



**The 2<sup>nd</sup> Regional Scientific and Technical Committee Meeting for  
the SEAFDEC/UN Environment/GEF Project on Establishment and Operation of  
a Regional System of Fisheries *Refugia* in the South China Sea and Gulf of Thailand**

21<sup>st</sup> – 23<sup>rd</sup> May 2019  
Thansur Sokha Hotel, Kampot Province (Fisheries Refugia Site), Cambodia

**REGIONAL STUDY ON FRIGATE TUNA  
GENERAL INFORMATION**

Prepared by PCU

**I. GENERAL INFORMATION**

**Classification / Names**

Actinopterygii (ray-finned fishes) > Perciformes (Perch-likes) > Scombridae (Mackerels, tunas, bonitos) > Scombrinae

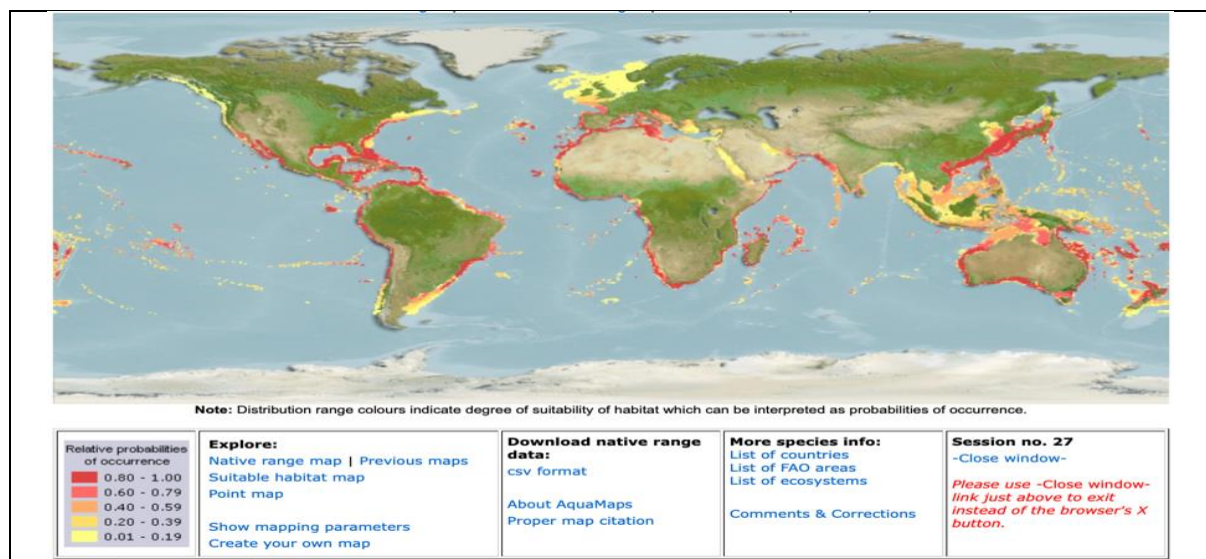
Etymology: Auxis: Greek, auxis = a variety of tunna (Ref. 45335). More on author: Lacepède.

**Environment: climate zone / depth range / distribution range Ecology**

Marine; pelagic-neritic; oceanodromous (Ref. 51243); depth range 50 - ? m (Ref. 9340). Tropical; 27°C - 28°C; 61°N - 51°S, 180°W - 180°E

**Distribution Countries**

Atlantic, Indian and Pacific (Western Central). Eastern Pacific population recognized as subspecies *Auxis thazard brachydorax* (Ref. 32349). Many authors have used the name *Auxis thazard* as including *Auxis rochei* in the belief that there was only a single worldwide species of *Auxis*. Highly migratory species, Annex I of the 1982 Convention on the Law of the Sea (Ref. 26139).



### **Length at first maturity / Size / Weight / Age**

Maturity: Lm 29.5, range 29 - ? cm

Max length : 65.0 cm FL male/unsexed; (Ref. 29114); common length : 60.0 cm TL male/unsexed; (Ref. 47377); max. published weight: 1.7 kg (Ref. 40637); max. reported age: 5 years (Ref. 29114)

### **Short description Morphology | Morphometrics**

Dorsal spines (total): 10 - 12; Dorsal soft rays (total): 10-13; Anal spines: 0; Anal soft rays: 10 - 14. This species is distinguished by the following characters: a robust body, elongated and rounded; teeth small and conical, in a single series; total gill rakers on first gill arch 36-42; dorsal fins 2, D1 X-XII, separated from the second by a large interspace (at least equal to length of first dorsal-fin base), second dorsal fin followed by 8 finlets; anal fin followed by 7 finlets; pectoral fins short, but reaching past vertical line from anterior margin of scaleless area above corselet; a large single-pointed flap (interpelvic process) between pelvic fins; body naked except for the corselet, which is well developed and narrow in its posterior part (no more than 5 scales wide under second dorsal-fin origin); a strong central keel on each side of caudal-fin base between 2 smaller keels. Colour of back bluish, turning to deep purple or almost black on the head; a pattern of 15 or more narrow, oblique to nearly horizontal, dark wavy lines in scaleless area above lateral line; belly white; pectoral and pelvic fins purple, inner sides black (Ref 9684).

### **Biology**

Adults are epipelagic in neritic and oceanic waters (Ref. 9340). They feed on small fish, squids, planktonic crustaceans (megalops), and stomatopod larvae (Ref. 5213). Because of their abundance, they are considered an important element of the food web, particularly as forage for other species of commercial interest. They are preyed upon by larger fishes, including other tunas (Ref. 9987). Marketed fresh and frozen (Ref. 9340) and also utilized dried or salted, smoked and canned (Ref. 9987).

### **Life cycle and mating behavior**

In correlation with temperature and other environmental changes, the spawning season varies with areas, but in some places it may even extend throughout the year.

### **Main reference**

FISHBASE: <https://www.fishbase.de/Summary/SpeciesSummary.php?ID=94&AT=frigate+tuna>

## **II. REGIONAL STUDIES<sup>1</sup>**

1. Tuna and tuna-like species are recognized as the most promising target species in off-shore waters of Vietnam. The first studies on biology of tuna were conducted in 1960. To ensure the sustainable exploitation of tuna resources in off-shore waters, studies on biology of tuna are being carried out by the Research Institute of Marine Products.
2. Materials on biology of tuna were collected on board of research and commercial vessels. Fishing gears were drift gillnets with different mesh-size and longline.
3. The results of study showed that tuna and tuna-like species are distributed widely in both neritic and oceanic waters of Vietnam. The percentage of Skipjack tuna caught by gillnet in total catch was highest (25.3%) then followed by Frigate tuna (8.9%) and Bullet tuna (3.4%). Yellowfin and Bigeye tunas were dominant in catch by longline.
4. Biological characteristics of Frigate Tuna length frequency distribution, reproduction, feeding, growth and recruitment, mortality rate were described as follows:

#### **4.1 Length frequency distribution**

- Size of Frigate tuna caught in the Southwest monsoon period ranged 23.5-43.0 cm with the mean length of 34.5 cm, mode of 39.0 cm and in the Northeast monsoon ranged 26.5- 45.0

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<sup>1</sup> Study on Biology of Tuna in the South China Sea, Area IV; Vietnamese Waters by Dr. Chu Tien Vinh (Proceedings of the SEAFDEC Seminar on Fishery Resources in the South China Sea, Area IV: Vietnamese Waters)

cm with the mean length of 36.7 cm. It shows the size caught in Northeast monsoon was a little bit larger than in Northeast monsoon.

- For the whole year, Frigate tuna have length ranged from 23.5 - 45.0 cm and weight ranged 0.1 to 1.9 kg respectively. The mean length of Frigate tuna captured by gillnet of mesh- size 73mm was 35.3 cm, of 95mm - 40.3 cm, of 123mm- 35.9 cm, of 150mm- 36.9 and of 160 mm- 37.3 cm.
- Total length and fork length relationship was:  $L_f = 0.9372 L_t + 3.1655$  and  $r^2 = 0.9856$

#### 4.2 Length-weight relationship

- Length-weight relationship of both sexes was:  $W = 0.0113 \times L^{3.1547}$ ,  $r^2 = 0.9298$

#### 4.3. Reproduction

- In the Southwest monsoon, 10.0 % and 16.7 % of females having gonads of IV and VI stage respectively, and 2.2 % of resting stage [ Fig.22 ]. In this period, the ratio of male and female was 1.7: 1. It showed that the spawning season of Frigate mackerel is in this monsoon period with the peak in April-June.
- In the Northeast monsoon, only 8.8 % of female having gonads belonged to IV stage, in this time the ratio of male and female was 1.5 : 1 [ Fig. 23 ].

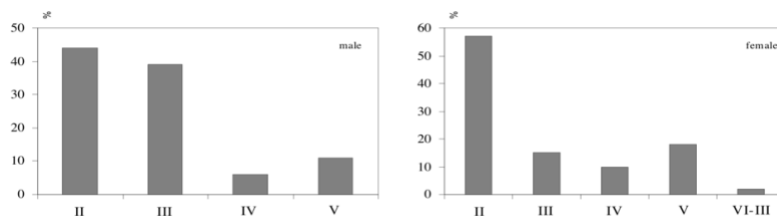


Fig. 22. Maturity stage of Frigate mackerel in Southwest monsoon.

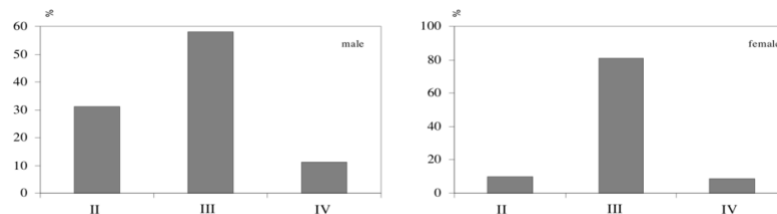


Fig. 23. Maturity stage of Frigate mackerel in Northeast monsoon.

- The absolute fecundity of females of 36.5-40.0 cm ranged 129,648- 357,006 eggs. Size at first maturity was about 34 cm.( 2 years group ).
- In Thailand Gulf, the length of first maturity of Frigate mackerel was 31 cm, and fecundity of fish of length 31-39 cm ranged 78.000- 719.900 eggs. [Yesaki ( 1994 )].

#### 4.4 Feeding

- In the Southwest monsoon, stomach fullness of 3 and 4 degree accounted only for 4.88 % while in the Northeast monsoon 18.44 %.

Degree of stomach fullness of Frigate mackerel.

Degree of fullness	Southwest monsoon (%)	Northeast monsoon (%)
0	25.61	64.54
1	61.38	5.67
2	8.13	11.35
3	4.88	17.02
4	0	1.42

- Squid and Shrimp were often found in their stomach.

4.5. Growth and recruitment

Areas	Growth parameters			Length at age			Authors
	K	L <sub>8</sub>	t <sub>0</sub>	1	2	3	
West of Java West coast of Thailand	0.70	47.5		24	36	42	Dwiponggo et al.,1986
Sri Lanca	0.80	47.2		26	37	43	Yesaki, 1994
India	0.54	58.0		25	39	47	Joseph et al.,1986
	0.49	63.0	-0.270	29	42	50	Silas et al,1985

- Growth parameters and length at age of Frigate tuna.

Parameters of the von Bertalanffy growth equation was estimated as follows:

- $L_8 = 49.02 \text{ cm}, K = 0.426, t^0 = -0.867$

4.6. Mortality rate

- Total mortality. Z=1.44,
- Natural mortality M=0.67,
- Fishing mortality. F=0.77and
- exploitation rate E = 0.53

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