DR. BALASAHEB SAWANT KONKAN KRISHI VIDYAPEETH,
DAPOLI, DIST RATNAGIRI – 415712 (MS)

COLLEGE OF FISHERIES, SHIRGAON, RATNAGIRI

Department of Fisheries Hydrography

1. **Name of the Department/Section:** Department of Fisheries Hydrography, College of Fisheries, Ratnagiri

2. **About Department**: Department of Fisheries Hydrography is in function since the inception of College of Fisheries, Ratnagiri. Under this Department, Post-graduate degree courses (M.F.Sc) in the discipline of Aquatic Environment Management (2 seats) are offered every year. Ph.D. Degree course in Aquatic Environment Management (2 seats) is also conducted.

3. **Academic Programs**:

1. Department-wise distribution of course credits:

DEPARTMENT OF FISHERIES HYDROGRAPHY

UNDER GRADUATE

Sr No.	Sem No.	Course Code	Credits		Departmental Courses
1	I	AEM 111	1+1	2	Meteorology, Climatology and Geography
2	I	AEM 112	1+1	2	Soil and Water Chemistry
3	I	AEM 113	1+1	2	Coastal Zone and Disaster Management
4	II	AEM 124	2+1	3	Limnology
5	II	AEM 235	2+1	3	Fisheries Oceanography
6	IV	AEM 356	2+1	3	Aquatic Ecology and Biodiversity
7	V	AEM 367	2+1	3	Marine Biology
8	VI	AHM 367	1+1	2	Fish Toxicology
9	VI	AEM 368	1+1	2	Aquatic Pollution
			13+09	**22**	

UG COURSES

Course No. : AEM 111	Title : Meteorology, Climatology and Geography
Credits : 2 (1 + 1)	Semester: I

Theory

Nature of Atmosphere: weather and climate; composition of atmosphere; structure of atmosphere. Heat energy of atmosphere: process of heat transmission; heating of atmosphere; disposal of insulation; irregular heating of atmosphere. Temperature: Temperature instruments; periodic, horizontal and vertical temperature variations; effects of vertical air motion on temperature. Humidity and water vapour: relationship between temperature and humidity; distribution of water vapour in atmosphere; evaporation, humidity instruments and measurements. Condensation and precipitation: process of conditions of condensation, forms of condensation; precipitation; forms of precipitation, measurement of precipitation; rainfall in India. Clouds and thunderstorms: amount of cloudiness; Ceiling; classification of clouds; conditions of cloud formation; reporting and identification of clouds; thunderstorms. Atmospheric pressure: meaning of atmospheric pressure; the laws of Gases; pressure units; pressure instruments. vertical, horizontal and periodic variations; isobars and pressure gradients. Wind: characteristics of wind motion; wind observation and measurement; wind representation; factors affecting wind motion. Terrestrial or planetary winds: ideal planetary wind system; planetary pressure belts. Planetary wind system; secondary winds; monsoon winds; land and sea breeze. Tropical cyclones: storm divisions; pressure and winds; vertical structure of storm centre; hurricane, sea, swell and surge; hurricane warning. Weather forecasting: forecasting process; forecasting from local indications; role of satellite in weather forecasting; synoptic weather charts. Effects of climate change on fisheries sector. Introduction to Geography: shape, size and structure of the earth; concepts of latitude, longitude and great circles. model globe, maps and different types of projections; cartography; landscape.

Practical

Graphic representation of structure of atmosphere; physical layering and compositional layering. Temperature instruments: simple thermometers; Six's Max-Min Thermometer; thermograph. Isotherms: world mean temperatures-January to July. India mean temperatures - January to July. Humidity measurement: hygrometer; psychrometer; relative humidity; dew point. Condensation: observation and identification of various types of clouds. Depicting sky picture. Precipitation: measurement of rainfall using rain gauge. Mapping Indian monsoons: south-west monsoon and rainfall in June, North-east monsoon and rainfall in December; isohyets. Atmospheric pressure measurement: fortin's mercurial barometer; Aneroid barometer. Isobars: India mean pressure - Jan to July. Wind observation and measurement: wind vane; cup anemometer. Ideal terrestrial pressure and wind systems: diagrammatic representation. Planetary pressure and wind systems Geography: The Earth: diagrammatic representation of shape, size, structure, zones. Latitudes, longitudes and great circles. Typical landscape mapping; map readings. Geographical terms used in landscape

Course No.: AEM 112	Title : Soil and Water Chemistry
Credits : 2 (1 + 1)	Semester : I

Theory

Solutions: Standard solutions, titration, indicators, dilute solutions, units of concentration: standard curve; nomograph. Chemistry of water: the water molecule, properties of pure water, fresh water and sea water. Composition of waters**:** surface water, ground water and sea water. Factors affecting natural waters. Acid, base, salts: Hydrogen ions, modern concept of pH and buffer. Physical properties of soil; soil colour. texture, structure, pore size, bulk density, water holding capacity. Soil types and their distribution. Soil chemistry: soil colloids, cation exchange, organic carbon. Carbon- Nitrogen ratio, soil fertility. Soil reaction. Acidity, alkalinity, conductivity, redox - potential. Submersed soils: wet lands, peat soils, fluxes between mud and water, methane and hydrogen sulphide formation. Saline soils, Alkali soils, acid sulphate soils, Iron pyrites, soil réclamations. Soil and water amendments. Lime, manures, fertilizers, micronutrients. Environmental amelioratives: chlorination, Deodorizers. Bacterial formulation, zeolites, alum, gypsum. Soil quality criteria/ requirements for aquaculture. Water quality criteria/ requirements for Aquaculture.

Practical

Collection of soil sample. Processing of soil samples Study of soil types. Principles of Titrimetry, Gravimetry, Potentiometry & Conductometry. Refractometry, Colourimetry & Turbidimetry. Spectrophotometry (UV, Visible, Flame, AAS). Computerized instrument system. Demonstration: demonstration of laboratory glass wares. Study of equipments used in water and soil analysis. Measurement of redox potential. Soil analysis: Determination of soil texture. Estimation of Soil pH & conductivity. Soil available nitrogen; preparation and digestion. Estimation of available soil nitrogen. Estimation of Available soil phosphorus. Estimation of Organic carbon in soil.

Course No. : AEM 113	**Title :Coastal Zone and Disaster Management**
Credits : 2 (1 + 1)	**Semester : I**

Theory

Coastal zone management**:** Estuaries, Wet lands and Lagoons, Living resources – Non-living resources. Principles of remote sensing: orbits, electromagnetic radiation, diffraction, electro-optical, and microwave systems. Data Input, Data Management, Data Quality. Remote Sensing for Coastal Management. Geographical Information System (GIS): Definition, Concepts, Data Acquisition and Data Management. Applications of GIS in aquatic resource identification. Coastal Regulation Zone (CRZ) Act, Coastal regulation zones for main land and islands – Environmental policies, planning, administrative and regulations. CRZ mapping. Integrated Coastal Zone Management (ICZM); concept, application and case studies. Communication, research, integration, institutional arrangements, regulations, stakeholder participation, the role of the private sector in ICZM. Impacts of human activities on coastal and ocean areas: Challenges related to climate change, expanding tourism, declining fisheries, intensive shipping and biodiversity protection. Problems related to sectors such as tourism and fisheries in the ICZM context. Analysis of multiple use management problems typical for the coastal areas with the maritime industry. Environmental Impact Assessment (EIA): Principles and process. EIA of coastal industries. Evaluation and Methodology; Social Impact Assessment and other developmental activities. *Disaster Management:* Basic concepts: Hazard, risk, vulnerability, disaster, capacity building. Multi-hazard and disaster vulnerability of India. Types of natural and manmade hazards along coastal zone in fisheries and aquaculture. Causes, characteristics and effects of disasters. Management strategies: pre-disaster, during disaster and post-disaster. Prevalent national and global management practices. Agencies involved in monitoring and early warnings at district, state, national and global levels.

Practical

Field visit to rocky coastal environment to study erosion of beach. Field visit to sandy coastal environment to study erosion of beach. Identification of ecologically sensitive areas. Protection measures for

ecologically sensitive areas. Study of CRZ along the coastal belt. Study of ICZM along the coastal belt. Study on implementation of CRZ. Study on violation of CRZ. Study of application of remote sensing and GIS. Project preparation of EIA. Sea safety and health. Acquaintance with fire-fighting devices. Life saving appliances and first-aid. Uses of distress signals and technologies. Relief and rehabilitation measures, Trauma counselling.

Course No. : AEM 124	**Title : Limnology**
Credits : 3 (2 + 1)	**Semester : II**

Theory

Introduction to limnology: inland water types, their characteristics and distribution. Ponds and lakes; streams and rivers. Dynamics of lentic and lotic environments. Lakes - their origin. Lakes - their diversity. Famous lakes of the world and India. Nature of lake environment. Lake Morphometry. Physical and Chemical conditions and related phenomena. Biological relations: influence of physical conditions on living organisms in inland waters. Biological relations: influence of chemical conditions on living organisms in inland waters. Plankton: planktonic organisms; classification of plankton. Distribution of plankton: geographic, vertical, horizontal, seasonal distribution of phytoplankton and zooplankton. Seasonal changes of body form in planktonic organisms. Food of planktonic organisms; primary productivity. Aquatic plants characteristics, classification, zonation. Aquatic plants: Seasonal variations, quantity produced chemical composition. Aquatic plants: Distribution in different waters, limnological role. Nekton: composition. Nekton: Distribution, movements. Benthos: classification;

periphyton; zonation; Benthos: Distribution; movements and migration;Seasonal changes in benthos. Profundal bottom fauna. Biological productivity: circulation of food material; classification of lakes based on productivity; laws of minimum; biotic potential and environmental resistance; Quantitative relationships in a standing crop; trophic dynamics; successional phenomena. Indices of productivity of lakes; artificial enrichment. Lotic environments: running waters in general; physical conditions; classification of lotic environments, Biological conditions; productivity of lotic environments. Influence of currents. Plankton; nekton; benthos. Temporary and head waters streams; ecological succession.

Practical

Morphometry of lakes, ponds and streams. Determination of Temperature and light penetration. Determination of colour, Determination of conductivity, Determination of DO, Determination of Free CO_2, Alkalinity and pH, Determination of Hardness, Determination of Nutrients, Collection and identification of fresh water phytoplankton.

Enumeration and biomass estimation of freshwater phytoplankton. Estimation of primary productivity in fresh water bodies. Collection and identification of fresh water zooplankton. Enumeration and biomass estimation of fresh water zooplankton. Collection and identification of benthos from lakes and ponds, streams and canals. Collection and identification of nekton/aquatic insects from freshwater bodies. Collection and identification of aquatic plants from different fresh water bodies. Field visit to lotic and lentic water bodies.

Course No. : AEM 235	**Title : Fishery Oceanography**
Credits : 3 (2 + 1)	**Semester : III**

Theory

Introduction to Oceanography: classification. Expeditions national and international. Earth and the ocean basin, distribution of water and land; relief of sea floor. Major feature of topography and terminology. Major divisions. Relief in Indian oceans. Ocean Waves: definition and terms; classification, Difference

between surface and long waves. Tsunamis, Seiches, internal waves. Ocean Tides: Definition; Tidal phenomenon, elementary tidal definition; tidal inequalities; tide producing forces. Types of tides, tidal bores. Ocean Currents: Definitions and features; drift currents Ekman spirals, upwelling, sinking, gradient currents; thermohaline circulation. Characteristics; course; and significance of some major ocean currents of the world. El-Nino. Physical properties of sea water: Salinity and chlorinity; temperature; thermal properties of sea water. Colligative and other properties of sea water; Residence time of constituents in seawater. Properties of sea ice. Transmission of sound. Eddy conductivity; diffusivity and viscosity. General distribution of temperature, salinity and density. Salinity and temperature of surface layer (SST), Subsurface: distribution of temperature and salinity. The T-S diagram. Water masses of Indian oceans. Chemistry of sea water: Constancy of composition. Elements present in sea water. Dissolved gases in sea water. CO_2 system, alkalinity. Inorganic agencies affecting composition of sea water, distribution of phosphorus, nitrogen compounds, silicates manganese in the oceans, Factors influencing their distribution.

Practical

Field visits and operation of oceanographic instruments- Nansen reversing water sampler. Study of Bathythermograph. Study of Grabs, Corers. Study of Current meters. Study of Tidal gauges. Study of Echo-sounder. Measurement of temperature. Measurement of Transparency. Determination of pH. Determination of DO. Determination of Salinity. Determination of Ammonia. Determination of Nitrate. Determination of Nitrite. Determination of Phosphate. Determination of Silicate in sea water.

Course No. : AEM 356	**Title: Aquatic Ecology and Biodiversity**
Credits : 3 (2 + 1)	**Semester: V**

Theory

Aquatic environment, Flora and fauna. Components of aquatic systems, Aquatic productivity. Energy flow, food chain. Animal associations, Symbiosis. Commensalisms. Parasitism. Prey-predator relationship. Host parasite relationship. Aquatic biodiversity-its importance, Species diversity, genetic diversity, habitat diversity. Diversity indices. Ecological and evolutionary processes. Ecological niches – lagoons, estuaries. Mangroves. Coral reefs. Flood plains, coastal wet lands, bheels, oxbow lakes. Threats to biodiversity- habitat destruction, introduction of exotic species. Conservation of habitats. Marine parks and sanctuaries. Conservation programmes for endangered species, *ex situ* and *in situ* conservation, captive breeding and management of endangered species. Various national and international conventions and regulations concerning biodiversity, including use of selective gears and exclusion devices. *Environmental Science:* Scope and importance. Natural Resources: Renewable and non-renewable resources. Water resources: Use and over-utilization of water, dams-benefits and problems. Ecosystems: Concept, Structure, function, Producers, consumers, decomposers. Energy flow. Ecological succession, food chains, food webs. Ecological pyramids. Characteristic features and function of the aquatic ecosystems (ponds, streams, lakes, rivers, oceans,).

Practical

Collection of species of fishes of rocky shores. Collection of species of fishes of sandy shores. Collection of species of fishes of muddy shores. Study of assemblages of organisms of rocky shores. Study of assemblages of organisms of sandy shores. Study of assemblages of organisms of muddy shores. Study of Lentic habitat. Study of lotic habitat. Observation of adaptive characters and interrelationships like commensalisms, symbiosis, parasitism and predation. Field visits to mangroves, marine parks, sanctuaries, coral reefs. Study of Rivers, hill streams. Study of lakes and reservoirs. Working out biodiversity indices. Visit to a local area to document environmental assets river, estuary. Visit to a local polluted environment, Study of common flora and fauna from aquatic environment.

Course No. : AEM 367	**Title : Marine Biology**

Credits : 3 (2 + 1)	**Semester : VI**

Theory

Introduction to Marine Biology. Divisions of marine environment- pelagic, benthic, euphotic, aphotic divisions and their subdivisions. Life in oceans. General account of major groups of phytoplankton. Major zooplankton groups. Sea weeds. Seagrasses. Marine invertebrates: sponges, corals, echinoderms etc. Environmental factors affecting life in the oceans-salinity, light, currents, waves, tides, oxygen, carbon dioxide. Vertical migration of zooplankton, Phytoplankton-Zooplankton relationship. Geographical and seasonal variation in plankton production, plankton and fisheries. Inter tidal ecology: Rocky shore. Sandy shore. Mud flats. Zonations. Communities, and the adaptation. Mud banks: formation, characteristics. Boring organisms, fouling organisms. Nekton outline, composition of nekton, habitats of nekton. Marine mammals –physiological adaptation for diving. Bioluminescence. Indicator species.Blooms, Red tides: cause and effects.

Practical

Study of common instruments used for collection of phytoplankton, zooplankton, benthos from rocky shore, benthos from muddy shore, benthos from sandy shore. Collection, preservation and analysis of phytoplankton and zooplankton from estuary, marine water. Analysis of phytoplankton from marine water, analysis of zooplankton from marine water. Study of green sea weeds, Study of brown sea weeds, Study of red sea weeds, Collection preservation and analysis of sandy, muddy and rocky shore inter tidal organisms.

Coutrse No. : AEM 368	**Title: Aquatic Pollution**
Credits : 2 (1 + 1)	**Semester : VI**

Theory

Introduction to aquatic pollution, the sources of pollutants, Point and Nonpoint sources. Sewage and domestic wastes- composition and pollution effects, sewage treatment and its reuse Agricultural wastes- organic detritus, nutrients, Adverse effects of oxygen demanding wastes. Importance of dissolved oxygen; Oxygen demand; BOD; COD; Oxygen budget. Excessive plant nutrients: Eutrophication. Pesticide types and categories; inorganic pesticides, Organo-chlorine compounds, Organo-phosphorous compounds; Polychlorinated biphenyls (PCBs). Bioaccumulation and impact on aquatic fauna and human health; toxicology. Heavy metals: Interaction of heavy metals with water and aquatic organisms. Bioremediation and Phytoremediation. Oil pollution; Crude oil and its fractions; Sources of oil pollution;. Treatment of oil spills at sea; Beach Cleaning; Toxicity of Petroleum Hydrocarbons Ecological Impact of Oil pollution- Case studies. Radioactivity and background radiation of earth: Radionuclide polluting, special effects of radioactive pollution. Thermal pollution and its effects. Physical and chemical nature of possible effluents from major industries in India with special reference to Konkan region. Monitoring and control of pollution: Biological indicators of pollution. Plastic waste management.

Practical

Collection preservation and transportation of waste water sample. Physical characteristics of polluted waters: Colour, Odour & Turbidity. Determination of pH. .Determination of BOD, Determination of COD. Determination of Hydrogen sulphide. Determination of Ammonia. Determination of Nitrites. Determination of Oil and grease in water. Determination of heavy metals in water. Determination of heavy metals in sediments. Methods of pesticide residue analysis in waters. Estimation of pesticide residue in fish.Pollution flora : indicator species- algae. Pollution fauna :in protozoa and insect larva. Bioassay study, Toxicity study.

Course No. : AHM 367	**Title : Fish Toxicology**
Credits : 2 (1 + 1)	**Semester : V**

Theory

General Toxicology: Definitions, Branches of Toxicology. Historical developments, Classification of poison. Types of poisoning- Toxicity testing - Chronocity factor. Untoward effects, Common causes. Diagnosis of poisoning. Factors modifying toxicity. Toxicokinetics. Toxicodynamics. General approaches to diagnosis and treatment of poisoning. Systemic Toxicology: Toxicity caused by metal and non-metals. Phytotoxins-Toxic principles of various alkaloids and toxic plants. Drug toxicity and toxicity caused by agrochemicals. Mycotoxins, Bacterial toxins. Collections and dispatch of specimens in Toxicological cases. Toxicity of drugs in Aquaculture: Maximum Residual Limits (MRL) of various drugs and chemicals in fish Metabolism of toxic substances by aquatic organisms.

Practical

Metal toxicity test on vertebrate –Cu, Metal toxicity test on invertebrate –Cu, Metal toxicity test on vertebrate-Cr, Metal toxicity test on invertebrate-Cr, Assessment of Histological changes in test animals: vertebrate, Assessment of Histological changes in test animals: invertebrate, Detection of Ammonia (ammonium ions) NH_4^+ from toxic environment. Detection of Chloride (Cl^-) from toxic environment. Detection of Phosphate ($P0_4$) from toxic environment. Detection of Sulphate ($S0_4$) from toxic environment. Qualitative detection of Nitrite. Qualitative detection of Nitrate. Estimation of LC_{5O}. Estimation of LD_{5O}. Estimation of ED_{5O}. Demonstration of drug toxicity.

The Deparment offers post-graduate courses viz., M.F.Sc. and Ph.D. in the discipline of Aquatic Environment Management

AQUATIC ENVIRONMENT MANAGEMENT
Course Structure

Course Code Course Title Credit Hours
Major Courses 20 Credits

AEM 501 Inland Aquatic Resource Management 2+1
AEM 502 Chemical Interactions in Aquatic Environment 2+1
AEM 503 Analytical Techniques in Environnemental Sciences 1+2
AEM 504 Climate Change: Impact and Management 1+0
AEM 505 Aquatic Pollution and Management 2+1
AEM 506 Eco-toxicology 1+1
AEM 507 Coastal Ecology and Coastal management 2+1
AEM 508 Aquatic Microbiology 1+1

Minor Courses 8 Credits
(From the subjects closely related to a students major subject)
AEM 509 Aquatic Environment and Biodiversity 1+1
AEM 510 Plankton Ecology and Trophic Dynamics 1+1
AEM 511 Environmental Biotechnology 1+1
AEM 512 Fisheries Oceanography 1+1
AEM 513 Utilization and Management of Aquatic Algal Resources 2+1
AEM 514 Restoration Ecology 1+1

Supporting courses 6 Credits
(The subject not related to the major subject. It could be
any subject considered relevant for students research work
(such as Statistical Methods, Design of Experiments etc.)
or necessary for building his/her overall competence)
Common courses 5 Credits

(The following courses, one credit each will be offered)

1. Library and Information Services
2. Technical Writing and Communication Skills
3. Intellectual Property and its management in Agriculture
4. Basic concepts in Laboratory Techniques
5. Agricultural Research, Research ethics and Rural Development Programmes

Total Course Credits 39 Credits

Course Code	**Course Title**	**Credit Hours**
Masters' Seminar 1 Credit		
AEM 591	Master's Seminar I	0+1
Masters' Thesis Research 30 Credits		
AEM 599	Master's Research (Semester III)	0+15
AEM 599	Master's Research (Semester IV)	0+15

Total M.F.Sc. Program Credit Hours 70 Credits

Note: Minor courses from Department of Fisheries Biology and Department of Aquaculture also can be accepted for AEM discipline students relevant to students research work.

Course Contents
M.F.Sc. in Aquatic Environment Management

I. Course Title : Inland Aquatic Resource Management
II. Course Code : AEM 501
III. Credit Hours : 2+1
IV. Aim of the course
• To educate the students on ecology of wetlands and its importance
• Manipulation and mapping of wetlands for sustainable management of these ecosystems.
V. Theory
Unit I
Types of inland aquatic resources: Concept of watershed; Lacustrine, Riverine, Wetlands, Floodplains, Swamps and Ponds, Habitat characteristics, Flora and Fauna, Economic importance; Relationship between productivity (primary and secondary) and fish yield.
Unit II
Wetlands: Trophic classifications, Functions, Degradation of wetlands (causes consequences; Constructed wetlands; Restoration, Conservation and management of wetlands, Ecological services and livelihood from wetland.
Unit III
Ecological engineering: Concept, Application and restoration; Resource enhancement; Biomanipulation - Top-down and bottom-up methods; Integrated Environment Management (IEM) Programme, Ramsar convention.
Unit IV
River continuum concept and new paradigm shift, River linking; Mapping of aquatic resources using remote sensing and GIS.
Unit V

Water budget and Environmental flow, Its significance in water conservation and ecology, Environmental Economics and auditing, Ecosystem approach to resource management.

Unit VI

Wasted and degraded resources, Coastal and inland saline areas, Adaptations of organisms, restoration/remediation strategies, Prospects of gainful use of available technologies.

VI. Practical

Collection, preservation and analysis of flora and fauna (plankton, macrophytes and benthos) of wetland/degraded aquatic ecosystem. Calculation of shoreline development index and morphometry. Calculation of Morpho-edaphic index. Field visits to selected lakes/wetlands/degraded/restored ecosystem.

I. Course Title : Chemical Interactions in the Aquatic Environment

II. Course Code : AEM 502

III. Credit Hours : 2+1

IV. Aim of the course

• To acquaint the students with basic principle of chemistry with special reference to soil chemistry

• To study physical, chemical, biological and geological interactions in the aquatic environment.

• To study the nutrient dynamics and fate of contaminates in the aquatic environment.

V. Theory

Unit I

Basic principles: Chemical kinetics, Chemical equilibrium and Redox chemistry, Solubility concept, Dissolution kinetics.

Unit II

Sediment properties: Weathering of rocks; Soil formation, Soil profile, Mineral weathering; transformation, weathering products, Structure of oxide and silicate minerals, Sources of charge, adsorption on to clay minerals of major cations and anions, Double layer, Ion exchange - concept and source of cation exchange capacity (CEC), Sediment texture.

Unit III

Nutrient dynamics: Nutrient holding capacity of sediments and fixation, Processes controlling elemental cycling.

Unit IV

Transport of nutrients: Availability of Nutrients and productivity in aquatic ecosystem

Unit V

Processes in the degradation and conversion of organic matter, Humus and biogeochemical substances.

Unit VI

Fate of Contaminants: Degradable and non-degradable contaminants, Speciation and transport of contaminants, Bio-availability; Bio-accumulation andBiomagnification.

VI. Practical

Sample collection techniques Determination of physicochemical parameters of sediment – pH, electrical conductivity, redox potential, soil texture, bulk density, particle density, porosity, total and organic carbon, total and available nitrogen, phosphorus, potassium and micronutrients; C: N: P ratio, CEC

I. Course Title : Analytical Techniques in Environmental Sciences

II. Course Code : AEM 503

III. Credit Hours : 1+2

IV. Aim of the course

• To teach the student advance analytical techniques employed in environmentalstudies

• To acquaint the student to the advanced instrumentation employed inenvironmental studies

V. Theory

Unit I

Qualitative and quantitative analytical techniques including Gravimetric and volumetric analyses used in environmental science, Sampling techniques and procedures, Factors affecting the choice of analytical

techniques, Interferences and their minimization, Laboratory safety measures.

Unit II

Photometric techniques: Theory, instrumentation and application of spectrophotometry and spectroscopy, AAS, FT-IR, ICP-MS, XRD, XPS, Biosensor, Microscopic Techniques etc. Theory and applications of electrophoresis, Principles and uses of ultra-centrifugation, Tracer Techniques, Isotopes in environmental analysis.

Unit III

Separation techniques: Chromatography – theory, instrumentation and applications of thin layer, paper, ion-exchange, size exclusion, high performance liquid and gas, Methods of preparing biological samples for chromatographic analysis, GC-MS.

Unit IV

Bioanalysis techniques: Immunoassay – Principle, methods and applications and Biosensors – components, characteristics, applications, impacts and challenges.

Nanotechnology: Preparation of nanoparticles, characterization and applications

VI. Practical

Estimation of environmental parameters by UV-Visible spectrophotometer, Estimation by AAS, Estimation of environmental parameters using HPLC, Estimation of environmental parameters using GC/GC-MS, Estimation of environmental parameters by CHNS analyser, etc.

I. Course Title : Climate Change: Impact and Management

II. Course Code : AEM 504

III. Credit Hours : 1+0

IV. Aim of the course

• To understand global warming, its impact on the aquatic environment and fisheries

• To know about the different legislation across the country to combat climate change

V. Theory

Unit I

Weather and climate, Greenhouse effect, Radiative balance, Climatic migration, Impact on women; Carbon Sequestration and trading, Projected trends of climate change and disasters.

Unit II

Climate change, Its impacts, Aquatic ecosystem, Capture and culture fisheries, Carbon footprint in fisheries and aquaculture.

Unit III

Ocean acidification, Global ocean circulation, El Nino and Southern Oscillation, IPCC and its reports, UNFCCC, Kyoto Protocol, Politics of climate change.

Unit IV

Climate change adaptation and mitigation, Vulnerability assessment, Mitigation and Adaptation measures, Climate-resilient aquaculture, Climate smart villages- NICRA.

I. Course Title : Aquatic Pollution and Management

II. Course Code : AEM 505

III. Credit Hours : 2+1

IV. Aim of the course

• To impart fundamental and advanced knowledge on different aspects of aquaticpollution

• To impart fundamental and advanced knowledge on management of differentaquatic resources

V. Theory

Unit I

Aquatic pollution: Sources, types and impacts, Pollution problems of groundwater resources (arsenic, fluoride, nitrate, pesticides), Sources of contamination and management issues.

Unit II

Pollutants: Sewage, pesticides, hydrocarbons, nutrients, Metals, Radioactive wastes, Biomedical wastes, hazardous chemicals, Microplastics, Nanoparticles; Dispersal and fate of pollutants.

Unit III

Air and soil pollution: Smoke, Smog, Photochemical smog and SPM, Impact of air and soil pollution on the aquatic environment.

Unit IV

Methods of waste disposal, water quality criteria: National and International standards; ISO-14000(EMS), EIA, Management strategies, Emerging issues in aquatic environment.

Unit V

Waste waters: Their nutrient potentials, Scope and limitations, Treatment methods; Recovery of nutrients from liquid and solid wastes, Ecological sanitation, closing the loop.

Unit VI

Integrated water management: Water conservation measures, Water use and reuse in aquaculture, Water use efficiency, Restoration ecology and rehabilitation

VI. Practical

Determination of total dissolved and suspended solids, Determination of BOD, Determination of COD, Determination of NH3–N, Determination of Nitrate/Nitrite-N, Determination of Phosphate-P, Determination of metals and pesticides, Visitto a sewage treatment plant/fish processing unit/industries.

I. Course Title : Eco-toxicology

II. Course Code : AEM 506

III. Credit Hours : 1+1

IV. Aim of the course

•To impart knowledge on toxicological aspects of various pollutants

• To impart the knowledge on emergent toxicants, their fate in aquatic environment and risk assessment

• To impart knowledge on the effects of toxic chemicals on populations, communities and aquatic ecosystems

V. Theory

Unit I

Toxicity: Factors influencing toxicity, Environmental, genetic and nutritional, Ecological effects of toxicants, Genotoxicity, Neurotoxicity, Toxicology of emerging contaminants, PBDE, New generation pesticides and antibiotics, Antibiotic resistance.

Unit II

Toxicity evaluation: Toxicity Testing, Microcosm and mesocosm Tests, Dose- Response Relationships, Bioassay, Physiological and molecular evaluation

Unit III

Metabolism: Metabolism of toxic substances by aquatic microbes and other organisms consequences, synergistic and antagonistic effects, Acute poisons and accumulative poisons, Biomonitoring and biosensors.

Unit IV

Bioaccumulation, Bioconcentration and Biomagnification, Systemic effects of toxic metals, Pesticides and Herbicides; Effect of select toxicants on aquatic life and detoxification mechanisms, Interrelationship of xenobiotics with other environmental variables, biofilter organisms.

VI. Practical

Toxicity evaluation of heavy metals on selected organisms by bioassay techniques, Toxicity testing methods, Toxicity assessment of pesticides and other contaminants on selected organisms.

I. Course Title : Coastal Ecology and Management

II. Course Code : AEM 507

III. Credit Hours : 2+1

IV. Aim of the course

• To impart theoretical and practical knowledge about fundamental and advanced aspects of marine ecology.

• To acquaint the students with the recent approaches for coastal resources management.

V. Theory

Unit I

Coastal resources: Characteristics of coastal ecosystems (flora and fauna, trophic relationship, nutrient production, cycle and transport).

Unit II

Mangrove ecosystem: Species diversity, distribution and importance; Other intertidal systems - Seagrass, Sandy beach, Lagoon and estuary.

Unit III

Developmental activities and biodiversity loss: Human settlements, Industries, Shore protection works, Ports, transport systems and Waste disposal.

Unit IV

Ecological issues, Impacts of environment changes, Threats to biodiversity, Habitat destruction; Depletion of fisheries resources.

Unit V

Coastal Zone Management: Integrated Coastal Zone Management (ICZM) - its benefits, Principles, Goals and objectives, scope, zonation.

Unit VI

National and international policies and planning for coastal resource management: Natural hazards and disasters -protection and management; Socioeconomic impacts and its assessment.

VI. Practical

• Analysis of soil and water characteristics of coastal areas and determination of different factors.
• Collection, preservation and identification of coastal biological communities
• Survey of different coastal zones.

I. Course Title : Aquatic Microbiology

II. Course Code : AEM 508

III. Credit Hours : 1 +1

IV. Aim of the course

• To impart knowledge on aquatic microorganisms with reference to their role in the aquatic environment and bioprospecting.
• To impart knowledge and skill on culture and culture independent techniques for microbial studies.

V. Theory

Unit I

Distribution and classification: Microbial community in freshwater; Estuarine and marine environment (types and abundance); Factors affecting microbial growth and abundance; Extremophiles and their significance.

Unit II

Microbial interaction: interrelationships, Microbial degradation of persistent organic pollutants (POPs); Microorganisms and public health: Water-borne pathogens of public health importance - Protozoans, bacteria, enteroviruses; Microbial toxins; Algal toxins; Disinfection methods; Microbial standards for different water uses.

Unit III

Principles and applications of bioprocesses: Bioremediation, Biofertilization, Biofilms, Biofloc, Probiotics, Bio-leaching, Bio-corrosion, Bio-fouling; Microorganisms as Bioindicators and Biosensors.

Unit IV

Methods of assessing microbial biomass production; Bioprospecting: Current practices in bioprospecting and biopiracy; Microbial metabolites and its industrial application.

VI. Practical

• Isolation, identification and enumeration of algae and bacteria from polluted aquatic habitats
• Maintenance of algal and bacterial cultures
• Microbial sensitivity testing
• Bio-activity testing
• Disinfection methods

I .Course Title : Aquatic Environment and Biodiversity
II. Course Code : AEM 509
III. Credit Hours : 1+1
IV. Aim of the course
• To acquaint the students with the theoretical and practical aspects of the aquatic environment and biodiversity concept.
• To impart knowledge on biodiversity conservation and ecosystem approach to resource management.
V. Theory
Unit I
Basic ecological concepts - Habitat ecology, systems ecology, Synecology, Autecology; Characteristic features of different biomes; Concept of community, Continuum, Community attributes, Community development, Ecological succession, Changes in ecosystem production, Concept of climax.
Unit II
Biodiversity – Definition and concept; Categories of biodiversity - Species diversity, Genetic Diversity; Habitat Diversity; Ecosystem services and Economic appraisal of biodiversity.
Unit III
Biodiversity indices and their significance; Concepts of Index of Biotic Integrity (IBI).
Unit IV
Biodiversity Conservation - Global diversity patterns and loss of biodiversity; Conservation measures; Biodiversity hotspots, Biosphere reserves; National parks, sanctuaries; Marine protected areas; Convention on Biological Diversity; IUCN; CITES; WWF; Ramsar Convention; Man and Biosphere Programme; Indian legislations to biodiversity conservation, Ecological Sensitive Areas (ESAs)
VI. Practical
• Collection and identification of flora and fauna from different ecosystems.
• Calculation of biodiversity indices – Shannon-Wiener index; Simpson index, Hill index etc.
• Visit to biodiversity hotspots and ESAs.

I. Course Title : Plankton Ecology and Trophic Dynamics
II. Course Code : AEM 510
III. Credit Hours : 1+1
IV. Aim of the course
• To impart theoretical knowledge about the ecology of plankton in diverse aquatic environment with a reference to their ecological role in trophic dynamics.
• To improve the technical skills for sampling, identification and effects of different ecological conditions on plankters.
V. Theory
Unit I
Plankton diversity and productivity: Definition, Classifications and functions in aquatic ecosystem; Primary and secondary production - Production - Biomass (P/B ratio), factors affecting production.
Unit II
Sampling and preservation techniques- Plankton nets and recorders, Cryopreservation methods and their significance, Indices of diversity.
Unit III
Ecology of phytoplankton: Freshwater and marine, Spatial and temporal variations, succession; Contribution of nanoplankton to primary production; Algal blooms and algal toxins; Nutrient manipulation for algal growth and control; Biological control of algal blooms; Mass culture of phytoplankton as a live-feed; Role of microalgae in carbon sequestration.
Unit IV
Ecology of zooplankton: Freshwater and marine –Feeding behavior, Reproduction of important zooplankters; Swarms; Indicator species; Predator-prey relationship; Impact of grazing on the aquatic ecosystem; Vertical migration of zooplankton in relation to fish catch; Importance of zooplankton in the larval rearing of fish; Environmental manipulation for live-feed production; Mass culture of zooplankton as a live-feed.

VI. Practical

• Collection, preservation and estimation of phytoplankton and zooplankton
• Periphyton estimation.
• Identification and classification of various phytoplankton and zooplankton.
• Mass culture of Phytoplankton and zooplankton.
• Preparation of permanent slide and sectioning.

I. Course Title : Environmental Biotechnology
II. Course Code : AEM 511
III. Credit Hours : 1+1
IV. Aim of the course

• To impart basic knowledge on biological methods for environmental management
• To impart basic knowledge on isolation of bacteria implicated in bioremediation and demonstration of their potential for environmental management
• To impart basic knowledge on Application of Molecular techniques in environmental management

V. Theory
Unit I

Fundamentals of environmental biotechnology: Environmental biotechnology- Concepts and Scope; Conventional and Modern approaches; IPR issues related to environmental biotechnology.

Unit II

Environmental monitoring: Cellular and molecular markers of environmental pollution monitoring; Bioindicators; Biosensors and nano-sensors.

Unit III

Remediation: Bioremediation; Genetically-improved/engineered organisms - Basic concepts; Applications in remediation of metals, Pesticides and hydrocarbons.

Unit IV

Consortia of microbes for environmental protection – Concept, Scope and Feasibility, Recombinant DNA technology, Culture intendent nucleic acid-based techniques.

VI. Practical

• Genomic, Metagenomic and plasmid DNA isolation.
• Case studies on wastewater treatment using biotechnological tools.
• PCR amplification of 16S rRNA gene as a tool for biomonitoring.
• PCR application of functional gene implicated in bioremediation.
• Screening of microbes for biodegradation properties.

I. Course Title : Fisheries Oceanography
II. Course Code : AEM 512
III. Credit Hours : 1+1
IV. Aim of the course

• To educate the students on the oceanographic concepts related to fisheries and impart skill to operate oceanographic equipment.
• To understand the role of different oceanographic parameters on fisheries production.

V. Theory
Unit I

Oceanographic factors in fisheries: Effects of physio-chemical and biological oceanographic factors on adaptation, Behaviour, Abundance and distribution of aquatic organisms; Primary and secondary productivity in ocean, Productivity changes in the ocean.

Unit II

Synoptic oceanographic analysis: El Nino and Southern Oscillation; Stratification; Mud banks, Upwelling and circulation patterns.

Unit III

Forecasting systems: Fisheries forecasts – Interpretation and use of ocean thermal structure; Fisheries forecasting system in India and other countries – Remote sensing; GIS, Application in fisheries;

Application of echo-sounders and SONAR; Potential fishing zones.

Unit IV

Factors affecting marine fisheries: Environmental factors influencing the seasonal variations in fish catch in the Arabian Sea and the Bay of Bengal.

VI. Practical

• Use of tide tables.
• Oceanographic data analysis – water temperature, salinity, pH, nutrients, benthos and sediment characteristics.
• Fisheries forecasting systems.
• Oceanographic equipment and fish finding devices.

I. Course Title : Utilization and Management of Aquatic Algal Resources
II. Course Code : AEM 513
III. Credit Hours : 2+1
IV. Aim of the course

• To provide a holistic knowledge about the aquatic algal resources and their utilization for alternate livelihood
• To convey the information about the strategies and protocols for the management of aquatic algal resources

V. Theory

Unit I

Role of algae in fisheries and aquaculture, Batch and mass cultivation, Selection of culture medium, Isolation and maintenance of algal cultures; Water quality for algal culture, Algal culture as a livelihood option

Unit II

Bio-prospecting of algal resources for value-added compounds/products-pigments, Agar agar, Carrageenan, Single cell protein, Nutraceuticals and pharmaceuticals

Unit III

Production of nanoparticles; Biofuels, Food and Feed, Algal compounds in cosmetics and Natural colourants, Polar algal resources and their applications.

Unit IV

Value addition through food chain; Enhancement of productivity of phytoplankton - Use of thermal energy, Artificial upwelling, Wastewater utilization for algal cultivation.

Unit V

Role of algae in global warming mitigation; Nutrient supplementation of sea for productivity enhancement, Exotic algal species source and Preventive measures.

Unit VI

International regulations for discharge of ballast water, Algal blooms and control measures.

VI. Practical

• Techniques for algal cultivation
• Maintenance of pure cultures
• *Spirulina*and *Chlorella* cultivation – indoor and outdoor
• Extraction of pigments from algae (Carotenoids and Phycocyanin)

I. Course Title : Restoration Ecology
II. Course Code : AEM 514
III. Credit Hours : 1+1
IV. Aim of the course

• To update and widen the knowledge about basic principles and recent concepts in ecology.
• To equip the students with an updated theoretical and practical knowledge and skills about restoration of aquatic ecosystems.

V. Theory

Unit I

Ecological restoration; Ecological processes and structures, Regional and Historical contexts, and sustainable culture practices; Ecosystem integrity; Community ecological principles; Disturbance, Succession, Fragmentation; Ecosystem function and Services.

Unit II

Emerging concepts-Assembly, Stable states; Environmental flows and cultural interactions; Application of theory-Invasion, Competitive dominance and resource use.

Unit III

Restoration planning; Wetland Assessment, Delineation, and Regulation; Recovery process, Mitigation, Rehabilitation**,** and Reclamation; Ecological Engineering – Ecosystem approach for restoration; Dynamics and restoration of degraded wetlands; Removal of threats to the health and integrity of the restored ecosystem, Use of constructed wetlands to eco-restoration.

Unit IV

Ecosystem modeling; Ecosystem auditing; Socioeconomics of recovery process; Ecosystem Health Cards

VI. Practical

- Collection and segregation of native and non-native species from a degraded environment
- Making list of historical and cultural interactions, status of assemblages
- Calculation of Index of Biotic Integrity
- Listing of the threats to the integrity of the ecosystem
- Organizing different participatory programs
- Designing a sustainable ecosystem

Course Title with Credit Load
Ph.D. in Aquatic Environment Management

Course Code Course Title Credit Hours

Major Courses 12 Credits

AEM 601 Techniques in Aquatic Environmental Studies 0+2
AEM 602 Dispersal and Fate of Pollutants 1+1
AEM 603 Water Issues: Challenges and governance 1+0
AEM 604 Management and Utilization of Waste and Waste Water 2+1
AEM 605 Environmental Impact Assessment 1+1
AEM 606 Ecology of Plankton and Benthos 1+1

Minor Courses 6 Credits

(From the subjects closely related to a students major subject)
AEM 607 Estuarine and Coastal Oceanography 1+1
AEM 608 Biotechnology in Aquatic Environment Management 1+2
AEM 609 Aquatic Plant Resource and its Management 1+1
AEM 610 Application of Remote Sensing and GIS in Fisheries 1+1

Supporting courses 5 Credits

(The subject not related to the major subject. It could be any subject considered relevant for students research work (such as Statistical Methods, Design of Experiments etc.) or necessary for building his/her overall competence).

Total Course Credits 23 credits

Doctoral Seminar 2 credits

AEM 691 Doctoral Seminar-I 0+1
AEM 692 Doctoral Seminar-II 0+1

Doctoral Research 75 credits

AEM 699 Doctoral Research (Semester II) 0+15

AEM 699 Doctoral Research (Semester III) 0+15
AEM 699 Doctoral Research (Semester IV) 0+15
AEM 699 Doctoral Research (Semester V) 0+15
AEM 699 Doctoral Research (Semester VI) 0+15

Total Ph.D. Program Credit Hours 100 credits

Note: Minor courses from Department of Fisheries Biology and Department of Aquaculture also can be accepted for AEM discipline students relevant to students research work.

Course Contents
Ph.D. in Aquatic Environment Management

I. Course Title : Techniques in Aquatic Environmental Studies
II. Course Code : AEM 601
III. Credit Hours : 0+2
IV. Aim of the course
To impart skill on various techniques in aquatic environment studies
V. Practical
• Analysis of ions
• Calculation of shoreline development index and other indices of lake productivity
• Eutrophication studies in natural waters-tanks and ponds
• Estimation of bio-indicator organisms in polluted waters
• Bioremediation experiments using different bio-agents
• Use of MS-GC in analysis of pesticide and other volatile and semi volatile organic substances
• Water quality improvement evaluation trials
• Field visits
• Visits to different institutes to learn the other techniques

I. Course Title : Dispersal and Fate of Pollutants
II. Course Code : AEM 602
III. Credit Hours : 1+1
IV. Aim of the course
• To impart knowledge on dispersal of pollutants.
• To impart knowledge on fate of pollutants.
V. Theory
Unit I
Common transport processes of pollutants, Influence of winds, tides, waves and currents on the dispersal of pollutants.
Unit II
Pollutant dispersion in rivers, Coastal waters, estuaries and near outfall sites; Pollutant dispersal, Dye diffusion studies.
Unit III
Mobility and speciation of pollutants; Nano particles; Recent advances in study of pollutants and their monitoring.
Unit IV
Lifecycle analysis; Bio-concentration, Bioaccumulation and Bio-magnification
VI. Practical
• Techniques of computation of dispersion coefficients
• Calculation of Richardson number
• Numerical analysis of estuarine dispersion
• Simple plume experiments – designs of waste discharge and thermal systems

I. Course Title : Water Issues: Challenges and Governance
II. Course Code : AEM 603
III. Credit Hours : 1+0
IV. Aim of the course
• To understand the current scenario and future challenges regarding water use.
• To understand different management measures for sustainable use of water.
I. Theory
Unit I
3R concept in water resource management, Best utilisation of water resources, Water as a global issue, Key challenges and needs, Policy option for water conservation and Sustainable use.
Unit II
Water availability in different regions of world, Factors affecting it and conservation; Role of society, Ancient wisdom.
Unit III
Conflicts in water resources utilisation and management, Social and religious importance of water resources.
Unit IV
National and international regulations for management and utilisation of water resources, Current scenario and future challenges of water resource management at national and international level.

I. Course Title : Management and Utilization of Waste And Wastewater
II. Course Code : AEM 604
III. Credit Hours : 2+1
IV. Aim of the course
To impart theoretical and practical knowledge on management and utilization of waste and wastewater.
V. Theory
Unit I
Industrial and domestic wastewater characteristic; Conventional and advanced treatment methods for wastewater, Use of Nanotechnology in treatment; Nanostructured material.
Unit II
Waste recycling and utilisation (including solid waste) in aquaculture, Plant assisted bioremediation.
Unit III
Urban Drainage Sewage System; Theoretical principles and design - Screens, Equalization basin, Grit chamber, Primary and secondary settling tanks, Advanced Wastewater Treatment – Need and technologies used, Nitrification and Denitrification Processes, Phosphorous removal, Wastewater disinfection, The management of residuals from water and wastewater treatment.
Unit IV
Hazardous waste disposal (by incineration), Required minimum incineration temperature, The thermal treatment of halogenated waste, Present-day waste incinerators, Waste minimization, Role of human behavior in waste management
Unit V
Production of Biogas and bio-fuel from waste; Wastewater-fed aquaculture, Integrated wastewater management, Green water technology, IMTA.
Unit VI
Wastewater disposal criteria - National and international standards; Monitoring-Role of Central and state pollution control boards and other agencies.
VI. Practical
• Estimation of physicochemical characteristics of wastewater (BOD, COD).
• Estimation of nutrients and contaminant of wastewaters.
• Analysis of living communities associated with treatment processes.
• Demonstration of liquid waste treatments (ozonization, chlorination, aeration, precipitation, coagulation etc.).

• Synthesis of nanostructured materials for wastewater treatment.

I. Course Title : Environmental Impact Assessment
II. Course Code : AEM 605
III. Credit Hours : 1+1
IV. Aim of the course
• To impart theoretical and practical knowledge of environment impact assessment for sustainable development.
• To give exposure of Environment Impact Assessment report preparation.
V. Theory
Unit I
Environmental legislations; Concepts and approaches to Environmental Impact Assessment (EIA), EIA with reference to aquaculture projects, Coastal industries and Other developmental activities.
Unit II
Social Impact Assessment (SIA), Process, Scope and Significance, Social auditing.
Unit III
Ecosystem services; Environmental economics; Analysis and computation, Environmental auditing, Importance in planning.
Unit IV
International and national environmental protection standards; Environmental quality monitoring; ISO-14000.
VI. Practical
• Field visits for EIA and SIA of certain aquacultural projects.
• Case study and EIA report preparation.
• Setting of the environmental audit programme.

I. Course Title : Ecology of Plankton and Benthos
II. Course Code : AEM 606
III. Credit Hours : 1+1
IV. Aim of the course
• To impart and enrich the theoretical and practical knowledge of the students about ecology of plankton and benthos.
• To develop the competence for analysis of plankton diversity.
V. Theory
Unit I
Plankton- Predator-Prey relationship; Role of plankters in food chain, Trophic level and food-webs; Factors affecting plankton distribution.
Unit II
Characterization of benthic habitats; Benthic resources; Role of benthos in bioturbation and reclamation, Detrital food chain; Factors affecting benthos distribution.
Unit III
Spatial and temporal variation of plankton and benthos; Assessment methods for plankton and benthos, Modern tools.
Unit IV
Plankters and Benthos as pollution indicators; Biofilters and Bio-monitors.
VI. Practical
• Collection and analysis of soil and water in relation to plankton and benthic ecology.
• Collectionand preservation of plankton and benthos; Identification of plankters, benthos.
• Experiment to explore the role of benthos in nutrient transformation.

I. Course Title : Estuarine and Coastal Oceanography
II. Course Code : AEM 607
III. Credit Hours : 1+1

IV. Aim of the course

• To strengthen the knowledge base of the students about the characteristics of estuarine ecosystems.

• To enhance the practical skills for the study of estuarine and coastal oceanography.

V. Theory

Unit I

Estuary; significance, Zonation, characteristics; Buoyancy input as freshwater; Biodiversity, Mangroves.

Unit II

Estuarine and Coastal dynamics, Flow and circulation; productivity, Fish and fisheries of estuaries, World famous estuaries and their ecological significance

Unit III

Salinity distribution; Freshwater fraction; Flushing time of an estuary and methods of determination; Sediment transport in estuarine ecosystem

Unit IV

Waves in shallow waters, Transformation, Refraction and reflection; Mass transport, Return flow, Momentum balance

VI. Practical

• Analysis of tidal heights – Net flow and residence time computations
• Computation of salt and nutrient flux
• Construction of wave refraction diagrams
• Visit to coastal and mangrove areas
• Study of coastal profiles

I. Course Title : Biotechnology in Aquatic Environment Management

II. Course Code : AEM 608

III. Credit Hours : 1+2

IV. Aim of the course

• To educate about the application of biotechnology in aquatic environment management.

• To impart practical knowledge about various biotechnological tools used in aquatic environment management.

V. Theory

Unit I

Bioremediation: Microbial and Phyto-remediation of contaminated water and pollutants, Biotechnological approaches for bio-energy

Unit II

Biosensor, Bioreactor, Bioreactor for single cell protein, Microbial enzymes and bio-molecules, Industrial application.

Unit III

Molecular tools for biotechnological applications-it's use toxic studies- Pollution bio-indicators and biomarkers; Culture-independent techniques.

Unit IV

Application of biotechnology in aquaculture; Aquatic organisms in industrial/medical biotechnology.

VI. Practical

• Isolation of prospective bacteria as bio-remediators
• Isolation of prospective bacteria as bio-fertilizers
• Enzyme assays
• Mass culture of bacteria
• Gel electrophoresis
• DNA isolation and amplification
• RFLP analysis
• Meta-genomics
• Genomic libraries

I. Course Title : Aquatic Plant Resources and its Management
II. Course Code : AEM 609
III. Credit Hours : 1+1
IV. Aim of the course
• To broaden the knowledge base of the students about aquatic plant resources and their significance.
• To improve the capacity of the students for better management of ecosystem.
V. Theory
Unit I
Aquatic plant resources- Definition and concept; Species diversity of aquatic plants in diverse habitats, Bio-prospecting- definition and concept, Bio-prospecting of aquatic plants.
Unit II
Economic importance of aquatic plants in fisheries and aquaculture, Environmental factors affecting aquatic plant resources, Role of aquatic plants as bio-filter in decontamination and Management of wastewater.
Unit III
Management of aquatic plant resources, Methods for increasing productivity of water bodies through thermal energy and Artificial upwelling, Artificial sea ranching, Plants as FAD's.
Unit IV
Utilization of aquatic plants for environmental management, Algae and angiosperms as bio-indicators, Global warming mitigation through algal biomass and biofuel production; Cultivation of economically important aquatic vegetation *viz.* Trapaand makhana.
VI. Practical
• Documentation of economically important plants from freshwater and marine habitats.
• Techniques for algal cultivation and maintenance of pure cultures, Spirulina and Chlorella cultivation – indoor and outdoor.
• Extraction and analysis of pigments from algae (Carotenoids and Phycocyanin)
• Heavy metal and dye removal by algae and macrophytes.

I. Course Title : Application of Remote Sensing and GIS in Aquatic Environmental Studies
II. Course Code : AEM 610
III. Credit Hours : 1+1
IV. Aim of the course
• To impart knowledge and skill on application of Remote sensing and GIS in Oceanographic studies and aquatic environment management planning.
• To impart knowledge on use of modern RS tools in ecosystem management.
V. Theory
Unit I
General consideration, Survey planning, Position fixing; Sampling frequency and duration, Data storage and transmission, Sensors for temperature and salinity (*via* conductivity); Measurement of depth (via pressure); CTD units for estuarine and open ocean work; Sensor calibration techniques; Sensors for measuring flow; Tracking of drogue buoys, Acoustic Doppler current measurements.
Unit II
In situ determination of pigment concentration; Remote sensing optical methods; Satellite measurements of temperature (*via* thermal IR), Interpretation of Microwave (geotropic currents, waves, surface winds), Optical measurements; transmittance and subsurface reflectance.
Unit III
Geographical Information System (GIS): Definition, Concepts, Spatial data management, Database management system, Data Capture, Digitization, Data integration, Projection and Registration, Data Structure, Data Modeling, Visual Image Interpretation; Applications of GIS in Aquatic Environment Management; Digital Image Processing (DIP), Different Methods and Approaches.
Unit IV

Recent advances in RS technologies and its applications in different studies, use of Artificial Intelligence, etc.

VI. Practical

• Position fixing techniques
• Various types of current meters and measurement of currents
• Wave recorders and measurements
• Determination of pigment concentrations
• Remote sensors – interpretation of data
• Practical on visual interpretation of data from map
• Digital Image Processing (DIP)
• Field practical on the Application of GPS
• Mapping of aquatic environment resources through GIS softwares (ARCVIEW, MAPINFO etc.)

5. Faculty:

a. Academic staff:

1. **Faculty**

a. **Academic staff:** Assistant Professor and above with the details of the staff as given below

STAFF PROFILE

Name of the Faculty	Dr. Anil S. Pawase
Post Held	Professor (CAS) and Head
Date of Birth	24/07/1968
Qualification	Ph.D
Area of Specialization	Aquaculture, Marine Fisheries
Experience (Years)	23 yrs
Research Projects guided PhD M.F.Sc.	 2 10
Present area of research	Aquaculture
Contact details Land line No. Mobile Fax Email	 02352-232241 9422430498 02352-232241 anilpawase@yahoo.com

Name of the Faculty member	**Dr. MILIND SHANTARAM SAWANT**
Post Held	Professor (CAS)
Date of Birth	27/04/1965
Qualification	M.F.Sc (Fisheries)Ph. D. (Marine Biology)
Area of Specialization	Marine Biology / Marine Fisheries
Experience (Years)	29 years
Research Projects guided PhD M.Sc./M.Tech B.Tech.	 Ph.D. : 01 M.F.Sc.:09
Present area of research	Aquatic Environment Management
Contact details Land line No. Mobile Fax Email	 (02352) 232241 Mobile: 9422965829 Email: milindsawant27@yahoo.co.in

Name of the Faculty member	**Dr. HARISH BHAIYYALAL DHAMAGAYE**
Post Held	Associate Professor (CAS)
Date of Birth	02/05/1975
Qualification	M.F.Sc (Aquaculture)Ph. D. (AEM)
Area of Specialization	Aquatic Toxicology, Aquatic Environment Management
Experience (Years)	20 years
Research Projects guided PhD M.Sc./M.Tech B.Tech.	 **Ph. D. 1 -In Progress** **M. F. Sc. :5 completed**

	Present area of research	Fish Toxicology
	Contact details Land line No. Mobile Fax Email	 (02352) 232241 9511295814 - harish_arombrs@yahoo.co.in

Name of the Faculty member	**Dr. ANIRUDDHA DATTATRAY ADSUL**
Post Held	Associate Professor (CAS)
Date of Birth	27/03/1977
Qualification	M.F.Sc (Aquaculture) Ph. D. (Aquaculture)
Area of Specialization	Marine Biodiversity, Aquatic Environment Management
Experience (Years)	16 years
Research Projects guided PhD M.Sc./M.Tech B.Tech.	**Ph. D.** 1) **1 -In Progress** **M. F. Sc.** **2) 8 Completed; 1 -In Progress**
Present area of research	Marine Biodiversity and Conservation
Contact details Land line No. Mobile Fax Email	 (02352) 232241 9423048802 - aniresearch1@gmail.com

b. Research staff : Nil

c. Infrastructure :

Water and soil analysis labs with different types of water samplers.Different types of water analysis kits, well developed and well equipped Central InstrumentationLab which having Spectrophotometers, Atomic Absorption Spectrophotometers for heavy meltsanalysis, HPLC with PC base analysis system, Compound microscope etc.,

d. Activities :

The department having B.F.Sc., M.F.Sc. (Aquatic Environment Management) and Ph.D. (Aquatic Environment Management) level teaching and research facilities.Department also conducted university and external funded several research projects on various aspects of environmental impact assessment, marine biodiversity, water quality and water pollution aspects etc.

3. Research Activities and Achievements (including projects)

B) Research Recommendations:

Research Recommendation	Year of Joint AGRESCO in which accepted
1) Üããñ¡ã ½ããÍããâÞ¾ãã ãä¹ãÊÊããâÞãñ ÔãâØããñ¹ã¶ã ,ãããä¥ã ÔãàÌã£ãÃ¶ã ‡ãŠÀ¥¾ããÔããŸãè ¾ããâÞãñ „¦¦ã½ã ,ã¶¶ã ½Ö¥ã•ãñ ,ãããä›Ããä½ã¾ãã ¶ããùãä¹Êã¾ãã+Àãñ›ãè¹ãŠÀ (,ãã‡ãŠãÀ½ãã¶ã < 150) ¾ããÞããè ãäÍã¹ãŠãÀÔã ‡ãŠÀ¥¾ãã¦ã ¾ãñ¦ã ,ããÖñ. ¦ãÔãñÞã Öãè ãä¹ãÊÊãñ Ôãï½ããÀñ 30 ¦ãñ 35 àããÀ¦ãñÞ¾ãã ¹ãã¥¾ãã¦ãÞã ÌããæÌããÌããè	2005

2) ¡ãù. ºãßãÔãäÖñºã ÔããÌãâ¦ã ‡ãŠãñ‡ãŠ¥ã ‡ãŠðäóã äãÌãªá¾ããäã¹ãŸã¶ãñ ¹ãÆ½ãäãä¥ã¦ã ‡ãŠñÊãñÊ¾ãã ¹ã£ª¦ãäè¶ãñ ¦ã¾ãäÀ ‡ãŠñÊãñÊãäè ºãäñºãäèÊã Þã›¥ãäè Ôãã½ãã¶¾ã ¦ãã¹ã½ãã¶ãäÊãã ¹Êãùãäô›‡ãŠ ,ãã̃ãÀ¥ãã½ã£¾ãñ (ãä¹ãÍãÌãäè) ÔããŸäàÌãÊ¾ãäÔã 90 ãäªÌãÔãã¹ã¾ãÃ¦ã Œãã¥¾ãã¾ãäñØ¾ã ãäÔ©ã¦ãäè¦ã ãä›‡ãŠ¦ãñ.	2006
3) ãäÖÀÌ¾ãã Œãñ‡ãŠ¡á¿ããÞãñ (ãäÔãÊÊãã ›Èãâ‡ãŠìºãñÀãè‡ãŠã) ãäÔã½ãñ›Þ¾ãã ›ã‡ãŠãè½ã£¾ãñ ¹ãìÓŸãè‡ãŠÀ¥ã ‡ãŠÀ¦ãñÌãñßãè Þããâ Øãã Êãñ¤ Öãñ¥¾ãã‡ãŠÀãè¦ãã Öñ Œãñ‡ãŠ¡ñ †‡ãŠ ¶ãØã ¹ãÆãä¦ã Þããõ.½ãäè. ¾ãã ¹ãÆ½ãã¥ãã¦ã ãäÔã½ãñ› ›ã‡ãŠãè¦ã ÔããŸÌã¥ãî‡ãŠ ‡ãŠÀãÌãñ ,ãÍãäè ãäÍã¹ãŠãÀÔã ‡ãŠÀ¥¾ãã¦ã ¾ãñ¦ã ,ããÖñ.	2007
4) ¹Êãùãäô›ãè‡ãŠÞ¾ãã 0.30 X0.30 X 0.30 ½ãäè›À ,ãã‡ãŠãÀãÞ¾ãã ¶ã… ãä¹ãâ•ã-¾ããâÞ¾ãã ºããâ£ã¥ãäè¦ãî¶ã ºã¶ããäÌãÊãñÊãã †‡ãŠ ãä¹ãâ•ãÀã (1.33 X 1.35 X 0.30 ½ãäè›À) ,ããäã©ãÃ‡ãŠªðÓ›¾ãã ãä‡ãŠ¹ãŠã¾ã¦ãääíãÀ ,ãÔãÊ¾ãã¶ãñ ,ãÍãã ¹ãÆ‡ãŠãÀÞ¾ãã ãä¹ãâ•ã-¾ããâÞ¾ãã ãäÖÀÌ¾ãã Œãñ‡ãŠ¡¾ããâÞ¾ãã (ãäÔãÊÊãã ›Èãâ‡ãŠìºãñÀãè‡ãŠã) ¹ãìÓŸãè‡ãŠÀ¥ããÞãã Ìãã¹ãÀ ‡ãŠÀãÌãã.	2007
5) It is recommended to plant one-year nursery grown *Rhizophora mucronata* and *Avicennia marina* mangrove saplings during June to September months after three months *in situ* acclimatization for maximum survival.	2020

D. Completed research project/programmes/schemes

Completed Research Project	Faculty project	Funded project
To study breeding and rearing of Seahorse fish (*Hippocampus kuda*) of Ratnagiri waters	2002, Completed	-
Comparative studies on different fattening systems for green crab, *Scylla tranquebarica* (Fabricius) in coastal estuarine region of Ratnagiri district- a pilot experiment	2004, Completed	-
The reproductive biology of the moony, *Monodactylus argenteus* from Ratnagiri coast	2005, Completed	-
Effective concentration of copper sulphate to eliminate cerethid snails.	2006, Completed	-
Study of macrofauna of Juve and Kalbadevi mangrove area Ratnagiri.	2010, Completed	-
Pollutional assessment of Mirkarwada fishing harbour,	2013, Completed	-
Study of the biodiversity of the Intertidal macrofauna of the rocky shores of Bhatkarwada & Ware	2014, Completed	-
Impact of Geotextile reef on the hydrobiology of Alawa, Mirya bay, Ratnagiri	2017, Completed	-
Studies on the thermal tolerance of commonly available native seaweed, *Sargassum* sp. along Ratnagiri coast	2018, Completed	-
Studies on the thermal tolerance. Of green seaweed, *Caulera peltata* of Ratnagiri coast	2019, Completed	-
Assessment of the environmental impact of the proposed thermal power plant of JSW energy (Ratnagiri) Ltd.. at Dhamankhol bay, Jaigad with special reference to the coastal ecosystems, fisheries and fishers.	-	48.91 lakh, 2012; JSW (Energy)
Consultancy service contract for conducting coordinated studies and development of Biodiversity conservation plan (Coastal microbiology , flora and fsuna of fresh water) for	-	74.46 lakhs 2015, NPCIL

the rehion around Jaitspur Nuclear Power Plant		
Ecological monitoring of the Arabian sea near Jaigad, Dist-Ratnagiri, Maharashtra with reference to the JSW (Energy) Power plant	-	26.80 lakh 2016, JSW(Energy)
Seed Production of Mud Crab, Scylla Species)	-	2012, RGSTC
Seed production of seahorse fish under captive conditions	2019, Funded project	2019, RGSTC

E. Ongoing Research Project/ Programmes/Schemes

Ongoing Research Project	Faculty project	Funded project
1. Ecological Monitoring of Coastal Zone near Jaigad Dist: Ratnagiri, Maharashtra with reference to the JSW (Energy) Power Plant	-	35.0 Lakhs; JSW (Energy) Pvt. Ltd.
2. Identification of potential snorkelling sites along Ratnahiri coast	onoing	-
3. Sea weed resources availability and its culture possibility along the Konkan coast	ongoing	-
4. . महाराष्ट्र राज्याच्या कोकण विभागातील अनू. जाती समूहातील लोकांच्या अन्नसुरकक्षा आणि त्यांचे ग्रामीण जीवन उंचविण्यासाठी मत्स्य संवर्धन तंत्रज्ञान आधारित संशोधन आणि विकास पथदर्शी प्रकल्प	2020	1.78 Crores, DST

F. Repository of abstracts of the theses: (Abstracts)

MFSc. (AEM)

Title of thesis :Distribution of seaweeds along the intertidal rocky shores of Bhatkarwada and Ware coast of Ratnagiri

Degree: M.F.Sc. **Subject:** Aquatic Environment Management
Name of the Student: Miss.Shinde Mohini Maheshwar **Registration No.:** FRRTM 0130281
Year of thesis submission: 2015
Name of the research guide: Dr.A.D.Adsul **Designation:** Assistant Professor

Abstract

The present study was undertaken to study the distribution of seaweed in relation to physico-chemical parameters water of exposed to intertidal rocky shores, Bhatkarwada and Ware, Ratnagiri from February 2014 to January 2015. Stratified random sampling was carried out for studying the seaweeds. The atmospheric and water temperature were high during pre-monsoon and minimum in post-monsoon season along Bhatkarwada and Ware shores. The maximum water pH was observed in post-monsoon while minimum in pre-monsoon along both shores. Along Bhatkarwada shore, the maximum dissolved oxygen was reported during post-monsoon while minimum in pre-monsoon. At Ware shore, the maximum dissolved oxygen was observed during monsoon while minimum in pre-monsoon. The maximum salinity was recorded during pre-monsoon and minimum in monsoon along both shores. Along Bhatkarwada, the maximum alkalinity was observed in late post-monsoon season and minimum in early post-monsoon season. At Ware shore, the maximum alkalinity was observed in late post-monsoon season and minimum in monsoon season. Along Bhatkarwada shore, the maximum nitrate was observed in post-monsoon and minimum in pre-monsoon. At Ware shore, the maximum nitrate was observed in early pre-monsoon and minimum in late pre-monsoon. The maximum content of nitrite, phosphate and silicate was observed in post-monsoon while minimum in pre-monsoon along both shores. Along Bhatkarwada shore, a total of 14 seaweed species (five chlorophyceae, three phaeophyceae and six rhodophyceae) and at Ware rocky shore, a total of 17 seaweed species (five chlorophyceae, three phaeophyceae and nine rhodophyceae) were recorded. The maximum seaweed abundance was recorded during post-monsoon and minimum in monsoon along both shores. Along both shores, *Ulva fasciata* and *Chaetomorpha antennina* occurred throughout year along both shores. The brown seaweed, *Sargassum tenerrimum* abundantly recorded in post- and pre-monsoon

along both shores. Among red seaweed, *Gelidium pusillum* was recorded throughout the year along both shores. Among green seaweed, *U. fasciata* showed positive correlation with alkalinity, nitrite and silicate along Bhatkarwada rocky shore. Along Ware rocky shore, the abundance of green seaweed, *U. fasciata* was positively correlated with pH, alkalinity, nitrite and phosphate. The significant negative correlation was observed between salinity and abundance of green seaweed, *C. antennina* along Ware shore. The species richness and diversity indices were maximum during post-monsoon season along both shores .Seaweed diversity along Ware rocky shore is more as compared to Bhatkarwada rocky shore.

Title of thesis : Hydrobiological Characteristics of Tarli Reservoir Satara District, Maharashtra

Degree: M.F.Sc.	**Subject:** Aquatic Environment Management
Name of the Student: Karewad Anil S.	**Registration No.:** FRRTM0130280
Year of thesis submission: 2015	
Name of the research guide: Dr.G.N.Kulkarni	**Designation:** Associate Professor

Abstract

The present work was undertaken to understand the seasonal fluctuations in the hydrobiological parameters of the Tarali reservoir, from March 2014 to February 2015, so that the baseline information would help in augmenting the fish production from this new reservoir. The representative samples of water and plankton were collected from the selected locations. The atmospheric temperature varied from of 26.1 to 27.6 ^{0}C. Temperature of the surface water ranged from 27.0 to 28.4 ^{o}C. The transparency was observed to range from 100 to 155 cm Secchi depths. The seasonal variation of total suspended solids ranged from 21 to 56 mg L^{-1}. The pH fluctuated from 6.5 to 7.7. The total alkalinity of the surface water varied from 75.8 to 146.2 mg L^{-1}. The total hardness showed narrow variation from 20.60 to 30.99 mg L^{-1}. The dissolved oxygen fluctuated from 4.0 to 6.4 mg L^{-1} at different stations of Tarali reservoir. The nitrate value at selected stations varied from 0.36 to 0.68 mg L^{-1}while nitrite ranged from 0.01 to 0.08 mg L^{-1}. The phosphate content of surface water varied from 0.22 to 0.56 mg L^{-1} during the present study. The silicate concentration varied from 0.42 to 0.78 mg L^{-1} during the study period. The phytoplankton and zooplankton was assessed from five selected stations. From the T_1 to T_5 stations phytoplankton density varied in the range of 934.8 to 1309.6, 901.8 to 1106.4, 841.9 to 1274.6, 821.0 to 1404.6 and 868.4 to 1197.4 no L^{-1}, respectively. From these five stations Chlorophyceae dominated over the groups Bacillariophyceae. The phytoplankton group mainly consisted of species belonging to *Closterium* sp., *Staurastrum* sp., *Arthrodesmu* sp., *Scenedesmus* sp., *Spirogyra* sp., *Pediastrum* sp. and *Gyrosigma* sp. The zooplankton density varied from T_1 to T_5 in the range of 477.2 to 866.1, 310.6 to 783.2, 565.2 to 844.0, 502.7 to 921.2 and 535.2 to 781.2 noL^{-1}, respectively. In these five stations, zooplankton comprised mainly of rotifers and copepod, the former being the predominant. The zooplankton group mainly consisted of species belonging to *Eucyclops* sp., *Brachionus* sp. and *Keratella* sp.

Title of thesis : Effect of placlobutrazol on fingerlings of Tilapia *Oreochromis mossambicus* (Peters,1852)

Degree: M.F.Sc.	**Subject:** Aquatic Environment Management
Name of the Student: Miss. Ghane Mayuri Nandu	**Registration No.:** FRRTM 0150316
Year of thesis submission: 2017	
Name of the research guide: Dr. H.B.Dhamgaye	**Designation:** Assistant Professor

Abstract

A static renewal bioassay was conducted to determine the lethal toxicity (LC_{50}) of fungicide, Paclobutrazol (PBZ) to fingerling of tilapia, *Oreochromis mossambicus*. The lethal toxicity of PBZ to fingerlings of *O. mossambicus* exposed for 96 h was found to be 11.80 mgL^{-1}. The effect of two sublethal concentrations of PBZ ($1/10^{th}$ of LC_{50} i.e. 1.18 mgL^{-1} and $1/5^{th}$ of LC_{50} i.e. 2.36 mgL^{-1}) were studied on haematology and physiology of tilapaia for a period of 28 days. In haematological study RBC, WBC, Hb, PCV, MCV, MCH and MCHC decreased significantly ($p<0.05$) at both sublethal concentrations of PBZ in *O. mossambicus* as compared to control group. Physiological parameters such as oxygen consumption rate and O: N ratio decreased significantly ($p<0.05$) while ammonia excretion rate increased significantly ($p<0.05$) at both sublethal concentration of PBZ as compared to control group. Studies suggested that sub-lethal exposure of PBZ alters the haematological, and physiological parameters and exerts stress on the fingerlings of *Oreochromis mossambicus*.

Title of thesis : Macrofaunal abundance with special reference to sea urchins of the rocky

shore, Varawade, Ratnagiri.

Degree: M.F.Sc.	**Subject:** Aquatic Environment Management
Name of the Student: Hodge Malhari Babruwan	**Registration No.:** FRRTM 0150317
Year of thesis submission: 2017	
Name of the research guide: Dr.A.D. Adsul	**Designation:** Assistant Professor

Abstract

The aim of this study was to examine seasonal changes in the aquatic biodiversity of exposed intertidal rocky shore, Varwade, Ratnagiri. Sampling was carried out from February 2016 to January 2017 by stratified random sampling method using 0.25 m2 quadrat frame. A total of 57 macrofaunal species comprising 21 gastropods, four bivalves, 10 crustaceans, nine fishes, three echinoderms, five anthozoans, three polychaetes and two poriferans were recorded along rocky shore, Varwade. The gastropods, *Euchelus asperus*, *Cypraea arabica*, *Morula granulate*, *Purpura panama* and *Planaxis sulcatus* and bivalve, *Saccostrea cucullata* were dominant throughout the investigation. The crustaceans such as *Gammarus* sp., *Chthamalus* sp., *Balanus amphitrite*, *Grapsus strigosus*, *Charybdis lucifera*, *Schizophrys aspera* and *Pagurus* sp. while the polycheates, *Spirorbis* sp., *Neries* sp. and *Sabellaria simplex* were dominant throughout the year. The anthozoans, *Actinia equina*, *Bunodosoma cavernata*, *Porites* sp., *Favia favus*, *Zoanthus* sp. and echinoderms, *Holothuria moebii* were reported throughout the year. The present study reported a new record of *Stomopneustes variolaris* along Varwade rocky shore with maximum abundance in post-monsoon season and showed positive correlation with seaweeds *Sargassum tenerrium*, *Padina tetrastromatica*, *Ceramium* sp. and *Gracilaria corticata*. The diversity indices revealed that the selected study area was moderately less diverse and observed moderately high dominance throughout the year. The dissolved oxygen was maximum during monsoon while atmospheric temperature, salinity and total alkalinity were highest during the pre-monsoon season. The water temperature and pH were maximum during the post-monsoon. The present study showed seasonal variation in the macrofaunal abundance with maximum number during the post-monsoon and minimum during monsoon season.

Title of thesis :Hydrobiological studies on coral reef area of Malvan, Sindhudurg District, Maharashtra.

Degree: M.F.Sc.	**Subject:** Aquatic Environment Management
Name of the Student: Miss.Bhatkar Ajaya Anil	**Registration No.:** FRRTM 0160338
Year of thesis submission: 2018	
Name of the research guide: Dr.A.D. Adsul	**Designation:** Assistant Professor

Abstract

The present study was carried out to determine the hydrobiological parameters in relation with plankton abundance and monthly variation at five sampling stations of Malvan coral reef area during Feb-17 to May-17 and Oct-17 to Jan-18. Monthly variation of physicochemical parameters viz., atmospheric temperature (28.6 to 33°C), water temperature (27.6 to 33.2°C), light penetration (160 to 191 cm), pH (8.08 to 8.86), dissolved oxygen (2.16 to 7.12mgl^{-1}), alkalinity (159.2 to 199.6mgl^{-1}), TDS (34.51 to 61.19mgl^{-1}), TSS (1.48 to 4.63mgl^{-1}) and salinity (30.0 to 34.42 psu). The variation in nutrient concentration of nitrate, phosphate and silicate ranged from 0.23 to 0.56µMl^{-1}, 0.12 to 0.39µMl^{-1} and 0.43 to 2.51µMl^{-1} respectively. The recorded values of Chlorophyll-a varied from 0.219 to 0.377mg/m^3. A total 56 species of phytoplankton representing different groups viz., diatoms (40), dinoflagellates (14), silicoflagellates (1) and unidentified (1) were recorded. Among the phytoplankton, diatoms such as *Bacillaria* sp. appeared to be dominant group in respect of total number of phytoplankton species. The zooplankton community comprised of 41 species among which the copepod nauplii, *Acartia* sp. and *Oithona* sp. occurred dominantly throughout the study period. Dissolved oxygen showed positive significant correlation with salinity and Chlorophyll-a, while TSS showed positive correlation with salinity and phosphate. Also positive correlation observed between salinity and phosphate; phytoplankton and zooplankton. The negative significant correlation was observed between air temperature and salinity and between light penetration and pH. The species richness and diversity indices were maximum in post-monsoon and minimum in pre-monsoon season.

Title of thesis : Response of fry of Deccan Mahseer, Tor Khudree (Sykes, 1839) exposed to Fipronil

Degree: M.F.Sc.	**Subject:** Aquatic Environment Management
Name of the Student: Jadhao Shubham Premsingh	**Registration No.:** FRRTM 0160339
Year of thesis submission: 2018	
Name of the research guide: Dr. H.B.Dhamgaye	**Designation:** Assistant Professor

Abstract

A static renewal bioassay was conducted to determine the lethal toxicity (LC_{50}) of insecticide, fipronil on fry to the mahseer, *Tor khudree*. The lethal toxicity of fipronil to fry of *Tor khudree* exposed for 96 h was found to be

64.6µgL^{-1}. The effect of two sublethal concentrations of fipronil1/10th and 1/5th (6.46 µgL^{-1}and 12.92µgL^{-1}) were studied on proximate composition and physiology of mahseer for a period of 28 days. The protein and fat decreased significantly ($p<0.05$) whereas moisture and ash increased significantly ($p<0.05$) at both sublethal concentrations of fipronil in *Tor khudree* as compared to control group. Physiological parameters such as oxygen consumption rate, ammonia excretion rate and O:N ratio decreased significantly ($p<0.05$) at both sublethal concentration of fipronil as compared to control group. The present study revealed that sub-lethal exposure of fipronil alters the physiological parameters and proximate composition of fry mahseer, *Tor khudree* which exerts stress on the fish.

Title of thesis : Physiological and haematological changes in koi carp, *Cyprinus carpio* (Linnaeus, 1758) exposed to glyphosate herbicide

Degree: M.F.Sc.	**Subject:** Aquatic Environment Management
Name of the Student: Felix Sanudi	**Registration No.:** FRRTM 0170358
Year of thesis submission: 2019	
Name of the research guide: Dr.Indulkar S.T.	**Designation:** Professor & Head

Abstract

Static lethal toxicity bioassay was carried out to the lethal toxicity (LC_{50}) of Glyphosate herbicide on Koi carp, *Cyprinus carpio* (Linnaeus, 1758). The 96 h lethal toxicity of glyphosate to fingerling of Koi carp was found to be 33.2 mgL^{-1}. The effect of two sublethal concentrations of glyphosate (1/10th and 1/5th of LC_{50} value i.e. 3.3 and 6 mgL^{-1} respectively) were used for physiological and haematological parameter studies for an accumulation period of 28 and a depuration period up to day 56 for haematological parameters. Physiological parameters such as oxygen consumption rate, oxygen: nitrogen ratio and food consumption rate decreased significantly ($P<0.05$) while ammonia-N excretion rate increased significantly ($P<0.05$) in both sublethal concentrations as compared to control groups. Haematological parameters like red blood cells, haemoglobin, haematocrit and mean corpuscular haemoglobin concentration decreased significantly ($P<0.05$) while mean corpuscular volume, mean corpuscular haemoglobin and white blood cells increased significantly ($P<0.05$) in both sublethal concentrations of glyphosate as compared to control groups. During the depuration period, haematological parameters turned towards initial day values. However, only means corpuscular haemoglobin and mean corpuscular haemoglobin concentration were insignificantly different with initial day values, hence, suggesting residual effect of glyphosate even after depuration phase. The studies suggested that sublethal exposure of glyphosate causes stress in Koi carp which leads to changes in physiological and haematological parameters. It was also evident from analysis of some haematological parameters that residual effects remained after the depuration period of 56 days.

Title of thesis : Biochemical and immunological impact of paclobutrazol on juvenile, *Litopenaeus vannamei* (Boone,1931)

Degree: M.F.Sc.	**Subject:** Aquatic Environment Management
Name of the Student: Kamble Sadanand Namdev	**Registration No.:** FRRTM 0170359
Year of thesis submission: 2019	
Name of the research guide: Dr. H.B.Dhamgaye	**Designation:** Assistant Professor

Abstract

The experiment was conducted to evaluate the toxicity effect of Paclobutrazol on biochemical and immunological parameters of juvenile *Litopenaeus vannamei*. The lethal toxicity test of PBZ was carried out on juveniles and 96 h LC_{50} value was found to be 81.05 mgL^{-1}. The juveniles were exposed to two different sublethal concentrations of paclobutrazol i.e. 8.1and 16.2 mgL^{-1}(1/10th and 1/5th of LC_{50}) for a period of 30 days exposure to analysis of biochemical and immunological parameters at 10 days sampling interval. Biochemical parameters such as protein and fat significantly decreased ($P<0.05$) while moisture and ash significantly increased ($P<0.05$) in both sublethal groups of PBZ as compared to control group. Immunological parameters like THC and superoxide anion production significantly ($P<0.05$) decreased whereas PPO activity and clotting time significantly ($P<0.05$) increased in sublethal concentrations of PBZ as compared to control group. Present results suggest that risk in *Litopenaeus vannamei* culture adjacent to Paclobutrazol treated areas and PBZ effects on biochemical and immune response of juveniles.

Title of thesis : Profiling of hydrobiological parameters of shrimp farms in Ratnagiri, Maharashtra.

Degree: M.F.Sc.	**Subject:** Aquatic Environment Management

Name of the Student: Miss. Namarta **Registration No.:** FRRTM 0170360
Year of thesis submission: 2019
Name of the research guide: Dr.M.S.Sawant **Designation:** Associate Professor

Abstract

The present study was carried out to observe the sediment-water characteristics and plankton productivity of selected shrimp farms near Ratnagiri, considering pond size, stocking density and seasons. Water and soil sampling were carried out for two crops from March 2018 to May 2019 from three different brackishwater shrimp farms located near Ratnagiri i.e. Waravade, Neware and Ranpar. Two ponds from each location were selected. The estimation of physico-chemical parameters of water like temperature, pH, transparency, salinity, dissolved oxygen (DO), biological oxygen demand (BOD), alkalinity, hardness, calcium, magnesium, hydrogen sulphide (H2S), nutrients like ammonia and nitrite were carried out. Also analysis of pH, electrical conductivity, available phosphorous, available nitrogen, organic carbon and calcium carbonate was done of soil. Additionally, phytoplankton and zooplankton productivity was also estimated and compared. Periodical data obtained for the physico-chemical water parameters revealed that, the mean values for temperature ranged from 25.4 to 29.3 °C with the lowest value (22 °C) and highest value (34 °C); both were recorded at Neware. Mean pH values ranged from 7.4 to 8.1 with the lowest pH (6.7) at Waravade and highest pH (8.6) at Ranpar. Mean transparency values ranged from 39.8 to 45.6 cm with the lowest value (10 cm) at Waravade and highest value (150 cm) at Ranpar. Mean salinity ranged from 11.4 to 40 psu with the lowest salinity (6 psu) at Neware and highest salinity (48 psu) at Waravade. Mean DO ranged from 3.5 to 4.6 mgl^{-1} with the lowest DO (2.8 mgl^{-1}) at Neware & Ranpar and highest DO (8.4 mgl^{-1}) at Neware. Mean BOD ranged from 1.6 to 2.5 mgl^{-1} with the lowest BOD (0.32 mgl^{-1}) at Neware & Ranpar and highest BOD (5.76 mgl^{-1}) at Neware. Mean alkalinity ranged from 110.3 to 145.1 mgl^{-1} with the lowest value (62 mgl^{-1}) and highest value (198 mgl^{-1}); both were recorded at Waravade. Mean hardness ranged from 1561.8 to 2868 mgl^{-1} with the lowest hardness (540 mgl^{-1}) and highest hardness (5250 mgl^{-1}): both were recorded at Waravade. Mean calcium ranged from 253 to 411.9 mgl^{-1} with the lowest value (90.6 mgl^{-1}) at Neware and highest value (879.8 mgl^{-1}) at Waravade. Mean magnesium ranged from 1267.1 to 2040.2 mgl^{-1} with the lowest value (274.47 mgl^{-1}) and highest value (4268.64 mgl^{-1}); both were recorded at Waravade. Mean H2S ranged from 0.5 to 0.7 mgl^{-1} with the lowest H_2S (0.21 mgl^{-1}) and highest H_2S (1.07 mgl^{-1}) at all three farms. Mean ammonia ranged from 0.0 mgl^{-1} to 0.1 mgl^{-1} with the lowest value (0.01 mgl^{-1}) at Neware & Ranpar and highest value (0.10 mgl^{-1}) at all three farms. Mean nitrite ranged from 0.1 to 0.8 mgl^{-1} with the lowest nitrite (0.02 mgl^{-1}) at Ranpar and highest nitrite (2.16 mgl^{-1}) at Neware. pH, hardness, calcium, magnesium, ammonia and nitrite differed significantly with respect to the locations and temperature & H_2S differed significantly with respect to the crops while salinity differed significantly with respect to the locations as well as the crops ($P < 0.05$). Monthly variations of soil parameters values viz. mean pH varied from 3.8 to 8.5 with the lowest pH (3.9) at Ranpar and highest pH (8.8) at Waravade, mean EC varied from 4 to 10.9 dSm^{-1} with the lowest EC (0.05 dSm^{-1}) at Ranpar and highest EC (20.57 dSm^{-1}) at Waravade, mean organic carbon varied from 1.3 to 2.2% with the lowest OC (0.78%) at Ranpar and highest OC (3.67%) at Waravade, mean calcium carbonate varied from 1.2 to 11.3% with the lowest value (0.87%) at all the farms and highest value (11.87%) at Waravade & Neware, mean available nitrogen varied from 1 to 2.9 with the lowest value (0.34 $mg100g^{-1}$) at Waravade and highest value (5.27 $mg100g^{-1}$) at Neware and mean available phosphorous varied from 0.2 to 1.8 $mg100g^{-1}$ with the lowest value (0.08 $mg100g^{-1}$) at Waravade and highest value (2.41 $mg100g^{-1}$) at Neware. pH, EC and available phosphorous differed significantly with respect to the locations and the crops ($P < 0.05$) while organic carbon and $CaCO_3$ differed significantly with respect to the locations and the crops ($P < 0.05$) respectively. No significant differences were found between the ponds ($P > 0.05$). Mean phytoplankton count ranged from 95.6 to 204.8 nosl-1 with the lowest count (24 $nosl^{-1}$) at Ranpar and highest count (616 $nosl^{-1}$) at Neware and mean zooplankton count ranged from 87.4 to 164.4 $nosl^{-1}$ with lowest count (24 $nosl^{-1}$) at Neware and highest count (308 $nosl^{-1}$) at Ranpar. The commonly encountered plankton classes were Bacillariophyta, Dinophyta, Cyanophyta (phytoplankton), protozoans, copepods and rotifers (zooplankton). Zooplankton showed significant difference with respect to the crops ($P < 0.05$). No significant differences were found for phytoplankton with respect to the location as well as the crops ($P > 0.05$). The present investigation showed that water quality and soil characteristics had profound effect as per stocking density and seasons. Pond management practices should be followed accordingly for *Litopenaeus vannamei* culture.

Title of thesis : Studies on macro-faunal abundance of Ware-Nevare sandy shore, Ratnagiri, Maharashtra.

Degree: M.F.Sc. **Subject:** Aquatic Environment Management
Name of the Student: Miss. Pardhi Shweta Ashokrao **Registration No.:** FRRTM 0170361
Year of thesis submission: 2019

Name of the research guide: Dr.A.D.Adsul **Designation:** Assistant Professor

Abstract

The present study described the macro-faunal abundance of Ware-Nevare sandy shore, Ratnagiri from February 2018 to January 2019. The intertidal sandy shore macro-faunal samples were collected from seven transects with three quarters each of 0.0625 m2 area. A total of 12 macro-faunal species comprising, seven crustaceans, two gastropods and one each bivalve, scaphopod, echinoderm were recorded from the shore. The ranges of various parameters recorded were atmospheric temperature (24±0.00 to 32.5±0.50 °C), interstitial water temperature (23±0.00 to 31±0.00 °C), sediment temperature (23±0.00 to 33±0.00 °C), interstitial dissolved oxygen (2.5±0.25 to 5.9±0.45 mgl-1), interstitial water salinity (25±0.55 to 38±0.20 psu) and interstitial water pH (7.2±0.00 to 8.3±0.05). The major composition of the sediment on the shore was sand (85.04±7.38 %) observed during pre-monsoon while the silt (10.71±6.05 %) during monsoon season. The clay content (0.01±0.01 %) was negligible during late post-monsoon season. *Donax siliqua* was abundant in the month of December and January. The hermit crab, *Diogene miles* was observed with discontinuous distribution. *Eurydice* sp. was observed during the post-monsoon and *Gastrosaccus* sp. during the monsoon and early post-monsoon seasons. The ghost crab, *Ocypode ceratophthalmus* and isopod, *Onisimus* sp. were abundant throughout the year. *Philyra coralicola* and *Umbonium vestiarium* were observed during the pre- and post-monsoon season. The echinoderm, *Astropecten indicus* and *Dentalium* sp. were recorded during the monsoon and post-monsoon seasons. The abundance of *Ocypode ceratophthalmus* was positively correlated with the atmospheric temperature and sediment temperature while negatively correlated with the abundance of *Dentalium* sp. The abundance of *D. siliqua* and *Eurydice* sp. was positively correlated with the interstitial water pH while negatively correlated with the abundance of *Turitella duplicata*. The present study showed seasonal variations in the macro-faunal abundance with maximum number during the post-monsoon and minimum during the monsoon season.

Title of thesis : Characterization of water masses associated with pelagic fish shoals

Degree: M.F.Sc. **Subject:** Aquatic Environment Management

Name of the Student: Patil Amit Sanjay **Registration No.:** FRRTM 0180401

Year of thesis submission: 2020

Name of the research guide: Dr.M.S.Sawant **Designation:** Associate Professor

Abstract

The present study was conducted on the Konkan coast of Maharashtra, India from September 2019 to February 2020 to correlate important environmental parameters with the pelagic fish catch obtained from commercial operations of purse-seine net fishery. The hydro-biological parameters were recorded along with the pelagic fish catch for all operations conducted by purse-seine boat (Saraswati). Number of samplings carried out for each month during study period were: September- two, October- four, November- eight, December- fourteen, January- six and February- four. During the present study period, sea surface temperature ranged from 25 to 29.7°C, salinity from 31 to 34.3 psu, pH from 8 to 8.9, secchi depth from 5.74 to 12.27 m, dissolved oxygen from 8 to 11.1 mg/l, chlorophyll-a from, 1.2004 mg/m3 to 7.2659 mg/m3. The herbivorous biomass which consisted of planktivore fish catch ranged from 0 kg to 768 kg, whereas, the total biomass consisting all the fish catch ranged from 0 kg to 2181 kg. The total fish catch consisted of *Rastrelliger kanagurta* (Indian mackerel), *Megalaspis cordyla* (horse mackerel), *Alepes djedaba* (shrimp scad), *Sardinella fimbriata* (lesser sardines), *Loligo duvauceli* (squids), *Scomberomorus commerson* (seer fish), *Lepturocanthus savala* / *Trichurus lepturus* (ribbon fish), *Pampus argenteus* / *Parastromateus niger* (silver and black pomfrets), *Coilia dussumeiri* (anchovy) and *Thunnus obesus* (big-eye tuna). The phytoplankton count ranged from 80 to 240 no. L-1, comprising of different groups viz., diatoms (26), dinoflagellates (7), silicoflagellates (1). The zooplankton count ranged from 39 to 110 no. L-1, comprising of different groups viz., copepods (8), tintinnids (5), rotifers (1), polychaetes (2), cladocerans (1) and others (3). Correlation coefficient analysis was carried out in two ways month-wise and for all six months together. Month-wise correlation coefficient showed no significant correlations during September, October and February. Significant positive correlations ($P < 0.05$) were observed between herbivorous biomass - salinity and total biomass - salinity in November, between D.O. - sea surface temperature and D.O., salinity in December and between pH - sea surface temperature, total biomass - D.O., total biomass, chlorophyll-a and total biomass - herbivorous biomass in January. For correlations of all six months together, significant positive correlations ($P < 0.05$) were observed between chlorophyll-a – sea surface temperature and D.O. – salinity. After analyzing ANOVA, no significant correlations were observed between the independent variables (months, sea surface temperature and salinity) and all the other hydro-biological parameters (pH, secchi depth, D.O., chlorophyll-a, herbivorous biomass, total biomass, phytoplankton and zooplankton). The available total pelagic fish catch mentioned above from the purse-seine net operation showed no significant correlation with hydro-biological parameters. Indian mackerel and horse mackerel were the major pelagic fish caught during the period of operations along-with other fish catch. As no significant correlations were observed for this study, longer

duration studies for two-three years and total catch landings from all purse-seiners fishing along the Konkan coast may help us to give nearly correct picture of correlation with the environmental parameters studied. As this was a pilot scale study, detailed study will be needed to suggest future measures for exploitation of pelagic fishes.

Title of thesis : Seasonal variation in macrofaunal diversity of Sandkhol sandy shore, Ratnagiri, Maharashtra

Degree: M.F.Sc.	**Subject:** Aquatic Environment Management
Name of the Student: Aitwar Vaijnath Sambayya	**Registration No.:** FRRTM 0190422
Year of thesis submission: 2021	
Name of the research guide: Dr.A.D.Adsul	**Designation:** Assistant Professor

Abstract

The present study revealed the seasonal variation among the intertidal macrofaunal abundance of Sandkhol sandy shore, Ratnagiri from February 2020 to January 2021. Monthly intertidal sandy shore macrofaunal samples were collected from seven transects with three quadrates each of 0.0625 sq. m. area. A total of 23 macrofaunal species comprising six gastropods, one bivalve, 12 crustaceans, one scaphopod, one polychaete worm and two echinoderms were recorded from the shore. Seasonal fluctuation in environmental parameters such as atmospheric temperature (26.91 to 29.58 °C), interstitial water temperature (27.33 to 29.25 °C), sediment temperature (26 to 28.66 °C), interstitial dissolved oxygen (4.71 to 6.23 mgl-1), interstitial water salinity (33.68 to 40.12 psu), and interstitial water pH (8.22 to 8.34) were recorded. A significant portion of the sediment on the shore was sand, followed by silt and clay. The dissolved organic carbon in sediment showed a declining trend throughout the study period. The crustaceans, *Ocypode ceratophthalmus*, *Eurobowmaniella simulans*, *Eurydice caudata*, *E. indicis*, *Gammariid* sp., *Onisimus* sp. were dominant throughout the study period. The interstitial water temperature showed a highly positive correlation with sediment temperature and interstitial dissolved oxygen while negatively correlated with the abundance of *Turitella duplicata* and *Clibanarius infraspinatus*. The sediment temperature positively correlated with interstitial dissolved oxygen while negatively correlated with the abundance of *Babylonia spirata*, *T. duplicata* and *C. infraspinatus*. However, interstitial dissolved oxygen showed a negative correlation with the same species. The macrofaunal diversity indices expressed that the faunal diversity was moderate and showed high evenness throughout the study period. The present study revealed that macrofaunal abundance was maximum during post-monsoon season, while minimum during monsoon season which may be attributed to the variations in environmental parameters.

Title of thesis : Toxic and sublethal effect of profenofos on fingerling of striped catfish, *Pangasianodon hypopthalmus*, (Sauvage, 1878)

Degree: M.F.Sc.	**Subject:** Aquatic Environment Management
Name of the Student: Tekam Ashvini Nilkant	**Registration No.:** FRRTM 0190423
Year of thesis submission: 2021	
Name of the research guide: Dr. H.B.Dhamgaye	**Designation:** Assistant Professor

Abstract

The experiment was conducted to determine the toxicity effect of Profenofos on haematological and physiological parameters of fingerling of *Pangasianodon hypophthalmus*. The static lethal toxicity test of profenofos was carried out on fingerlings exposed for 96 h was found to be 0.022 ppm. The effect of two sublethal concentrations of profenofos i.e 0.0022 and 0.0044 ppm ($1/10^{th}$ and $1/5^{th}$ of LC_{50}) respectively were studied on haematology and physiology of striped catfish fingerlings for a period of 30 days. Haematological parameters such as RBC, WBC, HB, MCV and MCH decreased significantly (P0.05) in both sublethal group of profenofos as compared to control group. Physiological parameters such as Oxygen consumption rate, Oxygen: Nitrogen ratio and food consumption rate decreased significantly (P0.05) in both sublethal group of profenofos as compared to control group. The present study suggested that sublethal exposure of profenofos alters the haematological and physiological parameter of fingerling of striped catfish, *Pangasianodon hypophthalmus* which exerts stress on fish.

Title of thesis : Effect of glyphosate herbicide on protein metabolism and haematological parameters on fingerlings of *Pangasianodon hypophthalmus*, (sauvage, 1878)

Degree: M.F.Sc.	**Subject:** Aquatic Environment Management
Name of the Student: Kokate Monali Kisan	**Registration No.:** FRRTM 0200447
Year of thesis submission: 2022	
Name of the research guide: Dr. H.B.Dhamgaye	**Designation:** Assistant Professor

Abstract

Glyphosate, a broad spectrum-systematic herbicide, is used in aquaculture to eliminate aquatic weeds and algae. The acute toxicity based on static bioassay (96 hrs LC_{50}) of Glyphosate 41% SL for *Pangasianodon hypophthalmus* fingerlings was found to be at 311.67 mg L^{-1}. The experiment was carried out to determine the effect of glyphosate on protein metabolism and hematological indices in different tissues of the fish *Pangasianodon hypophthalmus* for 30 days using two sub-lethal concentrations ($1/5^{th}$ - 62.352 mg L^{-1} and $1/10^{th}$ - 31.176 mg L^{-1} of LC_{50} respectively). The present study shows the alternation in a haematological parameter such as a significant decrease in RBC counts, Hb %, PCV %, Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin concentration (MCHC), Lymphocytes, and the significant increase in WBC count, neutrophil (%), Alanine aminotransferase (ALT), Aspartate Amino Transferase (AST) and Acetylcholinesterase (AChE) activity in the fish exposed to glyphosate, whereas no significant change was observed in eosinophil (%) and monocytes (%) in the fishes exposed to glyphosate. Total protein wasdecreased in all tissues for 30 days of exposure. Thus based on the obtained result in the present investigation, it can be concluded that 30 days exposure to 62.352 mg L^{-1} and 31.176 mg L^{-1} concentration of glyphosate solution has some toxic effect and suggests that exposure to glyphosate could cause some level of stress as indicated by changes in the haematological indices and protein metabolism of the fish Pangasianodon hypophthalmus under consideration.

Title of thesis : Profiling of hydrobiological parameters of shrimp farms in Navsari, gujarat

Degree: M.F.Sc.	**Subject:** Aquatic Environment Management
Name of the Student: Parmar Bindiya Kirtikumar	**Registration No.:** FRRTM 0200448
Year of thesis submission: 2022	
Name of the research guide: Dr. M. S. Sawant	**Designation:** Professor (CAS)

Abstract

The present study was carried out to observe the hydrobiological parameters of selected shrimp farms near Navsari, Gujarat considering pond size, stocking density and culture practice. Water, soil and plankton sampling was carried out for one summer crop during February to July 2022 from Aat, Karadi and Samapor shrimp farms, Navsari. Three ponds were selected for sampling. The water parameters comprising of pH, temperature, transparency, salinity, DO, BOD, carbonate alkalinity, bicarbonate alkalinity, total alkalinity, calcium, magnesium, total hardness, total ammonia, nitrite-nitrogen, nitrate-nitrogen, phosphorus and hydrogen sulphide ranged from 7.51 to 8.73, 20 to 30ºC, 8 to 107 cm, 17 to 34.7 ppt, 2 to 8.4 mg L^{-1} , 0.6 to 5.2 mg L^{-1} , 0.2 to 0.96 mg L^{-1} , 112 to 359 mg L^{-1} , 112.52 to 359.72 mg L^{-1} , 150 to 400 mg L^{-1} , 617 to 3048.90 mg L^{-1} , 2987.00 to 8464.32 mg L^{-1} , 0 to 0.98 mg L^{-1} , 0 to 0.75 mg L^{-1} , 0 to 0.46 mg L^{-1} , 0 to 0.03 mg L^{-1} and 0 to 0.1 mg L^{-1}, respectively. The majority of water parameters show significant ($p<0.05$) differences with respect to locations except temperature, DO, magnesium, total ammonia and nitrate-nitrogen. Soil parameters like pH, electrical conductivity, organic carbon, available nitrogen and available phosphorus ranged from 8.04 to 9.86, 0.530 to 4.318 dS m^{-1} , 0.42 to 2.22%, 22.13 to 191.84 kg ha-1 and 29.26 to 97.70 kg ha-1 respectively. No significant difference ($p>0.05$) was observed in soil parameters with respect to locations except electrical conductivity and available phosphorus ($p<0.05$). Phytoplankton and zooplankton ranged from 29 to 16,880 Nos. L^{-1} and 10 to 404 Nos. L^{-1} , respectively. Plankton density showed significant ($p<0.05$) differences with respect to locations. Throughout the culture period, 15 different species of phytoplankton and 8 different species of zooplankton were observed. The current study demonstrated that pond size and stocking density both had a significant impact on hydrobiological parameters.

Ph.D. (AEM)

Title of thesis : Comparative studies on hydrobiological parameters of selected reservoirs of Raigad District, Maharashtra.

Degree: Ph.D.	**Subject:** Aquatic Environment Management
Name of the Student: Miss.Lokhande Snehal Siddharth	**Registration No.:** FRRTM 0120016
Year of thesis submission: 2016	
Name of the research guide: Dr.S.T.Indulkar	**Designation:** Professor & Head

Abstract

During the study period of two years (February 2014 to January 2016), twenty three different parameters were analyzed from five reservoirs, viz. Kothurde, Ambawade, Warandh, Khaire and Vinhere reservoirs. The ranges of various parameters recorded were atmospheric temperature (22.1 to 36.4 ^{o}C), water temperature (20.1 to 35.8 ^{o}C), pH (5.2 to 8.4), DO (4.40 to 8.64 mg L^{-1}), free CO_2 (0.90 to 5.94 mg L^{-1}), EC (45.20 to 152.20 µS cm^{-1}), transparency (32.56 to 117.0 cm), TDS (0.30 to 26.63 mg L^{-1}), total hardness (31.23 to 77.46 mg L^{-1}), total alkalinity (29.45 to 74.21 mg L^{-1}), NO_3-N (0.013 to 1.604 mg L^{-1}), NO_2-N (0.004 to 0.106 mg L^{-1}), PO_4-P (0.031 to 2.860 mg L^{-1}), SiO_2 (0.31 to 16.21 mg L^{-1}), $Fe2^{+}$ (0.02 to 4.32 mg L^{-1}), Mg2+ (3.45 to 10.57 mg L^{-1}), Na^{+} (0.12 to 7.41 mg L^{-1}), K^{+} (0.03 to 2.34 mg L^{-1}), soil pH (4.20 to 7.20) and organic carbon (0.32 to 0.69 %). The sand, silt and clay compositions ranged from 29.70 to 62.20, 15.20 to 49.30 and 12.90 to 39.60 % respectively when all these five reservoirs were considered collectively. Similarly, the GPP, NPP and CR values ranged from 0.38 to 4.86, 0.18 to 2.65 and 0 to 3.24 mg C L-1 hr-1 respectively. A total of 38 genera of phytoplankton were recorded from all the five reservoirs, which included 14 genera of Chlorophyta, 17 Bacillariophyta, two Cyanophyta, two Euglenophyta, two Dinophyta and one Chrysophyta. Among these groups, Chlorophyta was recorded most dominant in all the reservoirs. With respect to zooplankton, total four groups were observed during the study period namely rotifers (two genera), cladocerans (three), copepods (calanoid and cyclopoid), other crustacean larvae and ostracods with one genera each. Among the zooplankton groups, rotifers were recorded dominantly in all the reservoirs. Seasonal variations in plankton composition were recorded with the maximum density during pre-monsoon and post-monsoon, while minimum during monsoon season. The diversity indices namely, the Shannon index (H') varied from 3.230 to 4.990, the Simpson index (S) from 0.845 to 0.967, Evenness index (J') from 0.687 to 0.993 and Dominance index (D) from 0.007 to 0.313 respectively. Atmospheric temperature was positively correlated with water temperature, free CO2 and EC from all the reservoirs, while water temperature was positively correlated with free CO2, EC and GPP in Ambawade, Warandh, Khaire and Kothurde reservoirs. Fe2+ showed positive correlation with Mg2+, Na+ and K+ in all the five selected reservoirs, while Mg2+ showed positive correlation with Na+, K+ and SiO2 in Kothurde, Warandh, Ambawade and Khaire reservoirs. Soil pH showed positive correlation with organic carbon, while GPP showed positive correlation with NPP in all the reservoirs. Rainfall showed strong negative correlation with phytoplankton and zooplankton in Kothurde and Warandh reservoirs, while it showed strong negative correlation only with zooplankton in Ambawade reservoir and only with phytoplankton in Khaire reservoir. GPP showed strong positive correlation with phytoplankton in Warandh and Vinhere reservoirs, while strong positive correlation was shown with zooplankton in Kothurde, Ambawade and Warandh reservoirs. Considering all the twenty three parameters and four diversity indices with the standards provided by Sugunan (2000) and Ayyappan (2011), Warandh, reservoir was found to be the most productive followed by Khaire, Kothurde, Ambawade and Vinhere reservoirs.

Title of thesis : Characterization and impact of thermal power plant effluent along the coast of Jaigad, Ratnagiri, Maharashtra.

Degree: Ph.D.	**Subject:** Aquatic Environment Management
Name of the Student: Miss. Tekade Ankita Shrikant	**Registration No.:** FRRTM 0130020
Year of thesis submission: 2017	
Name of the research guide: Dr.G.N.Kulkarni	**Designation:** Associate Professor

Abstract

The present investigation was undertaken to study the characteristics and effect of thermal power plant effluent on the coastal ecology of Jaigad during May-2014 1o August 2015 and also to examine the response of green mussels exposed to varying temperatures. The area of investigation was divided into nine different stations along Jaigad coast. Station 1 (S1) was considered as reference station at Shastri river mouth. Subsequently. Other stations were near-shore located away from the coolant water discharge point of the thermal power plant, namely S, and S; along the 5 fathom depth contour, S4 and Ss along the 10 fathom depth contour, S, and S- along the 15 fathom depth contour, while Ss and S, represented the 20 fathom depth contour. E, Ez and E, were the locations of effluent and effluent mixing zones. At effluent and effluent receiving locations, the water temperature ranged from 28 to 36°C, pH from 7.40 to 8.30, dissolved oxygen from 2.1 to 3.1 mg L^{-1}, salinity from 34.51 to 38.75 psu, total dissolved solids from 26.33 to 39.12 mg L, total suspended solid from 18.35 to 29.72 mg L^{-1}. Among other parameters, total alkalinity ranged between 110 to 151 mg L^{-1}, nitrate from 0.29 to 0.89 mg L^{-1}, phosphate from 0.112 to 0.331 mg L^{-1}, silicate varied from 0.789 to 1.429 mg L^{-1} and sulphate from 29.74 to 55.25 mg L^{-1} in the effluent and its immediate mixing zone. In the near-shore locations, the water temperature showed variations from 25.4 to 36.5°C, pH from 7.50 to 8.70, total alkalinity from 82 to 141 mg L^{-1}, dissolved oxygen varied from 3.0 to 6.9 mg L salinity from 29,11 to 37.29 psu, total dissolved solids from 11.10 to 39.90 mg L^{-1}, total suspended solid content showed the range of 5.01 to 30.24 mg L^{-1}, while the sulphate ranged from 29.03 to 83.56 mg L^{-1}, Extinction coefficient (K value) in all stations varied from 0.011 to 0.016. Nitrate, phosphate and silicate fluctuated from 0.15 to 1.31 mg L, 0.032 to 0.376 mg L and 0.258 and 1.985 mg L^{-1} respectively. Chlorophyll a ranged from 0.17 to 9.26 mg m. The data on sediment temperature revealed overall range of 23.9 to 28.9°C. Sediment pH varied from 7.40 to 8.61 and its organic carbon was between 1.21 and 2.38 % and sediment sulphate ranged between 28.03 and 37.87 mg kg Among phytoplankton, twenty eight genera were identified from nine stations including twenty diatoms, four dinoflagellates, one silico flagellates and two representing blue-green algae. The phytoplankton density at S, S2, S3, Sa, Ss. Se, S, Se and So ranged from 340 to 1655, 220 to 1215, 240 to 500, 1385 to 2865, 915 to 1897, 590 to 1350, 445 to 1335, 270 to 1120 and 210 to 770 no./L respectively. Zooplanktons were mainly composed of Copepoda (Calanoid and Cyclopoid), Dino-flagellates with one genus (*Noctiluca* sp), and Tintinnda with two genera (*Flavella* sp. and *Tintinopsis* sp). The zooplankton density at S1, S2, S3, S4, Ss, S6, S7, Sg and S, ranged from 125 to 440, 130 to 325, 45 to230,45 to 310, 80 to 415 280 to 720, 155 to 445, 300 to 455 and 315 to 505 no./L respectively. Thermal dispersion studies indicated dominant north and south wind and current. The temperature increase was maximum up to 5°C near the outlet vicinity with the thermal plume at a distance of 0.5-5 km from the outlet. Sub-lethal experiment revealed decrease in protein and glycogen in the green mussel with increase in temperature and the period of exposure, while ALP increased. The present investigation shows significant variation compared to reference locality in terms of temperature, DO, salinity, pH and chlorophyll a content considering 5 fathom contour line. The temperature difference between intake and outfall should be maintained minimum below 5°C, so that marine ecological conditions remain normal.

Title of thesis : Effect of Buprofezin and Imidacloprid Pesticides on haematology, biochemical and immune response in *Cyprinus carpio communis* (Linnaeus, 1758) fingerlings.

Degree: Ph.D. **Subject:** Aquatic Environment Management
Name of the Student: Adnan Amin **Registration No.:** FRRTM 0140023
Year of thesis submission: 2017
Name of the research guide: Dr. S.T.Indulkar **Designation:** Professor and Head

Abstract

Use of pesticides or insecticides in agriculture and domestic purpose is highly toxic to aquatic life. Buprofezin is an insect growth regulator while Imidacloprid is a pest inhibitor. During the study, aquaria acclimated carp fingerlings (*Cyprinus carpio*) were exposed to the said pesticides separately to study the acute toxicity (96 h) and sublethal (28 days) impact. When fingerlings of *C. carpio* were exposed to pesticides Buprofezin and Imidacloprid the 96 h LC_{50} values were found to be 9.364 and 128.224 mgL^{-1} respectively. Two concentrations i.e. $1/10^{th}$ and $1/5^{th}$ of 96 h LC_{50} i.e. 0.936 and 1.872 mgL^{-1} for Buprofezin and 12.822, 25.644 mgL^{-1} for Imidacloprid were selected for 28 days sublethal studies. The extent of damage was assessed at hematological, biochemical and immunological levels. During sublethal study, erythrocyte (RBC), hemoglobin (Hb) and haematocrit (Hct) values were found to be significantly ($p<0.05$) decreased. Whereas, leucocyte (WBC) count was significantly ($p<0.05$) increased in the pesticide treated fingerlings. The hematological indices like mean cellular volume (MCV) and mean cellular hemoglobin (MCH) were observed to be significantly ($p<0.05$) decreased. Mean cellular hemoglobin concentration (MCHC) was significantly ($p<0.05$) increased as compared to control group in both selected toxicants. Biochemical profiles like crude protein and crude fat showed

significantly decreased trend, whereas, crude fiber and ash content were found to be significantly ($p<0.05$) increased. Serum albumin and globulin were significantly ($p<0.05$) decreased. However, serum glucose was significantly ($p<0.05$) increased in pesticides treated fingerlings. Significant increase in Aspartate amino transferase (AST) and Alanine amino transferase (ALT) was recorded in Buprofezin exposed fingerlings. Whereas, significant ($p<0.05$) decrease in Liver AST and ALT was observed in Imidacloprid treated fingerlings throughout 28 days. Immune parameters like NBT, total blood protein were found to be decreased during the study period. Clotting time showed significant ($p<0.05$) increase as compared to control. Antioxidant enzymes like catalase, SOD, GST showed sharp increase as compared to control in both pesticides. The results of present study ascertained that the pesticides Buprofezin and Imidacloprid caused alterations on haematological, biochemical and immune parameters of *C. carpio* fingerlings and these alterations can be used as non-specific biomarkers in pesticide contaminated aquatic ecosystem.

Title of thesis : Effect of calcium carbide and ethephon on rosy barb, *Pethia conchonius* (Hamilton, 1822)

Degree: Ph.D.	**Subject:** Aquatic Environment Management
Name of the Student: Miss. Patel Sana Kausar	**Registration No.:** FRRTM 0150030
Year of thesis submission: 2018	
Name of the research guide: Dr.S.T.Indulkar	**Designation:** Professor & Head

Abstract

Attempts were made in the present investigation to determine the acute toxicity of two agrochemicals, viz. ethephon and calcium carbide on the widely popular ornamental fish, rosy barb, *Pethia conchonius*. A short-term acute toxicity test was performed adopting renewal bioassay technique over a period of 96 h, using different concentrations (0, 0.01, 0.1, 1.0, 10, 50 and 100 mg1-1) of ethephon and calcium carbide on the rosy barb fish. During the study, aquaria acclimated fishes were exposed to the said chemicals separately to study the acute toxicity (96 h) and sublethal (28 days) impacts. The values of 96 h LC50 were found to be 64.034 and 57.5 mgl^{-1}, respectively. For ethephon and calcium carbide two concentrations i.e. 1/10th and 1/5th of LC50 96 h value, 6.40 mgl-1 and 12.81 mgl^{-1} for ethephon and 5.75 $mg1^{-1}$ and 11.51 $mg1^{-1}$ for calcium carbide were selected for 28 days sublethal studies and samples were collected at every seventh day of exposure and analysis of various parameters were carried out. The extent of damage was assessed at haematological, biochemical and immunological levels. During the sublethal study, erythrocyte (RBC), haemoglobin (Hb) and haematocrit (Hct) values were found to be significantly ($p<0.05$) decreased, whereas leucocyte (WBC) counts were significantly ($p<0.05$) increased in the both agrochemical treated rosy barb fishes. The haematological indices like mean cellular volume (MCV) and mean cellular haemoglobin (MCH) were significantly ($p<0.05$) decreased, while, mean cellular haemoglobin concentration (MCHC) was significantly ($p<0.05$) increased as compared to control group in both the selected toxicants. Biochemical profiles like crude protein and crude fat showed significantly decreased trend, whereas crude fibre, ash content and moisture content were found to be significantly ($p<0.05$) increased. Serum albumin and globulin were significantly ($p<0.05$) decreased. However, serum glucose was significantly ($p<0.05$) increased in both the agrochemical treated rosy barb fishes during the study period. Immune parameters like NBT and total blood protein were found to be decreased during the study period. Clotting time showed a significant ($p<0.05$) increase as compared to control group. Antioxidant enzymes like catalase and SOD showed a sharp increase as compared to control. The histopathological changes such as severe necrosis of epithelial cells, proliferative gill inflammation, haemorrahage and severe progressive telanogietasis were observed in gills. Hepatocellular necrosis with parenchymal vacuolization, hypertrophy of hepatocytes, hemorrhages and widening of blood sinusoids were the distinct altered features in the agro-chemicals exposed to fish liver. The histopathological changes observed in the kidney were degeneration of renal tubule, fragmented glomerulus, infiltration of haematopoetic tissue in glomerulus and renal tubule, and increased tubular lumen which were severe the altered features in the agrochemicals exposed fish kidney. The results of present study ascertained that the agrochemicals, viz. ethephon and calcium carbide caused alterations on haematological, biochemical, immune parameters and histology of rosy barb fish, and these alterations can be used as non-specific biomarkers in pesticide contaminated aquatic ecosystem.

4. Extension Activities

A. The training programmes organized: NIL

B. Seminar/Symposia/Conference/Workshop Organized: NIL

C. Farmer Melawa Organized: NIL

D. Radio/TV Talks delivered by the staff members of the Department/Section:

Topic	Place of Recording /	Year

	Broadcasting	
Radio talks		
1.Coral reef and its conservation	AIR, Ratnagiri	2016
2. Ornamental fish breeding	AIR, Ratnagiri	2017
3. Ocean's Changing Climate	AIR, Ratnagiri	2018

E. Farmer-Scientist Forum: NIL

F. Other Extension Activities:

- Delivered lectures on the various topics such as Biodiversity and Conservation, Aquatic environment management of ornamental fish.

G. Publications: Provide the details of the following publications published by the Department/Section in bibliographical form

i) Books

Title	Author	Publisher Name	Year
Marine Biodiversity of Ratnagiri Rocky Shore	**Dr. A. D. Adsul,** Dr. S.T. Indulkar, Dr. R. Pai, Dr. G. N. Kulkarni	College of Fisheries,DBSKKV	2016
Practical Manual on Physical Oceanography	**Dr. A. D. Adsul,** Dr. S.T. Indulkar, Dr. R. Pai, Dr. G. N. Kulkarni	College of Fisheries,DBSKKV	2014
Practical Manual on Marine Biology	**Dr. A. D. Adsul,** Dr. S.T. Indulkar, Dr. R. Pai, Dr. G. N. Kulkarni	College of Fisheries,DBSKKV	2016

ii) Journal Research papers:

	Authors	Title of the research paper	Journal	Vol. No/Page No.Year of publication
Name of Staff member: Dr. Milind S. Sawsnt				
01)	Pawase A.S., Metar S.Y., **Sawant M.S.,** Barve S.K., Akhade R.R and Pai, R.	Stock Assessment of white fish, Lactarius lactarius (Bloch and Schneider, 1801) along Ratnagiri coast of Maharashtra, India	Indian Journal of Geo-Marine Sciences	2015 Vol. 44(1) pp.17-19
02)	Pawar Nitin, Nirmale V.H., Metar S.Y., Bhosale, B.P., **Sawant, M.S** & Naik, S.D.	Age, growth and mortality studies of Indian squid, *Uroteuthis* (Photololigo) *duvauceli* (d' Orbigny) along Ratnagiri coast of Maharashtra, India.	Indian Journal of Geo-Marine Sciences	2015 Vol. 44(1) pp.33-36
03)	Mangesh M. Bhosale, R.R.Mugale, R.A.Pawar, **M.S.Sawant** and A.S.Pawase	Multivariate techniques to differentiate portunid crabs (*Charybdis feriatus, Portunus pelagicus and Portunus sanguinolentus*) from Ratnagiri coast, India: A comparative study	J.Exp. Zool. India	2016 Vol.19 (2) pp.743-749
04)	Mangesh M. Bhosale, R.A.Pawar, **M.S.Sawant,**	Molecular characterization of portunid crabs (*Charybdis feriatus,*	J.Exp.Zool.India	2017 Vol.20 (1)

	Pavan Kumar and W.S.Lakra	*Portunus pelagicus and Portunus sanguinolentus*) along Ratnagiri coast, Maharashtra, India		pp.47-51
05)	U.R.Gurjar, **M.S.Sawant,** R.A.Pawar, V.H.Nirmale, A.S.Pawase and S.Takar	A study on food and feeding habits of white sardine, *Escualosa thoracata* (Valenciennes, 1847) from the Ratnagiri coast, Maharashtra.	J. Exp. Zool.India	2017 Vol.20 (2) pp.755-762
06)	U.R.Gurjar, **M.S.Sawant,** S.Takar, R.A.Pawar, V.H.Nirmale and A.S.Pawase	Biometric analysis of white sardine, *Escualosa thoracata* (Valenciennes, 1847) from the Ratnagiri coast, Maharashtra.	J. Exp. Zool.India	2017 Vol.20 (2) pp.845-849
07)	Pawase A.S., Metar S.Y., **Sawant M.S.,** Barve S.K., Akhade R.R and Pai, R.	Studies on growth, mortality and stock assessment of Indian mackerel, *Rastrelliger kanagurta* (Cuvier,1817) from Ratnagiri coast of Maharashtra, India.	Indian Journal of Geo-Marine Sciences	2017 Vol. 46(11) pp.2382-2385
08)	P.C.Lokhande, M.M. Shirdhankar, K.J.Chaudhari and **M.S.Sawant**	Digitization of inland water resources for fisheries through remote sensing and geographical information system –A study in Ratnagiri District.	Fishery Technology	2017 Vol. 54 pp.86-93
09)	Bhoy. P.C., Pawase.A.S.,Pai.R., **Sawant. M.S**., Indulkar S.T., Pawar. R.A., and Swain.S.	Species composition of freshwater prawn juveniles in river Amba, Raigad District of Maharashtra.	Journal of Indian Fisheries Association	2017 Vol. 44(2) pp.31-36
10)	Mangesh M Bhosale, R. A Pawar, M. P Bhendarkar, **M.S Sawant** and A. S Pawase	Truss based morphometric approach for the analysis of body shape in Portunid crabs (Charybdis feriatus, *Portunus pelagicus* and *P. sanguinolentus*) along Ratnagiri coast, India	Journal of Entomology and Zoology studies	2018 Vol. 6 (2) pp.2641-2648
11)	U.R.Gurjar, **M.S.Sawant,** R.A.Pawar, V.H.Nirmale and A.S.Pawase	Reproductive biology and fishery of the white sardine, *Escualosa thoracata* (Valenciennes, 1847) from the Ratnagiri coast, Maharashtra.	Indian Journal of Geo-Marine Sciences	2018 Vol. 47(12) pp.2485-2491
12)	Ubaid Qayoom, R.A.Pawar, S.A.Mohite, **M.S.Sawant**, V.H.Nirmale, S.P.Pawar, M.Goswami and W.S.Lakra	DNA barcoding of some commonly exploited fishes from the northern Western ghats, India	Indian Journal of Animal Sciences	2018 Vol. 88(2) pp.245-250
13)	F. Sanudi, S. T. Indulkar, A. D. Adsul, A. S. Pawase and **M. S. Sawant**	Lethal toxicity of glyphosate herbicide on koi carp, *Cyprinus carpio* (Linnaeus, 1758) fingerlings.	Toxicology International	2018 Vol.25 (2) pp.139-141
14)	L.S.Uskelwar, **M.S.Sawant**, R.A.Pawar, V.H.Nirmale, A.S.Pawase, S.Y.Metar.	Food and Feeding Biology of Brackish Water Fish *Epinephelus diacanthus* along the South Konkan Coast of Maharashtra, India	Int. Journal of Current.Microbiology and Applied Sciences	2018 Vol.7 (12) pp.3106 - 3110

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16)	A. D. Adsul, P. S. Shelar, M. M. Shinde, A. A. Shelke, S. T. Indulkar and **M. S. Sawant**	Seasonal variations of green seaweeds (Chlorophyta) from the Undi coastal area of Ratnagiri, Maharashtra	J. Indian Soc. Coastal Agric. Res.	2019 Vol.37 (1) pp.63-68
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19)	S.V. Pawase, V.H. Nirmale, B.P. Bhosale, R.A. Pawar, **M.S. Sawant** & D.R. Kende	Study on biology of *Thryssa dussumieri* (Valenciennes, 1848) from the coast of Ratnagiri, Maharashtra, India	Indian Journal of Geo-Marine Sciences	2020 Vol. 49(01) pp.87-94
20)	U. R. Gurjar, S. Takar **M.S. Sawant**, R. A. Pawar, V. H. Nirmale, A. S. Pawase, S. K. Chakraborty, K. K. Ramteke and T. Kumawat.	Preliminary observation on the sustainability of white sardine, *Escualosa thoracata* (Valenciennes, 1847), exploited from the central west coast of India	The Journal of Basic and Applied Zoology	2021 Vol. 82(20) pp.1-7
21)	B. K. Parmar, **M. S. Sawant**, A. S. Pawase, A. D. Adsul, Pragati Kumari, Udai Ram Gurjar	Profiling of hydrobiological parameters of shrimp farms in Navsari, Gujarat	J. Exp. Zool. India	Vol. 26, No. 2, pp. 1387-1399, 2023

Sr. No.	**Authors**	**Title of the paper**	***Journal***	**Vol,Page No, Year**
Name of Staff member: Dr. Harish Bhaiyyalal Dhamagaye				
1	**Dhamagaye H. B**., Chogale N. D., Bondre R. D., Bhatkar V.R., Indulkar S. T, Bhosale B. P. and Belsare S. G.	Evaluation of different live foods on growth and survival of Seahorse fish (*Hippocampus kuda*) ponies.	Asian Fisheries Science Journal.	Volume 20, 1-6, 2007
2	V. R. Bhatakar, R. D. Bondre, **H. B. Dhamagaye**, N. D. Chogale and B. P. Bhosale	Evaluation of some formulated diets for rearing of fry of Rabbit fish *Siganus canaliculatus*.	Aquacult	Vol.8 (2), 269-273, 2007
3	S. D. Naik, S. T. Sharangdhar, **H. B. Dhamagaye** and R. K. Sadavarte.	On the aspect of Seed Production And Prospects for Brackishwater Culture of Pearl Spot, *Etroplus suratensis*,	Ecology and Fisheries,	Vol.2(1):37-42, 2009
4	B. P. Bhosale, N. D. Chogale**, H. B. Dhamagaye,** V. R. Bhatkar and R. D. Bondre.	Preparation of Bombay duck chutney from dried Bombay duck fish *Harpodon neherus*.	Asian J. of Adv. Basic Sci.:	2(2), 66-71, 2014
5	S. J. Meshram, Shivananda Murthy H., H. S. Swain, Ali H., , Jagadeesh T. D., **H. B.**	Effect of dietary beta-glucan on growth and body composition of *Macrobrachium rosenbergii*.	The Bioscan	Vol. 9 No. 2, 2014

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6	**Harish B. Dhamagaye**, Gangadhara Gowda, C. Shruthisree, Harsha Nayak Shashikant J. Meshram	Oxygen Consumption and Ammonia Excretion of Iridescent Shark, Pangasius hypophthalmus Exposed to Cypermethrin.	J. Exp. Zool. India	Vol.18 No. 1, pp 381-385, 2015
7	C. Sruthisree, Gangadhara Gowda, Harsha Nayak, **Harish B. D**. and Adnan Amin,	Effect of heavy metal (lead) on oxygen consumption and Ammonia excretion of iridescent shark (*Pangusius hypohthalmus*)	J. Exp. Zool. India	Vol. 18, No. 2, 637-640, 2015
8	Harsha Nayak, Gangadhara Gowda, **Harish B. D**., C. Sruthisree and B. T. Naveen Kumar	Heavy metal in the commercially important fish *Rastrelliger kanagurta* from Mangaluru waters.	J. Exp. Zool. India	Vol. 18, No. 2, 583-587, 2015.
9	S.D. Naik, **H. B. Dhamagaye**, A.N Sawant, S.P. Hotekar.	Backyard hatchery operation for seed production of production of mudcrab, Scylla tranquebarica.	Global J Multidisc studies.	Vol 4(12), 405-411, 2015
10	R. K. Sadawarte, V.R. Sadavarte, V.B. Mulye, S.J. Meshram, **H. B. Dhamagaye.**	Effect of ethyl-estradiol on growth of fry of Rosy barb, *Puntius conchinius*. *Ecology,*	*Eco Env. Conserv.*.	Vol.22, s201-s203, 2016
11	R. K. Sadawarte, V.R. Sadavarte, V.B. Mulye, S.J. Meshram, **H. B. Dhamagaye**	Effect of 17 α–Methyltestosterone on growth of fry of Rosy barb, *Puntius conchinius*.	*Ecology, Env. Conserv*.	vol.22:s205-s208., 2016
12	R. K. Sadawarte, V . R. Sadawarte, **H. B. Dhamgaye**, J. M. Koli and V . B. Mulye	Effect of 3-Nitro (3-Nitro-4-Hydroxyphenyl-arsonic acid 5% premix) on adult of rosy barb.	The Asian Journal of Animal Sci.	vol 11(1):9-12, 2016.
13	R. K. Sadawarte, V . R. Sadawarte**, H. B. Dhamgaye,** V. V. Vishwasrao and V . B. Mulye	Effect of sodium bicarbonate ($NaHCO_3$) on fry of rosy barb	The Asian Journal of Animal Sci.	vol 11(1): 40-42, 2016
14	S. J. Meshram, Shivananda Murthy H, H., Swain H. S., Pai R. A. Ali and **H. B. Dhamgaye**	Preliminary Study of the Effect of Dietary Beta-Glucan on the Gut Morphology of Giant Freshwater Prawn, *Macrobrachium Rosenbergii*	Journal of Aquaculture & Marine Biology.	4(4), 2016
15	M.N. Ghane, **H.B. Dhamagaye**, S.J. Meshram and A.D. Salunke.	Toxicity Effect of Paclobutrazol Fungicide on Haematological Parameters in Oreochromis mossambicus Fingerlings	Trends *in Biosciences*	*10(33) :7146-7155,* 2017
16	Jayesh J. Balkate, Dr. Suresh Naik, Dr. Swapnaja A. Mohite, Dr. Milind S. Sawant, Dr. **Harish B. Dhamagaye**	Study on Morphometric Identification of Some Finfish Seed Along the Kasarveli Estuary of Ratnagiri Coast of Maharshtra.	Contemporary Research in India,	7(4), 183 – 188, 2017
17	M.N. Ghane, **H.B. Dhamagaye**, S.J. Meshram and A.D. Salunke.	Toxic Effect of Paclobutrazol Fungicide in Oreochromis mossambicus Fingerlings	Pesticide Research Journal	30(1):112-116, Special Issue, 2018
18	Shashikant J. Meshram, Shivananda Murthy, **Harish B. Dhamgaye**, B. R. Chavan, H. S. Swain, M. J. Gitte and A. Ali	Effect of dietary beta-glucan on the hepatopancreas of giant freshwater prawn, *Macrobrachium rosenbergii.*	Contemporary Research in India journal.	ERCA-2018, pp 87-90, Special Issue, 2018
19	**H. B. Dhamagaye**, A. M.	Proximate composition and growth	Contempor	(ERCA-2018)

	Ranade, S. J. Meshram, S. D. Naik, R. K. Sadavarte M. J. Gitte and Sachin Belasare	study of green mussel *Perna viridis* (L.) from Mirya creek in Ratnagiri, Maharashtra, India	ary Research in India journal.	pp 80-86, Special Issue, 2018
20	Bhosle R. V., Chavan B. R., Meshram S. J., **Dhamagaye H. B.**, Wasave S. S. and Pai R	Growth performance of gift tilapia (*Oreochromis niloticus*) fry in nursery rearing by using Brackish water	Contempor ary Research in India journal.	(ERCA-2018) pp 31-35, Special Issue, 2018
21	K. S. Sawant, S. J. Meshram, **H. B. Dhamagaye**, B. R. Chavan, R. M. Tibile and V. R. Vartak	Growth and survival of *Labeo rohita* (hamilton, 1822) fry in biofloc system using various dietary protein levels	J. Exp. Zool. India**.**	Vol. 23, Supplemen t 1, pp. 765-769, 2020
22	S. N. Kamble, **H. B. Dhamagaye**, S. J. Meshram, B. R. Chavan and G. N. Kulkarni	Toxic effect of fungicide paclobutrazol on immunological parameters of juveniles whiteleg shrimp, *Litopenaeus vannamei*	J. Exp. Zool. India**.**	Vol. 23, Supplement 1, pp. 895-901, 2020
23	S. J. Meshram, **H. B. Dhamagaye**, H. S. Swain, H. S. Murthy, A. Ali, M. J. Gitte and R. K. Sadawarte	Effect of dietary supplementation of mannan oligosaccharide on growth and survival of giant freshwater prawn, *Macrobrachium rosenbergii*	J. Exp. Zool. India**.**	Vol. 23, Supplement 1, pp. 895-901, 2020
24	**H. B. Dhamgaye**, S. P. Jadhao, S. J. Meshram , B. R. Chavan AND R. K. Sadawarte	Effect of fipronil on oxygen consumption and ammonia excretion of mahseer (*Tor khudree*) fry	Indian J. Anim. Hlth.	59(1): 91-96, 2020
25	M J Gitte, S J Meshram**,** B T Sawant, S V Patil, B V Naik, **H B Dhamgaye** and J S Arekar	Study on Aqua-entrepreneurship in *Litopenaeus vannamei* Culture in Raigad district of Maharashtra	J Krishi Vigyan	. 9 (2) : 221-224, 2020

Sr. No.	Author/s	Title of the paper	Journal	Volume, Page number, year
	Name of Staff member: Dr. Aniruddha D. Adsul			
1	S. S. Lokhande, A. D. Adsul	*Seasonal variations of environmental parameters of the Mirya sandy shore, Ratnagiri,*	Asian Journal of Environmental Science	Vol. 8, Issue l, 14-17 (2013).
2.	S. S. Lokhande, A, D, Adsul, S.T. Indulkar and R. Pai	*Seasonal variations of sandy shore crustaceans of Mirya Bay, Ratnagiri, Maharashtra.*	Journal of Marine Biological Association of lndia,	Vol.57 (l), 65-70. (2015).
3.	S. S.Lokhande, **A. D. Adsul**, S. T. Indulkar & A. S. Ninawe	*Seasonal variations of molluscs of Mirya sandy shore, Ratnagiri.*	Indian Journal of Geo-Marine Science	Vol.44 (l l), 1790-1795. (2015).
4.	Lokhande S.S., Indulkar S.T., Pai R., **Adsul A.D.** Nirmale V. H.	*Physico-chemical parameters and primary Productivity of Vinhere Reservoir, Mahad, Raigad District, Maharashtra*	Journal of Experimental Zoology of India.	Vol.19 No. 1, 333-339 (2016)
5.	Lokhande S.S., Indulkar S.T., Pai R., Nirmale V. H.	Studies on Physico-chemical parameters of Ambawade Reservoir, Raigad District, Maharashtra, India	Journal of Scientific Research & Reports	14(5): 1-10. 2017
6.	Karhale S. M., **Adsul A. D.,** Indulkar S. T. and Pai R.	Seasonal variation of intertidal mangrove area crustanceans of Shirgaon, Ratnagiri, Maharashtra.	Research *Journal of Chemical and Environmental Sciences*	Vol. 5 (6): 53-57 (2017)
7.	Karhale S. M., **Adsul A.D.** Indulkar S.T., Pai R.	Seasonal variation of Bivalves of Intertidal Mangrove area of Shirgaon, Ratnagiri, Maharashtra	Advances in Research	Vol. 12(4) 2017
8.	Lokhande S.S., **Adsul A.D.** Indulkar S.T., Pai R.	Soil composition of Mirya sandy shore, Ratnagiri	Research Journal of Chemical and Environmental Sciences	Vol 5(4) 2017
9.	Pakhmode P.K.Mohite S.A., Mohite A.S., **Adsul. A. D.**	Allometric relationship of shortneck clam, *Paphia malbarica* (Chemnitz, 1782) along Aare-Ware rocky shore of Ratnagiri, Maharashtra	Indian Research Journal of Genetics & Biotechnology	Vol.9(1): 66-72 2017
10.	Mestry C. M. **Adsul A.D.** Indulkar S.T., Pai R.	Seasonal variation of diatoms of Shirgaon estuary, of Ratnagiri, Maharashtra	Research Journal of Chemical and	Vol. 6 (2): 34-39 2017

			Environmental Sciences,	
11.	Karhale S. M., **Adsul A. D.,**	Seasonal variation in fishes of Intertidal Mangrove area crustaceans of Shirgaon, Ratnagiri, Maharashtra	International Multidisciplinary Quarterly Research Journal AJANTA	Vol.1: 33-35 (2019)
12.	Hodge M. B., **Adsul A. D.,** Indulkar S. T., Pai R. and Bhatkar A. A	Crustacean diversity of Varawade Rocky Shore, Ratnagiri, Maharashtra.	Biodiversity and Aquatic Research: An international Journal	Vol. 1(2): 1-4 (2019)
13	Chogale N. D., Bondre R. D., Pai R., Metar S., Satam S. B. and **Adsul A. D.**	Experimental studies on co-culture of Shrimp, *Litopenaeus vannamei* (Boon, 1993) with sea cucumber, *Holothuria moebii* (ludwig, 1883)	The Asian Journal of Animal Science	Vol. 11 (2): 81-85; (2016)
14	**Adsul A. D.,** Shelar P. S., Shelke A. A., Salvi D. A., Indulkar S. T. and Sawant M. S.	Seasonal variation of Red Seaweeds (*Rhodophyta*) from the Undi coastal area of Ratnagiri, Maharashtra.	Journal of the Indian Society of Coastal Agricultural Research	Vol.37 (1), 63-68. (2019).
15	Sanudi, F.; Indulkar, S.T.; **Adsul, A.D.**; Pawase, A.S.; Sawant, M.S.	Effects of Glyphosate Herbicide on Physiological Parameters of Koi Carp, *Cyprinus Carpio* (Linnaeus, 1758) Fingerlings.	Indian Journal of Animal Research	Vol. 55 (3): 81-85; (2021)
16	Sanudi, F.; Indulkar, S.T.; **Adsul, A.D**.; Pawase, A.S.; Sawant, M.S.	Lethal Toxicity of Glyphosate Herbicide on Koi Carp, *Cyprinus carpio* (Linnaeus, 1758) Fingerlings	Toxicology International	Vol. 25 (2): 139-141; (2019)
17	Karhale S. M., **Adsul A.D.** Indulkar S.T., Pai R.	Seasonal variation in polychaetes of intertidal mangrove area of Shirgaon, Ratnagiri, Maharashtra, India	International Journal of Life Sciences	Vol. 6 (1): 156-160; (2018)
18	Mestry C. M. **Adsul A.D.** Indulkar S.T., Pai R.	Seasonal variations of zooplankton in Shirgaon estuary of Ratnagiri, Maharashtra	Journal of Entomology and Zoology Studies	Vol. 9(2): 698-703 2021
19	Mestry C. M. **Adsul A.D.** Indulkar S.T., Pai R.	Seasonal variations of physico-chemical parameters in Shirgaon estuay of Ratnagiri, Maharashtra in Shirgaon estuary of Ratnagiri, Maharashtra	Journal of Pharmacognosy and Phytochemistry	Vol. 9(6); 2163-2168; (2020)
20	Hodge M. B., **Adsul A.D.** Indulkar S.T., Mestry C. M. Sawant N. S.	Seasonal variations of molluscs of Varawade rocky shore, Ratnagiri	Journal of Entomology and Zoology Studies	Vol. 9(1): 358-362 (2021)
21	Hodge M. B., **Adsul A.D.** Indulkar S.T.,Pai R. K., Mestry C. M. Sawant N. S.	First record of black spined sea urchin, *Stomopneustes variolaris* (Lamark, 1816) from Ratnagiri, (Echinoid, Stomopneustoida,	International Journal of Ecology and Environmen	Vol.3(1);42-44 (2021)

		Stomopneustidae) Maharashtra	tal Sciences	
22	V. S. Aitwar, **A. D. Adsu**l, A. S. Pawase, M. S. Sawant, V. H. Nirmale	Monthly variation in molluscan diversity along sandkhol sandy shore, Ratnagiri, Maharashtra.	Journal of Experimental Zoology, India	Vol. 26, No. 2, pp 1975-1979, 2023

ii) Full length research papers published in Proceedings of Seminar/Symposia /Conference/Workshop

Title of the research paper	*Authors*	Conference / Symposium / Workshop	Year of publication	Oral / Poster presentation
Status of aquaculture/fisheries education in India	B.R Chavan, D.P Thakur and **H.B. Dhamagaye**	International symposium on aquaculture and fisheries education	2009	Oral
Sustainable fish cage culture in riverine water by community management for rural livelihood	B.R. Chavan, V.B. Sutar and **H. B. Dhamagaye**	National conference	2010	Oral

6. other activities with photographs:

World Ocean Day Celebration

World Environment Day Celebration through mangrove propagule collection for plantation

DEPARTMENT OF FISHERIES HYDROGRSPHY LAB FACILITIES

Departmental Field studies regarding water parameters on Shrimp farm

Discussion on fish culture and water quality management with farmers

7. Contact information:

Name of the Head	**: Dr. A. S Pawase**
Name of the dept.,	**: Fisheries Hydrography,**
Postal Address	**: Fisheries Hydrography, College of Fisheries, Shirgaon, Ratnagiri-415629 (Maharashtra)**
Land line No.	**: +91 2352- 232241 (Ext. 221)**
Mobile:	**: +91 9422430498**
Fax:	**: +91 2352- 232987**

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