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Mangrove red snapper harvested after cage culture through CBA.
(Photo Credit: Anuraj, A.)

Marine Fisheries Information Service Technical and Extension Series envisages dissemination of information on marine fishery resources based on research results to the planners, industry and fish farmers, and transfer of technology from laboratory to the field.

MFIS

Marine Fisheries Information Service
Technical & Extension Series

From the Editorial Board

Warm greetings to all our esteemed readers

The marine fisheries sector in India has a rich natural resource base comprising more than 800 species of commercial importance, spread in fish landings over a long coastline of nearly 8000 km. Of the total fish diverstity in India,the marine fishes constitute 76% with 2,443 species belonging to 927 genera and as many as 91 endemic species in coastal waters. The valuation of marine fish landings in India at the landing centre was an estimated ₹52636 crores in 2018. Fish and fish products emerged as the largest group in agricultural exports from India in 2019, and a substantial portion was contributed by the marine fisheries sector. Realising the merit in sustainable exploitation of the fishery resources, the fisheries management regime in India is increasingly moving from an 'open-access' dominated nature towards regulated fisheries. Unique fisheries management templates for India with its basis on local socio-economic dimensions and human development needs are required. Innovative technologies in open sea cage farming as well as low-cost cages suitable in estuarine and coastal areas have emerged from research institutions and need to be taken to the fishermen and fish farmers in a big way to achieve the target of a Blue Revolution. Against this backdrop, some research insights are presented in this issue of MFIS

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Contents

Economic efficiency of inboard ring seine fishery of Ernakulam District, Kerala

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Abstract

The economic sustainability of marine fishing and livelihood security of fishers largely depend on the economic viability of fishing operations. The inboard ring seiners are one of the major fishing gears employed by the traditional fishermen for harvesting small pelagic fishes in Kerala. An economic analysis of the inboard ring seine operations in Ernakulam District revealed that although the gross revenue earned by these fishing units increased in nominal terms during 2014-2018 period, there was downward trend in the economic efficiency. The net operating income per fishing trip declined from ₹59,936 in 2014 to ₹33,527 in 2018 with pronounced rise in fishing costs from ₹88,806 in 2014 to ₹1,28,749 in 2018. The increase in the size of craft, gear and engine horse power contributed to enhanced fishing capacity and fuel costs and it is highly imperative to standardise the capacity of these fishing units to achieve optimal input use efficiency.

Keywords*: inboard ring seiners, economic efficiency, Kerala*

Introduction

Ring seine is the most important gear employed for harvesting small pelagic fishes like sardines, mackerels and anchovies along the Kerala coast. Ring seine, an encircling net, was first introduced in Alappuzha District in Kerala during 1985 as a technologically improved version of the traditional boat seine (*thanguvala*) (Sathiadhas *et al*., 1993). There has been a trend of increasing the capacity of the craft, gear and engine over the years and many of the inboard ring seiners (IBRS) currently operate with engines of capacities more than 400 HP. Medium sized boats (*vallom*), fitted with OB engines of 25 hp and above are being used as carrier vessels by these fishing units (Abdussamad *et al.*, 2015). The dwindling catches of many of the marine fishes coupled with increasing fishing costs are serious issues of concern in the marine fishing sector of Kerala. The catch of inboard ring seiners in Kerala declined from 73194 t in 2014 to 52471 t in 2016 and then increased to 1.65 lakh t in 2018 as per the fish landings estimated annually by the Fishery Resources Assessment Division of ICAR-CMFRI. The economic efficiency of fishing units decide the sustainability of the fishing operations and livelihood security of fishers. Hence, based on the data collected during 2014-2018 period an analysis of economic efficiency of inboard ring seiners in Ernakulam District was conducted.

The landings of inboard ring seiners in Ernakulam District declined from 13,531 t in 2014 to 6,153 t in 2015 and then increased to 14,293 t in 2018 (FRAD, CMFRI). Ninety units of inboard ring seiners are operated in Ernakulum District, of which 60 units operated from Kalamukku Fisheries Harbour and the others from Munambam Fisheries Harbour (Marine Fisheries Census 2010). Secondary data on species wise annual catch and fishing effort data of IBRS operating in Ernakulam District for the period 2014-18 were obtained from the National Marine Fishery Resources Data Centre (NMFDC) of ICAR-Central Marine Fisheries Research Institute (ICAR-CMFRI). Data on operational costs, fixed costs and revenue realized were collected at fortnightly intervals from 20 inboard fishing units operated in Ernakulam District. The operational costs included fuel cost, food, auction charges, crew share, crew '*bata*' or allowance, repair and maintenance costs of craft, gears and engine. The fuel costs comprised diesel cost for inboard ring seiners, kerosene cost for the carrier boats as well as cost of starter oil. The different economic indicators like net operating income, operating ratio and input-output ratio were used for assessing the economic efficiency.

Catch composition of inboard ring seiners: Among the different resources landed by inboard ring seiners in Ernakulam District in 2014, more than 90% of the landings were of oil sardine and Indian mackerel. The landings of oil sardine drastically declined from 10028 t in 2014 to 4410 t in 2018 while tuna (*E.affinis*) also considerably reduced during this period. Even though the landings of oil sardine drastically declined in 2018, it was compensated by the increased volumes of Indian mackerel, croakers and penaeid prawns landed (Fig. 1).

Economic efficiency of inboard ring seiners: The inboard ring seiners in the study area were predominantly owned by the traditional fishermen groups. The horse power of the engines ranged from 160-260 hp for the indigenous Leyland engines to more than 400 hp for the Chinese and other imported engines. The investment cost of a new IBRS unit at present ranges between ₹80 lakhs and over ₹1crore including craft, gears, engine and carrier unit. The average capital investment of the sampled fishing units indicated that the hull and accessories are costing ₹37.5 lakhs, engine ₹12.82 lakhs and gear and other accessories at ₹21.38 lakhs totalling ₹71,71,667 lakhs.

Analysis of operational costs and revenues per fishing trip revealed that the gross revenue declined from ₹1,48,742 in 2014 to ₹1,01,041 in 2016 and then rose to ₹1,62,276 in 2018. However the net operating income declined from ₹59,936 in 2014 to ₹33,527 in 2018 with upward trend in fishing costs from ₹88,806 in 2014 to ₹1,28,749 in 2018. The operating ratio increased from 0.60 in 2014 to 0.79 in 2018 and the input-output ratio increased from 0.2 to 0.37 during this period. The higher the operating ratio, the lower the capital productivity. The high operating ratio and input–output ratio indicate low economic efficiency of the fishing units. The high cost of diesel and kerosene along with reduction in the supply of subsidised kerosene to the carrier boats contributed to the rise in fishing costs. The share of fuel cost to total operational costs increased from 18% to 37% during 2014-2018 (Table 1).

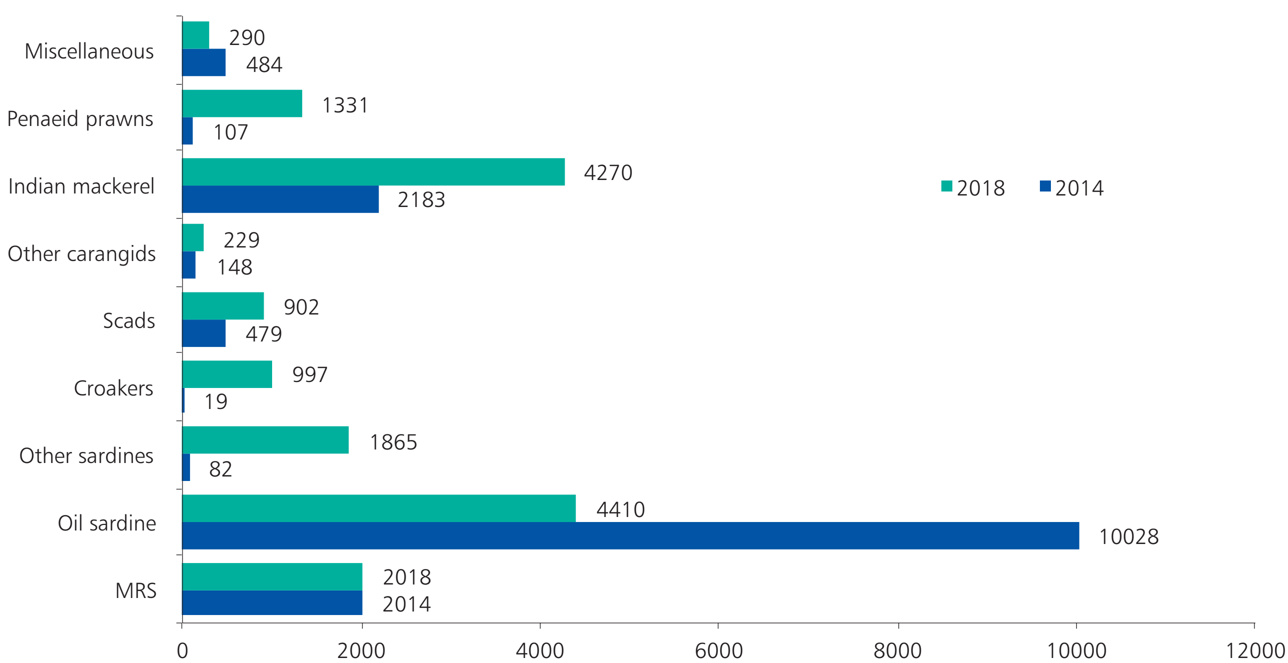

Fig.1. Species composition (in tonnes) of IBRS landings during 2014 and 2018

Table 1. Costs and returns (₹ per fishing trip) of inboard ring seiners

Particulars	2014	2015	2016	2017	2018
Fuel cost	16107 (0.18)	15177 (0.20)	23552 (0.31)	36799 (0.32)	48242 (0.37)
Crew wage	59482 (0.67)	50220 (0.65)	41785 (0.55)	66045 (0.57)	68420 (0.53)
Other expenses	13217 (0.15)	11664 (0.15)	11100 (0.15)	13918 (0.12)	12087 (0.09)
Total Operating Cost(OC)	88806	77061	76437	116762	128749
Gross revenue(TR)	148742	110773	101041	147149	162276
Net operating income (TR-OC)	59936	33712	24604	30387	33527
Capital productivity (Operating ratio) (OC/TR)	0.60	0.70	0.76	0.79	0.79
Input -output ratio (Input costs/TR)	0.20	0.24	0.34	0.34	0.37

Note: Figures in parenthesis indicate percentage to total operating cost

Conclusions

The analysis indicated that though the inboard ring seine units in Ernakulam District are economically viable, with rise in fishing costs, there was a downward trend in the economic efficiency over the years. The fishers reported major constraints in inboard ring seine fishing in the recent years as rise in price of fishing accessories such as nets, engines owing to implementation of GST, cut in kerosene subsidies and high fuel cost. A study on the impact of GST on the marine fishing sector of Kerala by ICAR- CMFRI reported that the fishing equipments including fishing rods and fishing twines are taxable at 12% and fishing ropes and hooks are taxable at 5% under GST. All these fishing gears were exempted from tax under the VAT (Value Added Tax) regime (CMFRI, 2018). The enhanced fishing capacity of IBRS units as a result of increase in the size of craft, gears and engine horsepower has resulted in huge fishing pressure on the pelagic resources caught by these units (Abdussamad *et al.*, 2015). Coupled with fluctuations in landings of the major resources targeted by these fishing units due to climate change impacts it raises concern about the sustainability of these fishing units. Hence regulating the fishing capacity to achieve optimal input use efficiency, effective utilisation of potential fishing zone (PFZ) advisories and adequate management strategies to curb the excess fishing pressure are essential for ensuring the economic sustainability of these fishing units.

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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.

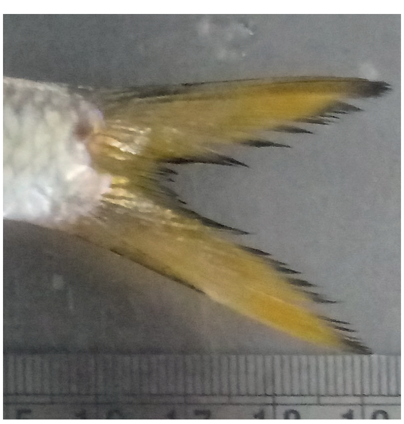
Key words: Aspect ratio, marine fishes, graph method

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).

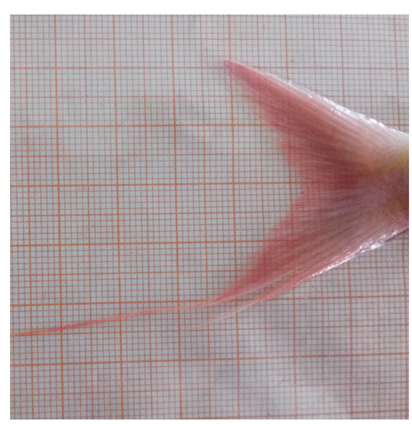
Fin shape and Aspect ratio (A)

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

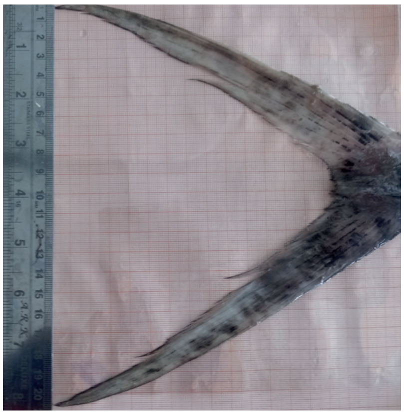


Thryssa mystax (EvenlyForked)

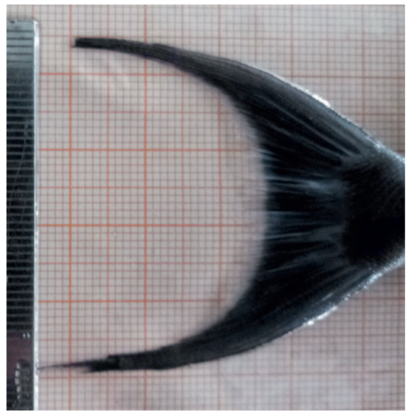
Cheilopogon furcatus (Unevenly forked)



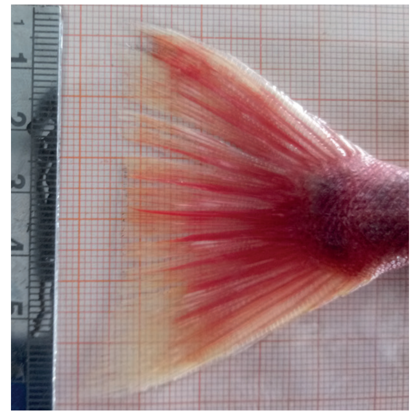
Nemipterus japonicus (Forked)



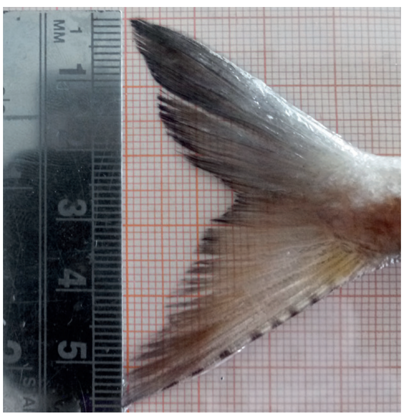
Istiophorus platypterus (Lunate)



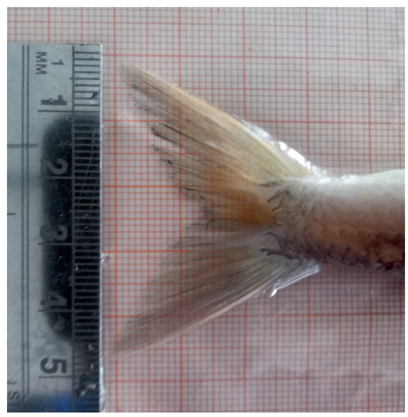
Odonus niger (Lunate)



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,

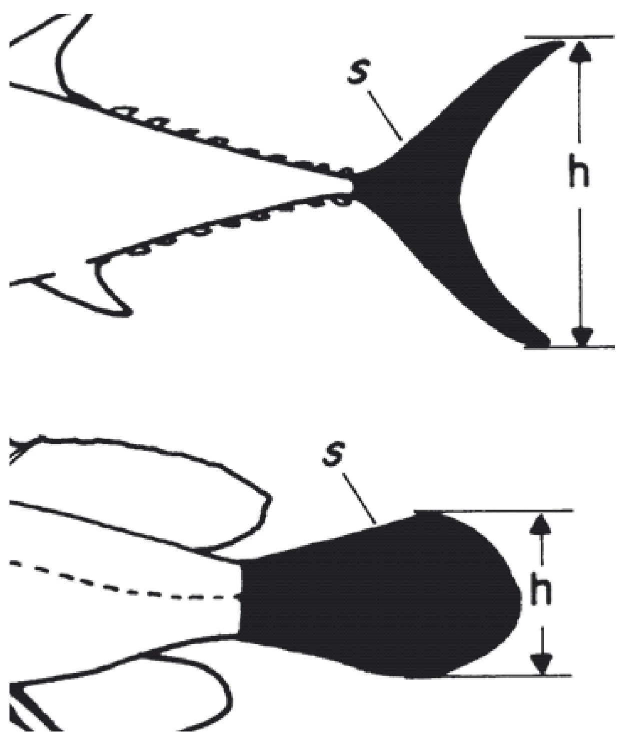


Fig.2. Aspect ratio calculation

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.

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Research Communications

Capture Based Aquaculture of Mangrove red snapper in marine cage farm

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Abstract

Capture Based Aquaculture (CBA) is practice of capturing wild seeds of commercially important species and its subsequent culture to marketable size in controlled conditions. In the present study, wild collected seeds of Mangrove red snapper, *Lutjanus argentimaculatus* was cultured in Galvanised Iron (GI) cage at Karwar. After 240 days of culture, fishes attained an average weight of 802.2±22.2 g with 64% survival.

***Keywords**: CBA, GI cage, Lutjanus argentimaculatus, growth parameters*

Introduction

Capture Based Aquaculture (CBA) is the practice of collecting live material from the wild and its subsequent use in aquaculture. It is, therefore, an aquaculture operation that involves some form of wild capture fishery activity for deriving seed material, broodstock specimens or feed up to the point of sale or trade (FAO, 2011). Worldwide, standardized CBA practices for commercially important fishes have been reported. CBA can be practiced either by utilizing the seeds of high value fishes during period of high occurrence in a sustainable way or by using the juvenile fishes caught as bycatch in fishing operations. In Karnataka, juveniles of high value fishes are often caught in non-selective gears and shore seines which are either discarded or sold at nominal prices which can be utilized for CBA (Dineshbabu *et al.*, 2012). In addition to grow-out culture, CBA could be employed for broodstock development of commercially important fishes which can be further used for seed production in the hatcheries. Karnataka state has 8,000 hectares of unpolluted brackish waters and estuarine areas, which are highly suitable for capture-based aquaculture (Dineshbabu, 2012a). During our survey in mangrove areas in Karwar, juveniles of *Caranx ignobilis*, *Lutjanus argentimaculatus, L. johnii, Lethrinus lentjan, Psettodes erumei, Siganus vermiculatus* and *S. javus* were identified as major species. These juveniles could be utilized for CBA, sustainably and in an extensive way as an additional income for the fishermen community residing nearby these mangrove ecosystems.

CBA of Mangrove red snapper, *Lutjanus argentimaculatus*

Wild collected seeds of *Lutjanus argentimaculatus* (300 nos.) with an average initial weight of 44.65±3.9 g and average initial length of 14.04±0.8 cm were stocked (November, 2018) in a 6 m diameter Galvanised Iron (GI) cage in marine cage farm of Karwar Research Centre of ICAR-CMFRI on an experimental basis. These fishes were co-fed with trash fish and pelleted feed (40% protein) twice a day in the morning and in the evening @ 5 to 8 % of body weight. Water quality parameters were analyzed on monthly basis using YSI ProDSS handheld water quality multi parameter instrument and were found to be within the conducive range for fish culture.

After 240 days of culture (in June, 2019), fishes reached an average weight of 802.2±22.2 g and average length

Table 1. Growth indices of cultured *L.argentimaculatus* under CBA

Weight gain (g)	757.55
Length gain (cm)	22.6
Average growth rate (g/day)	3.2
SGR (%/day)	1.2

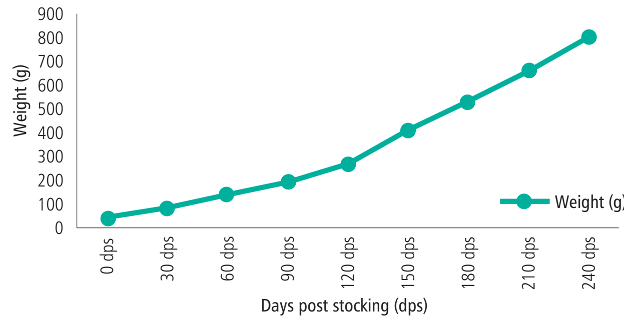

Fig 1. Weight gain in *L. argentimaculatus* under CBA

Fig. 2. Feeding fishes in cages

of 36.64±2.3 cm with 65% survival. Partial harvesting of fishes was done on demand basis and were sold at a farm gate price of ₹350-450. A few fishes were shifted to snapper broodstock cage for further rearing and broodstock development. Based on the results in an open backwater system, Shoji *et al* (2011) opined that CBA of *L. argentimaculatus* is a better option than marketing of under sized red snappers. CBA can also provide an alternative source of income generation for the traditional fishermen during the lean fishing seasons (Dineshbabu *et al.*, 2012). Results of this study also demonstrated that wild caught juvenile fishes can be used as seed material for marine cage culture and grown to marketable sizes.

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Stunted fingerling production ensures continuous supply of good quality seed for marine finfish farming

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Abstract

Application of compensatory growth pattern in finfishes for enhancing aquaculture production is an innovative method adopted by several farmers in freshwater farming systems. Stocking of stunted fishes have the primary advantages such as growth compensation, suitability for short duration farming, economic usage of feed, extended period of good quality seed availability and enhanced survival rate with better yield. An attempt has been initiated to adopt the principles of compensatory growth pattern in marine aquaculture systems and the possible interventions in these aspects is discussed. Preliminary results reveal that marine finfishes such as Snubnose pompano and Mangrove red snapper exhibits compensatory growth pattern during post- stunting rearing period in both marine and low saline conditions.

Keywords*: stunting, compensatory growth, low saline, marine, mariculture*

Introduction

Marine and coastal cage farming has emerged as a potential food production sector in India. With a vast coast line of more than 8000 km, the country has an immense potential for mariculture activities for the development of the fisheries sector. ICAR-Central Marine Fisheries Research Institute, Kochi has initiated popularisation of marine and coastal cage farming activities in an elaborate way. Several commercially important species such as Cobia, Orange spotted grouper, Snubnose pompano and Indian pompano have been successfully utilised for this purpose by developing and standardising the seed production and farming technologies. Good quality stocking material is an important prerequisite for open water cage farming. Success of any aquaculture venture depends on year round availability of quality seeds and affordable price of the stocking material. Even though seed production technology is available for many of the economically important species, continuous seed availability is a major bottleneck in expanding the commercial mariculture activities in India. At the same time, stunted fingerlings are considered better stocking material for culture because of their higher survival rate and ability to compensate the growth. They are less vulnerable to predation and diseases and are more tolerant to environmental fluctuations; require less time to reach marketable size leading to higher production. Besides, production of stunted fishes ensure the availability of seed for a longer duration since the fishes can be maintained in the nursery facilities with minimum cost and effort.

Compensatory growth in stunted fishes has been commercially adopted in the farming of several freshwater fishes such as Indian Major Carp, Big Head carp, Nile Tilapia etc. Even though compensatory growth pattern is observed in marine finfishes such as European seabass, Gilthead sea bream, Atlantic halibut, Atlantic cod and Alaska yellowfin sole, adoption of this technology in mariculture at a commercial level, has not been reported yet. Commercial scale farming experience in freshwater fishes and experimental evidences in marine finfishes have indicated that the stunted fishes attained compensatory growth when shifted to a favourable condition with adequate feeding. This growth compensation is achieved through the phenomenon of hyperphagia (excess feeding). The degree of compensation attained is classified as no compensation, partial compensation and complete compensation or over compensation, depending on the method and species selected for stunting. Survival rates obtained by stocking stunted fishes is at par or more than that of the normal fishes, since many of the weak and unhealthy fishes may be eliminated from the stock during the stunting process. Since the size and growth rate of the stocking material after long term stunting is greater than the normal fingerlings generally stocked, usual problems such as cannibalism and predation will be reduced. Generally stunted fishes are found to be hardy, more tolerant to environmental fluctuations and diseases. Stunted fingerling production is more economical since the quantity of feed utilised for this purpose is minimal (only for the subsistence of the fishes) during stunting. Above all, long term stunting protocols ensures the maintenance of these animals for a longer duration which will help to extend the seed availability for a longer period.

Stunting and growth compensation in marine fishes

Compensatory growth pattern in Snubnose Pompano, *Trachinotus blochii*, a potential candidate species for commercial marine cage farming has been evaluated in both high saline (> 30 ppt) and low saline conditions (< 15 ppt) at Mandapam Regional Centre and Karwar Research Centre of ICAR-CMFRI respectively. The fishes were stunted for 30, 60 and 90 days duration followed by post stunting rearing for 30, 60 and 90 days respectively. During the stunting period high stocking density (100 / $m^{3)}$ and low feeding rate (3 % body weight) were maintained and during the post stunting period stocking density was reduced to 20 / m^3 with increased feeding rate (15 % of body weight). The fishes during stunting and post-stunting were fed using a commercial floating pellet feed with a 45 % crude protein content. In the marine condition, the 90 day stunted fishes have shown over compensation. In the low saline condition, the 60 days stunted fishes showed near complete compensation.

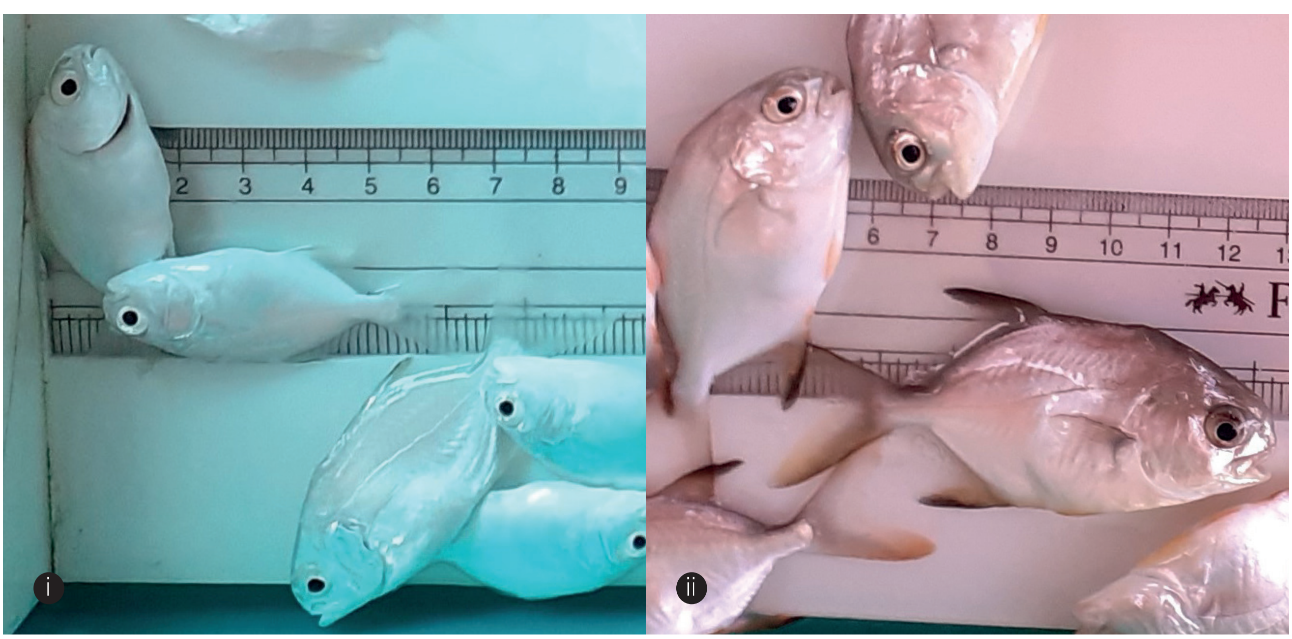

Fig.1. Stunted (i) and Normal (ii) Snubnose pompano belonging to same stock

Fig. 2. Normal (top) and stunted (bottom) *L. argentimaculatus* fingerlings

To standardise the stocking density of mangrove red snapper *Lutjanus argentimaculatus* fingerlings for stunting trials, experiments were conducted at Calicut Research Centre of ICAR-CMFRI. Red snapper fingerlings (wild collected) were stunted for 30 days at different stocking densities (@ 25, 50, 75 and 100 numbers / m^3) providing low value fish as feed at 5 % of body weight. The results indicated that high stocking density stunting is not possible in red snapper fingerlings due to aggressive behaviour of the fish. The ideal stocking density observed was 50 numbers per m^3 for stunting *L.argentimaculatus* fingerlings.

The compensatory growth pattern in stunted fingerlings of *L. argentimaculatus* was studied with thirty days stunting experiments conducted in high saline (35 ppt) and low saline (15 ppt) conditions. The fishes were stunted for 30 days at a stocking rate of 50/ m^3 providing trash fish at 5 % of body weight. They were further reared (post-stunting) for 30 days at a stocking rate of 20 / m^3 providing feed at 15% of body weight. Control was maintained at a stocking rate of 20 / m^3 and providing feed at 10 % of body weight for 60 days. The fingerlings exhibited partial compensatory growth compared to normal in low and high saline condition after one month stunting, with higher degree of compensation in low saline condition. Further stunting trials by increasing the stunting and post stunting duration to see whether complete compensation in growth can be achieved in this species is in progress.

A preliminary experiment was conducted with hatchery produced *Trachinotus mookalee* (Indian pompano) fingerlings at Vishakapatnam Regional Centre of ICAR-CMFRI. The 45 days stunted fishes have shown indications of compensatory growth in the refeeding period. The experiments on Snubnose pompano reveals that the long term stunted fish can be employed for the commercial cage culture practices in both low saline and marine condition. It demonstrated that stunting practice can be adopted even in carnivorous fishes such as red snapper and Indian pompano.

Economic efficiency of gill net fishing in Munambam, Ernakulam

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The most important fisheries management reforms in Kerala is the monsoon trawl ban when fishing using mechanized vessels like trawlers is banned as the monsoon season is considered to be the breeding and pre-recruitment period of most of the commercially important species. This period however witnesses extensive fishing activity by the motorised sector in Kerala and Munambam Fisheries Harbour, one among the nine major fishing harbours in Kerala was monitored for assessing the economic efficiency of motorised crafts. There are 145 motorised boats and 390 mechanised boats actively operating in the harbour. During monsoon trawl ban, motorized and non-motorized boats are operated, include those coming from other locations of the state. They are commonly using gillnets for fishing. The study conducted during June-July 2018 in the Munambam Fisheries Harbour used Survey method for collecting the information of fishing operations across gillnetters operating in the harbour. The primary data on the cost and revenue of 30 gillnetters were collected and analysis was done to assess the economic efficiency.

Fishing operations and Fishing efficiency: The crafts were registered across other parts of the states/ neighboring states. The fishing operations normally starts in the early mornings around 4 am. The average crew size is five members and will operate for multiday (2-3 days) trips. On an average, 40-50 fiber crafts bring fish landings in the harbour. The overall length of the fiber craft is 32-36 feet with engine capacity ranging from 9.9-26 HP. The gillnet made of nylon (thread size 2 mm) with a vertical length 16 m and horizontal length 1-2 km with mesh size of 2-3 inches costs around ₹7 lakhs.

The fishing efficiency was determined using revenue estimates and operating ratio. The average fishing expenditure per trip was found to be ₹3.76 lakh per trip contributed by crew share (₹3.02 lakhs), auction charges (₹0.40 lakhs), fuel (₹0.26 lakhs) others-Ice (₹0.02 lakhs) and provisions (₹0.06 lakhs). The average quantum of diesel used was 400-450 litres and 30-40 ice blocks. The wise expenditure incurred indicated that 80% of operating costs was towards crew share (wages and '*bata*' or allowance) followed by auction charges

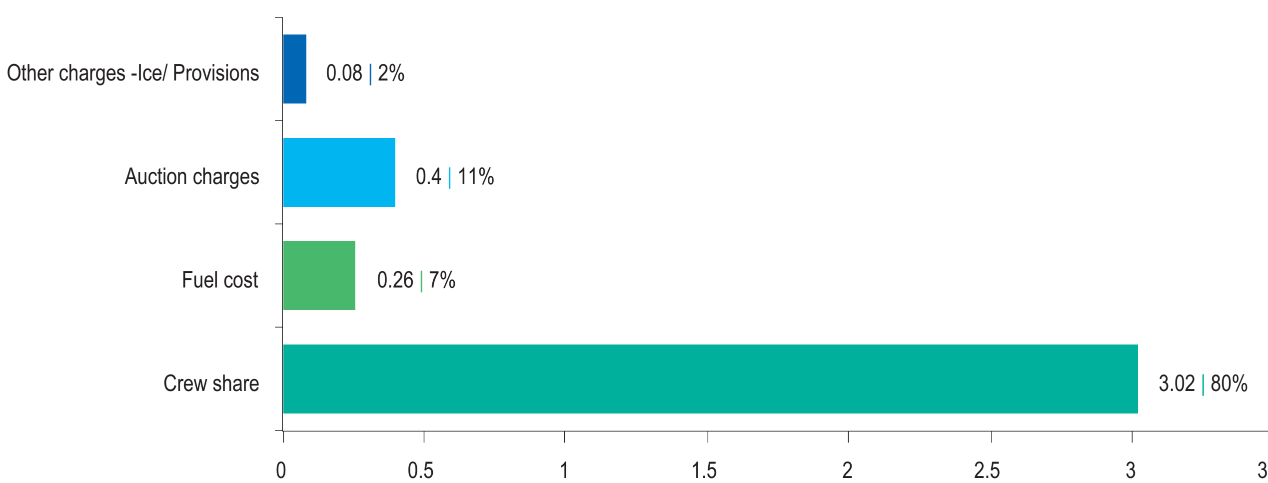

Fig. 1. Operating expenditure (in ₹ lakhs) in gillnet fishing

(11%). The subsidy for kerosene wasn't available for the fisher folks, so they used to buy it from the open market at higher prices.(Fig. 1).

The average landings per trip were estimated at 4 tonnes. The contribution of the different species included tuna (16%), moon fish (44%), sharks (25%) in addition to 10-12 other species (14%). The average fish prices and revenue realised for the gillnetters per trip is indicated in Table 1

Table 1: Average fish landings, price and revenue realised

Species	Landings (tonnes)	Revenue (₹ in lakh)	Average price realised (₹)
Tuna	1.75	2.81	160
Moonfish	1.01	2.02	200
Sharks	0.66	1.32	200
Others	0.42	0.64	150
Total	3.85	6.79	177.5

Profitability indicators: The capital productivity of the operations was found to be 0.55, average labour productivity 770 kg, input ratios as 0.11 and the gross value added at ₹3.77 lakhs per trip (Table 2).

During the monsoon, non-availability of popular fish varieties is common and the prices are high in the market. During monsoon trawl ban period in Kerala, the vendors have to mainly depend upon the catch by the fishermen of motorised gillnets crafts. Due to the freshness and superior quality of the catch landed in Munambam Fishing harbour fisherfolks and vendors will increase fish price, and the customer who needs the fresh fish tends to purchase without bargaining.

Table 2. Profitability indicators

Components	Amount (₹ in lakh)
Crew wages	3.010
Crew bata value	0.009
labour costs	3.019
Fuel cost	0.260
Auction charges	0.400
Other charges -Ice/ Provisions	0.080
input costs	0.740
Total operating cost	3.760
Catch(tonnes)	3.850
Gross revenue	6.790
Crew size (Number)	5
Net operating income =(Gross revenue-total operating cost)	3.03
Capital productivity (Operating ratio)=(Total operating cost/Gross revenue)	0.55
Labour productivity(kg) =(Catch /average crew size)	770
Input-output ratio =(Total input cost/ Gross revenue)	0.11
Gross value added	3.77

The implementation of trawl ban has its impact on the income of the labourers and the unemployment they face during the period force some of these fishermen to do gillnet operations. The catch from these motorised boats are largely composed of high value fishes and is profitable for the fisherfolks and fish vendors. The study revealed that economic efficiency measured in terms of labour, wages, input-output ratio and gross value added indicated the viability of motorised gillnetters operated during the monsoon period.

Brief Communications

Deformities recorded in fishes

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During regular field visits to Digha Mohana Fish landing centre (West Bengal, India) during August, 2018 to October, 2019 period, five abnormal fishes were collected and are recorded as given below. Deformed specimens of *Brevitrygon walga* and *Pateobatis bleekeri* (Rays), a deformed embryo of the shark *Scoliodon laticaudus*, guitarfish *Glaucostegus granulatus* and pomfret *Pampus argenteus* were recorded among the commercial landing. The rays were found to have rostral deformity. In case of *Brevitryogon walga* (Juvenile, Disc Width (DW) 14 cm), there was an incomplete fusion of both the left and right pectoral fin with the head, resulting in gap or cleft between the pectoral fin and rostrum (Fig.1). In the case of *Pateobatis bleekerii* (Female adult, DW 120 cm), the deformity was seen in the rostral bone making the rostral part slightly elevated and curved (Fig.2). The embryo of *Scoliodon laticaudus* was found to have scoliotic, lordotic and kyphotic bends in the vertebral column. The body had a hump like structure behind the head and the rest of the trunk was rolled clockwise up to the caudal region. The eyes and gills were well developed in the cephalic region but the fins were malformed (Fig.3). In case of *Glaucostegus granulatus* (Two adult females, TL: 137cm and TL: 183 cm), the tail and rostral portions were found to be deformed

Fig.1. Rostral deformity in *Brevitrygon walga*

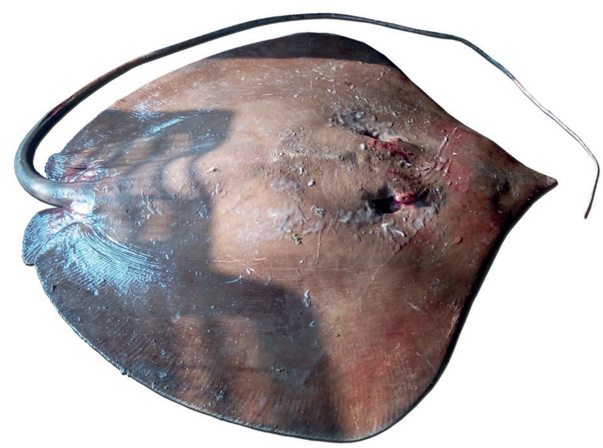

Fig.2. Rostral deformity in *Pateobatis bleekeri*

Fig.3. Deformed embryo of *Scoliodon laticaudus*

Fig.4. Deformity in the tail portion of *Glaucostegus granulatus*

Fig.5. Rostral deformity in *Glaucostegus granulatus*

Fig.6. Caudal fin deformity in *Pampus argenteus*

(Fig.4 & 5). Both the dorsal fins and caudal lobes were poorly developed with the curved vertebrae of tail in the first specimen while the second one was having unfused pectoral fins to the snout forming clefts in both sides. The abnormalities in granulate guitar fish is recorded for the first time from India. Spinal scoliosis and abnormal curvatures in the vertebrae has been reported in several elasmobranch species (Moore, 2015). One specimen of Silver pomfret (*Pampus argenteus*, Standard Length (SL) 21.8 cm) was also observed to have an atrophied caudal fin without any dorsal and ventral lobes (Fig.6). This does not appear to have simply been inflicted during escaping from a predation attempt, mainly because of the fusion of both the upper and lower caudal lobes and absence of any scar tissue. The fusion of lobes indicates the possibilities of skeletal deformity toward the caudal portion. The cause of such deformities and its impact on the affected fishes need to be studied further.

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Brief Communications

Present status of *Halophila beccarii* seagrass bed in Kadalundi Community Reserve

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Halophila beccarii (Beccarii's seagrass/ ocean turf grass/ estuarine spoon grass) is a seagrass variety belonging to Family Hydrocharitaceae. They inhabit the lagoon and estuarine areas with wide salinity variation. *H.beccarii* is listed as vulnerable by CITES and IUCN Red List as their habitat, mostly estuaries, are facing damages due to natural calamities as well as anthropogenic interventions. It is reported that the seagrasses helps in stabilizing the bottom sediment, provides refuge for fishes and other organisms from predators, act as nurseries for the fry and

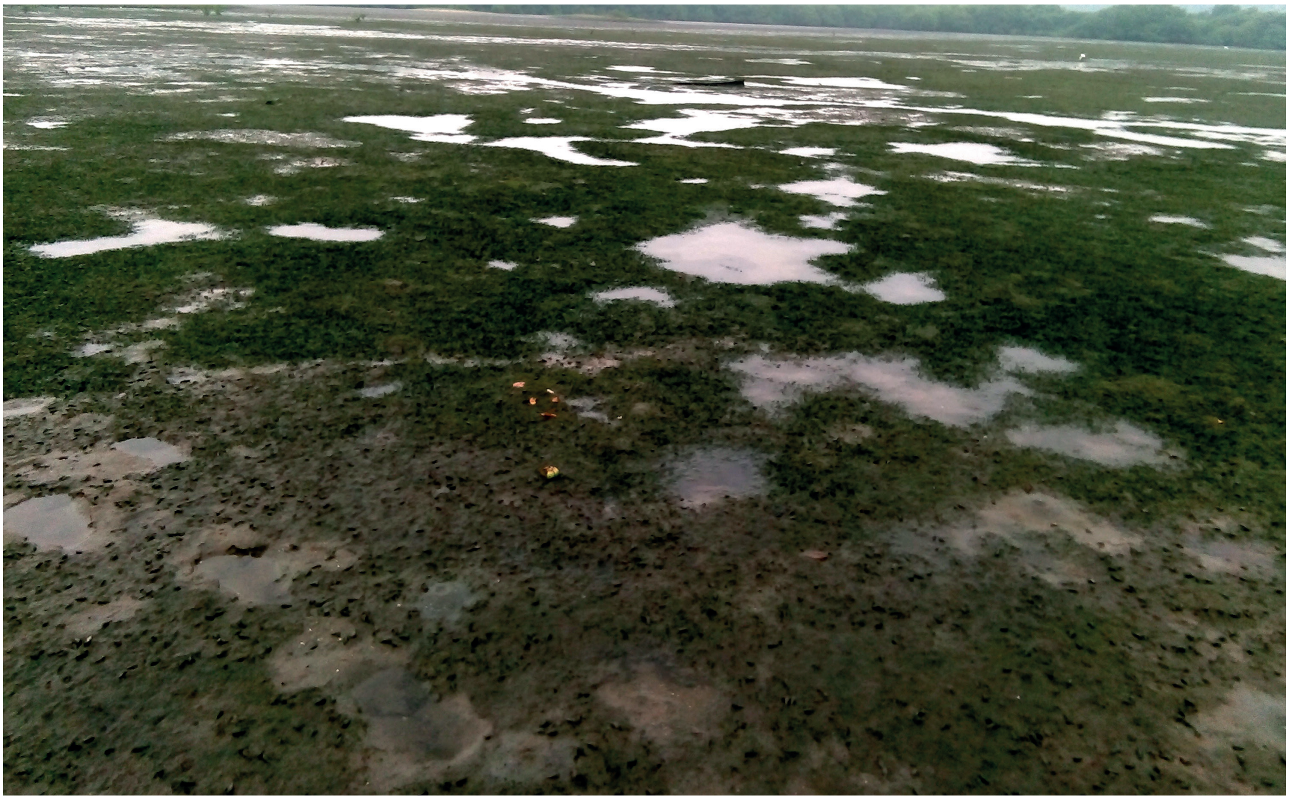

Fig.1. A small dense bed of *H. beccarii*

fingerlings of fishes and shellfishes and provides means of food sources for a complex and diverse community. The seagrasses are considered keystone species and can be indicators of healthy coastal ecosystems. In Kadalundi, Kozhikode the species is seen adjacent to mangrove dominated mudflat area and grows as a monospecific meadow. Its fast growth rate, seasonal appearance and a seasonal flowering pattern is indicating the colonizing nature of the species.

The occurrence of *Halophila beccarii* seagrass bed in the Kadalundi community reserve area was estimated to be covering an area of more than 2 hectares with a clayey substratum. The seagrass was growing predominantly with seaweed *Enteromorpha linza* and found exposed during the low tide period. The density of the seagrass *H. beccarii* ranged from almost nil during July 2012 to 420 g wet weight/m^2 (260 plants/ m^2) during December 2012. During April 2013 the distribution of *Halophila* plants was represented only by sparse occurrence of underground parts comprising rhizomes and roots (80 g/ m^2). Shoots could not be seen above the sediment substratum. The associated macro algae were red seaweed *Gracilariopsis lemaneiformis* (dominant during September to December), *Enteromorpha linza* and *Ulva reticulata.* The observations recorded in 2018 showed that the seagrasses were in dense and fast growth phase during October to December. In December 2018, the distribution was 320g wet wt/m^2 (178 plants/ m^2). The density of seagrasses faded with February and later during July, leaves are not visible and distribution was 13 g wet wt/m^2 (11 plants/ m^2) only. One of the threats or constraints observed in Kadalundi estuarine area is the sand bar formation near to the bar mouth as strict enforcement against sand mining in the river prevails. Due to this, the sand from the sea is depositing in the river barmouth and and gradually this is extending towards the mangrove area and seagrass meadows. Seagrass associated fauna and fishery resources were recorded. Polychaetes and isopods were observed in considerable numbers throughout. Gastropods such as *Tibia* sp, *Murex* sp, *Trochus* sp, *Babylonia spirata* also occur. Several finfishes, shellfishes and coastal birds including seasonal migratory birds were documented. Though there are no specific conservational measures prevailing for sea grasses, in Kadalundi, *H.beccarii* is protected as it is present within the mangrove ecosystem where conservation measures are enforced by the community reserve officials.

Brief Communications

Brief note on infestation of *Diplectanum* sp. in Asian seabass

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Recently open sea cage farming has emerged as an alternative and additional income source for fishermen and fish farmers in India. Asian seabass, *Lates calcarifer* is widely used in open sea cage culture due to its high market demand. In cage farming, high stocking densities and poor water quality enhance the parasite loads of the cultured fishes. In this study, 47 specimens of Asian seabass collected from cages located in Naganathwada, Sunkeri, Ankola were analysed with the aim of identifying the parasites prevalent among this species. All external and internal organs of each fish were examined separately under microscope for parasites. The collected monogenean parasites were washed in a 0.85% saline solution and fixed in 70% ethanol and identified. Most of the infected fishes had dark coloration of the body and postmortem findings revealed gills with excessive mucus secretion and sticking of the gill tips with greyish coloration. Heavy infestations can induce a range of histopathological changes to the epithelium, which facilitates the invasion and establishment of a range of secondary bacterial, viral and fungal infections. This study revealed the prevalence of infection with *Diplectanum* sp. was high in Sunkeri followed by Ankola and Naganathwada while severity of infection was same in all the three locations. No mortality due to this infestation was recorded but these parasites can induce stress, reduce the fitness of the host and risk other secondary infections. Hence, screening for the presence of these parasites at regular intervals to take precautionary measures for their control and prevention is needed.

Fig.1. *Diplectanum* sp. (400x) with squamodisc indicated

Trawl Fisheries in Andhra Pradesh: Facts and fishers insight

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Along Andhra Pradesh coast, only indigenous gear operating country crafts were in vogue till the turn of 1960 and since 1964, with the advent of the Indo-Norwegian project, fishing by small mechanized fishing crafts started. Initially, Pablo type (9.14 m length; 2.14 m beam; and 40-45 HP engine) were present and within three years, two other types, namely "Royya" (9.75 -10.0 m length; 2.9 m beam; and 45-60 HP engine) and "Sorrah" (11.4 m length; 3.2 m beam; and 60-80 HP engine) with modifications in structure and engine capacity were introduced. Until 1987, these were mainly meant for a single day or for 2-3 days cruise for shrimp fishing in the coastal waters. Voyage or Night fishing trips that started in 1980 was for two days duration each and restricted to four months (October-January), which continued till 1984. The year 1987 saw the introduction of "Sona" boats along the Andhra coast which lead to the start of voyage fishing lasting up to 10 days, aimed at saving fuel cost as compared to single day fishing. During the period from 1987 to 1990, voyage fishing was conducted in October-March and single day fishing in other months. From 1990 onwards, voyage fishing was extended to 9 months except in April, May and June and gradually by 1995, it was conducted throughout the year (Maheswarudu *et al.,* 2015; Rajkumar *et al.,* 2005). Mini trawlers made of wood, with overall length of 16 m, breadth 5.08 m, and draught 2.15 m, and fitted with 145 hp engines were introduced around year 2000. They did not have freezing facility and carried ice in the fish hold to store the fish catch. They stayed at sea for 10-15 days and operated two identical shrimp trawl nets simultaneously from the outriggers on both sides of the boat. A good quantity of fish and cephalopods were thus caught, along with shrimps. These operations were generally between Pentakota in the south of Visakhapatnam and Sunderbans in the north including the vast area of the Sandheads generally in the depth range of 40-80 m (Chennubhotla *et al.,* 1999). By 2004, there were about 300 small trawlers, 250 sona boats and 60 large trawlers, operating off the coastal waters of Andhra Pradesh. By 2005, the number of mechanized fishing crafts had gone upto 2,541 of which 1802 were trawlers. In 2010, among the 3167 mechanized crafts present trawlers constituted 42% (1341). In 2018, there were around 1800 trawlers which was proposed to be reduced to 1,300 units based on an analysis of the marine fisheries trends in the state (Muktha *et al.*, 2018).

In Andhra Pradesh, trawl nets are of three types based on the target groups–fish, shrimp or cephalopods. Shrimp trawls have undergone several changes evolving into different versions with regard to the number of panels/seams from two to six. Likewise, the vertical opening and the length of the net and length of head rope and tow had seen a lot of changes and increments. While size of the net as a whole kept increasing, the mesh size at the wings and fore parts too increased to help reduce the drag but the mesh size at cod end kept being decreased. Two seam fish trawls, with head rope of 20 to 81 m are widely used for exploitation of finfish in Andhra Pradesh. The cod end mesh size of all the trawls was and still is way below the size stipulated in the Andhra Pradesh Marine Fishing Regulation Act 1995 (Rajeswari *et al.,* 2012).

Trawls are contributing 40 - 50% of the marine landings of Andhra Pradesh over the last couple of decades. During 1997–2003, demersal resources were the major component (43%) of the catch in *sona* boats and followed by pelagic, crustacean and molluscan resources. Although, the quantum of catch in *sona* boats were higher compared to small trawlers, the catch composition of both were similar (Rajkumar *et al.,* 2005). Since 1999, after the introduction of 45 days fishing ban during the months of April and

May, total trawl landings showed an upswing during June - August. However, this was accompanied by a fall in CPUE indicating an intensification of fishing effort. During 2012 - 2016, the total trawl landings decreased from a peak of more than 1.4 lakh tonnes in 2012 to 0.78 lakh tonnes in 2016. Catch rate (kg/h) during the same period ranged from 34.1 (2014) to 19.6 (2016). In 2017, the landing was 0.93 lakh tonnes, contributing 47% to the overall landings and a catch rate of 22.06 kg/h. In 2018, trawler contributed 44% with an annual landing of 0.84 lakh tonnes with a catch rate of 23.11 kg/h. The major pelagic resource caught in trawls over the last decade was ribbonfish and Indian mackerel while demersal resources included threadfin breams, sciaenids, lizardfishes, goatfishes and silverbellies. Crustaceans (penaeid prawns and crabs) and cephalopods (squids and cuttlefishes) were landed and in most of the years, penaeid prawns was the highest contributor in the trawl landings.

A Stakeholder Perception documentation workshop held at Visakhapatnam Regional Centre of ICAR-CMFRI, on 14th and 15th November 2017 was attended by fishery scientists and representatives of Fishery Survey of India (FSI), Marine Products Export Development Authority (MPEDA), various fisheries related associations and other stakeholders. A questionnaire was developed during this documentation workshop and later multiple stakeholder consultations were organized at Visakhapatanam (17th May, 2018), Machilipatnam (18th May, 2018) and Nizampatnam (19th May, 2018) based on this questionnaire developed. At Visakhapatnam, Nizampatnam and Machillipatnam the main concern of the trawler based fishers was the delay in granting subsidy on fuel. The fishers were of the opinion that subsidy should be incorporated in the payment system right at the time of fueling or directly paid to their bank accounts. Also, lack of proper financial assistance by the banks was an issue of great concern. Surety against the loan to be given was a major obstacle for most small scale fishers. High speed engine installed in vessels were a matter of grave concern, and according to them, need to be banned along the entire coastline. Another issue expressed was the low responsiveness and the enormous time taken to attend to the distress calls of the fishers by the coast guard. Fishers were willing to go for diversification, particularly from trawling to deep-sea tuna long lining, with a positive response for capacity building and training. The fishers were of the opinion that re-installing engine from an old vessel to a newly fabricated vessel should be not allowed and expressed willingness to use square mesh at cod end of trawls. They agreed that with use of small cod end meshes in trawls, the quality of the catch in cod end is deteriorating to a great extent. At Nizampatnam and Machilipatnam, fishers expressed urgent necessity to increase the jetty length for accomodating all the crafts. According to the fishers, reduced depth of canal at landing centres is hindering vessels at Nizampatnam and Machilipatnam and they are forced to land and berth elsewhere. Power supply and cold storage are non-existent at both the landing centres. Ice blocks are purchased at high prices from ice plants or ice vendors located far from the harbour. Accessibility by road and availability of water was also an issue at Machilipatnam. Young fishers at Nizampatnam, were educated and tech-savvy and wanted training in vessel navigation. Subsequently, another stakeholder consultation organised at Visakhapatnam on 21st May, 2019 was attended by representatives from trawler associations of Visakhapatnam, Pudimadaka and Bhemunipatnam. Fishermen strongly favoured trawl ban in two spells, provided these periods are uniform thoughout the coast and the time between the two ban periods are spaced adequately. Fishermen wanted crop holiday (trawl ban) subsidy to be increased from ₹ 4000 to ₹ 9000. The fishermen in the motorized sector wanted the ban to be in place for traditional fishers also as they felt that, the traditional fishers catch substantial quantities of spawners and juveniles of high value fishes during the ban period. They opined that strict monitoring of trawl ban is lacking and also urged for creating a safe zone to retreat during natural calamities like cyclones. All fishers were unanimous in wanting defined territorial demarcations for fishing by each sector. With higher returns from cultured shrimps than wild caught shrimps, the fishermen wanted training in mariculture. Improving the facilities and hygiene standards of the fishing harbor for maintaining optimum fish quality and better price realization, advertisement and promotion of marine fisheries, in tune with poultry and dairy sectors were demanded. While, many fishers at Nizampatnam and Krishnapatnam felt the need for landing by-catch to make profit, fishermen at Visakhapatnam strongly condemned it and were willing to organise a meeting involving representatives of all fisher associations in the state to come to an agreement on not landing by-catch.

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A note on landings of pregnant sharks in Cochin Fisheries Harbour, Kerala

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Sharks formed the major bycatch of pelagic longline and gillnet fishery which target high value fishes like tunas until recently. However, owing to the great demand for fresh and dried shark meet in the domestic market and expansion of fishing to distant waters there is targeted fishing for sharks. In India, major portion of the sharks caught by mechanized longliners and gillnetters are landed in Cochin Fisheries Harbour and Thoothoor fish landing centre. The annual catch of sharks in Kerala during 2017 was estimated at 2936 tonnes, of which 80% was landed in Cochin Fisheries Harbour. Among the 12 shark species landed at Cochin Fisheries harbor, those

Fig. 1. Pups of *C. amblyrhynchoides* collected from the pregnant shark

Fig. 2. Pups of the Scalloped hammerhead *S. lewini*

belonging to the family Carcharhinidae dominated (70%) followed by Sphyrnidae (10%). They consisted of almost all the size groups including pregnant sharks as observed during the onsite processing of some the landed sharks. During such an observation, on 5th May 2018, one female Graceful shark *Carcharhinus amblyrhynchoides* with a total length of 246 cm and weighing 90 kg was landed at Cochin Fisheries Harbour. It was caught by a pelagic longline vessel operated at a location of 20^{o} 48′ 00″ N; 68^{o} 54′ 00″ E off Gujarat coast at a depth of 1760 m. The shark auctioned for ₹15000 by the local shark trader was transported to a nearby processing unit. The pregnant female was carrying a pup size of seven, measuring 45-55 cm in total length and weighing 1.5-2.0 kg and similar in appearance to that of the adult counterparts with fully developed fins and colouration. (Fig. 1).

Another female shark landed by the same vessel was a Scalloped hammerhead *Sphyrna lewini* measuring 210 cm in total length and 42 kg in total weight. The pregnant female carried five numbers of well-developed young ones whose total length ranged from 40 to 43 cm and weighing 0.9 to 1.3 kg each. Another incidence of a pregnant *S. lewini* landing was recorded on 10th October 2018. It was reportedly caught off Ratnagiri (16^{o} 22′ 00″ N; 72^{o} 11′ 00″ E) at a depth of 153 m. The shark which measured 260 cm in total length and weighed 88 kg carried six pups with a length rang of 40-47 cm each weighing 1.1 to 1.4 kg. The pups of both *C. amblyrhynchoides* as well as *S. lewini* were sold separately at the landing centre itself, as there was good demand for baby sharks in the domestic market, and the pups fetched higher price than that of the adult sharks.

Non-Detriment Findings for the export of shark and ray species listed in Appendix II of the CITES, which is intended to use as guidance in regulating or allowing international trade of the concerned species and its by-products and to help sustain the exploitation of elasmobranchs along the region for those species harvested from Indian EEZ has been published by ICAR-CMFRI. Knowledge on the life history traits especially on their reproductive parameters such as litter size, breeding season etc. facilitated through proper reporting helps in the formulation of management measures for the sustainable exploitation and conservation of this highly vulnerable group of marine resources.

Brief Communications

Bivalve fisheries in Andhra Pradesh

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In India states like Kerala and Karnataka have a flourishing bivalve fishery driven by demand for bivalve meat. However, in states like Andhra Pradesh and Tamil Nadu bivalve meat consumption is very negligible and demand is driven by the lime and shell craft industries only. Bivalves are locally known as "Gollalu" in Andhra coast with major species recorded being *Crassostrea madrasensis, Saccostrea cucculata, M. meretrix, Meretrix casta, Marcia opima, Paphia malabarica, Tegillarca granosa, T. rhombea* and *Perna viridis*. Mainly distributed along the shallow regions of Gostani estuary and Godavari estuary. In the Gostani estuary, the bivalve fishing grounds are Konadu, Moolaguddu, Nagamayyapalem, Thottepalem, Chinnanagarama, Asipalem, and Gudivada. Craft used for the bivalve exploitation are Theppa and Nava. Usually fishermen groups with 2-4 members go in fibre boats (Theppa) with chisels and scoop nets for fishing in Gostani estuary. In the East Godavari regions like Kakinada, Yanam, Yetimoga, Pedavalasa, Dummulapetta, Chollangi etc fishing ground is about 4-8 km from the shore and located around the Hope Island which is about 4-5 km^2. Usually the fishermen families of about 2-6 members live in the boat itself and go for fishing in Godavari estuary. Fishing by women and children is through hand picking and dragnets. The estimated average annual landings of the bivalves during the study period 2015-2019 were 1095 tonnes and showed a decreasing trend. The estimated landings of bivalves during 2015 was about 1118 tonnes (2015) and 1431 t (2016) which decreased to 783 t in 2017.

Marketing and Utilization trends indicate that more than about 60% are exported for meat purpose, 30% used as a major ingredient of shrimp feed and the remaining for shell industry. Domestic consumption is negligible with Blood clams only favoured. The traditional shrimp farms also use dried and boiled clam meat to feed shrimps. Some fish farms were also using it to feed *Pangasius pangasius* and Pompano. In hook and line fishery It is used as bait for some species. Bivalve shells with attractive sculpture like blood clams are used by the ornamental shell craft industry. The marketing of these shells depends on the nearby states like Tamil Nadu, Odisha, Maharashtra and Telengana; besides the small scale exporters of Kakinada, Yanam, Guntur and other regions of the Andhra Pradesh. The agents are collecting shells from the fishers and selling to the different buyers based on demand. The marketing is mainly based at Chollangi landing centre and from Bheemli, Nagamayapalem areas from where the dead shells are transported by road. The shells are sold on basket basis with small plastic baskets weighing about 40-50kg each costing ₹800-1200 depending on the size of the shell (grade). The fishers are getting about ₹ 10-22 per kg only. The small scale industries are selling both the cleaned shells as well as lime powder to the dealers. Shells of the *Anadara* spp. are mainly used in the shell craft industry while rest are used by small scale industries for making lime.

Dried tuna for export as a small scale industry in Andhra Pradesh

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Yellowfin tuna (*Thunnus albacares)* formed an average 33.5% of the total tuna catch of Andhra Pradesh, during the past decade. Fishing grounds for yellowfin tuna off northern Andhra Pradesh at depths of 200 m and more are gainfully exploited by the local fishers since 2002 using motorized crafts (*theppas*) with hooks and lines and trolls. Since 2006 a few mechanized trawlers were also converted to long liners for catching tunas.

Fig. 1. Ladies collecting the tuna loins after drying in sunlight

Fig. 2. Sorted tuna loins ready for packing

Targeted yellowfin tuna fishing contributes significantly to the marine landings of Andhra Pradesh and also to marine export.

Salt dried tuna is prepared by fishers of Machilipatnam based at Gilakaladindi Fisheries Harbour of Krishna district, Andhra Pradesh. Yellowfin tuna (*Thunnus albacares*), skipjack (*Katsuwonus pelamis*) and little tunny (*Euthynnus affinis*), which are landed in good quantity but fetch less value in local markets are taken up for semi processing and value addition. The process involves, boiling around 700 kg of semi dressed fish for two hours in steel utensils with water having 5 kg of salt added. After boiling, fish is kept as such overnight for curing and next day each fish is cut into 4 to 6 pieces (depending on size) or loins. After removing head and spine, these are dried for four days in sunlight. Dried loins are graded according to size and packed in polythene bags and transported to Thoothukudi in Tamil Nadu, from where they are exported to Sri Lanka. Usually women are involved in this venture as they purchase the raw material, process, dry and pack the tuna products. Fresh tuna fish are purchased at ₹20 to 25 per kg and the final dried product is sold at wholesale rate of ₹80 to 200 per kg based on the size grade, with larger loins fetching higher prices. This processing and export of dried tuna from Andhra Pradesh started in 2018.

Kaleidoscope

Heavy landing of tuna by multiday deep sea ringseiners at Cuddalore.

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In Tamil Nadu, Cuddalore fishing harbour is known for ringseine operation and in February 2018, the fishermen introduced multiday deep sea ringseine for oceanic tunas and the result was encouraging (Sivadas *et al*., 2018. *Mar. Fish. Infor. Ser. T & E Ser*. No.235). Now the fishermen from neighbouring areas like Pazhayar, Kalpakkam etc also started practising this fishing. In 2019 since July, there were good landings by this gear. A brief account of the landings during July and August is given below to highlight their role in exploitation of both inshore and oceanic tunas. In a boat the catch varied from 5 t to 30 t. Initially the catch was comprised by yellowfin tuna and skipjack tuna. But in August, the catch was almost fully dominated by kawakawa, frigate tuna and bullet tuna. In some boats, besides tuna, others such as seerfish, black pomfrets, *Scomberoides* spp., *Caranx* spp, *Mobula japonica* etc were also caught. Number of days per trip varied from 2 to 3 days in July. But in August, the fishing was mostly limited to single day though absence of enough catch made some boats to extend the fishing to 2 to 3 days. It was said that in August, the open sea was very rough which forced them to limit the fishing within 20 to 30 nautical miles away from the shore. In August, all the boats including those from neighbouring areas also landed their catch in Cuddalore. Yellowfin tuna was auctioned at ₹100-150 per kg, skipjack at ₹80-90 per kg, kawakawa at ₹70 to 80 per kg whereas bullet tuna and frigate tuna were auctioned at ₹40 to ₹45 per kg. Seer fish was auctioned at ₹600 per kg and black pomfret at ₹260 per kg. Entire tuna catch was transported to Kerala and the landing centre price depended on the demand from Kerala.

A note on catfish landing with gravid females, male brooders and young ones at Cuddalore, Tamil Nadu.

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In Tamil Nadu catfish is landed mainly as a by-catch in trawlers, drift gill netters and the hook and line units. In 2018, the total catfish landing in Tamil Nadu was 4165 t of which almost 90 % was contributed by trawlers. On 22.8.2019, around 3000 kg of catfish, *Arius maculatus* was landed by a ring seiner at Cuddalore, Tamil Nadu. The catch was comprised of gravid females and incubating males of total length ranging from 350 mm to 370 mm. Along with the catch, eggs in various stages of development, juveniles with yolk and without yolk were also seen in good quantity in the boat. One gravid ovary contained 24 eggs in the right ovary and 29 in the left. The young ones with yolk sac varied in total length from 30 mm to 44 mm and weight from 1.02 g to 1.43 g and those without yolk sac varied in total length from 35 mm to 60 mm and weight from 0.6 g to 1.73 g. This also indicates the spawning period. Lack of high demand of catfish acts as a natural deterrent against uncontrolled fishing of this resource.

Fig.1. Eggs and juveniles of *Arius maculatus*.

Unusual landings of deepwater bandfish along Chennai coast

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Large volumes of *Acanthocepola* Bleeker, 1874 landing by mechanized single day trawlers and motorized fibre glass boats were observed at Chennai Fisheries Harbour and Kovalam Landing Centre in Chennai respectively during the month of August and September, 2019. In single day mechanised trawlers operated in 12km north off Chennai at a depth of 18m total landings between 6^{th} and 13^{th} August,2019 were an estimated 1200 kg. The size range was 270-470mm with dominant mode at 340-360mm. The individual fish weight ranged between 57-112g with a mean weight of 78g. Landing of the same species was observed in Kancheepuram, Villupuram, Puducherry and Cuddalore districts during the same period. Increased sea water upwelling during this period that resulted in increased turbidity (locally called "*Vandalthanni*"). During that time the deep water fish like band fish were appearing in fishing zones and catches in large quantities along with other fishes was reported. Earlier reports on the landing of the *Acanthocepola* sp. in large quantities was during the month of August- September 1987 by motorized fibre boats operated in shallow waters at Panayurkuppam, Chennai and in September-November,2006 period by multiday trawlers at Madras Fisheries Harbour, Chennai (Rajapackiam *et al*., 2008 *Mar. Fish. Infor. Serv., T & E Ser*., 195: 20). This species is otherwise rarely occurring in the marine fisheries of the coast.

Fig. 1. *Acanthocepola* sp size range in the landings at Chennai Fisheries Harbour

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