Neritic tunas with special reference to distribution and fishery of *Auxis* spp. along the Indian coast

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ABSTRACT

The tuna fishery of India is supported by nine species, five neritic (longtail, kawakawa, striped bonito, bullet and frigate tuna) and four oceanic species (Yellowfin tuna, skipjack tuna, big eye and dogtooth). The tunas are exploited by the mechanized, motorized and non-mechanized units operating within the Indian EEZ. The neritic tunas are mostly exploited by gillnetters fitted with outboard engines and seines (Inboard engines as well as outboard engines). They are fished mainly along the continental shelf and adjacent oceanic waters. Gillnetters targets mainly large pelagics, especially Spanish mackerels, tunas, queenfishes and mahimahi; and the large meshed purse seines mainly exploit tunas, seerfishes, and large carangids.

Catch of neritic tunas along the Indian coast during 2010 to 2016 was analyzed. The catch varied from 44,500 t to 64,044 with an annual average catch of 57,097 t. The neritic tunas formed the mainstay of the total tuna catch and comprised 62 to 74% of the total tuna catch. Two species of *Auxis* viz. *A.thazard* and *A.rochei* contributed to the neritic tuna catch. The distribution and exploitation of A*uxi*s species is mostly along the south west coast found associated with knolls and oceanic ridges. The catch during the period ranged between 6,862t (2013) and 19,991 t (2011) with an average of 12,155 t. *Auxis* spp. formed 11 to 40% of the total neritic catch. *A.thazard* comprised 54.1% of the total *Auxis* catch. The fishery and important biological characteristics of these two species were studied. Trend analysis indicated that yield increased during 2016.

The tunas have been exploited since time immemorial along the Indian coast with neritic tunas being the mainstay of the tuna fishery. Presently, the tuna fishery in India is supported by

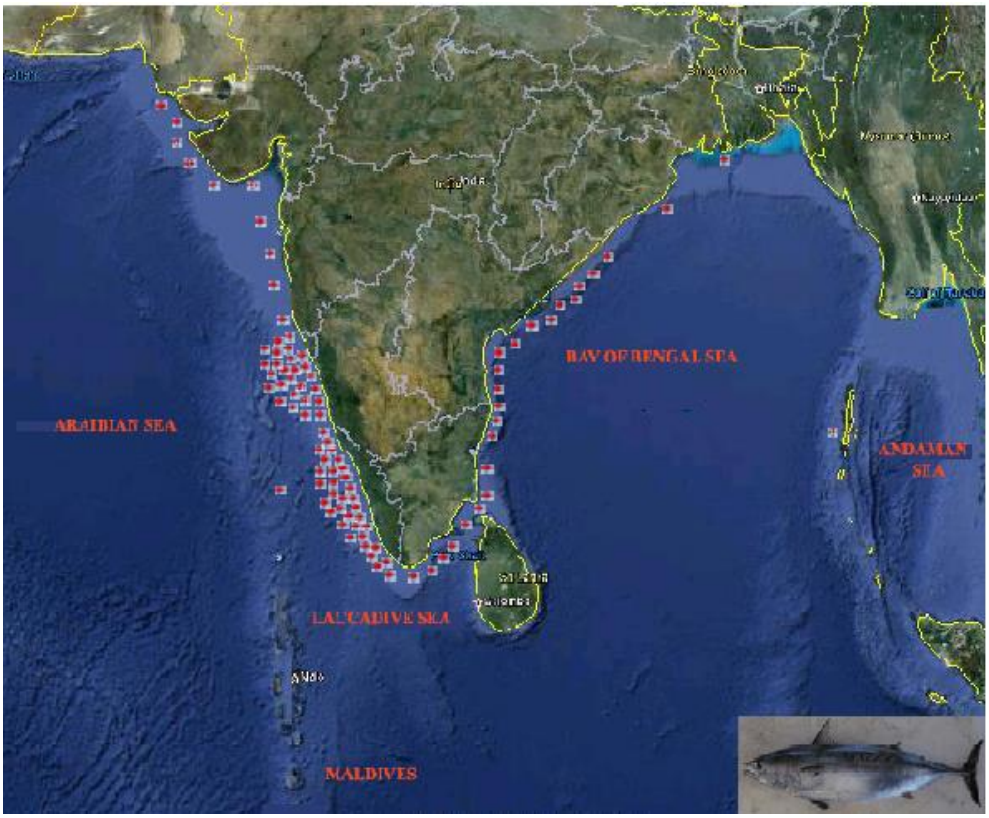
nine species; five neritic species (longtail, kawakawa, striped bonito, frigate and bullet tuna) and four oceanic species (Yellowfin tuna, skipjack tuna, big eye and dogtooth). A targeted fishery for tunas does not exist, however, smaller tunas comprising mainly of the neritic species form a significant component of the gillnet catch. These gillnets made of polyamide and having a mesh size ranging from 6 cm to 14 cm are operated in areas within a depth of 60 m. *Auxis* species does form a small and seasonal catch in seines, hooks and line and the trawls.

Distribution

The bullet and frigate tunas generally co-exist and enjoy a wide distribution all along the Indian coast with the major abundance along the southern coastal states (Kerala, Tamil Nadu and Karnataka) of India. These epipelagic fishes are distributed in neritic and oceanic waters with large abundance in deeper waters associated with knolls and oceanic ridges. Large abundance was observed along the Indian side of Chagos Laccadive ridge and exhibit strong shoaling behavior.

Frigate tuna: *Auxis thazard*

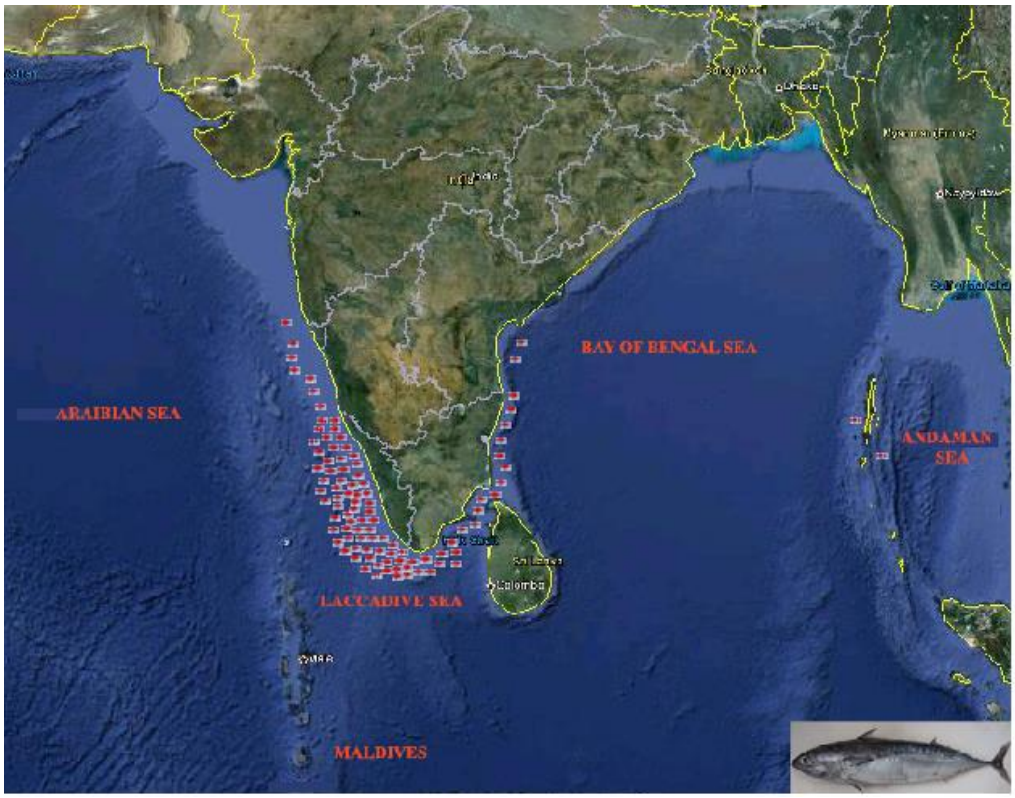
The second dominant neritic species enjoys a wide distributional range all along the west and east coast of India with major abundance towards southern coasts. An epipelagic fish, distributed in neritic and oceanic waters with large abundance in deeper waters associated with knolls and oceanic ridges. Large abundance was observed along the Indian side of Chagos-Laccadive ridge. They exhibit strong shoaling behavior and supported a fishery round the year.



Distribution Map of Frigate tuna (A.thazard) along Indian EEZ

Bullet tuna: ***Auxis rochei***

Distributed along the west and east coast of India, with large concentration along the southern coasts, especially along the coasts of Kerala and Tamilnadu. Epipelagic fish, found in neritic and oceanic waters with large abundance in deeper waters associated with knolls and oceanic ridges and often form large schools. Adults are caught from deeper waters around knolls, sea ridges and Islands



Distribution Map of bullet tuna (*A.rochei*) along Indian EEZ

Fishery

The data on catch, effort, species composition and biological information of bullet and frigate tuna were collected at weekly intervals from major landing centres on the Indian mainland coast following the Stratified Random Sampling Technique developed by CMFRI. Sampling was made for a period of seven years during 2010-2016. Length measurements (fork length, FL) were taken at the landing centres and were raised to the monthly and annual catches.

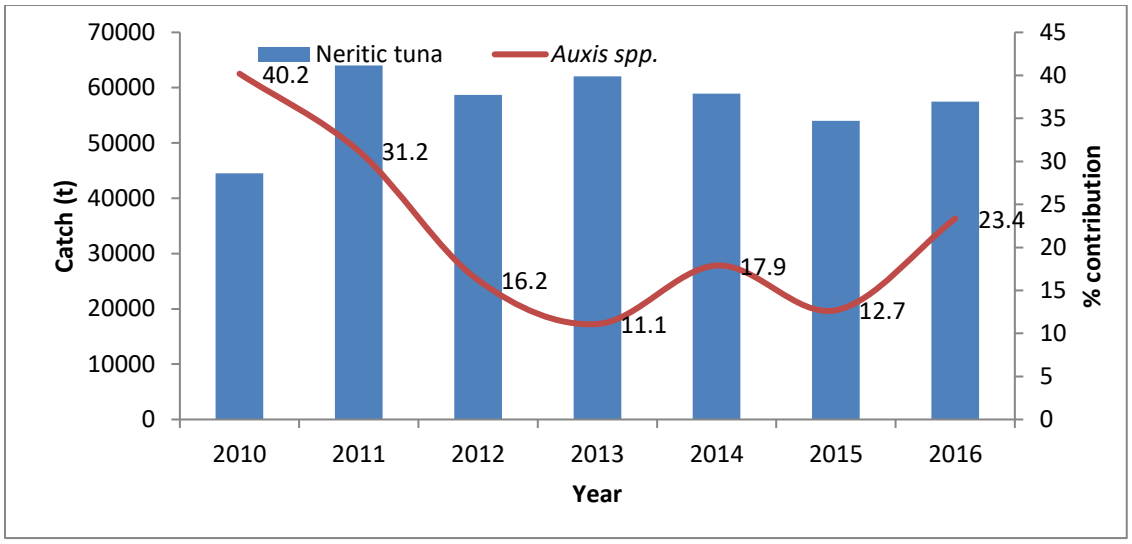


Fig. 1. Landings of Neritic tuna and % contribution of *Auxis spp*. along Indian coast

Fishery trend

The total catch of neritic tunas during 2010 and 2016 ranged between 44,500 t in 2010 to 64,044 t in 2011 with an average catch of 57,097t. It formed 62 to 76 % of the total tuna catch of the country. The *Auxis* species (*A.thazard* and *A.rochei*) with an average annual catch of 12,155t contributed 11 to 40% of the total neritic tuna catch during the study period (Fig.1). Trend analysis indicated that the yield of *Auxis spp.* increased during 2016. *A. thazard* comprised 36.7% in 2012 to 62.5 % in 2010 (Fig. 2) while *Auxis rochei* contributed to 37.5% (2010) to 63.3% in 2012.

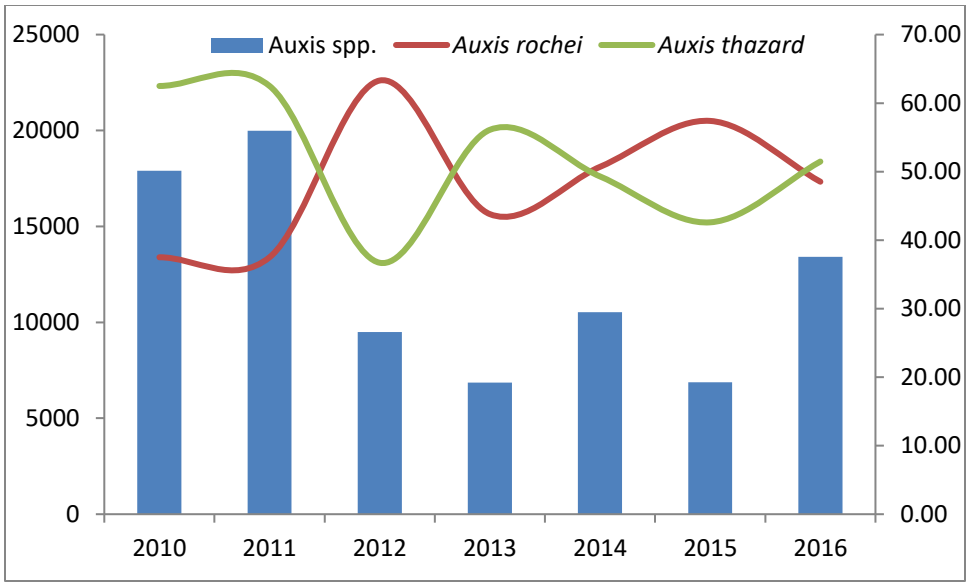


Fig. 2. Landings of *Auxis* spp., and % contribution *of Auxis thazard* and *Auxis rochei*

Gear-wise contribution

A. thazard was mainly exploited by gillnets (41%), purse seine (19%) and ring seine (19%). The contribution of other gears such as crafts deploying hooks and line (8%), trawlnet (4%) and non-mechanized indigenous gears (1%) to this resource is very meager (Fig. 3).

A. rochei was exploited mainly by crafts deploying hooks & lines (51%) and gillnets (28.8%). Purse seines (9.2%), ring seines (5.7%), trawls (4.9%) and other indigenous gears landed this resource in very less quantity (Fig.4).

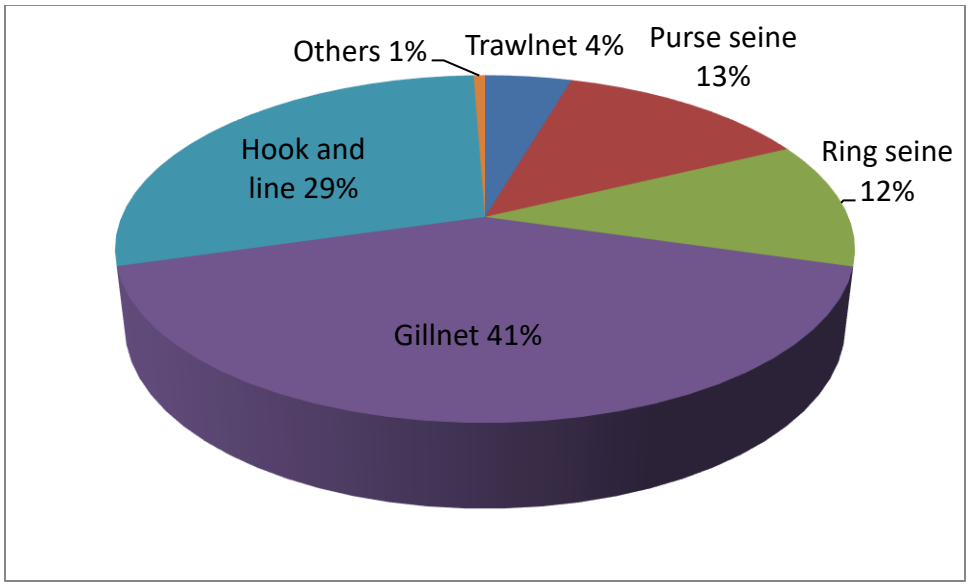


Fig. 3. Contribution of different gears to the fishery of *Auxis thazard* in India

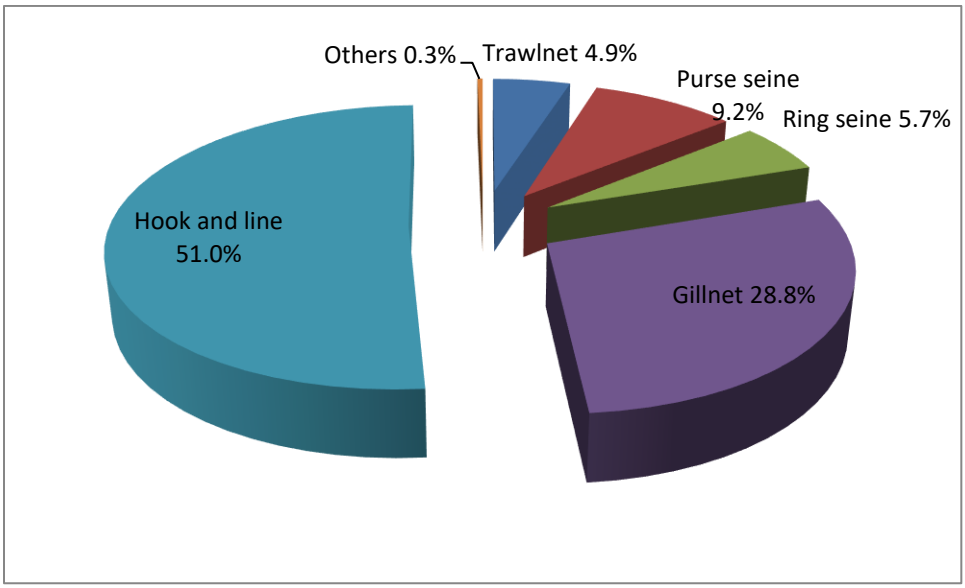


Fig.4. Contribution of different gears to the fishery of *Auxis rochei* in India

Seasonal abundance

Landings were observed throughout the year for *A. thazard* with peak landings during October (33%) and September (26%). *A. rochei* on the other hand formed a major fishery during January, August to October and December.

Length composition

The landings of *A. thazard* were supported by fishes of 22 to 52 cm FL (Fig. 5). Fishes having the length range of 48-52 cm dominated the catch and contributed to 38.9%. Major mode was at 50 cm and the annual mean length was estimated at 41.7 cm.

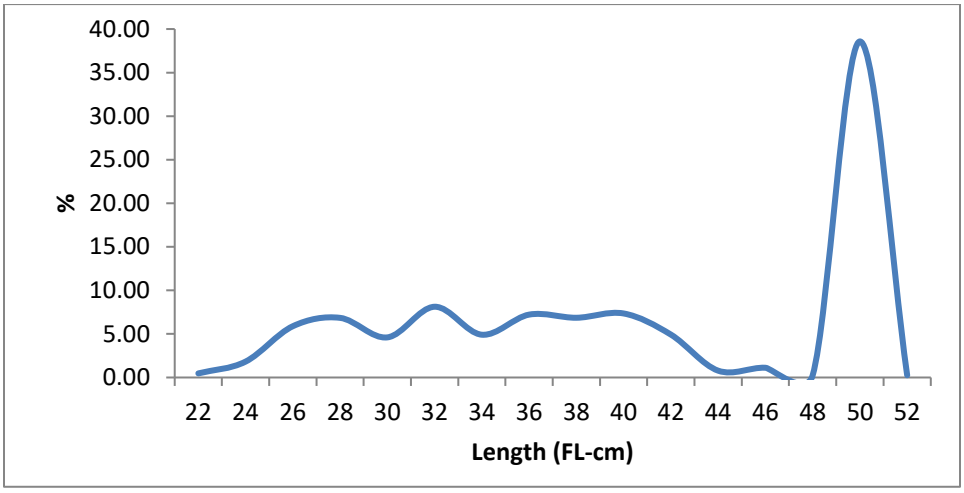


Fig. 5. Length frequency distribution (FL-cm) of *Auxis thazard* during 2010-16

The fishery of *A. rochei* was supported by fishes of 20-46 cm FL (Fig. 6). Fishes with a length range of 20–26 cm (84.3%) dominated the catch. Major modes were at 24, 28 and 42 cm having an annual mean length estimated at 26.6 cm.

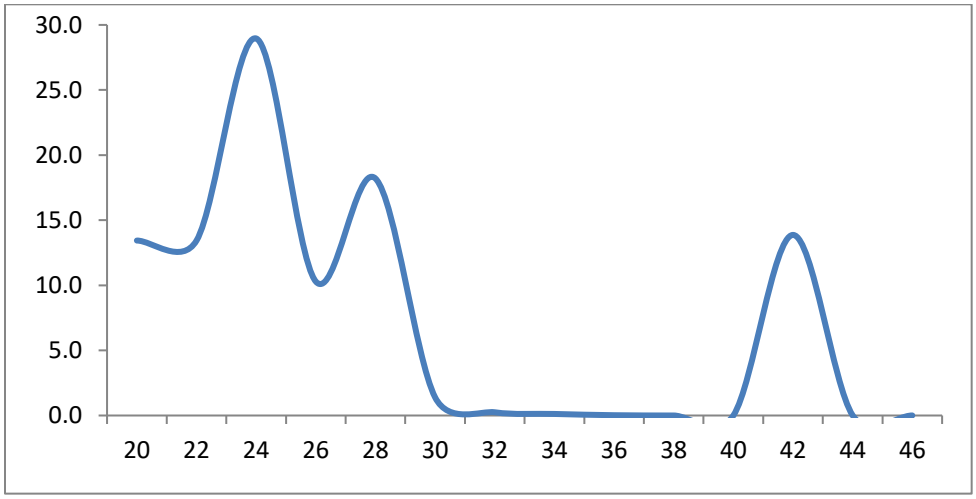


Fig. 6. Length frequency distribution (FL-cm) of *Auxis rochei* during 2010-16

Food and feeding

A. thazard

Feeding intensity was low for the species with only 2% of the sampled fish having gorged or full stomach condition. Stomachs in empty condition were dominant and contributed 52%. About 31% and 15.6% of the stomachs analysed were having one fourth full and half full food content respectively. Food preference indicated *A. thazard* to be a nonselective generalist feeder foraging mainly on small crustaceans, mollusks and finfishes. Crustaceans mainly included *Acetes* spp, followed by other penaeid prawns. Squids represented the molluscan component in the diet and fishes were represented by anchovies and sardines.

A. rochei

Stomachs in empty condition were dominant with a contribution of 93.5% and rest (6.5%) of the stomachs analysed were having half full food content. *A. rochei* is a nonselective generalist feeder foraging mainly on small crustaceans, finfishes and molluscs. The larval and juvenile stages of crustaceans and fishes contributed considerably to the diet. Crustaceans mainly included *Acetes* spp, followed by other penaeid prawns. Fishes were represented by anchovies, sardines and mackerel. Gastropods and cephalopods represented the molluscan component in the diet.

Length weight relationship

The length-weight relationship derived is $W = 0.0033\ L^{3.467}$ for *A. thazard* and $W = 0.0076\ L^{3.249}$ for *A. rochei* where 'W' is the weight of fish in g and 'L' is the fork length in cm. The length-weight relationship indicated that growth was allometric for both species.

Population parameters:

Growth and other population parameters of the species were estimated from length composition data following ELEFAN analysis

Population/Stock parameters of *A.thazard* & *A.rochei*

Sp. name	K	L_∞	W_∞	a	b	r^2	L_{max}	t_m	L (mean)	t_0	L_m	$\frac{L_m}{L_\infty}$
A.thazard	1.20	58.70	4471	0.0033	3.467	0.92	52.0	2.50	37.0	-0.0075	29.70	0.51
A. rochei	0.61	42.30	1461	0.0076	3.249	0.95	46.0	4.90	28.0	-0.0337	23.60	0.56

Growth

The von Bertalanffy growth equation for *A.rochei* was derived as Lt = 42.3 [1-e $^{-0.61(t-0.0337)}$]. The asymptotic weight obtained was 1,429 g, the growth performance index 3.0 and longevity 4.9 years. The lengths attained by the fish at the end of 1st, 2nd, 3rd and 4th years were 18.6, 29.3, 35.2 and 38.4 cm respectively.

The von Bertalanffy growth equation for *A.thazard* was derived as Lt = 58.7 [1-e $^{1.20(t-0.0075)}$]. The asymptotic weight obtained was 4,471 g, the growth performance index 3.0 and longevity 4.9 years. The lengths attained by the fish at the end of 1st, 2nd and 3rd year were 41.2, 53.4 and 57.1 cm respectively. Fishery was sustained mainly by the 1^{+} yr old fishes for both species