# SOME MORPHOMETRIC STUDIES ON FIVE SPECIES OF *CYNOGLOSSUS* (FAMILY CYNOGLOSSIDAE, ORDER HETEROSOMATA) FROM THE WEST COAST

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ABSTRACT

Selected morphometric and meristic characters have been analysed in five common species of *Cynoglossus* at Calicut, namely, *C. macrostomus* Norman, *C. dubius* Day, *C. puncticeps* (Richardson), *C. bilineatus* (Lacepede) and *C. lida* (Bleeker). For comparing the morphometric ratios Pearson's coefficient of variation (P.C.), is used as a measure of the degree of variability. The total length/body length ratios were found to be the least variable while the ratios connected with the eye and orbit showed the most variable P.C. in all the species. A comparative table and description are given of the ratios studied of the different characters for the five species chosen. The calculated values of $t$ for the mean ratios in all paired combinations of the five species have been tabulated, and the Probability (P) is found to be significant for most of the comparisons made.

## INTRODUCTION

Recent studies in the case of several fishes have made it clear that the range of variation in the characters used in the identification of the various species is of considerable importance, and though new species continue to be described now and then even on the basis of single specimens, such a procedure can be justified at the present time only in rare instances of isolated taxa, but in general the need for a fair idea of the variability of the different characters is now recognised in all taxonomic and systematic studies. The difficulty experienced frequently by workers in the absence of such data is the stimulus for the widespread studies of a statistical nature in fishery biological research, on the populations of concerned species, the changing variability according to environment being also another parameter of importance in this kind of work. For the family Cynoglossidae the important taxonomic works available up to now for this area have been those of Day (1878), Weber and Beaufort, (1929) Norman (1928), Munro (1955) and Punpeka (1964). All these works are of the traditional descriptive type, based in some instances, on a very small number of specimens. During the course of investigations on *Cynoglossus macrostomus* at Calicut the author also examined other species of the genus available in the routine collections and made comparative observations on the species so noticed. It was felt desirable to describe the results of these observations in the absence of published data in the line so far, and the present paper deals with five

species, namely, *Cynoglossus macrostomus* Norman, *C. dubius* Day, *C. bilineatus* (Lacépède), *C. puncticeps* (Richardson) and *C. lida* (Bleeker). As *C. macrostomus* was found to be the most variable, more specimens of this species have been included for this account. Some of the most important morphometric and meristic characters have been selected for this study.

## Material and Methods

The data used here relate to 105 specimens of *C. macrostomus*, 54 specimens of *C. dubius*, 25 specimens of *C. bilineatus*, 31 specimens of *C. puncticeps* and 39 of *C. lida*. The material was collected mainly from Calicut inshore catches, but in the case of *C. macrostomus* and *C. lida*, a few specimens from the nearby northerly centres such as Quilandy have also been included. From the data of the morphometric characters certain ratios commonly used in taxonomy were calculated, *viz.*, head in total length, head in body length, height in total length, height in body length, body length in total length, body height in head length, snout in head length, eye diameter in snout length, eye diameter in head length and interorbital width in eye diameter. Pearson's coefficients of variation (*i.e.* the percentage levels of the Standard Deviations in the Mean values of the ratios) have been used for studying the variability of the ratios. A table of comparative *t* values was prepared for paired combinations of species involved. The meristic characters taken into consideration for the purpose of the present paper were the numbers of dorsal and anal fin rays and the numbers of oblique rows of scales across the body counted along the median lateral line commencing from the cephalic junction or commissure of the lateral lines (this being about 9 to 12 more than the number from the opercular angle to the base of the caudal fin).

The *total length* was measured from the tip of the snout to the end of the longest caudal ray keeping the fish straight on the measuring board. The *body length* (=standard length) was derived by deducting from the total length the length of the caudal fin measured from the tip of this fin to the base of the caudal rays invariably standing out in a clear line against light. The *height* (=depth) of the body was taken as the maximum height behind the head and this was somewhere in the anterior part of the trunk region, the exact position varying to some extent with the species. The *head length* was taken as the straight length from the tip of the snout to the posterior edge of the operculum ignoring any membranous projection in this region. *Head height* was the maximum head height and this happens to be very near the lower opercular angle or curve at the hind region of the head. The *length of the snout* is the straight distance between its tip and the inner anterior angle of the right eye. The *diameter of the eye* is taken as that of the larger eye whenever there was a size difference between the two eyes. The eyes of cynoglossids are of a peculiar structure because of their known ability to protrude or retract as required during use, and among the various species of *Cynoglossus* studied by the author, the apparent size of the eye (or diameter) is subject to coniderable variation merely depending upon the state of protrusion or retraction at the time of preservation or death of the fish.

It has also been found that the same species can show some further variation in view of the fact that the state of protrusion of the eye through the skin after the completion of rotation during metamorphosis can some times be incomplete. In the past, there have been instances of authors having recognised differences in eye size as of specific importance within the genus *Cynoglossus*; Weber and Beaufort (1929) have pointed out the insignificance of the eye size as between certain species in view of the above difficulty; but still this is a character that cannot be completely left out in any ichthyological work and hence this has been measured in all the species studied in this work. The interorbital width is considered as the least distance between the two eyes considering the region of meeting between the eye balls and the skin as the boundary to be measured. Measurements and counts in all cases were taken from material preserved in 4% formaldehyde. Colour and details of shape were noted in the fresh condition wherever possible.

*Identity of the five species used in the work*

For the Indian species of the family Cynoglossidae the most recent and dependable taxonomic account is that of Norman (1928). Weber and Beaufort (1929) include some of the Indian species in their descriptive account of the family but not all of them, and of the present species *C. dubius* is not included in the above work. The work of Punpoka (1964) on the flatfishes of the Gulf of Thailand is the latest detailed taxonomic work on the group in the Indo-Pacific region but here also *C. dubius* is omitted; for descriptions of the species in this work, while this author has used the accounts of earlier authors from India also, it is not always clear whether she examined any fresh Indian material for basing the revised descriptions. However, considering these descriptions for forms common to our waters and Thailand there do not seem to be many differences to contend with, in the case of most of the forms. As Norman's work was based essentially on Indian material it would be more reliable to follow his key for the identifications, those of Punpoka and Weber and Beaufort being used for comparative purposes. Accordingly the present specific identifications are based mainly on Norman though other works have also been studied (see also Seshappa and Bhimachar, 1955, pp. 183 - 184 and Menon, 1971).

The genus *Cynoglossus* is mainly characterised within the Cynoglossidae as follows: This is a cynoglossid with dorsal fin above or in front of eye; no spinous dorsal rays; pelvic fins are without spines; maxillary is without supplemental bone; eyes are on the left side; dorsal and anal fins are confluent with the caudal; pectoral fins are absent. Pre-opercular margin is not free and lips are not fringed. There are two lateral lines on the eyed side.

**Cynoglossus macrostomus** Norman

Table 1 shows the maximum, minimum and mean values of the different ratios studied in the total of 105 specimens of *C. macrostomus*. It may be seen that the least variable of these ratios is the value of body length to total length, the

TABLE 1. *Comparative table of the range, mean values and standard deviations (S.D.) and standard error (S.E.) and Pearson's Coefficient (P.C.) for selected morphometric ratios of five species of* Cynoglossus *from the West coast*

| Species | | *C. macrostonus* | *C. dubius* | *C. puncticeps* | *C. bilineatus* | *C. lida* |
|---|---|---|---|---|---|---|
| Total length | Range (cm) | 17.20—3.40 | 39.30—6.30 | 18.35—9.31 | 29.35—13.00 | 17.68—7.62 |
| Head in total length | Range | 5.97—3.74 | 4.67—3.50 | 6.10—5.25 | 5.14—4.57 | 4.90—4.34 |
| | Mean & S.D. | 4.56±0.33 | 4.15±0.22 | 5.52±0.09 | 4.87±0.14 | 4.64±0.14 |
| | S.E. and P.C. | (0.0319) (7.2) | (0.0304) (5.3) | (0.0339) (3.4) | (0.0282) (2.9) | (0.0226) (3.0) |
| Head in body length | Range | 5.36—3.30 | 4.35—3.19 | 5.60—4.80 | 4.79—4.16 | 4.45—4.00 |
| | Mean & S.D. | 4.05±0.28 | 3.84±0.23 | 5.08±0.19 | 4.48±0.16 | 4.29±0.13 |
| | S.E. and P.C. | (0.0270) (6.9) | (0.0323) (6.0) | (0.0339) (3.7) | (0.0317) (3.6) | (0.0215) (3.0) |
| Height in total length | Range | 4.96—3.78 | 5.18—3.92 | 4.08—3.53 | 4.69—3.95 | 4.84—4.24 |
| | Mean & S.D. | 4.42±0.24 | 4.46±0.24 | 3.83±0.14 | 4.28±0.10 | 4.47±0.15 |
| | S.E. and P.C. | (0.0238) (5.4) | (0.0331) (5.4) | (0.0258) (3.7) | (0.0208) (2.3) | (0.0247) (3.4) |
| Height in body length | Range | 4.45—3.33 | 4.77—3.78 | 3.77—3.27 | 4.09—3.67 | 4.48—3.91 |
| | Mean & S.D. | 3.94±0.22 | 4.13±0.20 | 3.52±0.13 | 3.93±0.12 | 4.14±0.15 |
| | S.E. and P.C. | (0.0221) (5.6) | (0.0274) 4.8) | (0.0235) (3.7) | (0.0241) (3.1) | (0.0241) (3.6) |
| Body length in total length | Range | 1.15—1.10 | 1.11—1.06 | 1.10—1.06 | 1.09—1.07 | 1.09—1.07 |
| | Mean & S.D. | 1.12±0.01 | 1.08±0.01 | 1.09±0.009 | 1.08±0.01 | 1.08±0.01 |
| | S.E. and P.C. | (0.0014) (0.9) | (0.0015) (0.9) | (0.0022) (0.1) | (0.0022) (0.9) | (0.0010) (0.9) |
| Body height in Head length | Range | 1.14—0.83 | 1.30—0.91 | 0.83—0.61 | 0.94—0.82 | 1.04—0.90 |
| | Mean & S.D. | 0.97±0.07 | 1.08±0.09 | 0.70±0.04 | 0.87±0.04 | 0.96±0.03 |
| | S.E. and P.C. | (0.0086) (7.2) | (0.0125) (8.3) | (0.0075) (5.7) | (0.0074) (4.6) | (0.0054) (3.1) |
| Snout in Head length | Range | 4.35—3.06 | 2.44—2.05 | 3.81—3.04 | 2.80—2.33 | 2.42—2.14 |
| | Mean & S.D. | 3.57±0.21 | 2.23±0.08 | 3.38±0.17 | 2.63±0.11 | 2.29±0.06 |
| | S.E. and P.C. | (0.0210) (5.9) | (0.0110) (3.6) | (0.0304) (5.0) | (0.0216) (4.2) | (0.0100) (2.6) |

TABLE 1. (*Contd.*)

| Species | | *C. macrostomus* | *C. dubius* | *C. puncticeps* | *C. bilineatus* | *C. lida* |
|---|---|---|---|---|---|---|
| Eye diameter in | Range | 5.00—2.79 | 9.47—5.36 | 3.95—2.75 | 5.41—4.00 | 6.29—4.59 |
| Snout length | Mean & S.D. | 3.87±0.44 | 6.82±0.82 | 3.40±0.30 | 4.55±0.36 | 5.35±0.41 |
| | S.E. and P.C. | (0.0435) (11.4) | (0.1134) (12.0) | (0.0544) (8.8) | (0.0718) (7.9) | (0.0659) (7.7) |
| Eye diameter in | Range | 17.58—10.67 | 21.76—11.67 | 13.64—9.50 | 13.91—10.25 | 14.29—10.52 |
| Head length | Mean & S.D. | 13.78±1.38 | 14.91±1.58 | 11.44±0.99 | 12.08±0.78 | 12.29±0.81 |
| | S.E. and P.C. | (0.1366) (10.0) | (0.2208) (10.6) | (0.1769) (8.7) | (0.1210) (6.5) | (0.1295) (6.6) |
| Interorbital | Range | 3.00—1.44 | 1.42—0.80 | 2.00—0.90 | 1.50—1.00 | 2.17—1.31 |
| width in eye | Mean & S.D. | 2.13±0.32 | 1.13±0.14 | 1.49±0.29 | 1.29±0.11 | 1.73±0.22 |
| diameter | S.E. and P.C. | (0.0343) (15.0) | (0.0195) (12.4) | (0.0521) (19.5) | (0.0230) (8.5) | (0.0351) (12.7) |

Pearson's coefficient of variation (P.C.) being less than 1%; the most variable ratios are those connected with the eyes, the P.C. ranging from 10% to 15 %. In the case of the remaining characters, the P.C. varied between 5.5% and 7%.

In 62.5% of the specimens the dorsal fin rays numbered between 103 and 105, the mean number for the entire sample being 103.32 and the range of the numbers of fin rays in the dorsal fin being 101 to 108. Only three specimens out of 104 had 101 rays forming 2.9%, a similar percentage having 108 rays, so that the common range of variation of the dorsal fin rays may be said to be 102 to 107, the mean number for the entire sample being much nearer the lower end of the range than the higher end; 22.5% of the sample had fin-ray numbers (dorsal) above 105 while 15.4% had these numbers lower than 103.

The anal fin-rays numbered between 79 and 82, only 6.9% of the sample falling outside this range, 3 specimens having 83 anal rays and 4 specimens having 77 - 78 anal rays. Within the range of 79 - 82 there is no particular dominance of any number all being almost equally represented. The mean number of anal fin-rays in the sample was 80.43.

The frequency distribution of the numbers of the longitudinal series of scales along the lateral line in 82 specimens of *C. macrostomus* shows a rather scattered picture though 37 out of the 82 individuals show 95-98 scales in this row. The mean number of scales along the lateral line from this data is 99.3.

**Cynoglossus dubius** Day

Table 1 shows the values of the selected ratios in the case of 52 specimens of *Cynoglossus dubius*, arranged in the same order as in *C. semifasciatus*. Here also again the most variable characters or ratios were those connected with the eye, and the least variable was the total-length/body-length ratio.

The dorsal fin-rays in *C. dubius* in the different size-groups ranged in number from 107 to 116 - the largest single frequency being of the number 113 - in 21 individuals, the next largest being 114 - in 11 individuals. A total of 40 specimens out of the 54 examined had the fin-rays in the range 112-114. Apart from this, there is no correlation of any obvious kind between the size and the trend of numbers of dorsal fin-rays.

The anal fin-rays range from 83 to 91 in numbers; as many as 20 out of 54 examined showed 88 anal rays, while 39 had these rays in the range of 87-89; 10 specimens had less than 87 anal rays while five only had more than this number. The mean number of anal fin-rays for the whole sample was 87.7.

For the size-wise distribution of the numbers of lateral line scales in *C. dubius*, the number is counted from the beginning of the cephalic commissure; 10-11 scales will have to be subtracted from this to get the number from the region of the opercular

angle or from the posterior end of the head, the counts being actually to the base of the caudal fin (up to the origin of the caudal rays as viewed under a binocular microscope). The numerical range of the scales is from 109 to 119, the maximum of 11 fish out of 45 having 114 scales; 33 out of the 45 specimens had 112 to 116 lateral line scales. The mean number of longitudinal rows of scales for the entire sample was 111.5.

**Cynoglossus bilineatus** (Lacepede)

Twenty five specimens of *C. bilineatus* were examined, and the ranges and the mean values of the different ratios calculated for the different body proportions are shown in Table 1. In this case also it is the ratios concerning the eye and orbit that are found to be most variable.

In the distribution of the frequencies of fin-rays in the dorsal and anal fins in *C. bilineatus* according to size-groups, the dorsal rays vary from 108 to 112 while the anal rays vary from 86 to 89, the greatest frequency being for 110 rays in the case of the dorsal fin and 88 rays in the case of the anal fin. Twenty two out of 25 specimens examined had between 86 and 88 anal rays; 12% of the specimens had 108 dorsal rays, 4% had 109, 8% had 111 and 28% had 112 dorsal fin-rays. The distribution of the numbers in the table appears to be of an abnormal pattern (with a second mode) no doubt because of the relatively small numbers involved; the distribution of the anal rays showed what seems to be a normal pattern, this being perhaps a reflection of the more limited range in the numbers of these fin-rays.

The numbers of scales ranged from 96 to 102, there being no particular pattern or marked mode or modes in the occurrence of the different numbers. However, 98 rays occurred in 6 instances of about 25% of the specimens examined.

**Cynoglossus puncticeps** (Richardson)

The various morphometric ratios for *C. puncticeps* are shown in Table 1 based on the examination of 31 individuals. The eye and orbital characters are again the most variable, the P.C. for eye in snout and eye in head being 8.8% and 8.7% respectively.

The number of anal rays ranged from 75 to 81 while those of the dorsal rays ranged from 96 to 103. Seventy eight rays were found in the anal fin in 34.5% of the specimens examined, and 79.3% of the specimens had rays between 77 and 79; only 10.3% of the individuals had anal rays less than 77 and more than 79 respectively. The highest frequency in the case of the dorsal ray numbers was for 101, in 36.7% of the cases. 16.7% of the individuals had 100 dorsal rays and but for these special trends their distribution may be said to be more or less scattered. The mean numbers of dorsal and anal rays in *C. puncticeps* was 99.9 and 77.9 respectively.

TABLE 2. *Comparative statement of t values for pairs of species, for ten selected ratios of morphometric measurements among five species of* Cynoglossus *of west coast*

(P is $< 0.01$ for all $t$ values above 3 irrespective of the + or — sign, and significant)

| Combinations of species<br>Description of ratios | *C. macrostomus* and *C. dubius* | *C. macrostomus* and *C. puncticeps* | *C. macrostomus* and *C. bilineatus* | *C. macrostomus* and *C. lida* | *C. dubius* and *C. puncticeps* | *C. dubius* and *C. bilineatus* | *C. dubius* and *C. lida* | *C. puncticeps* and *C. bilineatus* | *C. puncticeps* and *C. lida* | *C. bilineatus* and *C. lida* |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Head length in total length | 9.3 | 21.03 | 7.74 | 4.87 | 3. 05 | 17.83 | 15.83 | 16.97 | 19.36 | 3.87 |
| 2. Head in body length | 5.0 | 24.07 | 11.56 | 10.17 | 26.71 | 15.23 | 14.40 | 12.07 | 17.16 | 3.39 |
| 3. Height in total length | 9.80 | 16.81 | 5.36 | 5.25 | 15.00 | 5.37 | 3.39 | 12.69 | 21.57 | 10.84 |
| 4. Height in body length | 5.41 | 13.04 | 0.31 | 8.26 | 16.90 | 5.48 | 1.83 | 12.17 | 20.47 | 8.21 |
| 5. Body length in total length | 19.05 | 13.64 | 5.63 | 11.43 | 1.45 | Mean ratios equal | Mean ratios equal | 1.39 | 1.28 | Mean ratios equal |
| 6. Body height in head length | 2.20 | 23.58 | 8.83 | 0.98 | 26.03 | 14.48 | 8.82 | 20.00 | 13.04 | 9.88 |
| 7. Snout in head length | 32.21 | 5.12 | 30.99 | 55.36 | 24.52 | 9.57 | 1.34 | 12.80 | 34.38 | 14.64 |
| 8. Eye diameter in snout length | 24.30 | 6.61 | 8.10 | 20.25 | 27.13 | 15.68 | 10.23 | 12.67 | 24.09 | 9.45 |
| 9. Eye diameter in head length | 4.35 | 10.19 | 8.21 | 7.91 | 12.02 | 8.77 | 10.24 | 2.42 | 1.75 | 1.04 |
| 10. Inter-orbital width in eye diameter | 25.13 | 10.49 | 20.29 | 8.76 | 6.39 | 5.32 | 14.21 | 3.37 | 5.49 | 9.75 |

The number of lateral line scales in this species ranged from 95 to 108; 33.3% of the specimens forming the largest single group, having 101 scales; owing to the relatively small numbers of fish involved and the rather wide range of the scale rows, the distribution was rather scattered on either side of the modal group.

**Cynoglossus lida (Bleeker)**

The ratios calculated from 39 individuals of *C. lida* are shown in Table 1. It is quite clear that in this species also the ratios relating to the eyes and orbits are the most variable as in other species of the genus.

The number of lateral line scales varies from 93 to 102, the maximum of 25.6% of the individuals for any one number group having 98 scales. Sixteen out of 39 specimens had 97 or 98 scales and the rest of the distribution was more or less scattered. The mean number of lateral line scales in the sample was 97.8.

The dorsal rays vary from 104 to 110 with a maximum of 15 individuals out of 38, *i.e.* 39.5% of the sample, having 107 dorsal rays and 29 out of the 38 (=76.5%) having rays ranging from 106 to 108. The mean number of dorsal rays for the species is 107.4.

The numbers of anal rays range from 81 to 86, 34 of the 38 individuals (=89.5%) having rays from 81 to 84, and 14 of these having 82 rays in the anal fin. The mean number of anal rays in the species is 82.8.

## Comparison of the Five Species

A comparative picture of the various calculated mean ratios of the morphometric characters can be had from Table 1. The table shows that the total length/body length ratio is the least variable in all the five species, the P.C. being 0.1% in *C. puncticeps* and uniformly 0.9% in the other four species. At the other end, the eye and orbit characters are the most variable in all the species, the lowest variation in the series being however seen in *C. bilineatus*. In all the species the percentages of the standard deviation in the mean values (that is, the values of the Pearson's Coefficient of variability) in respect of eye in snout, eye in head and interorbital width in eye diameter, are higher than in the case of any other ratio selected in this study.

In Table 2 are shown the calculated values of *t* for the mean ratios in all paired combinations of the five species; the Probability (P) is known to be significant for all *t* values above 3, and this is the case with most of the comparisons made here.

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