B.Sc. FISHERY SCIENCE
LAB MANUAL
5th Semester

Prepared By
Biological Science Dept.
Fishery Science

MIDNAPORE CITY COLLEGE

BFSC SEMESTER – V LAB MANUAL

BFSC-501: Microbial and Parasitic Diseases of Fish and Shellfish

General procedure for disease diagnosis. Methods of sampling fish and shellfish for disease diagnosis. Taxonomy, lifecycle and identification of fish and shellfish parasites. Sampling, preparation of media and culture of pathogenic bacteria: Techniques for bacterial classification. Techniques in disease diagnosis: Microbiological, haematological, Histopathological, immunological, molecular techniques and Biochemical tests. Agglutination test; Challenge tests; purification of virus; Stress related study of fish and shellfish; Disease treatment.

BFSC-502: Fish Toxicology

Detection of heavy metal poisoning. Spot tests for metals. Group reaction for metals - Arsenic, Antimony, Lead (Pb), Mercury (Hg), Zinc (Zn), Barium (Ba), Iron (Fe3+), Copper (Cu), Ammonia (ammonium ions) NH4+ Chloride (Cl-), Phosphate (P04) Sulphate (S04) Flouride (Fl-), Qualitative detection of Nitrite and Nitrate, Detection of hydrocyanic acid, Detection and Estimation of Mycotoxins, Test for detection of alkaloids, Estimation of LD5O and ED5O - Demonstration of drug toxicity.

BFSC-503: Coastal Zone Management and Disaster Management

Field visit to different coastal environments to study erosion of beaches, Identification of ecologically sensitive areas and protection, Study of CRZ, ICZM along the coastal belt, Study on implementation and violation of CRZ, Study of application of remote sensing and GIS, Project preparation of EIA. Methods for assessment of initial and long-term damages. Preparedness in pre, during and post disasters. Acquaintance with fire-fighting devices. Lifesaving appliances and first-aid. Operation and usage of communication of channels and media. Uses of distress signals and technologies. Relief and rehabilitation measures, trauma counselling. Field visits and case studies. Group discussion.

BFSC-504: Coastal Aquaculture and Mariculture

Identification of important cultivable species. Collection and identification of commercially important seed of fish and shellfishes. Types of fertilizers - Pond preparation. Seed selection, quality and acclimatization. Water quality parameters. Estimation of seed survival. Pond biomass estimation. Material, apparatus and machinery for shore-based aquaculture and sea farming. Estimation of feed intake. Growth and health monitoring. Fouling organisms in cages and pens.

BFSC-506: Marine Fisheries

Visit to fish landing centres, Observation and analysis of catches by major crafts and gears. Field collection of fishes, crustaceans, molluscs and seaweeds and record keeping of relevant data. Participation in fishing cruises. GIS and remote sensing in marine capture fishery.

BFSC-507: Fish Packaging Technology

Determination of grammage of paper and board, bursting strength, burst factor, punctures resistance, water proofness, stiffness of the board, ring stiffness of paper and board, flat crush, tensile strength and elongation at break of plastic films, density of plastic films, breaking length, impact strength of plastic films, tearing strength of paper and plastic films, water vapour

transmission rate, oxygen transmission rate, heat seal strength, suitability of plastic films for food contact applications, evaluation of retort pouch, identification of plastic films.

BFSC-508: Fish By-Products and Waste Utilization

Preparation of fish meal, fish body oil, fish liver oil, fish maws, isinglass, fish silage, ensilage, fish glue, fish gelatine, fattice, pearl essence, chitin, chitosan and fish manure. Preparation of acid and fermented silage. Preparation of fish protein concentrate and fish hydrolysate.

BFSC-509: Fishing Gear Technology

Study of net making tools; Knots and hitches used in net making. Methods of net making: Hand braiding- Chain mesh method and loop methods of net making. Shaping of webbing: baiting, creasing and reducing mesh size step by step. Tailoring method: T and N direction of webbing; T-cuts, N-cuts, B-cuts and their combination. Joining of net pieces. Net mounting – hanging coefficient, hung depth and their calculation. Selvedging. Methods of net mounting: reeving, stapling and norselling. Mending and net shooter techniques.

BFSC-510: Fishing Technology

Survey of fishing gears; Trawl; gillnet; long line and purse seine fishing gears. Rigging of trawl, purse seine, gillnet and hook & line. Commercial fishing techniques: Bottom trawling; purse seining; gillnetting and line fishing. Cast net fishing and trap fishing.

BFSC-501: Microbial and Parasitic Diseases of Fish and Shellfish

Introduction

The study of microbial and parasitic diseases in fish and shellfish is critical for the health management of aquatic species, especially in aquaculture. This course covers the general procedures for diagnosing diseases, identifying pathogens, understanding their taxonomy and lifecycle, and employing various diagnostic techniques, including microbiological, immunological, molecular, and biochemical methods. The lab exercises focus on practical applications of these techniques to detect and treat diseases in fish and shellfish populations.

Experiment 1: General Procedure for Disease Diagnosis

Objective

To familiarize students with the general procedure for diagnosing microbial and parasitic diseases in fish and shellfish.

Materials Required

1. Fresh fish/shellfish specimens
2. Sterile sampling containers
3. Microscope
4. Sample preservation containers (e.g., formalin)
5. Diagnostic protocol documents

Procedure

1. **Initial Inspection**:
    - Conduct a visual inspection of fish and shellfish for external signs of disease, such as lesions, ulcers, discoloration, and abnormal behavior.
    - Record symptoms and signs of disease (e.g., rapid breathing, lethargy, abnormal swimming patterns).
2. **Sampling**:
    - Select fish and shellfish showing visible signs of disease.
    - Using sterile equipment, collect external and internal samples (e.g., skin scrapings, gill biopsies, liver, and muscle tissue).
3. **Documenting Observations**:
    - Record detailed observations on the appearance and condition of the affected specimens.
    - Prepare a sample log with information such as species, age, environmental conditions, and symptoms.

4. **Preliminary Diagnosis**:
    - Based on symptoms, formulate a preliminary diagnosis and proceed with further diagnostic tests.

Observations and Results

- Discuss the possible causes of the symptoms observed and correlate them with known diseases.
- Note the importance of accurate sample collection and documentation for successful diagnosis.

Experiment 2: Methods of Sampling Fish and Shellfish for Disease Diagnosis

Objective

To understand the proper techniques for sampling fish and shellfish for disease diagnosis.

Materials Required

1. Fish/shellfish samples
2. Sterile sampling containers
3. Tweezers, scalpel, scissors
4. Preservative solutions (e.g., formalin, saline)
5. Lab notebook for recording observations

Procedure

1. **Selection of Sample**:
    - Choose diseased or symptomatic fish and shellfish for sampling.
    - Ensure that samples represent different sections of the body (e.g., gills, skin, fins, internal organs) to increase diagnostic accuracy.
2. **Sterile Sampling**:
    - Use sterile equipment (tweezers, scissors, scalpels) to avoid contamination.
    - Collect external samples such as gill biopsies, skin scrapings, and fin clips, and internal samples like blood or organ tissue for further analysis.
3. **Preservation**:
    - Preserve the collected samples in appropriate solutions (formalin for histopathology, saline for microbiological culture) to maintain the integrity of the sample.
4. **Record Keeping**:

- Label each sample with the necessary details (e.g., species, source, symptoms, date).
- Record the type of sample taken, method of collection, and observations.

Observations and Results

- Compare the samples collected from healthy and diseased specimens.
- Discuss the importance of maintaining sterility to avoid contamination during sampling.

Experiment 3: Taxonomy, Lifecycle, and Identification of Fish and Shellfish Parasites

Objective

To study the taxonomy, lifecycle, and identification methods for fish and shellfish parasites.

Materials Required

1. Parasitic samples (e.g., gill flukes, nematodes, ectoparasites)
2. Microscope and slides
3. Taxonomic identification keys
4. Dissecting tools
5. Fish/shellfish specimens

Procedure

1. **Parasite Identification**:
   - Examine infected fish and shellfish under a microscope.
   - Identify external and internal parasites such as protozoa, trematodes, nematodes, and crustaceans.
2. **Taxonomy Study**:
   - Use identification keys to classify the parasites based on their morphological features.
   - Study the lifecycle of common parasites (e.g., gill flukes, nematodes) by reviewing scientific literature or reference material.
3. **Lifecycle Analysis**:
   - If available, observe different developmental stages of parasites in infected specimens and record their morphological changes.

Observations and Results

- Record the species of parasites observed and their stage of development.
- Discuss the environmental and host factors that influence the lifecycle of parasites.

Experiment 4: Sampling, Preparation of Media, and Culture of Pathogenic Bacteria

Objective

To practice the preparation of media, culturing of pathogenic bacteria, and their identification.

Materials Required

1. Fish/shellfish tissue samples (e.g., liver, gills)
2. Sterile petri dishes
3. Culture media (e.g., agar, broth)
4. Incubator
5. Bacterial identification kits (e.g., API test strips)

Procedure

1. **Preparation of Media**:
    - Prepare appropriate solid and liquid media for bacterial culture, ensuring sterility.
2. **Inoculation**:
    - Inoculate tissue samples from infected fish or shellfish onto prepared agar plates.
    - Incubate at the optimal temperature (e.g., 37°C for fish pathogens).
3. **Bacterial Growth**:
    - After incubation, examine the growth of bacteria on the culture media.
    - Record the bacterial colonies' shape, color, and size.
4. **Identification**:
    - Perform biochemical tests or use identification kits to classify the bacterial isolates.
    - Confirm the bacterial species responsible for the disease in the infected sample.

Observations and Results

- Discuss the growth patterns of bacteria and their relevance to the disease in the fish or shellfish.
- Record the bacterial species identified and their characteristics.

Experiment 5: Techniques in Disease Diagnosis – Microbiological, Hematological, Histopathological, Immunological, Molecular Techniques

Objective

To understand and apply different diagnostic techniques for disease diagnosis in fish and shellfish.

Materials Required

1. Fish/shellfish samples (infected)
2. Microscope
3. Hematological equipment (e.g., centrifuge, blood smears)
4. Histological tools (e.g., tissue processing kit)
5. PCR kit (for molecular diagnostics)
6. Reagents for immunological tests (e.g., ELISA kits)

Procedure

1. **Microbiological Techniques**:
    - Follow the procedure from previous experiments for culturing and identifying pathogens.
2. **Hematological Techniques**:
    - Collect blood samples from fish and perform a blood smear.
    - Observe blood cell morphology under the microscope to detect abnormalities like anemia or leucocytosis.
3. **Histopathological Techniques**:
    - Process tissue samples (e.g., liver, gills) for histological analysis.
    - Prepare slides, stain, and examine under the microscope to identify tissue damage, parasite presence, or infection.
4. **Immunological and Molecular Techniques**:
    - Perform agglutination tests or ELISA to detect specific antibodies or antigens.
    - Use PCR to detect pathogenic DNA or RNA.

Observations and Results

- Compare the results of each diagnostic method and assess their effectiveness for different types of infections.
- Discuss the strengths and weaknesses of each technique.

Experiment 6: Stress-Related Study of Fish and Shellfish

Objective

To study how stress affects the health of fish and shellfish and contributes to disease susceptibility.

Materials Required

1. Healthy and stressed fish/shellfish samples
2. Environmental stressors (e.g., temperature changes, hypoxia)
3. Stress monitoring equipment (e.g., dissolved oxygen meter, thermometers)
4. Blood and tissue collection tools

Procedure

1. **Stress Induction**:
    - Induce controlled stress in fish and shellfish by altering environmental conditions (e.g., temperature fluctuations, oxygen depletion).
2. **Monitoring Stress Response**:
    - Measure physiological responses such as heart rate, breathing rate, and stress hormones.
    - Collect blood and tissue samples for analysis.
3. **Disease Assessment**:
    - Examine the effects of stress on disease susceptibility by observing any disease symptoms or pathogen growth following stress exposure.

Observations and Results

- Record the physiological changes and any signs of disease development in stressed specimens.
- Discuss how environmental stress can exacerbate disease outbreaks in aquaculture.

Experiment 7: Disease Treatment

Objective

To apply treatments for various diseases affecting fish and shellfish and evaluate their effectiveness.

Materials Required

1. Infected fish/shellfish specimens
2. Therapeutic drugs or chemicals (e.g., antibiotics, antifungals, antiparasitics)
3. Treatment tanks or tanks for controlled exposure
4. Monitoring tools (e.g., pH meter, dissolved oxygen meter)

Procedure

1. **Diagnosis Confirmation**:
    - Confirm the presence of disease using previously discussed diagnostic methods.
2. **Treatment Application**:
    - Administer the appropriate treatment (e.g., antibiotic bath for bacterial infection, salt bath for parasites).
3. **Effectiveness Monitoring**:
    - Monitor the health of treated fish or shellfish by observing changes in behavior, external appearance, and symptoms.
    - Measure environmental parameters (e.g., water quality) to ensure they are conducive to recovery.

Observations and Results

- Document the outcome of the treatment and its effectiveness.
- Discuss the potential side effects of treatments on fish and shellfish health and environmental impact.

BFSC-502: Fish Toxicology

Introduction

Fish toxicology is the study of the harmful effects of toxic substances on aquatic organisms, particularly fish and shellfish. This course provides an in-depth exploration of various toxicants, including heavy metals, chemicals, and mycotoxins, which can impact aquatic ecosystems. The laboratory exercises are designed to teach students how to detect and estimate the presence of toxic substances in aquatic environments and organisms, as well as assess their effects on fish health.

Experiment 1: Detection of Heavy Metal Poisoning

Objective

To identify and detect heavy metals (such as Arsenic, Antimony, Lead, Mercury, Zinc, etc.) in fish tissues or water samples using various chemical tests.

Materials Required

1. Fish tissue samples (e.g., liver, gills)
2. Water samples
3. Spot test kits for various metals
4. Chemical reagents for metal detection
5. Test tubes and pipettes
6. Protective equipment (gloves, goggles)

Procedure

1. **Sample Preparation**:
    - Obtain fish tissue samples or water samples suspected of containing heavy metals.
    - For fish tissues, homogenize the samples using a sterile blender or mortar and pestle.
2. **Spot Test for Metals**:
    - Conduct individual tests for each of the following metals: **Arsenic**, **Antimony**, **Lead**, **Mercury**, **Zinc**, **Barium**, **Iron (Fe3+)**, **Copper**.
    - Follow the protocol for each metal test using spot reagents. For example:
        - **Arsenic**: Add specific reagents to the sample, and observe color changes.
        - **Mercury**: Add a reagent that forms a precipitate in the presence of mercury.
        - **Zinc**: Add a reagent that forms a white precipitate with zinc ions.

3. **Group Reactions for Metal Detection**:
    - Conduct group tests where several metals are tested simultaneously in a single procedure.
    - Record color changes or precipitate formation as indicators of specific metals.
4. **Record Observations**:
    - Note the presence of heavy metals based on the chemical reactions and color changes observed in each test.

Observations and Results

- Record the presence or absence of each metal in the fish tissue or water sample.
- Discuss the possible health impacts of the identified metals on fish and their aquatic environment.

Experiment 2: Detection of Ammonia (NH_4^+) and Chloride (Cl^-) Ions

Objective

To detect and identify ammonia and chloride ions in water and fish tissue samples.

Materials Required

1. Water or fish tissue samples
2. Ammonia detection reagents
3. Chloride detection reagents
4. Test tubes, pipettes
5. Distilled water for dilution

Procedure

1. **Ammonia Detection**:
    - Add ammonia detection reagent (e.g., Nessler's reagent) to the sample.
    - Observe for a yellow or brown color change indicating the presence of ammonia (NH_4^+).
2. **Chloride Detection**:
    - Add a solution of silver nitrate to the sample.
    - If chloride ions are present, a white precipitate of silver chloride will form.
3. **Record Observations**:
    - Note the color changes or precipitate formations for both ammonia and chloride tests.

- Discuss the potential impact of these ions on fish health in polluted aquatic environments.

Observations and Results

- Record the presence of ammonia and chloride based on visual indicators.
- Analyze the implications of high levels of these substances in aquatic ecosystems.

Experiment 3: Detection of Phosphate (PO_4^{3-}) and Sulfate (SO_4^{2-}) Ions

Objective

To detect phosphate and sulfate ions in aquatic environments using qualitative tests.

Materials Required

1. Water samples
2. Phosphate detection reagent (e.g., ammonium molybdate)
3. Sulfate detection reagent (e.g., barium chloride)
4. Test tubes, pipettes
5. Distilled water

Procedure

1. **Phosphate Detection**:
   - Add ammonium molybdate solution to the sample.
   - Heat the mixture gently and observe for a yellow color formation, indicating the presence of phosphate ions (PO_4^{3-}).
2. **Sulfate Detection**:
   - Add a few drops of barium chloride solution to the sample.
   - A white precipitate of barium sulfate ($BaSO_4$) indicates the presence of sulfate ions (SO_4^{2-}).
3. **Record Observations**:
   - Record the color changes or precipitate formations.
   - Discuss the significance of phosphate and sulfate concentrations in aquatic systems, particularly regarding eutrophication.

Observations and Results

- Identify the presence of phosphate and sulfate based on color changes or precipitate formations.
- Discuss how elevated levels of these ions may affect aquatic ecosystems.

Experiment 4: Detection of Fluoride (F^-) and Nitrite/Nitrate (NO_2^- / NO_3^-)

Objective

To detect fluoride ions and nitrite/nitrate ions in water and fish samples.

Materials Required

1. Water samples
2. Fluoride detection reagent (e.g., zirconium alizarin reagent)
3. Nitrite/nitrate detection reagent
4. Test tubes, pipettes

Procedure

1. **Fluoride Detection**:
    - Add the zirconium alizarin reagent to the sample.
    - Observe a pink to purple color formation, which indicates the presence of fluoride ions (F^-).
2. **Nitrite and Nitrate Detection**:
    - Use a reagent such as Griess reagent to detect nitrites.
    - Nitrate ions can be detected by adding a reagent that forms a red color upon reduction to nitrite.
3. **Record Observations**:
    - Note any color changes indicating the presence of fluoride, nitrite, or nitrate.

Observations and Results

- Record the presence of fluoride, nitrite, or nitrate based on color changes.
- Discuss the potential toxic effects of these substances on fish and shellfish populations.

Experiment 5: Detection of Hydrocyanic Acid (HCN)

Objective

To detect the presence of hydrocyanic acid (HCN) in water and fish tissues.

Materials Required

1. Water or fish tissue samples
2. Hydrocyanic acid detection kit (e.g., Picrate paper or sodium picrate)
3. Test tubes, pipettes

Procedure

1. **Hydrocyanic Acid Detection**:
    - Add sodium picrate or other suitable reagents to the sample.
    - Observe for the appearance of a red or orange color, indicating the presence of cyanide ions (HCN).
2. **Record Observations**:
    - Note any color changes that indicate the presence of cyanide.

Observations and Results

- Identify the presence of hydrocyanic acid based on color formation.
- Discuss the toxicity of cyanide to aquatic organisms and the broader ecosystem.

Experiment 6: Estimation of Mycotoxins

Objective

To estimate the presence of mycotoxins in fish feed and tissues using qualitative tests.

Materials Required

1. Fish feed or tissue samples
2. Mycotoxin detection kit (e.g., ELISA test)
3. Reagents for mycotoxin detection
4. Pipettes, test tubes

Procedure

1. **Sample Preparation**:
    - Extract fish feed or tissue samples using an appropriate solvent.
2. **Test for Mycotoxins**:
    - Use an ELISA kit or another suitable method to detect the presence of mycotoxins in the sample.
3. **Record Observations**:
    - Record the concentration of mycotoxins present in the sample and compare it with safety limits.

Observations and Results

- Identify any positive results for mycotoxins and assess the potential health risks for fish.

Experiment 7: Detection of Alkaloids

Objective

To detect the presence of alkaloids in fish or shellfish tissues using qualitative chemical tests.

Materials Required

1. Fish or shellfish tissue samples
2. Alkaloid detection reagents (e.g., Dragendorff's reagent)
3. Test tubes, pipettes

Procedure

1. **Alkaloid Detection**:
    - Add Dragendorff's reagent or other suitable reagents to the sample.
    - A reddish-orange precipitate indicates the presence of alkaloids.
2. **Record Observations**:
    - Observe and record the appearance of any precipitates.

Observations and Results

- Discuss the significance of alkaloid contamination in aquatic species and its effects on fish health.

Experiment 8: Estimation of LD_{50} and ED_{50} – Demonstration of Drug Toxicity

Objective

To demonstrate the estimation of lethal dose (LD_{50}) and effective dose (ED_{50}) in fish.

Materials Required

1. Fish samples
2. Toxicant (drug or chemical)
3. Observation tanks
4. Recording sheet

Procedure

1. **Drug Application**:
    - Expose fish to different concentrations of a toxic substance and monitor their response.
2. **Observation**:

- Record the concentration at which 50% of the fish show signs of lethality (LD_{50}) or significant physiological response (ED_{50}).

3. **Record Results**:
   - Calculate the LD_{50} and ED_{50} values and discuss their significance.

Observations and Results

- Estimate the lethal and effective doses and interpret their significance in fish toxicology.

BFSC-503: Coastal Zone Management and Disaster Management

Introduction

Coastal Zone Management (CZM) focuses on the protection, preservation, and sustainable use of coastal areas. This course also covers the management of natural and man-made disasters in coastal regions, including disaster preparedness, response, and rehabilitation. Through field visits, case studies, and hands-on experience with techniques like GIS and remote sensing, students will gain practical knowledge on coastal ecosystem preservation and disaster management.

Field Visit 1: Study of Coastal Erosion

Objective

To understand the causes and impacts of coastal erosion and identify measures for beach conservation.

Materials Required

1. Notebook and camera for field observations
2. Measuring tapes for shoreline distance measurement
3. Topographical maps of the area
4. GPS device for location tracking

Procedure

1. **Visit the Coastal Area**:
    - Visit a coastal area where erosion is observed. This could be a sandy beach, cliff, or estuary.
    - Use GPS and maps to record the specific location.
    - Measure the extent of shoreline erosion by comparing current shoreline position with historical data.
2. **Identify Causes of Erosion**:
    - Look for natural causes of erosion (storms, tidal waves, etc.).
    - Identify human activities contributing to erosion (construction, sand mining, etc.).
3. **Observe Protection Measures**:
    - Identify any existing erosion control measures (sea walls, sand dune restoration, mangrove planting).
    - Evaluate their effectiveness.
4. **Document and Discuss**:

- Take photographs and notes to document the conditions and possible solutions to mitigate coastal erosion.

Observations and Results

- Discuss the observed types of erosion, causes, and potential methods for protecting the coastal area (e.g., vegetation planting, artificial barriers).

Field Visit 2: Identification of Ecologically Sensitive Areas (ESAs)

Objective

To identify and assess ecologically sensitive areas along the coast that require protection due to their biodiversity or environmental importance.

Materials Required

1. Field guide for coastal flora and fauna
2. GPS device and maps
3. Camera for documentation
4. Binoculars for birdwatching (if applicable)

Procedure

1. **Survey Coastal Areas**:
   - Visit various coastal ecosystems, such as wetlands, mangroves, coral reefs, or seagrass beds.
   - Use GPS and topographical maps to identify ecologically sensitive areas.
   - Observe the species diversity in the identified areas.
2. **Assess Environmental Impact**:
   - Note human activities around the area (tourism, fishing, urbanization) and their impact on the ecosystem.
   - Identify any species at risk or in danger due to habitat destruction.
3. **Identify Protection Needs**:
   - Discuss potential measures for protecting these sensitive areas (protected area designations, sustainable management practices).

Observations and Results

- Document the types of ecosystems identified, their ecological importance, and the threats they face.
- Discuss conservation strategies to protect the ecologically sensitive areas.

Field Visit 3: Study of CRZ (Coastal Regulation Zone) and ICZM (Integrated Coastal Zone Management)

Objective

To understand the Coastal Regulation Zone (CRZ) guidelines and their implementation along the coastal belt, as well as the principles of Integrated Coastal Zone Management (ICZM).

Materials Required

1. CRZ maps and guidelines
2. GPS device
3. Notebooks for recording observations
4. Government publications or reports on CRZ implementation

Procedure

1. **Visit CRZ Areas**:
    - Identify a coastal area regulated by CRZ guidelines. This could involve visiting zones that have restrictions on construction, industrial activities, or tourism.
    - Use GPS to record specific locations of the CRZ areas.
2. **Study CRZ Implementation**:
    - Discuss the CRZ classification system (CRZ-I, CRZ-II, CRZ-III, and CRZ-IV) and what is permissible in each zone.
    - Evaluate the impact of human activities in CRZ areas and the role of government enforcement in regulating these zones.
3. **Understand ICZM**:
    - Observe the use of integrated coastal zone management strategies (sustainable resource use, habitat protection, and community involvement).
    - Take note of successful or unsuccessful examples of ICZM implementation in the area.

Observations and Results

- Record the adherence to CRZ guidelines and the effectiveness of ICZM in managing coastal resources and protecting sensitive areas.
- Discuss how violations of CRZ impact coastal ecosystems and community livelihoods.

Lab Exercise 1: Application of Remote Sensing and GIS in Coastal Management

Objective

To demonstrate the application of remote sensing and GIS technology in mapping and managing coastal areas.

Materials Required

1. Remote sensing satellite images (for coastal areas)
2. GIS software (e.g., ArcGIS, QGIS)
3. Computer for data analysis
4. Coastal maps

Procedure

1. **Obtain Satellite Images**:
    - Use remote sensing images (satellite or aerial) to analyze coastal areas. These images can show land use, vegetation cover, and erosion patterns.
2. **Use GIS Software**:
    - Import the satellite images into GIS software.
    - Digitize and map coastal zones, identifying key areas of interest like beaches, mangroves, and coral reefs.
    - Analyze environmental changes over time, such as coastal erosion or habitat loss.
3. **Prepare Data for Analysis**:
    - Create thematic maps to highlight important ecological or socio-economic features (e.g., fishing zones, protected areas, urban development).
    - Analyze the spatial distribution of environmental problems such as pollution or habitat degradation.

Observations and Results

- Discuss how GIS and remote sensing help in effective coastal zone management by providing spatial data for planning and decision-making.

Lab Exercise 2: Project Preparation for Environmental Impact Assessment (EIA)

Objective

To prepare an Environmental Impact Assessment (EIA) for a proposed development project along the coast.

Materials Required

1. EIA guidelines and templates
2. Data on proposed development project (e.g., tourism, industry, infrastructure)
3. Environmental data (water quality, species diversity, etc.)
4. Computer and software for report preparation

Procedure

1. **Collect Baseline Data**:
    - Gather information on the current state of the coastal area, including environmental, social, and economic factors.
    - Identify the potential impacts of the proposed project (e.g., construction of a hotel, factory, or marina) on the environment.
2. **Impact Prediction**:
    - Predict the potential impacts of the project on coastal ecosystems, local communities, and biodiversity.
    - Use available data (e.g., water quality, land use patterns) to estimate short-term and long-term impacts.
3. **Mitigation Measures**:
    - Suggest mitigation measures to minimize the environmental impacts, such as pollution control, habitat restoration, or sustainable resource use.
4. **Prepare EIA Report**:
    - Write a detailed EIA report, following the guidelines for environmental impact prediction and mitigation.
    - Present the findings to stakeholders and the community.

Observations and Results

- Discuss the importance of conducting EIAs for coastal development projects and the role of EIA in sustainable coastal zone management.

Disaster Management: Preparedness, Response, and Rehabilitation

Objective

To learn and practice effective strategies for disaster preparedness, response, and rehabilitation in coastal areas.

Materials Required

1. Disaster management plan templates
2. First aid kits
3. Firefighting equipment
4. Communication devices (e.g., radios, mobile phones)
5. Lifesaving appliances (e.g., life jackets, life buoys)

Procedure

1. **Pre-Disaster Preparedness**:
    - Learn about disaster preparedness plans for coastal areas prone to natural disasters such as tsunamis, cyclones, and floods.
    - Study evacuation routes, early warning systems, and community awareness programs.
2. **During Disaster**:
    - Familiarize yourself with emergency procedures and communication channels during a disaster (e.g., distress signals, evacuation).
3. **Post-Disaster Response and Rehabilitation**:
    - Learn how to provide immediate relief (first aid, shelter, food) during a disaster.
    - Study long-term rehabilitation measures, such as trauma counseling, rebuilding communities, and ecosystem restoration.
4. **Field Practice**:
    - Participate in mock disaster drills and practice emergency response techniques (e.g., fire-fighting, using life-saving appliances).

Observations and Results

- Discuss the importance of disaster management in coastal zones and the role of preparedness, effective response, and rehabilitation in minimizing the impact of disasters.

BFSC-504: Coastal Aquaculture and Mariculture

Introduction

Coastal aquaculture and mariculture focus on cultivating aquatic organisms such as fish, shellfish, and seaweed in coastal and marine environments. This course provides practical skills in species identification, seed collection, pond preparation, water quality management, and growth monitoring. Students will also gain hands-on experience with aquaculture equipment and techniques for maintaining healthy and productive marine farms.

Lab Exercise 1: Identification of Important Cultivable Species

Objective

To identify and categorize commercially important fish and shellfish species for coastal aquaculture and mariculture.

Materials Required

1. Fish and shellfish identification guide
2. Field notebook and pen
3. Magnifying glass for examining specimens
4. Digital camera for documenting specimens
5. Field samples of local fish and shellfish (if available)

Procedure

1. **Collection of Species**:
    - Visit a local coastal aquaculture farm or collection point to obtain samples of various fish and shellfish species.
    - Collect samples of common species used in coastal aquaculture, such as prawns, tilapia, mussels, oysters, and seaweed.
2. **Identification**:
    - Use the fish and shellfish identification guide to determine the species of the collected samples.
    - Record the key identification features, such as body shape, color, and size for each species.
3. **Documentation**:
    - Take clear photographs of each species and record their scientific names, common names, and any notable characteristics in your field notebook.

Observations and Results

- List the identified species and provide a brief description of each, including their habitat, size, and commercial significance in coastal aquaculture.

Lab Exercise 2: Collection and Identification of Seed

Objective

To collect and identify commercially important seeds of fish and shellfish species for aquaculture.

Materials Required

1. Collection nets or traps for larvae or juvenile fish
2. Identification guide for fish larvae and juvenile shellfish
3. Microscope (for observing larvae)
4. Aquarium tanks for temporary storage of seed
5. Field notebook and camera for documentation

Procedure

1. **Collection of Seed**:
    - Use nets or traps to collect fish larvae or juvenile shellfish (seed) from coastal waters or aquaculture hatcheries.
    - If possible, visit a hatchery to observe the collection of seed directly from rearing tanks.
2. **Identification**:
    - Examine the collected seed using a microscope or magnifying glass to identify their species.
    - Record the physical characteristics of the seed, such as size, color, and body shape.
3. **Documentation**:
    - Note the species, quality of the seed, and any observations related to their health or condition.
    - Take photographs of the seed to document their appearance.

Observations and Results

- List the species of seed identified and document their potential for cultivation in coastal aquaculture.
- Assess the quality and viability of the seed for future aquaculture activities.

Lab Exercise 3: Pond Preparation and Fertilization

Objective

To understand the preparation of ponds for aquaculture, including the use of fertilizers to enhance water quality and promote healthy growth.

Materials Required

1. Organic and inorganic fertilizers (e.g., urea, superphosphate, manure)
2. Pond water samples
3. pH, ammonia, and dissolved oxygen meters
4. Pond preparation guide
5. Measuring spoons and scales for fertilizers

Procedure

1. **Preparation of Pond**:
    - Choose a test pond or tank to simulate pond preparation.
    - Clean the pond by removing any debris or unwanted vegetation.
    - Level the bottom of the pond to ensure even water distribution.
2. **Fertilization**:
    - Based on the soil and water conditions, choose the appropriate fertilizers (e.g., urea, superphosphate, manure) to add nutrients to the pond.
    - Measure and add the required amount of fertilizer to the pond to improve soil fertility and promote plankton growth.
3. **Water Quality Monitoring**:
    - Use water quality testing kits to monitor the pH, ammonia levels, and dissolved oxygen before and after fertilization.
    - Record the changes in water quality parameters over time.

Observations and Results

- Document the changes in water quality after fertilization.
- Discuss the role of fertilization in enhancing primary productivity and maintaining water quality for aquaculture.

Lab Exercise 4: Seed Selection, Acclimatization, and Quality Assessment

Objective

To assess the quality of seed and perform acclimatization before stocking in aquaculture ponds.

Materials Required

1. Water quality testing kits (pH, salinity, temperature)
2. Seed samples from various species
3. Acclimatization tanks or ponds
4. Oxygenation equipment (e.g., aerators)
5. Microscope for assessing seed health

Procedure

1. **Seed Selection**:
    - Select high-quality seed based on their size, health, and appearance.
    - Ensure that the seed is free from visible diseases or parasites.
2. **Acclimatization**:
    - Place the selected seed in a separate acclimatization tank or pond.
    - Gradually adjust the water parameters (temperature, salinity) to match those of the stocking pond.
3. **Health Assessment**:
    - Examine the seed under the microscope for any signs of diseases or parasites.
    - Record any abnormalities observed in the seed.

Observations and Results

- Document the quality of the seed selected and the acclimatization process.
- Report any observed health issues and suggest potential treatments or preventive measures.

Lab Exercise 5: Water Quality Parameters and Seed Survival Estimation

Objective

To monitor key water quality parameters and estimate seed survival rates in aquaculture ponds.

Materials Required

1. Water quality testing kits (for pH, salinity, temperature, dissolved oxygen, ammonia, nitrate)
2. Seed samples
3. Survival rate calculation formula
4. Notebook and pen

Procedure

1. **Monitoring Water Quality**:
    - Use water quality testing kits to measure pH, salinity, temperature, dissolved oxygen, ammonia, and nitrate levels in the pond.
    - Record the results and compare them with the ideal water quality ranges for the selected species.
2. **Estimating Seed Survival**:
    - Count the number of surviving seeds at regular intervals (e.g., weekly).
    - Use the following formula to estimate the survival rate:

$$\text{Survival Rate}(\%) = \frac{\text{Number of Surviving Seed}}{\text{Total Number of Seed Stocked}} \times 100$$

3. **Assessing Growth**:
    - Measure the growth rate of the seed periodically (length, weight) to monitor their development.

Observations and Results

- Calculate the seed survival rate and discuss the factors affecting survival, such as water quality, feed, and acclimatization.
- Analyze growth rates and suggest possible improvements in management practices.

Lab Exercise 6: Biomass Estimation and Feed Intake Monitoring

Objective

To estimate pond biomass and monitor feed intake to ensure efficient growth and productivity.

Materials Required

1. Feed samples
2. Feed distribution equipment (e.g., feeders)
3. Biomass estimation tools (scales, measuring tapes)
4. Notebook for recording feed intake

Procedure

1. **Estimating Biomass**:
    - Measure the size and weight of fish or shellfish in different ponds to estimate the total biomass.
    - Use appropriate sampling techniques (e.g., random sampling) to calculate the biomass in the pond.
2. **Feed Intake Monitoring**:

- Distribute feed evenly to the stocked fish or shellfish.
- Monitor feed intake by measuring the amount of feed provided and the amount consumed over a set period.

3. **Growth Monitoring**:
    - Regularly monitor the growth rate of the species by measuring their size and weight.

Observations and Results

- Calculate the biomass of the stocked species and analyze the feed conversion efficiency.
- Discuss the relationship between feed intake, growth, and water quality.

Lab Exercise 7: Fouling Organisms in Cages and Pens

Objective

To identify and manage fouling organisms in mariculture systems, such as cages and pens.

Materials Required

1. Water samples from mariculture cages or pens
2. Microscope for examining fouling organisms
3. Collection nets or brushes for removing fouling organisms
4. Cleaning tools (scrapers, brushes)

Procedure

1. **Identification of Fouling Organisms**:
    - Collect samples of fouling organisms from mariculture cages or pens.
    - Use a microscope to identify common fouling species such as barnacles, mussels, algae, and biofilm.
2. **Control and Management**:
    - Discuss methods for controlling fouling organisms, such as cleaning schedules, anti-fouling coatings, and the use of cleaner fish.
3. **Monitoring Fouling**:
    - Regularly monitor the level of fouling and assess its impact on water quality and fish health.

Observations and Results

- Identify common fouling organisms and suggest control strategies.
- Discuss the effect of fouling on mariculture systems and the measures to maintain optimal conditions for fish growth.

BFSC-506: Marine Fisheries

Introduction

Marine fisheries play a crucial role in global food security, providing livelihoods for millions and supplying a significant portion of the world's seafood. This course focuses on understanding marine fisheries through field observations, data collection, and analysis of catches from major fishing crafts and gears. It also explores the use of GIS (Geographical Information Systems) and remote sensing technologies in the management and monitoring of marine capture fisheries.

Lab Exercise 1: Visit to Fish Landing Centers

Objective

To observe and analyze the types of fish, crustaceans, molluscs, and other marine organisms landed at fish landing centers and study the operational dynamics of these centers.

Materials Required

1. Notebook and pen for data recording
2. Camera for documenting catches and operations
3. Field guide for species identification (if available)
4. GPS device (optional, for location mapping)

Procedure

1. **Visit the Fish Landing Center**:
    - Visit a local fish landing center to observe the operations and types of catches.
    - Engage with the fishers and fishmongers to understand the processes involved in landing, sorting, and selling the catches.
2. **Species Identification and Record Keeping**:
    - Identify the species of fish, crustaceans, molluscs, and seaweeds landed at the center.
    - Record the following data for each species:
        - Common name and scientific name
        - Quantity landed (in kilograms or number of specimens)
        - Size and weight (for key species)
        - Condition of the catch (e.g., fresh, frozen, or spoiled)
3. **Analysis of Catch Composition**:
    - Analyze the composition of the catch (e.g., percentage of fish, crustaceans, molluscs, etc.).

- Discuss the seasonal variations in catch and any trends or shifts observed over time.

Observations and Results

- Document the species identified and their abundance.
- Discuss the commercial significance of the species observed and any challenges faced by the fishers in terms of sustainable harvesting.

Lab Exercise 2: Observation and Analysis of Catches by Major Crafts and Gears

Objective

To observe and analyze the fishing gear and crafts used in marine fisheries, and to understand how these influence catch composition and fishery sustainability.

Materials Required

1. Field guide on fishing gears
2. Notebook and pen for recording data
3. Camera for documenting different crafts and gears
4. GPS device (optional)

Procedure

1. **Identification of Fishing Crafts and Gears**:
    - Observe the fishing crafts (e.g., trawlers, boats, canoes) used at the landing center and during fishing cruises.
    - Identify the different types of fishing gears being used (e.g., nets, lines, traps, dredges).
2. **Catch Analysis**:
    - Document the catches obtained from different crafts and gears.
    - Record the type of gear used, the species caught, and the quantity of each species.
3. **Impact Assessment**:
    - Discuss the efficiency of different gears in terms of catch rates.
    - Consider the potential environmental impact of different fishing methods, focusing on bycatch, overfishing, and sustainability.

Observations and Results

- Provide a detailed account of the types of crafts and gears used in marine fisheries.

- Analyze the efficiency and sustainability of these methods in relation to the fish caught and environmental concerns.

Lab Exercise 3: Field Collection of Marine Species (Fishes, Crustaceans, Molluscs, and Seaweeds)

Objective

To collect marine species such as fish, crustaceans, molluscs, and seaweeds from the marine environment for further analysis.

Materials Required

1. Collection nets or traps for fish and invertebrates
2. Containers or bags for storing specimens
3. Field guide for species identification
4. Measuring tape or scale for recording size
5. Camera for documenting specimens

Procedure

1. **Collection of Species**:
    - Collect fish, crustaceans, molluscs, and seaweeds using appropriate collection methods (e.g., hand nets, traps, or diving).
    - Ensure that the specimens are handled carefully to avoid damage.
2. **Identification**:
    - Use a species identification guide to determine the names of the collected organisms.
    - Measure the size and weight of key specimens, and record any distinguishing features (e.g., color, patterns, or shell structure).
3. **Storage and Documentation**:
    - Store the collected specimens in containers to prevent spoilage, and document their collection locations and conditions.

Observations and Results

- Record the species collected, along with their sizes, weights, and any notable features.
- Discuss the ecological roles of these species in the marine ecosystem and their potential for commercial harvesting.

Lab Exercise 4: GIS and Remote Sensing in Marine Capture Fisheries

Objective

To understand how GIS and remote sensing technologies are applied in the management of marine capture fisheries, particularly in resource mapping and monitoring.

Materials Required

1. GIS software (e.g., ArcGIS, QGIS)
2. Remote sensing data (satellite imagery or aerial photos)
3. Laptop with GIS software installed
4. GPS coordinates for field data (if available)

Procedure

1. **Introduction to GIS and Remote Sensing**:
    - Discuss the basic concepts of GIS and remote sensing, focusing on their applications in marine fisheries.
    - Learn how satellite images and GPS data can be used to map fishing grounds, monitor fish stocks, and assess environmental changes.
2. **Application of GIS in Marine Fisheries**:
    - Use GIS software to analyze maps and spatial data related to marine fisheries, such as fishing zones, migration patterns, and marine habitats.
    - Input real-world data (e.g., GPS coordinates) into the software to visualize the data on the map.
3. **Remote Sensing Data Analysis**:
    - Download and interpret remote sensing images related to sea surface temperature, chlorophyll concentration, and fishing activity.
    - Use the data to assess potential fishing areas and their sustainability based on environmental conditions.

Observations and Results

- Present the GIS-based maps showing the distribution of marine species, fishing zones, or environmental conditions.
- Discuss how remote sensing and GIS technologies aid in sustainable fisheries management by providing real-time data for decision-making.

Lab Exercise 5: Participation in Fishing Cruises

Objective

To participate in a fishing cruise to observe real-world fishing operations, catch assessment, and resource management in the marine environment.

Materials Required

1. Field notebook and pen for recording observations
2. Camera for documenting the fishing process
3. Safety equipment (life jackets, gloves, etc.)

Procedure

1. **Participating in the Fishing Cruise**:
    - Join a research or commercial fishing cruise to observe the operations onboard, including fishing methods, catch processing, and data collection.
    - Take note of the fishing techniques used, the crew's activities, and any environmental challenges encountered during the cruise.
2. **Catch Assessment**:
    - Assist in the collection of catch data, including the types of fish and other marine organisms, as well as their sizes and weights.
    - Discuss the challenges faced during the cruise, such as weather conditions, bycatch, or gear malfunctions.

Observations and Results

- Record your observations during the fishing cruise, focusing on the practical aspects of marine fishing operations.
- Evaluate the sustainability of the fishing methods used during the cruise, considering both ecological and economic factors.

BFSC-507: Fish Packaging Technology

Introduction

Packaging plays a critical role in ensuring the quality, safety, and shelf-life of fish and fishery products. The application of appropriate packaging materials and techniques can significantly impact the preservation and marketability of fish products. This lab focuses on determining the physical properties of various packaging materials, including paper, board, and plastic films, and evaluating their suitability for packaging fish products. It also includes the evaluation of retort pouches, a common packaging material for processed fish.

Lab Exercise 1: Determination of Grammage of Paper and Board

Objective

To determine the grammage (weight per unit area) of paper and board used in fish packaging.

Materials Required

- Paper or board samples
- Precision balance
- Ruler or caliper
- Calculator

Procedure

1. **Weighing the Sample**:
    - Cut a sample of the paper or board to a known size (typically 100 cm^2).
    - Weigh the sample using a precision balance to determine its mass (in grams).
2. **Calculation**:
    - Use the formula:

$$\text{Grammage } (g/m^2) = \left(\frac{\text{Mass of sample } (g)}{\text{Area of sample } (cm^2)} \right) \times 100$$

    - **Observations and Results**

- Record the grammage for each sample tested.
- Discuss the impact of grammage on the durability and performance of packaging materials.

Lab Exercise 2: Determination of Bursting Strength and Burst Factor

Objective

To determine the bursting strength and burst factor of paper and board materials used for packaging.

Materials Required

- Bursting strength tester
- Paper or board samples
- Ruler for measuring sample dimensions

Procedure

1. **Testing Bursting Strength**:
    - Prepare the sample of paper or board according to the tester's specifications.
    - Place the sample in the bursting strength tester, ensuring it is centered properly.
    - Activate the tester to apply pressure until the paper bursts, and record the bursting strength in kPa.
2. **Calculation of Burst Factor**:
    - Calculate the burst factor using the formula:

$$\text{Burst Factor} = \frac{\text{Bursting Strength (kPa)}}{\text{Grammage (g/m}^2\text{)}}$$

Observations and Results

- Record the bursting strength and burst factor for each sample tested.
- Discuss how bursting strength affects the integrity of fish packaging materials under pressure.

Lab Exercise 3: Puncture Resistance Test

Objective

To measure the puncture resistance of paper, board, and plastic films used in fish packaging.

Materials Required

- Puncture resistance tester
- Paper, board, or plastic film samples
- Ruler to measure sample size

Procedure

1. **Testing Puncture Resistance**:
    - Prepare the sample by placing it in the puncture resistance tester.
    - Apply force gradually until the sample is punctured, and record the puncture resistance (in Newtons).

Observations and Results

- Record the puncture resistance for each sample.
- Evaluate the suitability of different materials based on their resistance to puncture, which is crucial for packaging fish to prevent damage during handling and transportation.

Lab Exercise 4: Water Proofness Test

Objective

To evaluate the waterproofness of paper and board materials used for fish packaging.

Materials Required

- Water-proofness tester or water container
- Paper or board samples

Procedure

1. **Testing Waterproofness**:
    - Immerse the paper or board sample in water for a specified time (usually 24 hours).
    - Check for any signs of water penetration or degradation.
    - Evaluate the sample based on the degree of water absorption or failure.

Observations and Results

- Record the waterproofness of each sample.
- Discuss the importance of waterproofing in fish packaging, particularly for maintaining freshness and preventing spoilage during storage and transit.

Lab Exercise 5: Tensile Strength and Elongation at Break of Plastic Films

Objective

To measure the tensile strength and elongation at break of plastic films used in fish packaging.

Materials Required

- Tensile strength testing machine

- Plastic film samples
- Ruler or caliper for measuring sample dimensions

Procedure

1. **Tensile Strength Testing**:
    - Cut plastic film samples to the appropriate dimensions (typically rectangular).
    - Place the sample in the tensile strength tester and apply force until the film breaks.
    - Record the maximum tensile strength and elongation at break values.
2. **Calculation**:
    - Calculate the tensile strength (in MPa) and elongation at break (as a percentage).

Observations and Results

- Record the tensile strength and elongation at break values for each sample.
- Discuss how the tensile properties of plastic films affect the durability and flexibility of packaging for fish products.

Lab Exercise 6: Evaluation of Retort Pouch

Objective

To evaluate the properties and suitability of retort pouches as packaging materials for fish and other seafood products.

Materials Required

- Retort pouch samples
- Heat-sealing equipment
- Tensile strength tester
- Heat seal tester
- Gas permeability tester (optional)

Procedure

1. **Examine the Material**:
    - Inspect the retort pouch for its construction (multi-layer structure) and overall integrity.
    - Test the heat seal strength by applying heat-sealing equipment to the edges of the pouch and determining the strength of the seal.
2. **Tensile Strength Testing**:

   - Conduct a tensile test on the retort pouch to assess its strength.

3. **Gas Permeability Testing**:
   - Test for water vapor and oxygen transmission rates by using a permeability tester.

Observations and Results

- Record the heat seal strength, tensile strength, and gas transmission rates for the retort pouches.
- Discuss the advantages and disadvantages of retort pouches in comparison to other packaging materials for fish, considering factors such as shelf-life, convenience, and environmental impact.

Lab Exercise 7: Identification of Plastic Films

Objective

To identify different types of plastic films commonly used in fish packaging based on their physical properties.

Materials Required

- Various samples of plastic films
- Identification guide or reference book

Procedure

1. **Visual Inspection**:
   - Inspect the samples for their appearance, thickness, and flexibility.
2. **Physical Property Testing**:
   - Test properties such as tearing strength, impact resistance, and water vapor transmission.
3. **Identification**:
   - Identify each sample based on its characteristics and compare it with known plastic films used in food packaging.

Observations and Results

- Record the identification of each plastic film.
- Discuss the properties that make certain types of plastic films suitable for packaging fish and other perishable goods.

BFSC-508: Fish By-Products and Waste Utilization

Introduction

Fish processing generates a wide variety of by-products and waste, many of which can be utilized in various industries, including food, pharmaceuticals, agriculture, and cosmetics. The utilization of fish by-products helps to reduce waste and add economic value to the fishery sector. This lab will focus on the preparation of various fish by-products, including fish meal, fish body oil, fish liver oil, fish silage, chitin, chitosan, and more. The processes involved in the preparation of these products are essential for understanding the full potential of fish resources and their environmental and economic benefits.

Lab Exercise 1: Preparation of Fish Meal

Objective

To prepare fish meal from fish waste and learn its applications in animal feed.

Materials Required

- Fish waste (heads, bones, offal, etc.)
- Drying oven or sun-drying area
- Grinder or hammer mill
- Sifter or sieve
- Weighing balance

Procedure

1. **Cleaning and Preprocessing**:
    - Clean the fish waste thoroughly to remove any extraneous materials like scales and dirt.
    - Steam or cook the waste to extract moisture and fat.
2. **Drying**:
    - Dry the processed fish waste using a drying oven at 60–70°C or by sun-drying until the moisture content is below 10%.
3. **Grinding**:
    - Grind the dried waste into a fine powder using a grinder or hammer mill.
4. **Sieving**:
    - Sift the ground product to obtain uniform fish meal particles.

Observations and Results

- Record the yield of fish meal obtained and discuss the potential applications of fish meal in animal and poultry feed.

Lab Exercise 2: Extraction of Fish Body Oil

Objective

To extract fish body oil and understand its uses in industries such as pharmaceuticals and cosmetics.

Materials Required

- Fish body tissue (such as fillets or scraps)
- Oil extraction equipment (cold press or solvent extraction)
- Heater (if using solvent extraction)
- Separation funnel or centrifuge
- Weighing balance

Procedure

1. **Preparation**:
    - Cut the fish body tissue into small pieces and place them in the oil extraction device.
2. **Extraction**:
    - For cold pressing: Use a cold press to squeeze the oil out of the fish tissue.
    - For solvent extraction: Add a solvent (such as hexane) and heat the mixture to extract the oil. Use a separation funnel to separate the oil from the solvent.
3. **Purification**:
    - Purify the oil by filtering or centrifuging to remove solid impurities.

Observations and Results

- Record the quantity and quality of fish body oil obtained.
- Discuss the applications of fish body oil in the production of omega-3 fatty acids, pharmaceuticals, and cosmetics.

Lab Exercise 3: Extraction of Fish Liver Oil

Objective

To extract fish liver oil and understand its nutritional and medicinal applications.

Materials Required

- Fish liver
- Oil extraction equipment (cold press or solvent extraction)

- Heater (if using solvent extraction)
- Separation funnel or centrifuge
- Weighing balance

Procedure

1. **Preparation**:
    - Clean the fish liver and place it in the extraction equipment.
2. **Extraction**:
    - For cold pressing: Extract the oil using a cold press.
    - For solvent extraction: Use a solvent (such as hexane) to extract the oil.
3. **Purification**:
    - Filter or centrifuge the extracted oil to remove any solid particles.

Observations and Results

- Record the yield of fish liver oil and discuss its applications in the food and pharmaceutical industries, particularly for vitamin A and omega-3 fatty acid production.

Lab Exercise 4: Preparation of Fish Silage

Objective

To prepare fish silage, a fermented product made from fish waste, and understand its use in agriculture.

Materials Required

- Fish waste (offal, heads, bones, etc.)
- Acid (formic acid or lactic acid)
- Plastic containers or fermentation tanks
- Mixing rod

Procedure

1. **Preparation of Fish Waste**:
    - Clean and chop the fish waste into small pieces.
2. **Acidification**:
    - Add acid (formic acid or lactic acid) to the fish waste in a plastic container or fermentation tank. Mix thoroughly.
3. **Fermentation**:

   - Seal the container and allow it to ferment for 2-3 weeks at room temperature. Monitor the pH and temperature during fermentation.

4. **Harvesting**:
   - After fermentation, the fish silage can be used as fertilizer or animal feed supplement.

Observations and Results

- Record the characteristics of the fish silage produced.
- Discuss its application as a soil fertilizer and animal feed additive.

Lab Exercise 5: Preparation of Fish Protein Concentrate

Objective

To prepare fish protein concentrate (FPC) from fish waste.

Materials Required

- Fish waste (heads, bones, skin, etc.)
- Acid (e.g., hydrochloric acid)
- Separation equipment (centrifuge, filter)
- Drying equipment (freeze dryer or oven)

Procedure

1. **Preparation**:
   - Clean the fish waste and grind it into a fine paste.
2. **Acid Extraction**:
   - Mix the fish paste with a dilute acid solution (e.g., hydrochloric acid) to extract protein.
3. **Separation**:
   - Use a centrifuge or filtration to separate the protein concentrate from the waste material.
4. **Drying**:
   - Dry the protein concentrate using a freeze dryer or oven at low temperatures to preserve the protein content.

Observations and Results

- Record the yield and quality of the fish protein concentrate.
- Discuss its uses in the production of high-protein feed for animals and aquaculture.

Lab Exercise 6: Preparation of Fish Hydrolysate

Objective

To prepare fish hydrolysate, a liquid protein source, from fish waste.

Materials Required

- Fish waste (scraps, heads, bones)
- Enzymes (e.g., proteases) or acid
- Water
- Heating equipment
- Separation equipment (centrifuge, filter)

Procedure

1. **Preparation**:
    - Clean and grind the fish waste.
2. **Hydrolysis**:
    - Add water and enzymes (or acid) to the fish waste and heat the mixture to promote hydrolysis of proteins.
3. **Separation**:
    - After hydrolysis, separate the liquid portion using centrifugation or filtration.
4. **Concentration**:
    - Concentrate the liquid using evaporation or freeze-drying.

Observations and Results

- Record the yield and properties of the fish hydrolysate.
- Discuss its potential use as a high-quality fertilizer, feed additive, or food ingredient.

Lab Exercise 7: Preparation of Chitin and Chitosan

Objective

To prepare chitin and chitosan from fish shells and understand their applications.

Materials Required

- Fish shells (such as shrimp or crab shells)
- Sodium hydroxide (NaOH)
- Acetic acid

- Hot water bath
- Filtering equipment

Procedure

1. **Chitin Extraction**:
    - Clean the fish shells and remove any remaining flesh.
    - Treat the shells with a dilute NaOH solution to demineralize them, then rinse and dry to obtain chitin.
2. **Chitosan Conversion**:
    - Deacetylate the chitin by treating it with concentrated NaOH to convert it into chitosan.

Observations and Results

- Record the yield of chitin and chitosan and discuss their applications in biomedical, agricultural, and industrial fields.

BFSC-509: Fishing Gear Technology

Introduction

Fishing gear technology is a critical aspect of the fishing industry, focusing on the design, construction, and maintenance of tools used for catching fish. This lab manual will cover the various methods involved in net making, such as hand braiding, shaping, tailoring, and mounting. It also introduces the different types of knots, hitches, and net mounting techniques required to ensure the strength, efficiency, and durability of fishing nets.

Lab Exercise 1: Study of Net Making Tools

Objective

To familiarize students with the various tools used in net making.

Materials Required

- Scissors
- Needles (heavy-duty)
- Shuttles (for braiding)
- Twine (nylon, cotton, or polyester)
- Spools and bobbins

Procedure

1. **Examine Tools**: Discuss each of the tools listed above, their functions, and how they contribute to the process of making fishing nets.
2. **Demonstration**: Show how tools like needles and shuttles are used in different parts of the net-making process (e.g., hand braiding and looping).
3. **Handling of Materials**: Demonstrate the proper handling of twine and bobbins.

Observations and Results

- Understand the significance of each tool in creating efficient fishing nets.
- Learn how tool selection influences net strength, durability, and overall performance.

Lab Exercise 2: Knots and Hitches Used in Net Making

Objective

To learn and practice various knots and hitches used in net making.

Materials Required

- Nylon twine or rope

- Scissors
- Netting needles

Procedure

1. **Common Knots**:
    - **Overhand Knot**: Used for securing the end of the twine.
    - **Reef Knot**: Used for joining two ropes of the same thickness.
    - **Bowline Knot**: Used for creating loops at the end of twine.
2. **Hitches**:
    - **Clove Hitch**: Used for fastening the net to the framework.
    - **Round Turn and Two Half Hitches**: Commonly used for securing lines to poles or other structures.
3. **Practice**:
    - Tie the knots and hitches on twine, ensuring tightness and security.

Observations and Results

- Learn how each knot serves a different function in securing or joining parts of the net.
- Understand how these knots contribute to the overall functionality and strength of the net.

Lab Exercise 3: Methods of Net Making - Hand Braiding

Objective

To practice hand braiding using the chain mesh and loop methods of net making.

Materials Required

- Twine (Nylon or Cotton)
- Netting needles
- Ruler or measuring tape

Procedure

1. **Chain Mesh Method**:
    - Start by tying the first knot and then weave the twine in a repetitive chain pattern to form the mesh.
    - Ensure that the loops are uniform in size.
2. **Loop Method**:

- In the loop method, create individual loops that are linked together, forming a net structure.
- After tying the first loop, continue to form the remaining loops with equal tension.

3. **Practice**:
    - Continue braiding until a section of net is completed, observing the consistency of the mesh.

Observations and Results

- Understand the differences between the chain mesh and loop methods.
- Learn how to control loop size and mesh consistency to create an effective fishing net.

Lab Exercise 4: Shaping of Webbing - Baiting, Creasing, and Reducing Mesh Size

Objective

To learn and practice the techniques of shaping webbing for net making.

Materials Required

- Twine (Nylon or Cotton)
- Netting frame or hoop
- Scissors

Procedure

1. **Baiting**:
    - This method involves adjusting the tension of the twine to create uniform mesh sizes.
2. **Creasing**:
    - Crease the webbing in a way that alters the shape of the mesh for specific fishing needs (e.g., for targeting specific fish species).
3. **Reducing Mesh Size**:
    - Gradually reduce the size of the mesh by adjusting the knots or loops step by step. This is particularly important for creating nets that can trap smaller fish.

Observations and Results

- Understand the importance of webbing shape in optimizing fishing performance.
- Learn how mesh size and tension influence fish capture efficiency.

Lab Exercise 5: Tailoring Methods – T and N Direction of Webbing

Objective

To learn and practice the tailoring methods used in net making.

Materials Required

- Twine (Nylon or Cotton)
- Netting frame
- Measuring tape

Procedure

1. **T and N Directions**:
    - The webbing can be shaped in two main directions: T and N direction. Learn to create and measure the T and N patterns for constructing a net.
2. **T-cuts, N-cuts, B-cuts**:
    - Practice making T-cuts, N-cuts, and B-cuts and their combination to create various net structures.
    - Measure and check each cut to ensure the correct shape is being produced.
3. **Joining of Net Pieces**:
    - Once multiple net sections are prepared, practice joining them using knots, ensuring strength and durability.

Observations and Results

- Understand the various cutting techniques and their role in the overall construction of nets.
- Learn how to efficiently join sections of a net to create larger fishing nets.

Lab Exercise 6: Net Mounting - Hanging Coefficient and Hung Depth Calculation

Objective

To learn the process of mounting nets and how to calculate hanging coefficients and hung depth.

Materials Required

- Complete net sections
- Measuring tape
- Net mounting frame

Procedure

1. **Mounting the Net**:

- Attach the net to a mounting frame, ensuring the proper alignment and tension.

2. **Hanging Coefficient**:
    - The hanging coefficient refers to the ratio of the mesh size when the net is hung to its original size. Calculate this ratio using the appropriate formula.
3. **Hung Depth Calculation**:
    - Measure the depth of the hung net and use the formula to calculate its hung depth.

Observations and Results

- Learn how to accurately calculate hanging coefficients and hung depths, crucial for determining how the net behaves in water.

Lab Exercise 7: Net Mounting Techniques – Reeving, Stapling, and Norselling

Objective

To learn different net mounting techniques.

Materials Required

- Twine (Nylon or Cotton)
- Mounting frame
- Staples or norsels

Procedure

1. **Reeving**:
    - This technique involves feeding the netting into the frame or structure using a rope or string.
2. **Stapling**:
    - Use staples to secure the netting onto the frame at regular intervals.
3. **Norselling**:
    - This technique involves using special hooks or norsels to secure the net in place.

Observations and Results

- Compare and contrast each method for net mounting and understand when each is appropriate.

Lab Exercise 8: Mending and Net Shooter Techniques

Objective

To learn and practice mending and repairing nets.

Materials Required

- Netting material
- Needles and twine
- Scissors

Procedure

1. **Mending**:
    - Use the appropriate knots to mend torn or damaged nets.
    - Practice mending various types of damage such as small holes, large rips, or frayed edges.
2. **Net Shooter Techniques**:
    - Learn how to use a net shooter (a device for quickly repairing nets) to speed up the mending process.

Observations and Results

- Understand the importance of mending in prolonging the lifespan of fishing nets.
- Learn the technique of using a net shooter for efficient repairs.

Course: BFSC-510: Fishing Technology

Introduction

Fishing gear technology is a critical aspect of the fishing industry, focusing on the design, construction, and maintenance of tools used for catching fish. This lab manual will cover the various methods involved in net making, such as hand braiding, shaping, tailoring, and mounting. It also introduces the different types of knots, hitches, and net mounting techniques required to ensure the strength, efficiency, and durability of fishing nets.

Lab Exercise 1: Study of Net Making Tools

Objective

To familiarize students with the various tools used in net making.

Materials Required

- Scissors
- Needles (heavy-duty)
- Shuttles (for braiding)
- Twine (nylon, cotton, or polyester)
- Spools and bobbins

Procedure

1. **Examine Tools**: Discuss each of the tools listed above, their functions, and how they contribute to the process of making fishing nets.
2. **Demonstration**: Show how tools like needles and shuttles are used in different parts of the net-making process (e.g., hand braiding and looping).
3. **Handling of Materials**: Demonstrate the proper handling of twine and bobbins.

Observations and Results

- Understand the significance of each tool in creating efficient fishing nets.
- Learn how tool selection influences net strength, durability, and overall performance.

Lab Exercise 2: Knots and Hitches Used in Net Making

Objective

To learn and practice various knots and hitches used in net making.

Materials Required

- Nylon twine or rope

- Scissors
- Netting needles

Procedure

1. **Common Knots**:
    - **Overhand Knot**: Used for securing the end of the twine.
    - **Reef Knot**: Used for joining two ropes of the same thickness.
    - **Bowline Knot**: Used for creating loops at the end of twine.
2. **Hitches**:
    - **Clove Hitch**: Used for fastening the net to the framework.
    - **Round Turn and Two Half Hitches**: Commonly used for securing lines to poles or other structures.
3. **Practice**:
    - Tie the knots and hitches on twine, ensuring tightness and security.

Observations and Results

- Learn how each knot serves a different function in securing or joining parts of the net.
- Understand how these knots contribute to the overall functionality and strength of the net.

Lab Exercise 3: Methods of Net Making - Hand Braiding

Objective

To practice hand braiding using the chain mesh and loop methods of net making.

Materials Required

- Twine (Nylon or Cotton)
- Netting needles
- Ruler or measuring tape

Procedure

1. **Chain Mesh Method**:
    - Start by tying the first knot and then weave the twine in a repetitive chain pattern to form the mesh.
    - Ensure that the loops are uniform in size.
2. **Loop Method**:

- In the loop method, create individual loops that are linked together, forming a net structure.
- After tying the first loop, continue to form the remaining loops with equal tension.

3. **Practice**:
    - Continue braiding until a section of net is completed, observing the consistency of the mesh.

Observations and Results

- Understand the differences between the chain mesh and loop methods.
- Learn how to control loop size and mesh consistency to create an effective fishing net.

Lab Exercise 4: Shaping of Webbing - Baiting, Creasing, and Reducing Mesh Size

Objective

To learn and practice the techniques of shaping webbing for net making.

Materials Required

- Twine (Nylon or Cotton)
- Netting frame or hoop
- Scissors

Procedure

1. **Baiting**:
    - This method involves adjusting the tension of the twine to create uniform mesh sizes.
2. **Creasing**:
    - Crease the webbing in a way that alters the shape of the mesh for specific fishing needs (e.g., for targeting specific fish species).
3. **Reducing Mesh Size**:
    - Gradually reduce the size of the mesh by adjusting the knots or loops step by step. This is particularly important for creating nets that can trap smaller fish.

Observations and Results

- Understand the importance of webbing shape in optimizing fishing performance.
- Learn how mesh size and tension influence fish capture efficiency.

Lab Exercise 5: Tailoring Methods – T and N Direction of Webbing

Objective

To learn and practice the tailoring methods used in net making.

Materials Required

- Twine (Nylon or Cotton)
- Netting frame
- Measuring tape

Procedure

1. **T and N Directions**:
    - The webbing can be shaped in two main directions: T and N direction. Learn to create and measure the T and N patterns for constructing a net.
2. **T-cuts, N-cuts, B-cuts**:
    - Practice making T-cuts, N-cuts, and B-cuts and their combination to create various net structures.
    - Measure and check each cut to ensure the correct shape is being produced.
3. **Joining of Net Pieces**:
    - Once multiple net sections are prepared, practice joining them using knots, ensuring strength and durability.

Observations and Results

- Understand the various cutting techniques and their role in the overall construction of nets.
- Learn how to efficiently join sections of a net to create larger fishing nets.

Lab Exercise 6: Net Mounting - Hanging Coefficient and Hung Depth Calculation

Objective

To learn the process of mounting nets and how to calculate hanging coefficients and hung depth.

Materials Required

- Complete net sections
- Measuring tape
- Net mounting frame

Procedure

1. **Mounting the Net**:

- Attach the net to a mounting frame, ensuring the proper alignment and tension.

2. **Hanging Coefficient**:
    - The hanging coefficient refers to the ratio of the mesh size when the net is hung to its original size. Calculate this ratio using the appropriate formula.
3. **Hung Depth Calculation**:
    - Measure the depth of the hung net and use the formula to calculate its hung depth.

Observations and Results

- Learn how to accurately calculate hanging coefficients and hung depths, crucial for determining how the net behaves in water.

Lab Exercise 7: Net Mounting Techniques – Reeving, Stapling, and Norselling

Objective

To learn different net mounting techniques.

Materials Required

- Twine (Nylon or Cotton)
- Mounting frame
- Staples or norsels

Procedure

1. **Reeving**:
    - This technique involves feeding the netting into the frame or structure using a rope or string.
2. **Stapling**:
    - Use staples to secure the netting onto the frame at regular intervals.
3. **Norselling**:
    - This technique involves using special hooks or norsels to secure the net in place.

Observations and Results

- Compare and contrast each method for net mounting and understand when each is appropriate.

Lab Exercise 8: Mending and Net Shooter Techniques

Objective

To learn and practice mending and repairing nets.

Materials Required

- Netting material
- Needles and twine
- Scissors

Procedure

1. **Mending**:
    - Use the appropriate knots to mend torn or damaged nets.
    - Practice mending various types of damage such as small holes, large rips, or frayed edges.
2. **Net Shooter Techniques**:
    - Learn how to use a net shooter (a device for quickly repairing nets) to speed up the mending process.

Observations and Results

- Understand the importance of mending in prolonging the lifespan of fishing nets.
- Learn the technique of using a net shooter for efficient repairs.