Experiment 1   **Date:**

APPRAISAL OF VARIOUS MORPHOMETRIC AND MERISTIC CHARACTERS USED FOR THE IDENTIFICATION OF FRESHWATER FISHES

Aim:

1. To become familiar with the morphometric features of various freshwater fish species for the identification

2. To become familiar with the meristic features of various freshwater fish species for the identification

Materials required

Fish specimens, dissection instruments, divider or a dial reading calliper, stainless steel ruler with measurements to mm, balance, marker, tray, dissection board etc.

Procedure

- Collect freshwater and estuarine fish specimens belonging to wide range of orders either from the fish landing centre or from the institute museum

- Wash them in running water

- Keep all the specimens in individual trays

- Observe the following morphometric and meristic features of the fishes collected

- Draw illustrations

Observation

List out all morphometric and meristic features

Morphometric and meristic characters of freshwater fishes used for classification and identification

The term, morphometry denotes the measurement of the structures and parts of organisms. The term, meristics denotes the counting of quantitative features of a fish, such as its number of fins or of scales.

I. Morphometric measurements

Sharp pointed needle-like dividers or dial-reading calipers are used for taking body measurements. A Stainless steel ruler with measurements to millimetre is recommended for accurate readings.

The various body measurements of a fish are:

1. **Total length:** The greatest distance between the most anterior projecting parts of the head (even if it is prolonged beak as in *Hemiramphus*) to the posterior most tip of the caudal fin, including filamentous prolongations, if any. The measurement is a straight line and is not taken over the curves of the body. Where the caudal fin has either of the lobes longer than the other, the maximum length is taken. Where the jaws are unequal, the mouth is closed and measured from the tip of the jaw that is longer.

2. **Standard length:** The straight distance from the anterior most part of the head to the end of the vertebral column. In actual practice, the flexure line of the body over the caudal peduncle is taken as the posterior most point. Some authors however take this as mid of the caudal fin base.

3. **Body depth:** The vertical measurement from a point in the body of the fish on its back where its height is the greatest to a straight line to the ventral surface or profile. The fleshy or scaly structures pertaining to fin bases are excluded. It need not necessarily be in middle of the fish.

4. **Head length:** A Straight measurement of the distance from the tip of the snout to the most distant point on the opercular membrane on the upper angle of gill opening. Any fleshy membrane of the gill cover is also included.

5. **Head depth or height of head at occiput:** The perpendicular distance measured from the midline at the occiput vertically downwards to the ventral contour of the head or the breast. In actual practice, one arm of the divider is placed at the occipital crest and the other arm below the head vertically opposite to the upper arm of the divider, to form a vertical lie. Unlike body depth this measurement is not taken up to ventral profile line.

6. **Head width:** Straight distance across the head in a ventral position: if the opercles are dilated they are forced into a reasonably normal position.

7. **Eye diameter:** The distance between margins of the cartilaginous eyeball across the cornea.

8. **Snout length:** The distance from the most anterior midpoint on the snout or upper lip to the front hard margin of the orbit.

9. **Inter-orbital width:** The least distance between the bony rims between inner margin of the eyes.

10. **Pre-dorsal length:** A straight measurement from the midpoint or tip of the snout or upper lip or the anterior most part of the head to the structural base of the anterior most dorsal fin ray. In fishes with a dorsal spine, the basal bone of the dorsal fin, also called the nuchal shield, is taken as the structural base.

11. **Post-dorsal length:** A straight line measurement from the structural base of the dorsal fin to the flexure line of the body over the caudal peduncle or the end of the vertebral column.

12. **Pre-pelvic distance:** A straight distance from the midpoint of the base of the pelvic fin to the anterior most point of head.

13. **Height of dorsal or length of dorsal fin spine:** It is measured from the anterior point of junction with the body to anterior tip of the fin or spine even if the other rays do not reach this point.

14. **Length of base of spinous or soft dorsal adipose:** The greatest distance measured in a straight line between the anterior most and posterior most points of junction with the body.

15. **Length of pectoral height and pelvic fins, dorsal fin or spines:** Measured between its origin or place of insertion into the body to its extreme tip.

16. **Depth or least height of caudal peduncle:** The least vertical distance from the dorsal to ventral profile at the narrowest part of the caudal peduncle. It is a straight measurement.

17. **Length of caudal peduncle:** An oblique measurement from the last point of contact of anal fin posteriorly to the end of the vertebral column or the flexure line of the body over the caudal peduncle.

18. **Length of longest fin ray:** Measured from the structural base of the longest fin ray to its tip.

19. **Length of occipital process:** The distance from the point of origin or base of the occipital process on the supra occipital bone to its posterior most tip where it meets the basal bone of the dorsal fin, the latter is excluded. Where it meets the inter-neural shield, the shield is excluded.

20. **Post-orbital length:** The greatest distance from the posterior edge of orbit to the posterior tip of the fleshy operculum.

21. **Sub-orbital width:** The least distance from the lowermost margin of the orbit to sub-orbital or pre-orbital margin.

22. **Width of gape of mouth:** The greatest transverse distance across the opening of the mouth, without stretching the mouth opening.

23. **Width of pre-maxillary teeth band:** The maximum width of the band

24. **Width of base of occipital process:** The maximum width at base of occipital process where it originates from the supra-occipital bone.

II. Meristic counts

The accurate enumeration of meristic data or counts of fin rays is of diagnostic importance. Great care should be taken to count accurately the simple and branched rays and present the data in charts of frequency distribution wherever possible.

1. Fin rays: All paired and median fins in bony fishes have long, mobile filament like prolongations called rays. The movements of the fins are due to the action of the muscles, these movements being possible of the articulations and often flexibility of these rays. The term "ray" also applies to spines whether they are included within the membrane of a fin or not.

Three chief types of fin rays are encountered:

(i) Soft ray – Are often very thin, flexible and most often branched.

(ii) Hard rays – Are a number of soft rays united solidly to compose hard rays which are rigid and sometimes sharply pointed. These are formed of cartilage, and when freed from the membranous sheath holding them, clearly show the juxtaposed soft rays. Some of perches and sisorids have such hard rays. The outermost caudal fin ray called the principal ray is also a hard ray.

(iii) Spinous rays – Are made of bone tissues, and are harder and stronger than rays. These are usually not covered by the membrane of the fin and often are with serrations or teeth. They are common in catfishes. These are cited in the fin formulae by capital roman numerals (I, II, III etc). Hard and soft rays can be distinguished easily. Soft rays are so constructed that they can be readily split into right and left in the median. Hard rays on the other hand do not have such cleavage flexure.

2. Lateral line scale counts: The number of scales with perforation along the lateral line up to the structural caudal base or end of hypural plate or at the flexure line of the body over the caudal peduncle. The scales wholly on the caudal fin base or beyond this point without such perforations are excluded. If the lateral line is divided as in loaches, cichlids and anabantids, the lateral line count includes all the pored scales in the upper and lower line: only the count on the lower line starts from the scale following that directly below the last one on the upper line. Indicated as L.L. or L.I. in fin formulae. If the lateral line is incomplete or absent, or if all the scales do not have pores or perforations, the scales themselves may be counted along the normal course of line. Near the had the first scale to b counted is one which touches the pectoral girdle and which is followed by a scale which does not touch it. Transverse scale counts are taken as scale rows crossing an imaginary vertical line. Scales from the anterior base of fins are generally taken. The number and nature of the striae and pores on the scales are important.

3. Scales from dorsal fin to lateral line: Generally the count is taken from the insertion of the first dorsal fin including the small scales, counting downward and backward following the natural scale row to but not including the lateral line itself. The small scales at base of the fin are however included.

4. Scales below lateral line or from lateral line to pelvic base: Are counted as above but from below upwards and forward from base of pelvic to lateral line. Small scales are included. The scale nearest the pelvic fin in counted as half when, it is so. When counting upward and forward, if the scale rows are found wavy backward and forwards, the backward rows are taken.

5. Pre-dorsal scales: The number of scales from the origin of the dorsal fin to the occiput. All scales which wholly or partly intercept the straight midline running from the origin of the dorsal fin to occiput is taken, Indicated as P.D.S in fin formulae.

6. Pre-anal scales: Counted from the anterior most base of the anal fin to the vertical base of the occiput or end of the scale rows on the head.

7. Scales in lateral or linear series: Where the lateral line is absent, the number of transverse rows of scales between the occiput and the structural base of the caudal fin is counted. Indicated as L.r. in fin formulae.

8. Circumpeduncular scales: Scales around the least depth of caudal peduncle. It is always better and useful to indicate the number of circumpeduncular scales above and below the lateral line.

9. Branchiostegal rays: Numerous tiny tin bones arranged fanwise from the lower edge of the opercle to the ventral surface of the head and covered by the branchiostegal membrane. Care should be taken to include the most anterior branchiostegals which are likely to be very short, slender and hidden.

10. Gill rakers: Thin needle like filamentous prolongations on the gill arches. For count purposes, the rakers on the first arch is taken. If the counts of both the upper and lower limbs of the gill arch are taken they are separated by a plus (+) sign; generally the lower limb alone is considered. If rudiments are included this fact should also be mentioned.

11. Pharyngeal teeth: "Throat teeth" borne on two bones which are modified fifth gill arches, each with one to three rows of teeth. The in each row are counted and are indicated in formula in order from left to right. For example 2,5 – 4,2 would indicate that the pharyngeal bone of the left side has two teeth in the outer row, five in the inner whereas the right bone has only four teeth in the inner row and two in the outer. The formula 3-3 would show that no teeth are developed in the outer row. The number and series of pharyngeal teeth are of classificatory value.

Draw a neat diagram of fish showing morphometric measurements

Draw a neat diagram of fish and label parts showing meristic counts

Experiment 2   **Date:**

FAMILIARIZATION OF RIVERINE FINFISHES OF INDIA

Aim: To become familiar with the identification of riverine fish species by collecting samples of specimens from a river based landing centre

Materials required
- Stainless steel ruler with measurements to mm
- balance
- divider
- insulated box
- fish species identification guides
- field identification guides
- bucket
- calculator
- record book
- pen etc.,

Procedure
- Visit to a river based landing centre
- Collect one or two fish specimens for each species and bring to laboratory
- Collect the vernacular name for each species
- Observe the morphological features, measure the morphometric features and count meristic features for each specimen collected
- Identify each species with the help of fish species identification sheets / field identification guides
- If it is difficult to identify, keep the specimen in the insulated box filled with ice and bring to the laboratory and confirm the identity
- Make a note of characters of order, family, genus and species with their systematic position, scientific name, common name and vernacular name
- Make illustrations for each species

Observations
- Systematic position
- Scientific name
- Common name
- Vernacular name
- Order characters
- Family characters
- Genus characters
- Species characters

	Fish 1	Fish 2	Fish 3	Fish 4
Systematic position				
Scientific name				
Common name				
Vernacular name				
Order characters				
Family characters				
Genus characters				
Species characters				
	Fish 1	Fish 2	Fish 3	Fish 4

Experiment 3   **Date:**

FAMILIARIZATION OF ESTUARINE FINFISHES OF INDIA

Aim: To become familiar with the identification of estuarine fish species by collecting samples of specimens from a estuary based landing centre

Materials required
- Stainless steel ruler with measurements to mm
- balance
- divider
- insulated box
- fish species identification guides
- field identification guides
- bucket
- calculator
- record book
- pen etc.,

Procedure
- Visit to a estuary based landing centre
- Collect one or two fish specimens for each species and bring to laboratory
- Collect the vernacular name for each species
- Observe the morphological features, measure the morphometric features and count meristic features for each specimen collected
- Identify each species with the help of fish species identification sheets / field identification guides
- If it is difficult to identify, keep the specimen in the insulated box filled with ice and bring to the laboratory and confirm the identity
- Make a note of characters of order, family, genus and species with their systematic position, scientific name, common name and vernacular name
- Make illustrations for each species

Observations
- Systematic position
- Scientific name
- Common name
- Vernacular name
- Order characters
- Family characters
- Genus characters
- Species characters

	Fish 1	Fish 2	Fish 3	Fish 4
Systematic position				
Scientific name				
Common name				
Vernacular name				
Order characters				
Family characters				
Genus characters				
Species characters				
	Fish 1	Fish 2	Fish 3	Fish 4

Experiment 4   **Date:**

FAMILIARIZATION OF COLD WATER FISHES OF INDIA

Aim: To become familiar with the identification of Cold water fish species by collecting samples of specimens from cold water based landing centre

Materials required
- Stainless steel ruler with measurements to mm
- balance
- divider
- insulated box
- fish species identification guides
- field identification guides
- bucket
- calculator
- record book
- pen etc.,

Procedure
- Visit to a cold water based landing centre
- Collect one or two fish specimens for each species and bring to laboratory
- Collect the vernacular name for each species
- Observe the morphological features, measure the morphometric features and count meristic features for each specimen collected
- Identify each species with the help of fish species identification sheets / field identification guides
- If it is difficult to identify, keep the specimen in the insulated box filled with ice and bring to the laboratory and confirm the identity
- Make a note of characters of order, family, genus and species with their systematic position, scientific name, common name and vernacular name
- Make illustrations for each species

Observations
- Systematic position
- Scientific name
- Common name
- Vernacular name
- Order characters
- Family characters
- Genus characters
- Species characters

	Fish 1	Fish 2	Fish 3	Fish 4
Systematic position				
Scientific name				
Common name				
Vernacular name				
Order characters				
Family characters				
Genus characters				
Species characters				
	Fish 1	Fish 2	Fish 3	Fish 4

Experiment 5   **Date:**

MAPPING OF VARIOUS MAJOR INLAND WATER BODIES WITH FISHERIES POTENTIAL IN INDIA

Aim:

1. To locate and map various river systems, reservoirs and other inland open water bodies of India

2. To understand the fish and fisheries of various river systems, reservoirs and other inland open water bodies of India

Materials required
- India river map
- Pencil

Procedure

Locate and map various inland open water bodies of India

Write down the profile of the following major river systems / reservoirs / lakes / estuaries etc with the following details:

(i) Place of origin

(ii) Total length

(iii) Catchment area

(iv) Status through which it flows

(v) Distributaries / Tributaries

(vi) Major composition

(vii) Fishing gears and crafts employed

(viii) Conservation status

Major inland water bodies in India

I. Fish and fisheries of Riverine systems of India

1. Himalayan river systems

a. The Ganga river system

b. The Brahmaputra river system

c. The Indus river system

The Ganga river system

The Brahmaputra river system

The Indus river system

2. Fish and fisheries of Peninsular river systems

a. East coast river systems

 (i) River Mahanadi

 (ii) River Godavari

 (iii) River Krishna

 (iv) River Cauvery

b. West coast river systems

 (i) River Narmada

 (ii) River Tapti

River Mahanadi

River Godavari

River Krishna

River Cauvery

River Narmada

River Tapti

II. Fish and fisheries of Reservoirs of India

Draw the map of India, locate and mark the major reservoirs like Stanley reservoir, Bhavani sagar, Tungabhadra, Krishnaraja sagar, Nagarjuna sagar, Nizam sagar, Gandhi sagar, Hirakud, Ranaprathapsagar and Gobind sagar

Stanley reservoir

Hirakud reservoir

III. Fish and fisheries of Estuaries of India

Draw the map of India, locate and mark the major estuaries like Hooghly – Matlah estuary, Mahanadi estuary, Rushikulya estuary, Godavari estuary, Krishna estuary, Cauvery estuary, Vellar estuary, Vaigai estuary, Narmada estuary, Tapti estuary, Asthamudi esturary and Mandovi – Zuari estuary.

Hooghly – Matlah estuary

Narmada estuary

IV. Brackish water lakes / Back waters

Draw the map of India, locate and mark Chilka lake, Pulicat lake, Cochin backwater, Vembanad backwater, Kakinada backwater and Killai backwater

Chilka lake

Pulicat lake

Cochin backwater

Vembanad backwater

Experiment 6   **Date:**

FISHING GEARS USED IN INLAND OPEN WATERS IN INDIA: DIAGRAM AND DESCRIPTION

Aim: To become familiar with the common fishing gears used in inland water bodies in India.

Procedure
   (i) Type of inland water bodies where used
   (ii) Specification of fishing gear
   (iii) State where used
   (iv) Major fish species groups caught
   (v) Any other specific remarks
Draw a neatly labelled diagram for each fishing gear

Classification of fishing gears
   1. The place of their use (river, reservoir, pond)
   2. The mobility (Active/passive)
   3. Depth of operation (surface, pelagic, demersal, mid water, bottom)

Gears according to their place of use

Gears according to their mobility

Gears according to the depth operation

Fishing without gears
1. Grappling and wounding gears
2. Fishing by hunting
3. Fishing with animals
4. Stupefying gears

Grappling and wounding gears

Fishing by hunting

Fishing with animals

Stupefying gears

Common inland fishing gears
1. Drag net (Shore seines)
2. Gill net and Drift net
3. Trammel net
4. Cast net
5. Dip net or Lift net
6. Purse Net
7. Bag set net
8. Hooks and lines- Bait and its types
9. Dredges
10. Traps
11. Fish Aggregation Device (FAD)
12. Fishing gears of rivers
13. Fishing gears of hill streams
14. Fishing gears of lagoons and backwaters

Drag net (Shore seines)

Gill net and Drift net

Trammel net

Cast net

Dip net or Lift net

Purse net

Bag set net

Hooks and lines- Bait and its types

Dredges

Traps

Fish Aggregation Device (FAD)

Fishing gears of rivers

Fishing gears of hill streams

Fishing gears of lagoons and backwaters

Experiment 7   **Date:**

FISHING CRAFTS USED IN INLAND OPEN WATERS IN INDIA: DIAGRAM AND DESCRIPTION

Aim: To become familiar with the common fishing crafts used in inland water bodies in India

Procedure
- Prepare list of major fishing crafts used in inland water bodies in India
- Provide the following details for each fishing craft

(i) Type of inland water bodies where used

(ii) Specification of fishing craft

(iii) State where used

(iv) Major fish species groups caught

(v) Any other specific remarks

Draw a neatly labelled diagram for each fishing craft

Fishing crafts are most essential for catching the fish in large scale in water bodies. The types of fishing crafts of India falls under two general categories.

- Non-mechanized
- Mechanized fishing crafts

Based on the topographical variations and difference in habits and habitats of fishes, different types of crafts and gears are used in various inland water systems of India. The simplest and most primitive types of craft used for fishing in inland waters are the rafts and songas, operated in calm waters. In the larger rivers and estuaries subject to strong current and tidal movements, sturdier plank built boats are used.

Major fishing crafts

Rafts
Coracle
Catamaran
Dug-out canoes
Plank built boat
Large fishing boats
Bachhary boat
Mechanised boats

Rafts

Coracle

Catamaran

Dug-out canoes

Plank built boat

Large fishing boats

Bachhary boat

Mechanised boats

Fishing crafts of backwaters

Fishing crafts of reservoirs

Experiment 8   **Date:**

OPERATION OF GPS AND DETECTION OF ORDINATES OF DIFFERENT LANDING / ASSEMBLING CENTRES / WATER BODIES

Aim:
1. To know the operation of GPS
2. To record the longitude and latitude of the sampling site
3. To track the route of different sampling sites

Materials required

GPS hand set, map of the locality (Possibly large scaled map), scale, pencil, eraser etc.

Procedure

- Visit to fish landing centre / assembling centre / wetland / village or institute pond.
- Record the longitude and latitude of different sampling sites
- Various recorded ordinates should be marked on the available map with pencil.
  .

Observation

Map with longitude and latitude of different sampling sites along with different tracked routes.

Experiment 9   **Date:**

VISIT TO THE LANDING CENTRE AND ANALYSIS OF CATCH COMPOSITION AND ESTIMATION OF TOTAL CATCH

Aim:
1. To collect data on size (length) distribution of selected species in the catch
2. To estimate raising factor to raise the data from the sample to the level of total catch
3. To know the approximate total number of individuals caught in catch in each length group

Materials required
- Stainless steel ruler with measurements to mm
- Balance
- Divider
- Insulated box
- Fish species identification guides
- Field identification guides
- Bucket
- Calculator
- Record book

Procedure
- Collect details about the number of boats ventured for fishing on the day of visit, type of fishing gears used, mesh size of each gear, type and size of boat, average number of fishermen in each boat
- Select 10 % of boats at random for each type of gear being operated
- Identify all the fish species caught by the boats selected
- Measure the total/forked length of more than 50 specimens randomly for each species representing various sizes to nearest mm.
- Measure the weight of the sampled specimens to nearest gram using a balance, which is called as sample weight.
- Assess the total weight of each species approximately, caught by the boats selected and project for the whole landing centre based on the number of boats sampled and total number of boats ventured for fishing.
- Prepare the length frequency table for each species caught by single type of gears
- Calculate Raised factor for the day = Day's catch / Sample weight
- Frequency in a particular length class is multiplied by the raising factor for the day to get the daily raised numbers.
- Add the raised numbers of all length class to get total numbers caught on that day.

Bar diagram/histogram showing length frequency distribution

Comment on length-wise size distribution of the catch

a. Field trip to Balugaon fish landing centre

b. Field trip to Bahuda estuary

c. Field trip to Bahuda estuary

Experiment 10   **Date:**

VISIT TO THE STATE FISHERIES DEPARTMENT TO GATHER INFORMATION ON CATCH RECORDS

Aim: To visit the state fisheries department to gather information on the maintenance of records on catch data

Procedure
- Visit the state fisheries department
- Enquire the officials about the followings:
    - Estimation of area of various inland capture fisheries resources Sampling procedures adopted for collecting data on inland fish catch from various resources
    - Analysis of catch composition
    - Maintenance of records on catch data

Fisheries data

Comment on Problems in estimation of inland fish catch statistics

Suggest suitable measures to improve the data collection system