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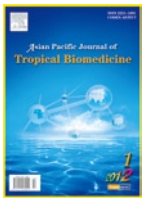

Document heading

Length-weight relationship and morphometrics of the sailfish, *Istiophorus platypterus* (Shaw & Nodder) from Parangipettai, Southeast coast of India

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ABSTRACT

Objective: To obtain the morphometric characters and to determine the length-weight relationship for the sailfish captured off from Parangipettai, Tamil Nadu, Southeast coast of India. **Methods:** Samples of the sailfish were collected from the landing centre of this region during July 2010 to June 2011 using longline, gillnet and handline through commercial vessels. Salient morphometric and meristic characters were also measured (cm). **Results:** The total length recorded in the present study was ranged between 92 and 385 cm (mean 244.30±15.08). The I dorsal fin base was varied from 18 to 145 cm (mean 98.40±3.21); I dorsal ray fin height from1.4 to 21 cm (mean 10.30±0.30); last ray fin length from 0.9 to 16 cm (mean 8.30±0.05) and the highest ray length from 28.2 to 126 cm (mean 85.60±2.15). The linear regression analysis was also executed to study the length-weight relationship; the '*r*' value for the sailfish from this region was found to be 0.986 6 and the regression equation Log W= -5.4431 $L^{3.007}$. **Conclusions:** In the present study, the slope value (b) was in the expected '3' that indicates a fish becomes more slender as it increases in length. Further the slope value which is greater than 3 denoting stoutness or allometric growth. However, deviation from isometric growth is often observed, as most fish change their body shape as they grow.

1. Introduction

The Indo-Pacific Sailfish *Istiophorus platypterus* (*I. platypterus*) (Shaw and Nodder, 1792) (Family (Istiophoridae) is one of the world's charismatic fish species and cosmopolitan in nature. Report on the fishing effort and size groups of the sailfish in the landings are essential[1]. The sailfish is currently emerging as a significant billfish fishery along the Indian coast[2] and they are captured using hooks and longlines in India. The billfish (including sailfish) catch was 8 303 tonnes in the year 2010[3] and their resources along the Indian coast has been reported[1-7]. Meanwhile, studies on sailfish from Parangipettai region are also available on distribution[8] and dietary composition[9]. Being an important factor in the biological study of fishes and their stock assessments, the length-weight relationship (LWR) plays a significant role in parameterizing yield equations and in the estimations of stock size[10] and this relationship can also be used for the studies on gonad development, feeding rate, metamorphosis, maturity and condition[11]. The present study is on the salient morphometric parameters and length-weight relationship of the sailfish (*I. platypterus*) from Parangipettai coast (Tamil Nadu), southeast coast of India.

2. Materials and methods

A total of 130 sailfishes (*I. platypterus*) were measured and weighed (Length: 92 cm to 385 cm TL; weight: 2.5 kg to 105 kg, respectively) from the landing centre at Parangipettai (Lat. 11° 29′ N; Long. 79° 46′E) during the study period (July 2010 to June 2011). In this region, the fishing gears used include drift gillnets/ longline gears. Total length of the sailfish was measured from the tip of the snout to the extended tip of the caudal fin. Total weight of individual fish was gauged to the nearest gram with an electronic balance after the removal of excess water from surface of the body. Salient morphometric and meristic characters were also measured (cm). Identification of species was made based on FAO Species Identification Sheets[12]. The length-weight relationship (LWR) was estimated by using the equation W

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$= aL^b$ where W = weight in kilograms, L = total length in centimeters, 'a' is a scaling constant and b the allometric growth parameter. Logarithmic transformation was used to understand the linear relationship:

log W = log a + log b L regression was used for each species to estimate the intercept (Log a) and the regression coefficient or slope (b), using Microsoft Excel spread sheet.

3. Results

3.1. Morphometric and meristic characters of the Sailfish

Various parameters of the morphometric and meristic characters of the sailfish, *I. platypterus* are presented in Table 1 & 2, respectively and the simulated I Dorsal fin of the sailfish is also shown in Figure 1 & 2. The total length recorded in the present study was ranged between 92 and 385 cm (mean 244.30±15.08). The length of upper jaw and lower jaw among sailfishes varied between 19 and 138 cm (mean 77.90±2.60) and 7 to 68.8 cm (mean 38.40±1.40), respectively(Table 1). The characteristic feature of the I Dorsal fin base varied from 18 to 145 cm (mean 98.40±3.21); I Dorsal ray fin height from 1.4 to 21 cm (mean 10.30±0.30); last ray fin length from 0.9 to 16 cm(mean 8.30±0.05) and the highest ray length was 28.2 to 126 cm (mean 85.60±2.15) (Figure 1 & 2). The meristic characters of the sailfish are presented in Table 2. The I Dorsal fin ray count varied from 42 to 48 (mean 45.00± 2.00) (Figure 1&2).

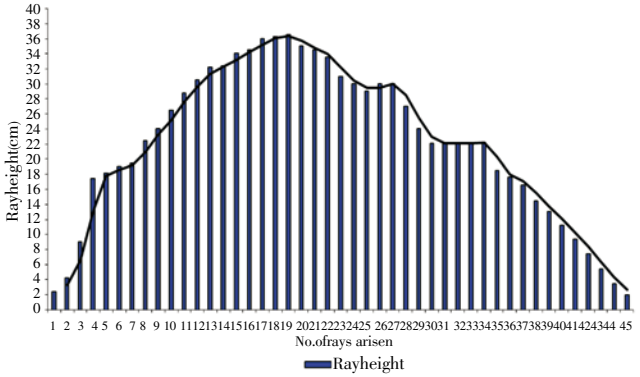

Figure 1. Simulated model of the 1st dorsal fin of the sailfish (Total length 122 cm).

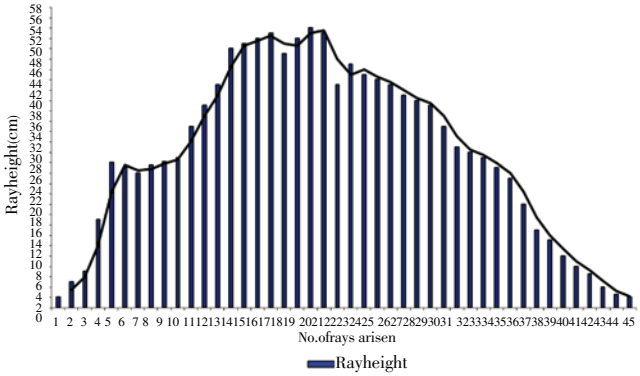

Figure 2. Simulated model of the 1st dorsal fin of the sailfish (Total length 186 cm).

Table 1.
Morphmetric characters of the sailfish recorded.

Parameters		Range(cm)	Mean±SD(cm)
Total length		92.0–385.0	244.30±15.08
Head length		18.0–130.0	80.90±5.89
Snout length		13.0–91.0	55.60±4.57
Eye diameter–total		0.9–8.5	4.40±0.30
Eye diameter–retina		0.4–6.8	2.80±0.41
Upper jaw length		19.0–138.0	77.90±2.60
Lower jaw length		7.0–68.8	38.40±1.40
Body depth near pectoral		15.0–38.0	29.70±1.43
Body depth near anal		5.1–20.5	13.50±0.84
Body depth near flipper		3.9–19.5	11.90±0.72
Eye orbit –Fork length		65.0–294.0	181.10±3.70
I Dorsal–Fork length		27.0–245.0	142.80±4.03
Pectoral fin length		29.0–125.0	78.50±8.07
Pectoral–I dorsal length		4.8–25.0	18.00±0.85
Pectoral –anal length(I)		22.0–81.0	54.50±0.38
Pelvic fin length		12.0–60.0	45.90±0.03
1st Dorsal fin length	Base length	18.0–145.0	98.40±3.21
	1st ray height	1.4–21.0	10.30±0.30
	Last ray height	0.9–16.0	8.30±0.05
	Highest ray length	28.2–126.0	85.60±2.15
	Inter distance of rays	0.8–2.5	1.50±0.08
	2nd dorsal fin height	1.7–18.0	11.50±0.53
	2nd dorsal fin base	3.7–15.0	9.40±0.51
	pelvic fin groove length	21.0–85.0	54.70±2.63
	Flipper base length	10.8–20.0	13.40±3.19
	Flipper height	0.8–5.0	1.80±0.34
	caudal fin length	13.0–55.0	43.70±1.32
	Caudal fin inter distance	17.0–53.0	43.60±1.45
	Lateral line straight	31.0–180.0	109.30±2.20
	Lateral line 1st curve	1.9–18.0	11.80±0.20
	Lateral line 2nd curve	1.7–17.0	10.50±0.03

Table 2.
Meristic characters of the sailfish recorded.

Parameters	Range(cm)	Mean±SD(cm)
1st dorsal fin ray count	42– 48	45.00±2.06
2nd dorsal fin ray count	6–7	7.00±0.52
Pectoral fin	17–20	19.00±1.29
Pelvic fin	2	2.00±0.00
Anal fin (I)	12 –15	14.00±1.32
Caudal fin	6 –7	7.00±0.52

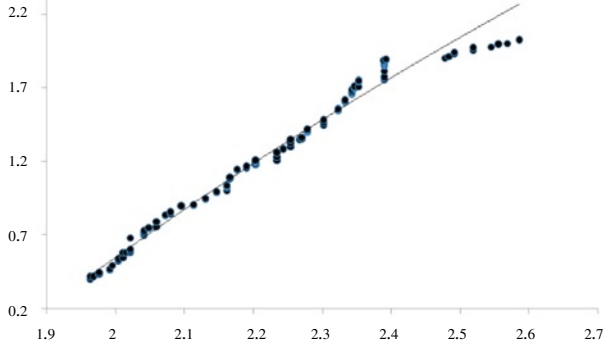

Figure 3. Length– weight relationship in the sailfish.

3.2. Length- weight relationship

The regression line obtained from the data revealed a linear relationship between the two variables *viz*., length and weight (Figure 3). The points lied more or less close to the line and possessed a close relationship between the two variables. Additionally the correlation analysis was closely related to regression analysis and so the correlation coefficient (*r*) value was also calculated. The *r* value for the sailfish *I. platypterus* was 0.9866 and the regression equation was:

$$\text{Log } W = -5.4431\ L^{3.007}$$

4. Discussion

Sailfish is considered to be one among the fastest fish in the world and has been measured in excess of 110 km/h (68 mph) over short periods. The characteristic feature of the sailfishes is mainly through their enormous sail-like I dorsal fin which is taller than its body and that runs almost the length of its body. This prominent dorsal fin also provides erectile and stability when raised, but can be flattened into a groove along the back to reduce drag during explodes of speed. In the present study, each risen ray of the I dorsal fin were counted with the range of 42 to 48 and ray height were plotted and simulated. From this observation, the original shape and structure of the I dorsal fin could be noticed. Regarding the morphometric measurements for the sailfish, very few attempts were made by Lenarz *et al*[13]. It is reported 66 cm- 236 cm total length from Western Atlantic waters[14], 107 cm to 288 cm total length from Northeastern Brazil waters and 147 cm to 246 cm total length[15] from Arabian Gulf waters. In the present study, the sailfish was measured with the range of 92 cm to 385 cm total length.

More attempts on length- weight relationship for the sailfish (*I. platypterus*) were made by Freire *et al*[14] (Western Atlantic waters), Hoolihan *et al*[15] (Arabian Gulf) and Wang *et al*[16] (Taiwan waters). Hile (1936) and Martin (1949) reported the value of the exponent (slope) 'b' in the parabolic equation usually lied between 2.5 and 4.0[17,18]. For an ideal fish which maintains a constant shape, b=3.0[19]. In the present study, the slope value (b) was in the expected '3' that indicates a fish becomes more slender as it increases in length. Pauly[20] described that a slope value greater than 3 denotes stoutness or allometric growth. However, deviation from isometric growth is often observed, as most fish change their body shape as they grow[21].

The distribution, growth, and mortality of sailfish *I. platypterus*, larvae in the northern Gulf of Mexico were studied[22]. Mean density for all neuston net collections (n=288) combined was 1.5 sailfish per 1 000 m^2, and maximum density was observed within frontal features created by hydrodynamic convergence (2.3 sailfish per 1 000 m^2) and the *Sagittal otoliths* extracted from 1 330 larvae, and otolith microstructure analysis indicated that the sailfish ranged in age from 4 to 24 days after hatching (mean=10.5 d, standard de-viation=3.2 d). Instantaneous growth coefficients (g) among survey periods (n=5) ranged from 0.113 to 0.127[22]. In the length distributions, weight-length relationships and sex ratios at lengths for the billfishes in Taiwan Waters, the results of likelihood ratio tests indicated that the length-weight relationship did not differ significantly between sexes for all the billfishes (P = 0.79-0.96)[16].

Age and growth of Indo-Pacific sailfish, *I. platypterus*, from the Arabian Gulf were performed[15]. In which the relationships of measured morphological traits to LJFL derived from the non-linear equation Y = a LJFLb their regression coefficients showed a negative allometric growth for weight, head, and pelvic fin length. Most other measurements were effectively isometric, with the exception of the anal fin in males, which showed positive allometric growth[15].

Conflict of interest statement

We declare that we have no conflict of interest.

Acknowledgements

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