Government of India
Ministry of Environment, Forests& Climate Change
ZOOLOGICAL SURVEY OF INDIA
Andaman and Nicobar Regional Centre
Port Blair-744 102, A & N Islands

SYLLABUS - MARINE BIOLOGY

PHYSICAL OCEANOGRAPHY

Introduction to Oceanography - history of oceanography- expeditions, marine biological Institutions, origin of oceans- bottom topography, abyssal hills-plains: submarine canyons- ocean trenches. • Physical Properties of Seawater- density, viscosity, surface tension, conductivity and their relationship, temperature distribution in the sea-heat budget, UV radiation, acoustics. • Dynamics of the ocean-general surface circulation - wind and thermohaline circulation. forces causing currents, boundary currents, Langmuir circulation, Geotropic currents, turbidity currents, monsoon and trade winds, Upwelling. • Waves, Currents and Tides theories of waves-tidal waves- formation of swells internal and standing waves- storm surges tsunami - tide generating forces- tidal currents- tidal effects in coastal areas tide and wave energy. • Estuaries -origin and classification estuarine circulations- estuarine zonation- lagoons. Sedimentation- origin and physical properties of sediments (lithogenous, biogenous and cosmogenous), distribution and transport of sediments, determination of age of sediments.

CHEMICAL OCEANOGRAPHY

Introduction to marine chemistry- ocean as a chemical system - origin of sea salts-properties of water molecules differences between fresh and seawater. • Chemical composition of seawater- ionic, major and minor constituents, constancy- ionic compositions and factors affecting constancy- major and minor elements, trace elements- their importance, distribution. Chemistry of seawater constituents- concept of chlorinity and salinity - methods of measurements. • Radio nuclides in the sea- origin, distribution and use as tracers of water masses. Dissolved Gases- carbon dioxide- origin, importance and distribution. Oxygen origin and factors governing the distribution- BOD and COD. Other Gases nitrogen, hydrogen sulphide, methane. • Nutrients- Inorganic, origin, distribution and important role in the fertility of the sea. Nitrogen, Phosphorous and Silicon in the sea- distribution, cycling, regeneration concept- new and regenerated production, N: P ratio. Mineral wealth of the sea- salts, glauconite, petroleum, phospharite, manganese nodules- potential, economy of extraction. Desalination - recovery of chemicals. • Organic matter- dissolved, particulate and colloidal species, sources, classification, composition, distribution, seasonal variation- ecological significance- growth promoting and growth inhibiting effects biogeochemical cycle.

BIOLOGICAL OCEANOGRAPHY

Sea as a biological environment- Plankton- classification based on size, mode of life and habitat. Phytoplankton and Zooplankton - methods of collection, estimation of standing crop-wet and dry weight estimation-plankton volume settling and displacement methods. Oxidation as carbon (as organic matter). • Adaptation of plankton- structural (weight, increase of surface area, flotation) physiological (specific gravity, water content, fat content, mono and divalent ions, gas, defensive vacuoles) mechanisms. Phytoplankton and Zooplankton interrelationship-microbial loop- red tide phenomenon- causes and effects. • Organic production- Primary and secondary productions methods of estimation of primary production. Factors affecting primary production- regional differences in (primary and secondary) production. • Seaweeds- Occurrence and distribution in India - economic importance. Life cycles of Ulva, Sargassum and Gracilaria. Seagrasses - morphological and anatomical adaptations ecological role. Mangroves - distribution, adaptation, conservation and ecological role. • Salt marsh and sand dune vegetation - morphological, anatomical and physiological features, ecological role, uses and conservation. Biological

resource assessment and management using remote sensing techniques and Geographical Information System (GIS).

INVERTEBRATES

Classification - life history and phylogenetic relationship of Protozoa and Sponges. Coelenterate - polymorphism, life history- theories of Coral reefs, distribution. Polychaete classification, morphology, reproduction and adaptive radiation. • Functional morphology, development and evolution Nemertinea, Entoprocta, Ectoprocta, Phoronida, Pogonophora. Chaetognatha- Classification, distribution, morphology and anatomy, embryology and evolution. Brachiopoda - classification, morphology, paleontology and evolution. • Crustacea classification, comparative morphology, crustacean appendages, larval forms, evolution and paleontology. • Mollusca classification, general characters with reference to bivalves, gastropods and cephalopods. • Echinodermata- water vascular system, - larvae, their comparative morphology and evolution. Prochordata - classification and comparative morphology, reproduction and early development, larval metamorphosis.

VERTEBRATES

Origin of chordates; geological time scale- progression of vertebrates through time, chordate features and theories on the origin of chordates. • Evolution of bony fishes and amphibian: characteristic features of ancestral vertebrates- classification and evolution of jawless and primitive jawed vertebrates. Evolution and adaptive radiation of elasmobranches and bony fishes. Origin and distribution of amphibia - anatomical peculiarities and affinities of urodele and apoda. • Reptiles and Marine birds- origin of reptiles- adaptive radiation of contemporary reptiles, turtles, amphibian and reptilian features of Seymouria,- mammal like reptiles, rise and fall of dinosaurs, including Mesozoic marine reptiles- importance of coastal and marine birds. • Evolution of mammals- general characters of mammals-, classification and evolution of monotremes, marsupials and placentals - aquatic mammals- classification, adaptation and evolution of cetaceans and sirenians. Aquatic adaptation of respiratory and circulatory mechanisms- comparative anatomy of skin derivatives. • Developmental biology- gametogenesis, fertilization, cleavage, development upto gastrulation with special reference to Amphioxus. Embryology (with special reference to marine vertebrates fish, bird and mammal). Nuclear transplantation- embryo transplantation, artificial insemination.

MARINE MICROBIOLOGY

Ecology of coastal, shallow and deep sea microorganism - importance and their significance. Diversity of microorganism - Archaea, bacteria, cyanobacteria, algae, fungi, viruses and actinomycetes in the mangroves and coral environs. • Importance of taxonomy conventional and modern methods. General microbial techniques. Unculturable forms. 16S rRNA genomic similarity - content of guanine (G) + cytosine (C) (%GC)., DNA-DNA homology, Fatty acid analysis and genomic sequencing using Microbial identification system (GCFAME), DNA hybridization, polyphasic taxonomy. • Nutrient cycles- Role of microorganisms in carbon, nitrogen, phosphorous and sulphur cycles in the sea under different environments including mangroves. • Food Microbiology- pathogenic microorganisms, distribution, indicator organisms prevention and control of water pollution, quality standards, International and National standards. Microbiology of processed finfish and shellfish products. Microbial diseases diagnosis and control. • Microbial biodegradation - natural and synthetic material in the marine environment- pesticide, cellulose degradation, hydrocarbon production. Bioremediation of xenobiotics oil, heavy metals, pesticides, plastics, etc. Mining and metal biotechnology.

MARINE ECOLOGY

Marine environment ecological factors light, temperature, salinity, pressure. Classification of marine environment pelagic environment, planktonic and nektonic adaptations, benthic environment intertidal, interstitial and deepsea adaptation. Other coastal environments coral reefs, estuaries, mangroves, seagrass beds, kelp forests, polar seas and hydrothermal vents. • Animal association in marine environment- endoecism, inquilinism- phoresis-epizoism - mutualism- communalism- symbiosis- parasitism. Marine zoogeography with reference to Indian Arctic and Antarctic Oceans. • Population Ecology- group attributes, population growth, density variations, concept of carrying capacity. Dispersal, prey-predator relationship- density dependant- density independent factors. • Structure and composition, diversity and stability, concept of niche, succession, community wise adaptation, e.g. fouling and boring community. • Marine Ecosystems concepts- principal components- marine food chains-trophic structure food web- ecological pyramids- energy flow- evolution and management- system ecology and modeling.

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