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MORPHOMETRIC AND MERISTIC CHARACTERS OF FISHES

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Introduction

Both from the taxonomic as well as the management point of view, a correct identification of marine fishes is important. The 'Folk taxonomies' that developed in earlier times contained 250 to 800 kinds of animals. The invention of printing in the fifteenth century and world explorations have made expansion of taxonomy both possible and inevitable. A number of attempts to classify animals were made, but were limited in scope until Linnaeus introduced the binomial nomenclature in the eighteenth century. He has recognised species as the basic unit in nature. This meant that it is necessary to describe only one individual to know of an entire species. But later Linnaeus and his successors have encountered natural variation within each species and they were forced to recognise 'varieties'. The scientific names based on binomial nomenclature provide names that are recognised all over the world. Each name has two parts: the genus name which is always capitalised and the trivial name or the species epithet which is not capitalised. The two names together constitute a species name.

Continuing the effort to catalog all kinds of animals, taxonomists are concerned not only with the description of new forms but also with the placing of each form within a taxonomic system that shows its relationship to other forms.

Individuals are grouped into populations (sub species - geographically isolated and morphologically different from other similar populations), populations into species, species into genera, genera into families, order, phylum etc., and upto the Animal Kingdom.

TAXONOMIC METHODS

A modern taxonomist may be able to draw information from such varied fields as biochemistry, genetics, behaviour, physiology, geographical distribution, palaeontology and cytology to supplement and strengthen the more conventional laboratory data on morphology and anatomy. Foremost among these tools is the computer which permits complex multivariate analysis of large amount of data. Sufficient sampling and adequate coverage of the characteristics are important. The data are gathered using both old and new techniques. These include: 1.Morphometric measurements and ratios, 2. Meristic counts, 3. Anatomical characteristics, 4. Colour patterns, 5. Karyotype, 6. Electrophoresis and 7. Test for reproductive isolation.

Morphometric and Meristic Characters

Morphometric Measurements:

Measuring the linear dimensions of the whole or part of a fish is probably the most widely used technique in fisheries biology studies. Morphometric measurements are any standard measurements that can be taken on a fish such as Standard Length, Snout Length, length of largest fin ray of the dorsal fin, depth of the caudal peduncle and so on. Since these measurements change as the fish grows, these are usually expressed as ratios to Standard Length. Such ratios are only useful if comparisons are made between samples of fish of approximately the same size and sex, since the growth of a fish is not always proportional in all directions and sexual dimorphisam is also noticed among fishes. Thus morphometric measurements while vital for

describing fish species may be of limited usefulness.

Three overall length measurements in common use are 1. Standard length, 2. Fork length and 3. Total length. The latter two measurements are more commonly used in fishery biology. Overall length measurements are made between perpendiculars along the median longitudinal axis from snout (U, the position of the maxillary symphysis) or from the tip of the lower jaw (L, the mandibular symphysis), vide Fig. 3.2.1. Measurements from L are taken with the mouth closed. If the lower jaw is projecting, measurements from the symplysis may necessitate provision of a special stepped nose piece on the measuring board. Generally measurements are made on the left side of the fish, with the right side of the fish resting on the measuring board. For definitions of positions, reference may be made to the next section.

1. Standard Length: Taken from U to the tip of the hypural bone (urostyle). This varies from species to species.
2. Fork Length: Measured from U or L to the cartilaginous tip of shortest or median caudal ray.
3. Total Length: Measured from U or L to the longest caudal fin ray, upper or lower, or an average of them both.

Longitudinal measurements other than overall length are also made between perpendiculars using measuring board with, for example a sliding cursor. When these are made radially from point U, calipers are recommended. Point-to-point measurements are sometimes made on big fishes such as tunas by tapes. These would be indicated by the word 'Surface' as these are not generally recommended. All measurements from LX to LM and also their 'upper' equivalents are grouped under the general name 'total length' LT. LM has been called 'bilobular length' and total 'auxiliary length'. The word 'Extreme' is used in LX,

LX' instead of 'maximum length to avoid confusion with the asymptotic length. LF and LF' are also called 'median' length or 'midcaudal' length. The term 'depth' is used instead of 'height'. Again the term 'width' is not recommended as an alternative to 'breadth' but 'thickness' would be an ideal term. Pectoral and ventral fins are to be measured in the folded position opposed to the body side (to keep the rays straight) from foremost visible point of insertion to the distal tip of the membranous edge.

Definitions of position

U	Maxillary symphysis.
L	Mandibular symphysis.
OO	Anterior edge of orbit.
O'	Posterior edge of orbit.
J	Posterior edge of mandible (buccal commissure).
Y	Gill-cover notch.
G	Posterior bony edge of operculam.
G'	Posterior membranous edge of gill cover.
P	Anterior point of insertion of the first pectoral fin ray.
D1	Insertion of anterior dorsal (intersection of anterior margin of first dorsal spine, fin held erect with the contour of the back).
D1'	Position of last ray of anterior dorsal.
D2	Insertion of first ray of posterior dorsal.
D2'	Position of last ray of posterior dorsal.
Z	Anterior edge of cloaca.
A	Insertion of first anal fin ray.
A'	Position of last anal fin ray.
B	Insertion of dorsal lobe of caudal fin.
S	Posterior tip of urostyle (forward protuberance of hypural blade).
S'	Posterior edge of fleshy peduncle or of pigmented zone.
S''	Point of upper caudal keel.
S'''	Posterior limit of silvering (either last scale of the lateral line or the posterior zone limit of

the scale covered by the peduncle).

F — Cartilaginous tip of shortest (median) caudal ray.

F' — Membranous edge of caudal fin at fork.

N — Distal tip of the longest caudal fin ray with lobe normally extended.

N' — Distal tip of the longest ventral fin ray with lobe normally extended.

M — Point where line NN' intersects median longitudinal axis.

M' — Mid point of line NN'.

X — Distal tip of longest dorsal caudal fin ray, with the lobe brought to the median longitudinal axis.

X' — Distal tip of the longest ventral caudal fin ray, with the lobe brought to the median longitudinal axis.

Overall length measurements:

LT and UT — total length (any extreme or normal length).

LX — Dorsal extreme length.

LX' — Ventral extreme length.

LX'' — Greater extreme length (LX or LX', whichever is greater.

LN — Dorsal normal length.

LN' — Ventral normal length.

LN'' — Greater normal length (LN or LN', whichever is greater.

LM — Median normal length.

LM' — Mean normal length.

LF — Midcaudal length.

LF' — Fork length.

LS — Standard length to urostyle (or to some external feature corresponding with it).

LS' — Standard length to peduncle (or to the pigment under scales).

LS'' — Standard length to keel.

LS'''	Standard length to silvering.
LB	(Dorsal) Body length.

Other longitudinal measurements

UJ	Maxillary sheath length.
LJ'	Mandibular length.
UO	Snout length.
UY	Upper head length.
LG	Opercular head length.
Lg	Greatest head length.
OO'	Orbital diameter.
Id	Longitudinal iris diameter (cf, Ih and Ig).
Ed	Longitudinal pupil diameter (cf, Eh and Eg).
O'Y	Postorbital distance.
UD1	Preanterior dorsal distance.
UP	Prepectoral distance.
UV	Preventral distance.
UD2	Preposterior dorsal distance.
D1D1'	Anterior dorsal fin base length.
D2D2'	Posterior dorsal fin base length.
UA	Preanal distance.
AA'	Anal fin base length.

Vertical measurements (Perpendicular unless otherwise stated)

Oh	Orbital depth (from orbital crest to lower edge of maxillary, passing over middle of pupil).
Ih	Perpendicular iris diameter.
Eh	Perpendicular pupil diameter.
YJ'	Head length.
D1P	Back depth (oblique).
D1V	Anterior dorsal depth (or dorsoventral depth).
h	Greatest depth.
D2Z	Posterior dorsal depth.
D2A	Dorsoanal depth (slightly oblique).
h'	Perpendicular anal depth.
q	(Least) peduncle depth.

Lateral measurements

PP	Pectoral breadth.
b	Greatest breadth.
OO	Interorbital distance (at level of pupil centre)

Other measurements

D1h	Anterior dorsal height distance from insertion to tip of longest spine).
D2h	Posterior dorsal height (distance from insertion to tip of longest spine).
Ph	Pectoral fin length.
Vh	Ventral fin length.
Ah	Anal fin height.
Ch	Dorsal caudal fin length.
Ch'	Ventral caudal fin length.
Ch''	Greater caudal fin length.
Ig	Greatest iris diameter.
Eg	Greatest pupil diameter.
g	Greatest girth.
VV	Length of interventral flap.
NN'	Spread caudal distance.

Skeletal dimensions

Ax	Axial length (anterior face of vertebra 1 to tip of urostyle).
Sk	Skull length (maxillary symphysis to posterior occipital boundary).
An	Anatomical length (= Ax + Sk).

Meristic counts

These counts are generally considered to be the most reliable taxonomic characteristics because most are easy to make and reliable. It includes anything on a fish that can be counted, such as the number of vertebrae, fin rays, spines, scale rows, pyloric caecae, lateral line

scales, pores, finlets and gillrakers. Since there is often considerable variation in these characteristics within species, it is important to make the counts on adequate number of individuals so that their mean, range and standard error can be determined, if the fishes involved are to be compared with other populations.

Number and disposition of the vertebrae

The backbone of a fish is a piece of machinery performing a variety of functions. At the anterior end it is designed to make connection with the head and the trunk. At the posterior end it is modified to act as the basal support and frame work for the caudal fin. It gives support to the median fins, provides attachment for the muscles, houses the central nervous system and the haemal artery, gives suspension and protection of the viscera and so on. It is a vital part in the turning and propulsion mechanism. Hence the form of the vertebral elements changes in its length to suit various functions. Every structural feature of a vertebral segment, even to the smallest zygapophyses forms one unit of a descrete gradation series and the natural compounding of these series gives a pattern which is distinctive to species. Furthermore, after comparing species with species, it is impossible to escape the impression that phylogenetic relationship is made manifest by agreement both in the character of individual gradation series and in their compounded pattern. The suggestion is all gadoid backbone conform to a gadoid pattern, all clupeoids to a clupeoid pattern and so on.

General pattern of division of a vertebral column

The total number of vertebrae is quite variable in fishes and within genera and species. They may be divided conveniently into precaudal (abdominal) and caudal portions. The first caudal vertebra is that which possesses an elongated haemal spine. Depending upon various other features,

the vertebrae may be grouped, but their number varies from fishes to fishes. The total number, number of vertebrae showing common features, their range and mean are important.

Some general features are as follows (Fig.3.2.2):

1. The post cranial vertebrae bear stout neural arches and spines.
2. The mesabdominals follow the post cranials, bear ribs, but do not possess haemal arches.
3. The posterio-abdominals have closed haemal arches and bear ribs.
4. The anterio-caudals greatly resemble the posterio-abdominals except that they have lost the ribs and have developed haemal spines.
5. In the tail segment the vertebrae have their neural and haemal spines entering into the support of the caudal fin.
6. The hypural complex is almost symmetrical and fan like, receiving the rays of the caudal fin. The rays of the caudal fin are supported by altered vertebral elements (penultimate hypurals, epurals, urostyle).

The number and characters in each of these divisions in the vertebral column may be compared to arrive at meaningful conclusions.

Anatomical characteristics

These include features such as shape, completeness and position of the lateral line, position and size of the internal organs, special anatomical features (such as air bladder, air breathing apparatus, electric organs, otoliths, arrangement of the musculature etc.,), secondary sexual characters (breeding tubercles in males, enlarged fin rays, etc.,), shape size and interrelationship of bones and muscles.

Most of these are "yes" or "no" characters, either a fish has them or it does not have. These can be definitive characteristics for separating species as well as higher taxa.

Colour patterns

Colour patterns are quite variable with age, time or environment. These are part of the species description and are species-specific. The main problem in using colour pattern as a taxonomic tool is that it tends to fade in preservatives and descriptions of living fish tend to be highly subjective.

Karyotype

These are descriptions of the number and morphology of chromosomes. The number and position of chromosomes are conservative characters and so may be used as an indicator of the closeness of species interrelationship within families.

Electrophoresis

This technique of evaluating the protein similarities in fishes could be used as a taxonomic tool. The protein can be identified and genetic similarity of individuals and species can be compared.

Taxonomic tools in racial investigations

A combination of all or some of these taxonomic methods have been used for racial investigations from time to time with interesting and at times with negative results. These studies are important in fishery biology for evolving suitable management policies for judicious exploitation of the resources, among which the identification of the eggs and larvae to the species to which they belong is one important aspect.

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