to 2025. Aquatic Ecosystems: Trends and Global Prospects. (ed N.V.C. Polunin), pp. 172–187 (Chapter 12). Foundation for Environmental Conservation. Cambridge University Press, UK.
2. Donato, D.C., Kauffman, J.B., Murdiyarso, D., Kurnianto, S., Stidham, M. & Kanninem, M. (2011) Mangroves among the most carbon-rich forests in the tropics. Nature Geoscience, 4, Doi:10.1038/NGEO1123.
3. Kathiresan, K. and S.Z. Qasim. *Biodiversity of Mangrove Ecosystems*. Hindustan Publishing Corporation, New Delhi, 2005, 251 pp
4. Noralene Uy, Rajib Shaw (ed.) *Ecosystem-Based Adaptation (Community, Environment and Disaster Risk Management , Volume 12)*, Emerald Group Publishing Limited
5. Ong, J. E., & Gong, W. K. 2013 Structure, Function and Management of Mangrove Ecosystems ISME Mangrove Educational Book Series No. 2
6. Robertson A.I., D.M. Alongi Eric Wolanski, Yoshiro Mazda, Peter Ridd Mangrove Hydrodynamics Published Online: 15 MAR 2013 Mangrove Ecosystems: Function and Management ed. Luiz Drude de Lacerda DOI: 10.1029/CE041p0043
7. Shanker K. 2005 Biodiversity of Mangrove Ecosystems, *Conservation Soc.* 3: 537-9
8. Snedaker, S. C.;Snedaker, J. G. The mangrove ecosystem: research methods.1984 pp. 251 pp.

LIST OF JOURNALS

Applied Phycology
 Aquaculture
 Aquaculture in Tropics
 Aquatic Botany
 Asian Fisheries Science
 Australian Journal of Marine Science
 Bio Techniques
 Biodiversity Assessment
 Bio-techniques.
 Biotechnology
 Botanica Marina
 Cambridge journal online Systematics and biodiversity
 Canadian Journal of Remote Sensing
 Canadian Journal of Fisheries and Aquatic Sciences
 Conservation Biology
 Conservation Letters
 Continental Shelf
 Copeia
 Coral Reef Conservation
 Current Science
 Developmental Biology
 Ecology

Journal of Marine Biology
 Knowledge Management for Development Journal
 Lakes & Reservoirs: Research & Management
 Limnology and Oceanography
 Marine Biology
 Marine Ecology
 Marine Policy
 Marine Pollution Bulletin
 Molecular ecological notes
 Molecular Marine biology and biotechnology
 Nature
 Phycology
 Plantae
 Systematic Zoology
 Tailor and Francis online Systematics and biodiversity
 Threatened Taxa
www.barcodinglife.org
 Zootaxa

Ecology and Society
Ecology of Freshwater Fish
Embryology
Estuary and Coastal Shelf
Fish and Fisheries
Fish Biology
Fisheries Research
Fisheries Science
Fishery Technology
Freshwater Biology
Gene
Hydrobiologia
Indian Journal of Ecology
Indian Journal of Fisheries
Indian Journal of Geomarine Sciences
Infofish
Infofish International
International Journal of GIS
International Journal of Remote Sensing
ISPRS Journal of Photogrammetry & Remote Sensing
Journal of Environmental Engineering and Health
Journal of Environmental Management
Journal of Indian Fisheries Association
Journal of Indian Ocean Studies
Journal of Marine Biological Association of India
Journal of Marine Biological Association of United Kingdom

Broad Research Areas

Application of Remote Sensing to fisheries
Aquaculture policy issues and perspectives
Assessment of Biodiversity of various water bodies.
Assessment of By catch from trawl, bottom set gill net
Biodiversity monitoring, conservation strategies
Biology, biomass estimates and stock assessment of selected finfish and shellfish.
Biosystematics of commercial fish stocks
Catalogue preparation of commercially important fishes (FW , BW Marine)
Coastal pollution assessment
Comparative histology of alimentary canal of fishes with different feeding habit
Comparative studies on swim bladder of different families of fish
Comparative study of skeleton
Coral Reef Monitoring
Cryopreservation of rare, endangered, commercially important plants
Degree of destructiveness of modern fishing gears

Development of location-specific, efficient fish catching methods.

Development of Responsible Fishing Techniques

Ecomodelling

Ecopath modelling for minor reservoir, small waterbody

Estimation of Age employing hard parts from different geographical areas.

Estimation of growth and mortality parameters based on secondary data source.

Fishing gear selectivity.

Fishing rights and resource rents.

Food ;and feeding habit of commercially important group of fishes and shellfishes.

Habitat restoration

Identification and prospects of local candidate species for culture

Identification of Stocks

Impact of oceanographic features on fish production

Inland fisheries policies, legislations and regulations.

Inventorization of coastal resources

Investigations in traditional fisheries (oil sardine, mackerel, Bombay duck etc)

Issues related to exploitation and management of highly migratory and straddling fish stocks.

Karyotaxonomy of commercially important fishes and shellfishes

Lake ecosystem restoration

Mangrove ecosystem restoration

Mapping of inland and coastal water bodies

Mapping of marine fish diversity along the west coast of India.

Microsatellite base identification of commercial fishes

Monitoring and implementation of the regulations

Prospects of different fish culture systems (Pen/cage).

Restoration of critical ecosystems

Seagrass ecosystem modelling and restoration

Species and stock differentiation based on Truss and molecular markers

Stock assessment of commercially important resources

Stock assessment of individual freshwater and marine fish using FiSAT

Stock enhancement

Stock Identification employing morphometric and molecular tools.

Studies on biodiversity estimates for coastal resources, fresh water bodies.

Study of developmental stages of commercially important species

Trophic dynamics of ecosystems

Use of remote sensing for Potential fish Zone

Ex-situ conservation of endangered and threatened species

Restoration of coral reefs

Reef vegetation utilization

Efficacy of software application in stock assessment

Modelling of aquatic ecosystem

Impact of fishing on environment and biodiversity

Impact of stratification of physico-chemical parameters

Documentation of by-catch and discards.

Case studies on the decline of large growing fish from Northwest coast of India

Study of overcapacity of shrimp trawlers

Underutilization of reservoir fishery potential

Biosystematics of commercial fish stocks

BYcatch and discard studies

Comparative study of single day and multiday fishing systems

Compliance of marine fisheries with the provisions of FAO CCRF

Design and catch efficiency/operational performance of gill nets, lines, traps etc

Development of Responsible Fishing Techniques

Efficacy of software application in stock assessment

Participatory GIS in different fishing systems

Species and stock differentiation based on Truss and molecular markers

Techno-economic efficiency of fishing gears