Research Communications

Aspect ratio of marine fishes from India

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Abstract

Fish morphometrics is an important aspect in fish taxonomy and fish biology studies. The aspect ratio (A) of fishes is related to metabolism and food consumption. It is also as an attribute for determining swimming speed that influences escape from predators and resulting survival in the wild. In this study the aspect ratio of 54 species of commonly exploited marine fishes using a manual graph method that can be used for comparisons across species is presented. Unlike digital imaging methods, this procedure does not involve the 'perspective' and 'distortion' errors which means that it can be used even for fishes with large caudal fins and allows results to be compared with other studies.

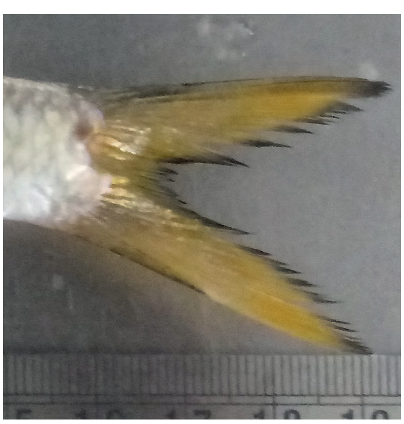
Key words: Aspect ratio, marine fishes, graph method

Introduction

Eco-morphological studies in fishes focus on species specific patterns. Feeding related morphological traits in fishes include caudal tail characteristics besides mouth gape and gut length. Empirical models to obtain food consumption estimates require information on the fish feeding habit (herbivore, omnivore, detritivore, carnivore), metabolism (preferred temperature), level of activity (swimming speed, fin shape and life history) inputs have been developed (Froese and Pauly, 2019).

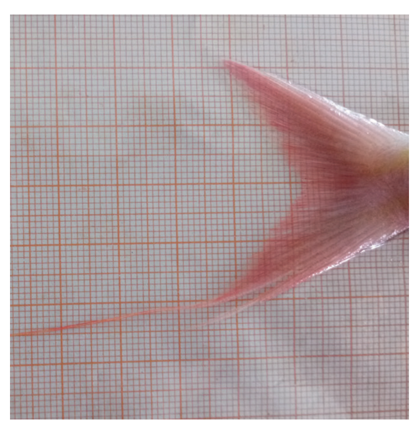
Fin shape and Aspect ratio (A)

Aspect ratio (A) is influenced by fin shapes which differ among different fish families and species. Fish samples were collected from trawl, gillnet and ring seine landings and individual fish lengths (in cm) and weight (in grams) were recorded. 54 fish species from 23 families were taken for the study. Of these, 34 were pelagic species belonging to 11 families and 20 were demersal species from 12 families (Table 1). The tail shapes of fishes were classified as rounded, truncate, emarginated, forked or

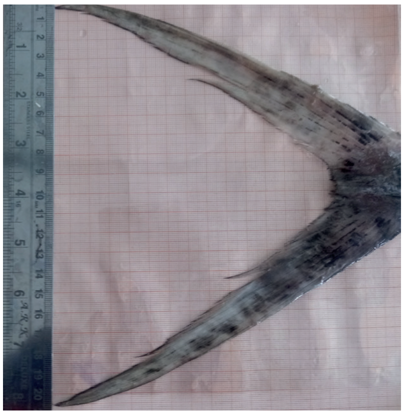


Thryssa mystax (EvenlyForked)

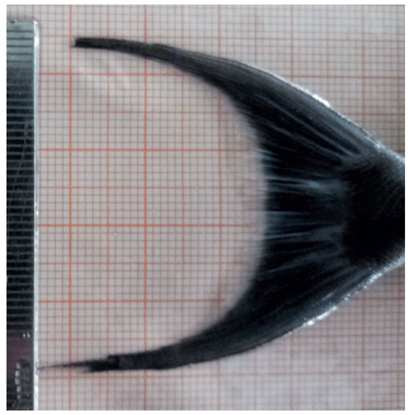
Cheilopogon furcatus (Unevenly forked)



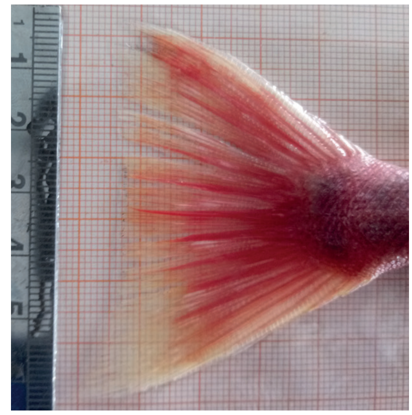
Nemipterus japonicus (Forked)



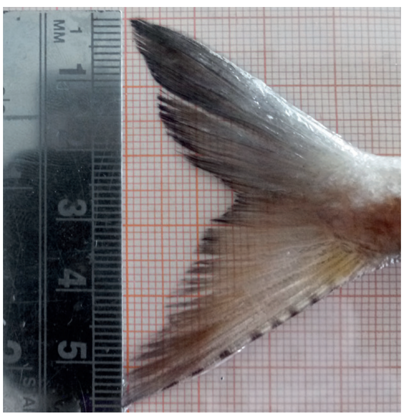
Istiophorus platypterus (Lunate)



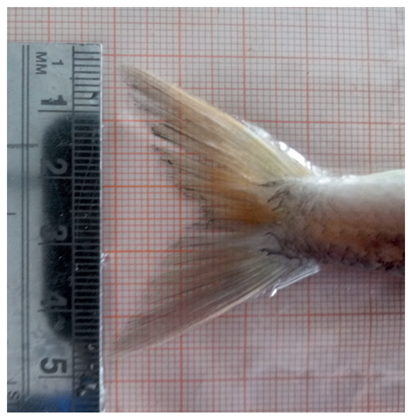
Odonus niger (Lunate)



Priacanthus hamrur (Truncate)



Trachinocephalus myops (Emarginate)



Saurida undosquamis (Emarginate)

Sphyraena forsteri (Emarginate)

Figure.1. various fin shapes recorded in fishes

lunate (Figure1) and Aspect ratio was calculated using the equation

$A=h^2/s$

Where h pertains to the height of the caudal fin and s (shaded aread) is its surface area (Fig.2) following Sambilay (1990).

For the calculation of A, the caudal fin was spread out on a glass paper and the exact shape drawn. These individual sketches which were transferred to a graph paper and calculation as per the formula given above was done for each fish.

Caudal fin is the most important factor determining locomotor activities in fish especially in pelagics. Pelagic fishes with higher aspect ratio were active fishes with high metabolic rates (scombroids) while fishes with lower metabolism (belonids, clupeids) had lower aspect ratio (Table 1). Full beaks, flying fishes and half beaks (Belonidae,

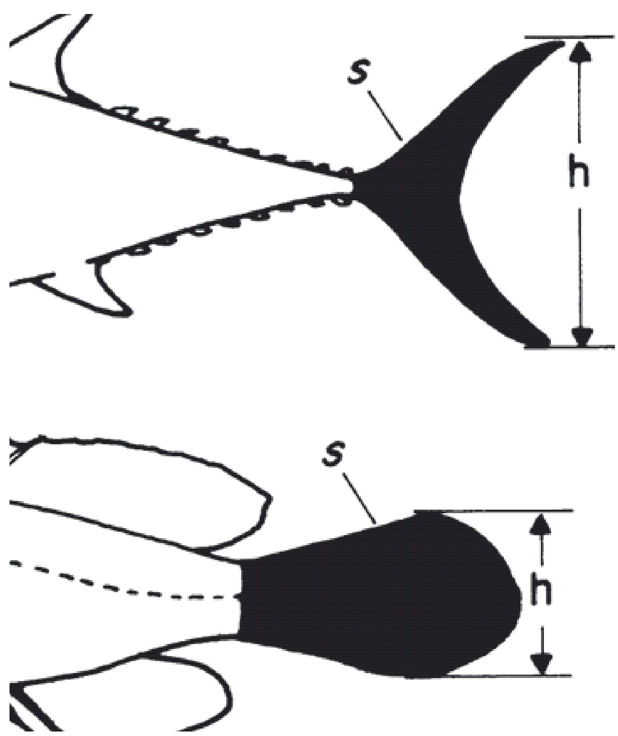


Fig.2. Aspect ratio calculation

Table.1 Aspect ratio of pelagic fishes

Species	Family	Common name	A
Strongylura strongylura	Belonidae	Spottail needlefish	1.1
Strongylura incisa	Belonidae	Reef needlefish	1.25
Rhynchorhamphus malabaricus	Hemiramphidae	Malabar half-beak	1.75
Hemiramphus lutkei	Hemiramphidae	Lutke's half-beak	1.92
Dactyloptena orientalis	Dactylopteridae	Oriental flying gurnard	1.921
Hyporhamphus quoyi	Belonidae	Quoy's garfish	2
Escualosa thoracata	Clupeidae	White sardine	2.06
Encrasicholina devisi	Engraulidae	Devis anchovy	2.07
Stolephorus commersonni	Engraulidae	Commerson's anchovy	2.13
Cypselurus poecilopterus	Exocoetidae	Yellowring flyingfish	2.22
Strongylura leiura	Belonidae	Banded needlefish	2.266
Opisthopterus tardoore	Pristigasteridae	Tardoore	2.4
Alepes vari	Carangidae	Herring scad	2.48
Caranx heberi	Carangidae	Blacktip trevally	2.49
Thryssa mystax	Engraulidae	Moustached thryssa	2.5
Alepes djedaba	Carangidae	Shrimp scad	2.6
Ablennes hians	Belonidae	Flat needlefish	2.71
Sphyraena forsteri	Sphyraenidae	Bigeye barracuda	2.73
Hemiramphus far	Hemiramphidae	Blackbarred halfbeak	2.99
Caranx ignobilis	Carangidae	Giant trevally	3.15
Seriolina nigrofasciata	Carangidae	Blackbanded trevally	3.21
Megalaspis cordyla	Carangidae	Torpedo scad	3.38
Rastrelliger kanagurta	Scombridae	Indian mackerel	3.38
Alepes kleinii	Carangidae	Razorbelly scad	3.5
Sardinella longiceps	Clupeidae	Indian oil sardine	3.5
Cheilopogon furcatus	Exocoetidae	Spotfin flying fish	3.8
Selar crumenophthalmus	Carangidae	Bigeye scad	3.89
Scomberoides commersonnianus	Carangidae	Talang queenfish	4.15
Decapterus russelli	Carangidae	Indian scad	4.38
Anodontostoma chacunda	Clupeidae	Gizzard shad	4.57
Auxis thazard	Scombridae	Frigate tuna	5.9
Istiophorus platypterus	Istiophoridae	Indo-Pacific sailfish	6.15
Katsuwonus pelamis	Scombridae	Skipjack	6.84
Thunnus albacares	Scombridae	Yellowfin tuna	8.76

dactylopteridae, Hemiramphidae) had A ranging from 1.1 to 3.38. The carangids had a wide range of A from 2.5 in *A.vari* to 4.4 in *D. russelli*. This group classified as scads, trevallies, leather jackets and queen fishes have diverse morphometrics and resulting life history traits (maximum body size attained, schooling or solitary nature, preferring deep sea or shallow/coastal habitats). In Clupeidae A was lowest in *E.thoracata* (2.06) and highest in *A.chacunda* (4.57). In family scombridae (tunas) A ranged from 5.9 in the largely coastal, frigate tuna *Auxis thazard* to 8.76 in the oceanic yellowfin tuna (*Thunnus albacares*). The sail fish (*Istiophorus platypterus*) found in the coastal and oceanic water had A of 6.15. With speeds of nearly 70 mph, the sailfish is reportedly the fastest fish in the ocean

Table 2. Aspect ratio of demersal fishes

Species	Family	Common name	A
Johnius glaucus	Sciaenidae	Pale spotfin croaker	0.75
Kathala axillaris	Sciaenidae	Kathala croaker	1.3
Nemipterus randalli	Nemipteridae	Randall's threadfin bream	1.36
Epinephelus quoyanus	Serranidae	Longfin grouper	1.38
Psammoperca waigiensis	Latidae	Waigieu seaperch	1.61
Epinephelus chlorostigma	Serranidae	Brownspotted grouper	1.67
Odonus niger	Balistidae	Red-toothed triggerfish	1.77
Priacanthus hamrur	Priacanthidae	Moontail bullseye	1.84
Pampus argenteus	Stromateidae	Silver pomfret	1.96
Sufflamen fraenatum	Balistidae	Masked triggerfish	2.45
Nemipterus japonicus	Nemipteridae	Japanese threadfin bream	2.53
Trachinocephalus myops	Synodontidae	Snakefish	2.81
Lactarius lactarius	Lactariidae	False trevally	2.86
Saurida undosquamis	Synodontidae	Brushtooth lizardfish	2.95
Saurida tumbil	Synodontidae	Greater lizardfish	3.02
Otolithes ruber	Sciaenidae	Tigertooth croaker	3.6
Pristipomoides typus	Lutjanidae	Sharptooth jobfish	3.74
Otolithes cuvieri	Sciaenidae	Lesser tigertooth croaker	3.87
Mene maculata	Menidae	Moonfish	3.93
Arius subrostratus	Ariidae	Shovelnose sea catfish	4.47

(https://oceanservice.noaa.gov/facts/fastest-fish.html) while the barracuda is a sprinter, capable of bursts of speed in pursuit of prey. Among demersal fishes, A ranged from 0.75-4.47. Sciaenidae and serranidae had the lowest A with *Johnius glaucus* having 0.7 and *Arius subrostratus* with 4.47 (Table 2). Swimming speed, acceleration and manoeuvrability of the fishes is affected by A with high values in fishes showing long-distance 'cruising' or rapid acceleration (eg. tunas) and low aspect ratios in fishes with slower movements and greater manoeuvrability (eg. groupers). The habitats of these two groups are very different being the open ocean and coral reefs respectively. The carangids had a wide range of A from 2.5 in *A.vari* 4.4 in *D. russelli*. This is probably because the various species in the group classified as scads, trevallies, leather jackets and queen fishes are of various characteristics (maximum body size attained, schooling or solitary nature, preferring deep sea or shallow/coastal habitats). Groupers (family Serranidae) are essentially ambush predators, and the thrust provided by low aspect ratios for occasional bursts of speed to capture prey is considered more beneficial than the swimming efficiency provided by a high aspect ratio.

Review of literature of the species wise estimates of A indicated regional influences in different databases. Such differences may largely be due to methods used and inherent measurement errors across these studies reporting A values. Drawbacks of the digital imaging technology in fish morphometrics is the perspective (specimen orientation related) and distortion (equipment related) errors that occur which can lead to inaccurate images and faulty results from a digital image based morphometric analysis (Muir *et al*., 2012). However, the manual graph method avoids this pitfall and also allows results to be compared across studies. This is indicating that the methodology can be applied with more species or locations and results can be compared to arrive at inputs required for ecosystem modelling exercises with specific reference to Indian seas for which such information is limited.

References

Froese, R and D. Pauly (editors) 2019. FishBase world wide web electronic publications www.fishbase.org (02/2019)

Sambilay, JR, V. C.1990. *Fishbyte, ICLARM Contribution no 689*, p.16-20

Muir *et al*., 2012. *Trans. Am. Fish. Soc.*,141(4): 1161 -1170