*J. mar. biol. Ass. India*, 1982, **24** (1 & 2) : 106-111

# LENGTH-WEIGHT RELATIONSHIP OF THE FISHES OF THE GENUS *CHIROCENTRUS* CUVIER*

G. LUTHER**

*Central Marine Fisheries Research Institute, Cochin* 682031

ABSTRACT

*Chirocentrus nudus* and *C. dorab* from Palk Bay and Gulf of Mannar around Rameswaram Island were examined for this study. The regressions obtained for the length-weight relationships of male and female from the two localities were compared by analysis of covariance. The rate of growth of juvenile is different from that of adult for *C. nudus*, but it is the same in both for *C. dorab*. Consistent with its relatively slender body form *C. dorab* weighs much less than *C. nudus*. *C. dorab* does not show significant difference in weight between sexes or localities. For *C. nudus*, however, male is heavier than female and fish from Palk Bay is heavier than that from the Gulf of Mannar. The latter could be due to the difference observed in the physiological state of the fish in the two localities.

## INTRODUCTION

INFORMATION on the length-weight relationship is not available for the two species of *Chirocentrus* being exploited in Palk Bay and the Gulf of Mannar around the Rameswaram Island. Though *C. nudus* Swainson and *C. dorab* (Forskal) occurring in these two adjacent localities mix freely and belong to the same stock (Luther and Dharma Raja, 1982), the distribution of fish with mature gonads is not homogeneous between the two localities, more fish in advanced stages of maturity being found in the Gulf of Mannar than in Palk Bay (Luther, 1986). The objective of the present account is to furnish formulae for length-weight relationship for the two species and to compare them for this aspect. An attempt has also been made to understand whether these two species of wolf-herrings show difference in this relation between sexes and the two localities.

Grateful thanks are due to Dr. S. Jones for supervision of this work and to Dr. E. G. Silas for the kind encouragement. The author is grateful to Shri K. Krishna Rao for help extended in the statistical treatment of the data. Thanks are due to Shri K. V. Narayana Rao and Shri T. Jacob for critically reviewing the manuscript.

## MATERIAL AND METHODS

Samples of both the species were collected once a week from the landing centres on the Palk Bay and the Gulf of Mannar around the Rameswaram Island from July 1968 to June 1969. The specimens were measured for length to the caudal fork (in mm), weighed (in gm) and sex examined the in fresh state. Altogether 727 fish of *C. nudus* of the length range 153-832 mm were examined. Out of them 84 males and 314 females in the length ranges of 205-560 mm respectively were from the Palk Bay; and 120 males and 209 females in the length range of 238-560 mm and 350-832 mm respectively were from the Gulf of Mannar. For *C. dorab*, a total of 436 fish of 225-712 mm length range were examined from both the localities. Out of them 83 were males with 242-510 mm length range and 353 were females with 225-712 mm length range.

* Formed a part of Ph. D. Thesis, Andhra University, Waltair.

** *Present address:* Waltair Research Centre of CMFRI, Waltair.

For both the species, the log values of observed weights and lengths showed linear relationship conforming to the well-known equation:

$$\text{Log } W = \text{Log } a + b \text{ (log } L)$$

where W = weight, L = length and 'a' and 'b' are constants. Length-weight relationship was calculated separately for male and female and for fish from the two localities as well as for juvenile and adult wherever it was found necessary. The significance of the difference between the regression coefficients 'a' and 'b' for the samples was tested by Analysis of Covariance method (Snedecor and Cochran, 1968) and the resultant F-value was considered for significance at 5% level.

## Length-Weight Relationship

### *Chirocentrus nudus*

A preliminary plot of the length and weight measurements showed that the same equation would not fit the data for the entire length range, as breaks occurred around lengths of 310 mm for male and 420 mm for female. These lengths represent the sizes at first maturity for the respective sexes (Luther, 1986). Therefore, separate estimates were made for juvenile and adult. Data for juvenile from the two localities were pooled for each sex, because of the small number of fish examined from the Gulf of Mannar. For the adult, however, this relationship was examined separately for each locality and sex, because of the differences in the state of sexual maturity and feeding condition of fish observed between the two localities (Luther, MS 1). The length-weight relationships for the juvenile and adult as well as the respective coefficients of correlation, which are high in each case, are as follows:

*Juvenile*

Male (N = 30) : $\log W = -4.923456 + 2.872955 \log L$ ($r = 0.9855$)

Female (N = 64); $\log W = -5.374376 + 3.049632 \log L$ ($r = 0.9945$)

*Adult*

PB(M) (N = 62) : $\log W = -5.491146 + 3.097682 \log L$ ($r = 0.9913$)

PB(F) (N = 254) : $\log W = -5.825540 + 3.220667 \log L$ ($r = 0.9832$)

GM(M) (N = 112): $\log W = -5.833836 + 3.224009 \log L$ ($r = 0.9882$)

GM(F) (N = 205): $\log W = -5.922688 + 3.251976 \log L$ ($r = 0.9902$)

(PB = Palk Bay; GM = Gulf of Mannar; M = Male, F = Female; N = Number of fish in the sample and r = Coefficient of correlation)

The results of analysis of the two regressions of the juvenile and the four regressions of the adult indicate no significant difference in the comparison of slopes (rate of increase in weight with respect to length) between sexes of juveniles and among samples of adults. But in the comparison for elevations the analysis shows significant difference (Table 1). For juvenile, the regressions indicate that male is heavier than female (Fig. 1 a, b). For adult, however, in order to determine which of the samples contribute to this difference in elevation, two samples at a time, in six combinations, were tested. The results indicate significant difference between sexes and localities in five out of six comparisons, the exception being the samples of female of Palk Bay and male of the Gulf of Mannar (Table 2). The relative differences in the levels of the four regression lines (Fig. 1 e – h) generally indicate that among adult fish also, both male as well as female of Palk Bay are heavier than those of similar length from the Gulf of Mannar and that between sexes of the same locality, male is heavier than female.

TABLE 1. *Analysis of covariance for comparison of regression lines. Data on log Weight (Y) on log fork length (X) for* C. nudus *and* C. dorab. *(Comparisons were made in the case of* C. nudus *between male and female of juvenile; among adult male and female from Palk Bay and the Gulf of Mannar; between adult male and female, irrespective of locality; and between* C. nudus *and* C. dorab)

| Test for equality of | Source of variation | *C. nudus* (J) M:F | | | | *C. nudus* (A) M:F PB:GM | | | | *C. nudus* (A) M:F | | | | *C. nudus* : *C. dorab* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | df | SS | MS | F | df | SS | MS | F | df | SS | MS | F | df | SS | MS | F |
| Regression Coefficients | Deviation from hypothesis | 1 | 0.0014 | 0.0014 | 1.75 (NS) | 3 | 0.0043 | 0.0014 | 1.4 (NS) | 1 | 0.0011 | 0.0011 | 1.10 (NS) | 1 | 0.0005 | 0.0005 | (NS) |
| | Residuals due to separate regressions | 90 | 0.0744 | 0.0008 | | 625 | 0.6181 | 0.0010 | | 629 | 0.6407 | 0.0010 | | 1065 | 1.2393 | 0.0012 | |
| | Residuals due to pooled regressions (W) | 91 | 0.0758 | 0.0008 | | 628 | 0.6224 | 0.0010 | | 630 | 0.6418 | 0.0010 | | 1066 | 1.2398 | 0.0002 | |
| Elevations | Deviation from hypothesis | 1 | 0.0055 | 0.0055 | 6.1 (S) | 3 | 0.0242 | 0.0081 | 8.1 (S) | 1 | 0.0048 | 0.0048 | 4.8 (S) | 1 | 4.0535 | 4.0535 | '3378 (S) |
| | Residuals to common regression | 92 | 0.0813 | | | 631 | 0.6466 | | | 631 | 0.6466 | | | 1067 | 5.2933 | | |

(J = Juvenile; A = Adult; M = Male; F = Female; PB = Palk Bay ; GM = Gulf of Mannar) NS = Not significant; S = Significant.

TABLE 2. *Analaysis of covariance for comparison of regressions of* C. nudus. *Data of log Weight (Y) on log fork length (X) in the adult male and female from Palk Bay and the Gulf of Mannar : Comparison of elevations*

| Locality | Sex | *Deviations from total* df | SS | df | *Deviations from individual* S S | MS | df | *Difference* SS | MS | F–value |
|---|---|---|---|---|---|---|---|---|---|---|
| PB<br>PB | male<br>female | 314 | 0.335980 | 313 | 0.331367 | 0.001059 | 1 | 0.004613 | 0.004613 | 4.36 (S) |
| PB<br>GM | male<br>male | 172 | 0.145754 | 171 | 0.139774 | 0.000817 | 1 | 0.005980 | 0.005980 | 7.32 (S) |
| PB<br>GM | male<br>female | 265 | 0.248524 | 264 | 0.232290 | 0.000880 | 1 | 0.016234 | 0.016234 | 18.45 (S) |
| PB<br>GM | female<br>male | 364 | 0.390130 | 363 | 0.390111 | 0.001075 | 1 | 0.000019 | 0.000019 | < 1 (NS) |
| PB<br>GM | female<br>female | 457 | 0.494975 | 456 | 0.481050 | 0.001055 | 1 | 0.013925 | 0.013925 | 13.20 (S) |
| GM<br>GM | male<br>female | 315 | 0.297940 | 314 | 0.289605 | 0.000922 | 1 | 0.008335 | 0.008335 | 9.04 (S) |

S = Significant; NS = Not significant PB = Palk Bay; GM = Gulf of Mannar.

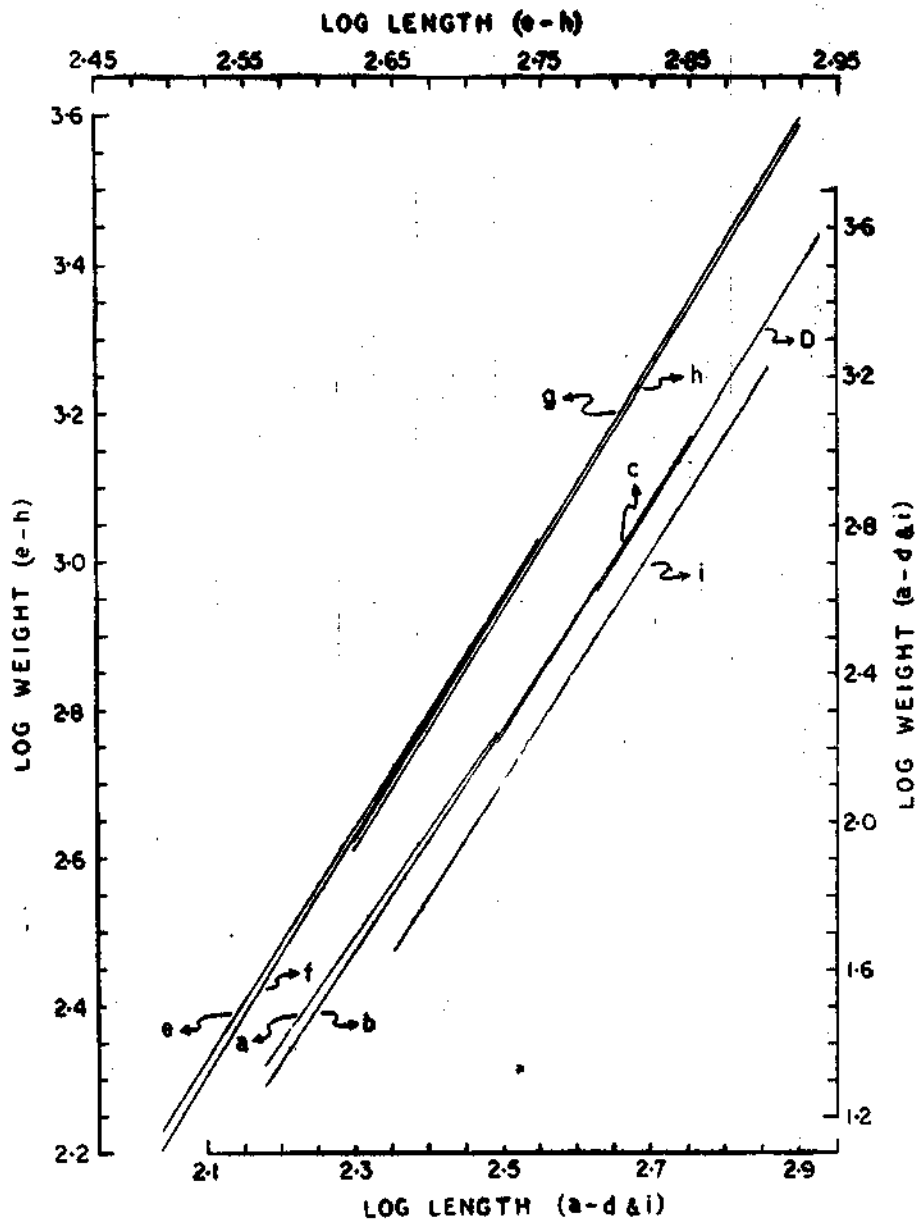


Fig. 1. Logarithmic relationship between length and weight of *C. nudus* (a-h) and *C. dorab* (i) from Palk Bay and the Gulf of Mannar. Regression lines a-d and i are drawn to one scale and the rest are drawn to a different scale. a,b: Regression lines of juvenile male (a) and female (b) of *C. nudus* (data pooled for Palk Bay and the Gulf of Mannar), c, d: Regression lines for adult male (c) and female (d) of *C. nudus* (data pooled for Palk Bay and Gulf of Mannar), e-h: Regression lines for adult *C. nudus* separately for male and female from Palk Bay and the Gulf of Mannar(e). Male from Palk Bay : (f). Male from the Gulf of Mannar; (g). Female from Palk Bay and (h). Female from Gulf of Mannar. (i) Regression line for *C. dorab* (data pooled for the whole size range, sexes and for the two localities).

The author (Luther, 1986 MS) has observed the fish from Palk Bay to be relatively better fed and at a lower level of gonadal maturity with its associated lesser strain on the fish, as also to be with a higher amount of fat deposition over the viscera, compared with those from the Gulf of Mannar. These differences in the physiological state of the fish in the two localities could have contributed to the relatively heavier weight for fish from Palk Bay.

In view of the above, the data for adults of each sex were pooled irrespective of the locality to examine whether male would differ from female, in general, in the length-weight relationship. The two equations are as follows:

Male (N = 174) : log W = −5.655208 + 3.157733 log L (r = 0.9890)

Female (N = 459) : log W = −5.786414 + 3.204472 log L (r = 0.9880)

Comparison of the two regressions (Table 1) show no significant difference between the slopes, but show significant difference between the elevations indicating that male is heavier than female (Fig. 1 c, d).

The common length-weight relations, irrespective of sex and locality as mentioned below are, however, worked out for the juvenile and adult fish to facilitate obtaining overage weight of fish at different lengths and for the purpose of comparison with those from other localities and related species:

Juvenile (N = 94): log W = −5.249000 + 3.001798 log.L (r = 0.9942)

Adult (N = 633) : log W = −5.686559 + 3.168297 Log L (r = 0.9918)

*C. dorab*

A preliminary plot of the length and weight measurements indicated that a single equation would fit the data for both the juvenile and adult. Hence data on both these categories were pooled for further analysis. On testing the significance of the difference between the regression coefficients 'a' and 'b' for the four sets of samples it is seen that the comparison of slopes and of the elevations gave F-values that are not significant. Hence the length-weight data were pooled and the relation was found to be:

Log W = −5.767724 + 3.151180 log L (r = 0.9889)

### Comparison of the Length-Weight Relationship

For this purpose, the data for adults of *C. nudus* of both sexes and localities were pooled and compared with that of *C. dorab*. The significance of the difference between the regression coefficients 'a' and 'b' for these two samples was tested by analysis of covariance. The results show no significant difference in the comparison of slopes. But in the comparison of elevations the analysis shows the difference to be highly significant (Table 1). This could be readily observed by comparing regressions a - d with i in Fig. 1. The average weights of the two species in gm at each successive 100 mm fork length starting with 150 mm, with those of *C. dorab* given in parenthesis are as follows: 19 (12), 89 (62), 244 (177), 524 (392), 990 (737), 1681 (1248), 2645 (1962). Thus, for the same length of fish *C. nudus* is quite heavier than *C. dorab*.

### References


Luther, G. 1986. Reproductive biology of the fishes of the genus *Chirocentrus* Cuvier. *In:* P. S. B. R. James (Ed.) *Recent Advances in Marine Biology*. Today and Tomorrow's Printers & Publishers, New Delhi.

Luther, G. (MS 1). Food and feeding habits of the fishes of the genus *Chirocentrus* Cuvier. *Indian J. Fish.* (In press).

Luther, G and S. K. Dharma Raja 1982. Population studies on the fishes of the genus *Chirocentrus* Cuvier. *J. mar. biol. Ass. India*, **24** (1 & 2): 118–123.

Snedecor, G. W. and W. G. Cochran 1968. *Statistical Methods*. Oxford IBH Publishing Co, Calcutta, 593 pp.