TUNA AND TUNA-LIKE FISHES FROM THE INDIAN SEAS

By

S. JONES AND E. G. SILAS

Central Marine Fisheries Research Institute
Mandapam Camp, India

Abstract

An account of the tuna and tuna-like species from the Indian Ocean and contiguous seas is given along with a tentative key for their identification. Regional references for each species and subspecies, as well as pertinent synonyms are included. The species and subspecies dealt with are: Grammatorcynus bicarinatus (Quoy and Gaimard); Auxis thazard (Lacépède); Auxis thynnoides Bleeker; Cybiosarda elegans Whitley; Sarda orientalis (Temminck and Schlegel); Gymnosarda unicolor (Rüppell); Thunnus (T.) thynnus orientalis (Temminck and Schlegel); Thunnus (T.) alalunga (Bonnaterre); Thunnus (Parathunnus) obesus sibi (Temminck and Schlegel); Kishinoella tonggol (Bleeker); Thunnus (Neothunnus) albacares macropterus (Temminck and Schlegel); Thunnus (Neothunnus?) itosibi Jordan and Evermann; Allothunnus fallai Serventy; Katsuwonus pelamis (Linnaeus); and Euthynnus affinis affinis (Cantor).

THONS ET ESPECES VOISINES DES EAUX INDIENNES

Résumé

La communication traite des thons et espèces voisines de l'océan Indien et des mers contiguës, et fournit une clef provisoire pour leur identification. Pour chaque espèce et sous-espèce sont données les références régionales ainsi que les synonymes pertinents. Les espèces et sous-espèces en question sont les suivantes: Grammatorcynus bicarinatus (Quoy et Gaimard); Auxis thazard (Lacépède); Auxis thynnoides Bleeker; Cybiosarda elegans Whitley; Sarda orientalis (Temminck et Schlegel); Gymnosarda unicolor (Rüppell); Thunnus (T.) thynnus orientalis (Temminck et Schlegel); Thunnus (T.) alalunga (Bonnaterre); Thunnus (Parathunnus) obesus sibi (Temminck et Schlegel); Kishinoella tonggol (Bleeker); Thunnus (Neothunnus) albacares macropterus (Temminck et Schlegel); Thunnus (Neothunnus?) itosibi Jordan et Evermann; Allothunnus fallai Servanty; Katsuwonus pelamis (Linnaeus); Euthynnus affinis affinis (Cantor).

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ATUNES Y PECES AFINES DE LOS MARES DE LA INDIA

Extracto

Se hace una reseña de los atunes y peces afines del Oceano Indico y mares contiguos, a la vez que se presenta una clave provisional para su identificación. Se incluyen asimismo referencias regionales correspondientes a las especies y subespecies así como los sinónimos correspondientes. Las especies y subespecies de que trata son: Grammatorcynus bicarinatus (Quoy y Gaimard); Auxis thazard (Lacepede); Auxis thynnoides Bleeker; Cybiosarda elegans Whitley; Sarda orientalis (Temminck y Schlegel); Gymnosarda unicolor (Ruppell); Thunnus (T.) thynnus orientalis (Temminck y Schlegel); Thunnus (T.) alalunga (Bonnaterre); Thunnus (Parathunnus) obesus sibi (Temminck y Schlegel); Kishinoella tonggol (Bleeker); Thunnus (Neothunnus) albacares macropterus (Temminck y Schlegel); Thunnus (Neothunnus?) itosibi Jordan y Evermann; Allothunnus fallai Servanty; Katsuwonus pelamis (Linnaeus); Euthynnus affinis affinis (Cantor).

1 INTRODUCTION

The comparative study of scombroid fishes by Kishinouye (1923) has contributed a great deal to our knowledge of tunas and related fishes in the Indo-Pacific and it still remains the most comprehensive account on the subject though the species dealt with were those found in Japanese waters. The last twenty years have, however, seen several attempts to straighten out the nomenclature of tuna and tuna-like fishes from various parts of the world (Serventy, 1941, 1956; Godsil and Byers, 1944; Brock, 1949; Fraser-Brunner, 1950; Godsil and Holmberg, 1950; Schaefer and Walford, 1950; Rosa, 1950; de Beaufort, 1951; Rivas, 1951, Ginsburg, 1953; Godsil, 1954; de Sylva, 1955; Bullis and Mather, 1956 and several others). Yet the picture that emerges out of all this is one of vagueness, though some understanding has been achieved in regard to the recognition of certain species in the Atlantic and in the Pacific. Conflicting views are held regarding the higher categories.

At the informal Pacific Tuna Biology Conference held at Honolulu, Hawaii, in August 1961 two contributions which have direct bearing on taxonomy and nomenclature of tunas were presented. Of these, Collette (1961) while recognising six species of tunas proper, relagated Neothunnus, Parathunnus and Kishinoella, recognised by many workers as distinct genera (Kishinouye, 1923; Jordan and Evermann 1926, etc.) or subgenera (Fraser-Brunner, 1950, Rivas 1961 etc.) to the absolute synonym of Thunnus remarking that the differences between these are only of specific importance. Roedel and Fitch (1961) on the other hand, speaking of the commercially important species of tunas, namely, the albacore, bluefin, bigeye, yellowfin and skipjack, drew attention to the inadequacies in our present understanding of the species problem in tunas as we are still unaware whether in each case we are dealing with a single world-wide species, perhaps separable into sub-species; or whether we are concerned with several geographically limited species, themselves perhaps divisible into sub-species. Unless efforts are made to solve this problem, it will be hard to obtain unanimity on any conclusion regarding recognition of species or races of tunas. As a tentative suggestion, until the problem can be tackled on a global basis, Roedel and Fitch (1961) have followed the course of suppressing Germo to the synonym of Thunnus, while retaining Parathunnus, Neothunnus and Kishinoella as separate genera, and so also Katsuwonus, Euthynnus and Auxis.

At the symposium on "Scombroid fishes" held at Mandapam Camp in January 1962, the authors (Jones and Silas, 1962a) have drawn attention to the desirability of having one or more centres where good series of scombroid material from different regions could be accummulated for comparative study and reference, which would also enable elucidation of the species problem in tuna and tuna-like fishes on a global basis. A preliminary account of Indian tunas was given by Jones and Silas (1960) and other notable recent contributions on the systematics of tunas of the Indian Ocean in general are those by Talbot (1962) from South African waters; Williams (1962) from East African coast; Fourmanoir and Crosnier (1962) from Madagascar; Baissac (1962) from Mascarene waters and Whitley (1962) from Australian waters.

In the light of the authors' investigations and those mentioned above, the following are recognised from the Indian Ocean. (Table I)

The precise identity of some of the species from the Indian Ocean is lacking as shall be shown presently for the bluefin, bigeye etc. However, current names used are based on the result of logical deductions, the validity of which will be known only when the species are studied on a world-wide basis.

Some nomenclatorial discussions are given on tuna and tuna-like fishes recognised by the authors from the Indian Ocean. Detailed discussions are given by Jones and Silas (1962a). A key for the identification of the species mentioned here is given below.

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Table I
TUNAS FROM THE INDIAN OCEAN

Common name	Genus	Sub-genus
Tunas - Proper		
Albacore	Thunnus	Thunnus
Bluefin	Thunnus	Thunnus
Bigeye	Thunnus	Parathunnus
Yellowfin	Thunnus	Neothunnus
Northern bluefin	Kishinoella	
Skipjack	Katsuwonus	
Little tunny or mackerel tuna	Euthynnus	
Slender tunny	Allothunnus	
Tuna-like fishes		
Bonito	Sarda	
Frigate mackerel	Auxis	
Dogtooth tuna	Gymnosarda	
Leaping bonito	Cybiosarda	
Double-lined mackerel	Grammatorcynus	

2 TENTATIVE KEY TO THE IDENTIFICATION OF TUNAS AND RELATED FISHES FROM THE INDIAN OCEAN

1a. Corselet obscure; two lateral lines, an upper and a lower, latter commencing from former in a line below anterior part of first dorsal and deeply decurved following lower contour of body, eventually joining upper lateral line near peduncular keel; vertebrae 31.

Grammatorcynus bicarinatus (Quoy and Gaimard)

1b. Corselet well developed; lateral line single 2

2a. First and second dorsal fins widely separated by distance exceeding length of base of first dorsal 3

2b. First and second dorsal fins contiguous or separated by only a narrow interspace not exceeding diameter of orbit 4

3a. Corselet scales abruptly taper immediately below end of first dorsal and continue as a very narrow band having not more than four or five rows of scales in a line below second dorsal; total gill rakers about 39-42 (mean 39.8)

Auxis thazard (Lacépède)

3b. Corselet scales gradually taper behind first dorsal and continue as a wide band with 7 to 12 rows of scales in a line below seventh dorsal finlet; total gill rakers about 40-47 (mean 44.8)

Auxis thynnoides Bleeker

4a. Distance from tip of snout to end of maxilla 50 percent or more of head length; end of maxilla surpasses vertical below middle of orbit 5

4b. Distance from tip of snout to end of maxilla considerably less than 50 percent of head length; end of maxilla does not surpass vertical below middle of orbit 7

5a. Vomer with villiform teeth; dorsal and anal finlets 9 or 10/7 or 8

Cybiosarda elegans Whitley

5b. Vomer edentulous; dorsal and anal finlets 6 to 8/5 or 6 6

6a. Dorsal with 18 or 19 spines; end of maxilla surpassing vertical below posterior border of orbit; 6 to 9 horizontal dark stripes on upper half of body appear as short broken bars in juveniles

Sarda orientalis (Temminck and Schlegel)

6b. Dorsal with 12-14 spines; end of maxilla reaching to vertical below posterior third of orbit; no dark stripes on body.

Gymnosarda unicolor (Rüppell)

7a. Body completely scaled; those of corselet and lateral line usually larger 8

7b. Body naked except for corselet and lateral line (exception Allothunnus) 13

8a. Anterior insertion of second dorsal nearer to posterior end of caudal keel than to posterior margin of orbit 9

8b. Anterior insertion of second dorsal nearer posterior margin of orbit than to posterior end of caudal keel 11

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9a. Pectoral short, not exceeding head length excluding snout and falling short of vertical below anterior insertion of second dorsal by distance equalling almost its own length; preoperculum distinctly rounded along posterior margin.

Thunnus (T.) thynnus orientalis (Temminck and Schlegel)

9b. Pectoral elongate, one to one and a half times length of head and surpasses vertical below anterior insertion of second dorsal; preoperculum more or less angular at lower posterior margin. 10

10a. Gill rakers on lower limb 19 to 21; surface of liver markedly striated; vent rounded; distance between tip of pectoral and end of caudal keel much less than head length.

Thunnus (T.) alalunga (Bonnaterre)

10b. Gill rakers on lower limb 16 to 18; liver marked with faint striations on margin only; vent elliptical; distance between tip of pectoral fin and end of caudal keel greater than head length.

Thunnus (Parathunnus) obesus sibi (Temminck and Schlegel)

11a. Total gill rakers 19-26 of which 13-19 on lower limb (generally 15 to 17); air bladder absent; finlets with hardly any yellow being predominantly dusky.

Kishinoella tonggol (Bleeker)

11b. Total gill rakers 27-32 of which 19 to 22 on lower limb (generally 20-22); air bladder present; finlets lemon yellow with narrow dusky edging 12

12a. Pectoral surpassing vertical below anterior insertion of second dorsal; anal and second dorsal not elongate and shorter than pectoral.

Thunnus (Neothunnus) albacares macropterus (Temminck and Schlegel)

12b. Pectoral falls short of vertical below anterior insertion of second dorsal; anal and second dorsal greatly elongate, being considerably longer than pectoral.

Thunnus (Neothunnus?) itosibi (Jordan and Evermann)

13a. First dorsal with 17 spines; body outside corselet uniformly scaled; total gill rakers 73 to 75 (24-25 + 48-51); sides of body devoid of any conspicuous colour pattern.

Allothunnus fallai Serventy

13b. First dorsal with 15 spines; body outside corselet naked; total gill rakers not exceeding 60; body with conspicuous colour pattern 14

14a. Four to six dark conspicuous longitudinal stripes on lower half of body; gill rakers 15 or 17 + 33 to 42.

Katsuwonus pelamis (Linnaeus)

14b. No dark stripes on lower half of body, instead a few conspicuous black spots on side of body behind corselet below pectoral base; gill rakers 7 to 10 + 22 to 25.

Euthynnus affinis affinis (Cantor)

3 DOUBLE-LINED MACKEREL Grammatorcynus bicarinatus (Quoy and Gaimard, 1824)

3.1 Synonyms

Thynnus bicarinatus Quoy and Gaimard, 1824
Thynnus bilineatus Rüppell, 1835
Grammatorcynus bilineatus Gill, 1862
Nesogrammus piersoni Evermann and Seale, 1907
Grammatorcynus bicarinatus McCulloch 1922
Grammatorcynus bicarinatus (in part) Fraser-Brunner 1950)

3.2 References from Indian Ocean and contiguous waters

Quoy and Gaimard (1824); Rüppell (1835); Günther (1860); Kluzinger (1871); Hardenberg (1935); Fraser-Brunner (1950); de Beaufort (1951); Roux-Estevi and Fourmanoir (1955); Munro (1958b); Jones, Silas and Dawson (1960); Jones and Silas (1960, 1962a); Silas (1962e).

3.3 Distribution

General: Red Sea, eastwards to coast of Australia; New Guinea; Marshall Islands; Sulu Sea; Philippines; and Ryukyu Islands, Japan.

In Indian Ocean and contiguous waters: Red Sea, Andamans, west coast of Java, and west coast of Australia.

3.4 Remarks

This is a very distinct species and phylogenetically placed close to the Scombridae. Essentially a reef dweller, the species is taken on handlines along with the dogtooth tuna Gymnosarda unicolor, the rainbow runner Elagatis bipinnulatus, the dolphin, Coryphaena hippurus and similar fishes from the vicinity of reefs.

References to work dealing with this species outside the Indian Ocean are mainly those by Kishinouye (1915, 1923); Evermann and Seale (1907); McCulloch (1922); Herre (1953); Roxas and Martin (1937); Umali (1950); Warfel (1950); Wade (1951); Sette (1952); Dung and Royce (1953); Ogibly and Marshall (1954); Munro (1958a) and Schultz (1960).

The synopsis of biological data on this species presented at this conference by Silas (1962e) summarises available information.

4 FRIGATE MACKERELS Genus Auxis Cuvier

Two forms of frigate mackerels, a short corseletted and a long corseletted one are at present recognised from the Indo-Pacific and denoted as Auxis thazard (Lacépède) and A. thynnoides Bleeker respectively. The Atlantic and Mediterranean frigate mackerel appears to be the short corseletted form for which the name A. thazard has been used, although detailed comparison between the typical A. thazard from the Sunda Sea (from where the species was first described) and those from the Atlantic is wanting. It is also of special interest that whilst the two forms mentioned above are recognisable throughout the Indo-Pacific distributional range of the genus, only one type should be known from the Atlantic and Mediterranean. Matsumoto (1959) however suggests the likelihood of the occurrence of the long corseletted form in the Atlantic as well, but this needs elucidation.

Intermediate conditions in the nature of the corselet (Jones and Silas, 1962a) may give rise to some doubts as to the identity of the two species. If so, the gill-raker counts as well as the following characters not mentioned in the 'key' but dealt with elsewhere (Jones and Silas, 1962a) should facilitate identification:

1. For A. thazard the gill rakers number 9-10 and 29-32 in the upper and lower limbs of the outer arch giving a total of 39-42 while in A. thynnoides they are 8-12; 31-36 and 40-47 respectively.

2. The forward extension of the scaleless portion of the body above the lateral line was found to differ in the two species. As could be seen from figure 1a, in A. thynnoides a vertical line drawn through the anterior end of the scaleless area passes downwards not touching the tip of the pectoral fin, while in A. thazard (Figure 1b, c) the line passes through the posterior third

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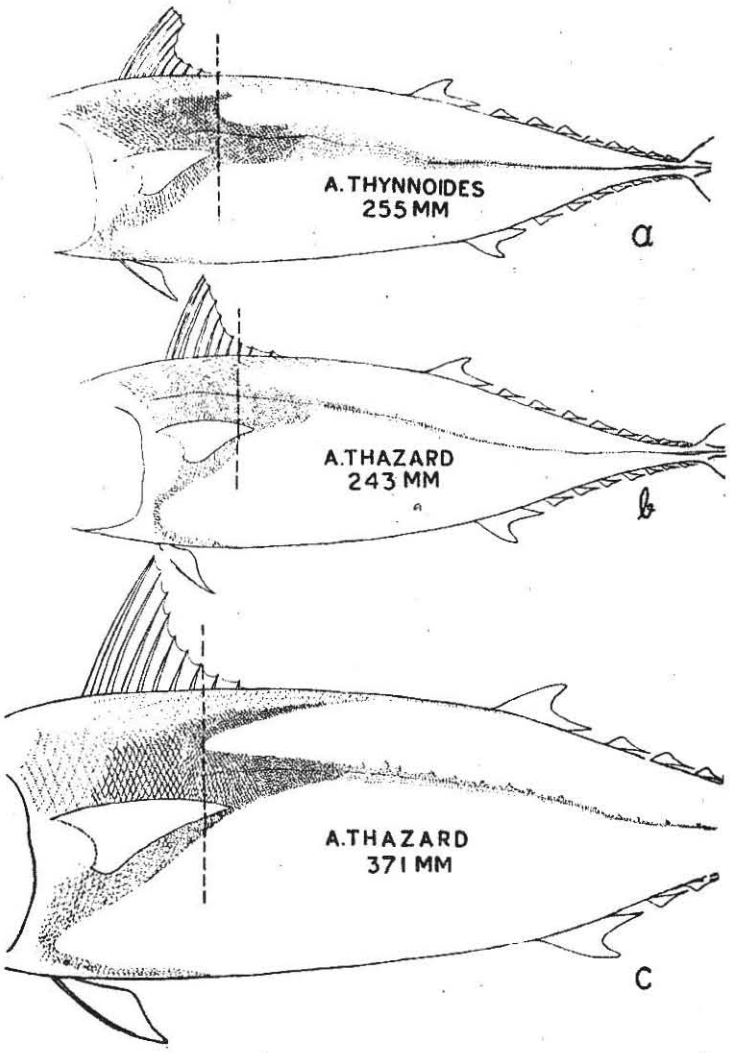

Figure 1. Forward extent of scaleless portion above lateral line in relation to pectoral fin in specimens of Auxis thazard and A. thynnoides (after Jones and Silas, 1962)

or fourth of the fin.

3. The viscera in situ in specimens of about the same length in both the species shows differences in the disposition of the organs (Figure 2). In A. thazard (Figure 2a, c) when viewed ventrally, the right lobe of the liver takes a complete loop crossing over the mid-ventral longitudinal axis while in A. thynnoides the right lobe does not show such a curve and even the hepatic vein does not fall in line with the mid-ventral longitudinal axis. In the former, the stomach (whether containing food or empty) extends to slightly behind the level of the anal opening as the right lobe of the liver, while in A. thynnoides the stomach is shorter, the distal end hardly reaching the vent, though the right lobe of the liver may extend slightly backwards, but apparently not surpassing a line above origin of anal fin. The caecal mass in A. thynnoides is more developed and occupies a greater space than in A. thazard in which species the spleen is smaller. The left lobe of the liver in A. thazard is relatively longer than in A. thynnoides. In a lateral view, part of the gall-bladder can be seen in the latter species (Figure 2d) while it is not so in A. thazard.

4. In general body form, A. thynnoides is more rounded and robust while in A. thazard the body is more compressed from side to side. (Figure 3) Six cross sections (A-F) taken at almost identical locations of the body in a specimen each of A. thazard (243 mm) and A. thynnoides (255 mm) illustrate further differences between the two species. The shape of the visceral cavity is totally different in the two species. Besides, in A. thazard (Figure 3 b, c, d) it appears to be slightly asymmetrical probably due to the looping of the liver ventrally, and accommodation in the form of narrow cavities for the liver and stomach above the origin of the anal fin is seen (Figure 3 e). There appear to be slight differences in the disposition of the coloured portion of the muscles in both the species. As the specimens are formalin-preserved however, over a period of time, many details are not discernible. Sections at the origin of the second dorsal (Figure 3 d) in both the species show that in A. thynnoides the number of myotomes cut through is more than for A. thazard.

Godsil (1954) has drawn attention to certain other anatomical differences between the long corseletted and short corseletted forms. Godsil (1954) and Matsumoto (1959) comment that the gill raker counts for A. thazard from the eastern Pacific are higher than for specimens from the central and western Pacific, very closely approximating the condition seen in A. thynnoides. This would need further investigation as Wade (1949) described two specimens from the Pacific coast of Central America (Schaefer and Marr, 1948 collection) showing higher gill raker counts as A. thynnoides. The close similarity between the two species may be responsible for several discrepancies in species identity in earlier literature and there is a great need for a more detailed comparison between these two species as well as in the same species, on a global basis.

5 SHORT CORSELETTED FRIGATE MACKEREL (Auxis thazard Lacépède, 1801)

5.1 Synonyms

Scomber thazard Lacépède, 1801
Scomber bisus Rafinesque, 1810
Scomber rochei Risso, 1810
Thynnus rocheanus Risso, 1826
Auxis vulgaris Cuvier, 1831
Auxis taso Cuvier, 1831
Auxis tapeinosoma Bleeker, 1854
Auxis rochei (partim) Günther, 1860
Auxis thazard Jordan and Evermann, 1896
Auxis hira Kishinouye, 1915
Auxis thazard (partim) Fraser-Brunner, 1950

5.2 References from Indian Ocean and contiguous waters

Günther (1860); Fowler (1928); Jones (1958, 1962); Williams (1960, 1962); Jones and Silas (1960, 1962a); Ranade (1961); Silas (1962b); Talbot (1962); Whitley (1962); Jonklass (1962).

5.3 Distribution

General: Atlantic, Mediterranean Indo-Pacific.

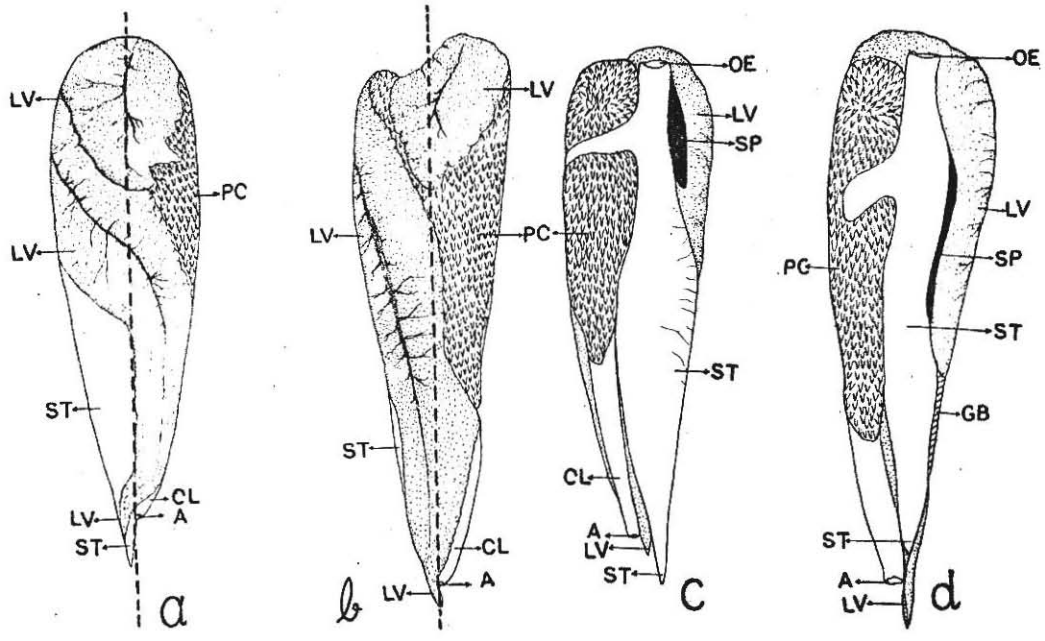

Figure 2. Ventral and lateral views of viscera in situ in: (a and c) Auxis thazard and (b and d) A. thynnoides 243 mm and 255 mm in length respectively. (A - Anal opening; CL - Colon; GB - Gall bladder; LV - Liver; OE - Oesophageal end; PC - Caecal mass; SP - Spleen; and ST - Stomach) (after Jones and Silas, 1962)

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In Indian Ocean and contiguous waters: East coast of South Africa from Natal coast northwards; Gulf of Aden; west and east coasts of India; Laccadives, Maldives; Ceylon, south west Sunda Sea; Western Australia.

5.4 Remarks

A seasonal visitor to the coastal waters, A. thazard is usually caught in shore seines, drift nets and by trolling. It is the more common of the two species of the genus and collections have been examined by the authors from various parts along the west coast of India from Veraval (Gujurat) to Cape Comorin; from the east coast from Tuticorin and from the Laccadive Sea, but no appreciable differences have been noticed.

It may be mentioned here that de Beaufort's (1951) description given under A. thazard actually refers to the next species. A question which may be difficult to settle is whether Lacépède's A. thazard from New Guinea actually refers to the short corseletted form as currently believed.

6 LONG CORSELETTED FRIGATE MACKEREL (Auxis thynnoides Bleeker, 1855)

6.1 Synonyms

Auxis thynnoides Bleeker, 1855
Auxis thazard (nec Lecépède, 1935) Jordan and Evermann 1900; de Beaufort, 1951
Auxis thazard (partim) Fraser-Brunner, 1950
Auxis rochei (partim) Günther, 1860
Auxis maru Kishinouye, 1915
Auxis tapeinosoma (nec Bleeker) Herre and Herald, 1951; Jones 1958, 1960; Talbot, 1962 of Japanese workers.

6.2 References from Indian Ocean and contiguous waters

Bleeker (1855); Fraser-Brunner (1950); Rosa (1950); de Beaufort (1951); Jones (1958, 1962 a, b); Williams (1960); Jones and Silas (1960, 1962 a); Kumaran (1962); Talbot (1962).

6.3 Distribution

General: Indo-Pacific.

In Indian Ocean and contiguous waters: East coast of South Africa off Cape Peninsula and Mosal Bay; west coast of India (Malpe, Calicut, Quilandy, Vizingam and Colachel).

6.4 Remarks

For long a problematic species, its position in the system is now well defined. Jones (1962) has summarised the knowledge on this species from which it would appear that much more has been written about it than one would expect. Talbot (1962) who records this along the east coast of South Africa mentions "said to attain about 600 mm. South African specimens known to 300 mm". We have measured specimens up to about 300 mm from the west coast of India, but much larger specimens have, on at least one occasion, been noticed in the curing yard at Vizhingam on the south-west coast of India.

Unlike A. thazard this species is rarely seen in commercial catches, but when it occurs it is seen in very large shoals and considerable quantities are landed by shore seine.

7 LEAPING BONITO (Cybiosarda elegans Whitley, 1935)

7.1 Synonyms

Cybiosarda elegans Whitley, 1935
Gymnosarda elegans Fraser-Brunner, 1950

7.2 References from Indian Ocean and contiguous waters

Whitley (1935, 1962); Serventy (1941); Fraser-Brunner (1950); Munro (1958); Jones and Silas (1960, 1962a).

7.3 Distribution

General: East and west coast of Australia.

In Indian Ocean and contiguous waters: Along west coast of Australia at least as far south as Fremantle.

7.4 Remarks

The authors feel that Cybiosarda elegans should be retained as a distinct genus and species, although Fraser-Brunner (1950) relegated the genus to the synonym of Gymnosarda. The presence of villiform teeth in the vomer, the greater number of dorsal and anal finlets (9 or 10/7 or 8) and 15 or 16 dorsal spines in Cybiosarda should differentiate it generically from Gymnosarda in which genus the vomer is edentulous, the dorsal and anal finlets fewer (6 or 7/6 or 7), and the dorsal spines number 12 to 14.

By its occurrence along the west coast of Australia, it qualifies to be included in this account. Information on the biology of this tuna is scarce, but indications are that like Allothunnus, and Thunnus (T. alalunga, etc.), it is subtropical in distribution. According to Serventy (1941) it is said to be an excellent sport fish and specimens between 3/4 lb and 2 lb are usually taken in trolling, and shoals of many hundreds are often seen. Serventy further remarks that it ".... is the one tuna whose flesh is appetizing in the fresh condition. The meat is white and may be smoked quite well".

8 ORIENTAL BONITO (Sarda orientalis Temminck and Schlegel), 1842

8.1 Synonyms

Pelamys orientalis Temminck and Schlegel, 1842
Pelamys chilensis Day, 1878, 1889 (nec Cuvier)
Sarda velox Meek and Hildebrand, 1923
Sarda orientalis Kishinouye, 1923
Sarda chilensis (partim) Bernard 1927
Sarda orientalis serventyi Whitley 1945
Sarda chilensis Smith, 1948 (nec Cuvier)

8.2 References from Indian Ocean and contiguous waters

Günther, (1860); Day, (1878, 1889); Barnard (1927); Chabanaud, (1944); Whitley (1945, 1962); Smith (1948, 1961); Wheeler and Ommanney (1953); Fraser-Brunner, (1950); Jones (1960); Jones and Silas (1960, 1962a); Rosa and Laevastu (1961); Rao (1962); Talbot (1962); Silas (1962a, 1962d).

8.3 Distribution

General: Indo-Pacific.

In Indian Ocean and contiguous waters: Natal coast of South Africa; Somalia coast; Gulf of Aden; south west coast of India; Seychelles; south west coast of Australia.

8.4 Remarks

The synopsis of biological data on the oriental bonito from the Indian Ocean (Silas 1962b) summarises existing knowledge about the species from this area. Godsil (1955) has shown that S. velox and S. orientalis are conspecific. The known distributional pattern of the species shows that while only two species, S. orientalis and S. chilensis are recognisable from the Indo-Pacific (latter only in the Pacific) the distribution of S. orientalis is not continuous, but appears to be isolated to certain coastal stretches, and the species has not been collected from the high seas of the Indian Ocean. It is evidently this disjunct distribution that led Whitley (1945) to designate the southwestern Australian population as a subspecies S. orientalis serventyi. Along the east coast of Africa also, the species which occurs along the Natal coast and upward has not been collected from the British East African coast, but is known from further north from the Somali coast where there appears to be a minor fishery for it. It is found in the Seychelles plateau and also along the west coast of India where it forms a seasonal fishery along the Kerala coast. Comparison of good series of specimens from these areas with material of the typical S. orientalis from Japanese waters is wanting.

Kumaran (1962) has studied the food of juvenile S. orientalis from Kerala coast while Silas (1962 a, d) and Rao (1962) have made observations on the fecundity and spawning habits of this species in Indian waters.

9 DOGTOOTH TUNA (Gymnosarda unicolor Rüppell)

9.1 Synonyms

Thynnus unicolor Rüppell, 1838
Pelamys nuda Günther, 1860

Gymnosarda nuda Kishinouye, 1915
Scomber vau Curtiss, 1938
Gymnosarda unicolor Fowler 1949

9.2 References from Indian Ocean and contiguous waters

Rüppell (1838); Günther (1860); Kluzinger (1871); Kishinouye (1923); Rosa (1950); Fraser-Brunner (1950); Wheeler and Ommanney (1953); Williams (1956, 1962); Smith (1956); Fourmanoir (1957, 1962); Migdalski (1958); Blanc and Postel (1958); Whitley (1962); Jones, Silas and Dawson (1960); Jones and Silas (1960, 1962a); Silas (1962c).

9.3 Distribution

General: Red Sea to Tahiti in the South Pacific and northwards to Ryukyu Islands, Japan.

In Indian Ocean and contiguous waters: Red Sea; British East African coast; Madagascar; Seychelles; Mauritius; Reunion; Maldives; Laccadives; Basses Reef along south east coast of Ceylon; Andamans; Indonesian waters south of Java.

9.4 Remarks

As is the case of the double-lined mackerel Grammatorcynus bicarinatus and the wahoo Acanthocybium solandri, it is essentially a reef dweller.

There is hardly any doubt that the genus is monotypic and the available data (Silas 1962c) do not indicate any marked variations in this species.

Information on the biology of this species is scarce. Specimens in mature running stage (V) have been taken from East African waters between December and February, suggesting spawning in the northeast monsoon. Specimens taken off Mafia, range from 40 lb to just under 100 lb. (Williams 1962) From the Seychelles - Mauritius area Wheeler and Ommanney (1956) reported catching on troll lines specimens 78 cm to 115 cm, weighing 12 lb to 38 lb. According to Kishinouye (1923) this species grows to about 240 cm and attains a weight of about 80 kg. (176 lb) Dung and Royce (1953) have given morphometric data for 123 specimens of G. unicolor from the Pacific.

10 ORIENTAL BLUEFIN (Thunnus (T.) thynnus orientalis Temminck and Schlegel, 1844)

10.1 Synonyms

Thynnus orientalis Temminck and Schlegel 1844
Thynnus maccoyii Castelnau, 1872
Orcynus schlegelii Steindachner 1884
Thunnus thynnus (in part) Jordan and Evermann 1896
Orcynus thynnus Kitahara, 1897
Thunnus schlegelii Jordan and Snyder, 1901
Thunnus orientalis Kishinouye, 1915, 1923
Thunnus saliens Jordan and Evermann, 1926
Thunnus phillipsi Jordan and Evermann, 1926
Thunnus maccoyii Jordan and Evermann, 1926
Thunnus thynnus maccoyii Serventy 1956
Thunnus thynnus orientalis Jones and Silas, 1960
Thinnus maccoyii Whitley, 1962
Thunnus (Thunnus) thynnus orientalis Jones and Silas, 1962

10.2 References from Indian Ocean and contiguous waters

Barnard, 1925; Serventy,(1941); Godsil and Holmberg,(1950); Nakamura et al (1951); Abe (1955); Serventy (1956); Mimura (1958); Mimura and Nakamura (1959); Smith (1961); Mimura (1961); and Talbot (1962).

10.3 Distribution

General: Indo-Pacific.

In Indian Ocean and contiguous waters: Southwestern Indian Ocean from off coast of South Africa; eastern Indian Ocean south of Java and off Western Australia.

10.4 Remarks

The nomenclature and status of bluefins from various parts of the world are in a state of chaos. Thunnus thynnus is recognised as the typical species from the eastern Atlantic and Mediterranean while some recognise the western Atlantic bluefin as T. secundodorsalis. At least

three specific or subspecific names are currently in use in fishery literature to denote the bluefins from the Pacific and part of the eastern Indian Ocean, namely - T. orientalis (Japan) T. saliens (California) and T. maccoyii (around Australia and New Zealand). No attempts have been made to check the status of the bluefin, from the Indian Ocean. Jones and Silas (1960) considered it best to denote the bluefin from the Indian Ocean also as T. thynnus orientalis and would still advocate this course for the very reason that no direct comparisons of either T. maccoyii or T. saliens have been made with good series of T. orientalis from Japanese waters. The general body form, profile, short pectorals, etc. are very characteristic for bluefins while some differences in gill raker counts and a few body proportions have been noted by Godsil and Holmberg (1950), Serventy (1956) and Mather (1959) between bluefins from the Atlantic, Pacific coast of California and Australia. It is not certain however that this data would suffice to denote these as different species. For gill rakers, a range from 22 to 31 for the outer curve has been recorded by various authors from South African waters through the Indo-Pacific to the Atlantic. Serventy (1956) recognised six subspecies of bluefins from the world, mainly based on the modes of gill raker counts for the different areas:

"Thunnus thynnus thynnus (L.) 1758 - European seas,
T. t. corretta (C. and V.) 1831 - North America, Atlantic coast
T. t. saliens Jordan and Evermann 1926 - North America, Pacific coast
T. t. orientalis (Temminck and Schlegel), 1842 - Asiatic coast of north Pacific
T. t. maccoyii (Castelnau), 1872 - Australia and New Zealand

The South African population has remained unnamed, but, from a consideration of the morphological differentiation which has gone on in similar isolated populations (vide in particular the work of Godsil and Holmberg) it will probably require designation as a new subspecies when its characters have been worked out".

Smith (1961) gives the meristic counts of T. thynnus from Cape waters as "D XII - XV 12-14+8-10, A I-III 11-12+7-9, 26-31 slender gill-rakers". The modal figures for gill rakers for different areas given by Serventy (1956) are:

"Australia: 11/22-23 = 33-34
California: 12/23-24 = 35-36
Japan: 12-13/24-26 = 36-39
Europe: 13/24-26 = 37-39".

For South African waters, Talbot (1962) gives the gill raker counts for 13 specimens of T. t. orientalis as ranging from 31 to 36 with the mode at 33-34 and for two specimens of T. t. thynnus the total counts to be 41 and 43

Mather's (1959) data would suggest the following to be modes for bluefins from the eastern and western Atlantic:

Eastern Atlantic: 12/25-27 = 37-39
Western Atlantic: 13/25-27 = 38-40

The Japanese call the bluefin from the eastern Indian Ocean indomaguro (T. maccoyii of Australia) and large-scale fishing for it is carried out at two centres, one 10° to 17°S and 113° to 120°E and the second 20° to 30°S and 100° to 110°E. Mimura (1961) suspects that although the fish in both these areas may belong to the same population, two spawning groups may exist as seen from differences in length/weight and gonad weight of specimens caught from these areas.

While evidences at present tend to picture the bluefins as six isolated populations, it may be mentioned that unlike the yellowfins the bluefins may occur in waters with a temperature as low as 12°C. Our knowledge is too inadequate to even speculate whether there could be mixing between bluefins from the eastern Atlantic and South Africa (Cape Sea) and between the latter and those in the Indian Ocean except for observations made by Talbot (1962). So also little is known about the movements of the bluefin in the Pacific though it is at present presumed to be localised (Chatwin and Orange, 1960). The taxonomic distinctions are very

subtle and it is the authors' contention that until good series from all these areas as well as from the Indian Ocean are critically examined, it will be better to use the oldest name available for the bluefins from the Indo-Pacific, namely, T. orientalis, and on account of the considerable similarities between the bluefin of the Indo-Pacific and the Atlantic to consider it a subspecies of T. thynnus from the Atlantic.

11 ALBACORE (Thunnus (Thunnus) alalunga Bonnaterre, 1788)

11.1 Synonyms

Scomber alalunga Bonnaterre, 1788
Scomber alalunga Gmelin, 1789
Scomber germo Lacepède, 1800
Orcynus germon Cuvier, 1819
Orcynus alalonga Risso, 1826
Thynnus alalonga Cuvier, 1831
Thynnus pacificus Cuvier, 1831
Thunnus alalonga South, 1845
Germo alalunga Jordan and Evermann, 1896
Germo germo Jordan and Seale, 1906
Thunnus alalunga Jordan, Tanaka and Snyder, 1913
Thunnus germo Kishinouye, 1923
Germo alalonga Barnard, 1927

11.2 References from Indian Ocean and contiguous waters

Ueyanagi (1955); Suda (1956); Mimura (1957); Yabe et al (1958); Kurogane and Hiyama (1959); Jones and Silas (1960, 1962a); Hiyame and Kurogane (1961); Baissac (1962); Talbot (1962); Whitley (1962); Williams (1962).

11.3 Distribution

General: Atlantic, Indo-Pacific and contiguous seas; see under 'Remarks'.

11.4 Remarks

There are no definite records of this species from the Indian coast. Apparently it is a southern species found more towards the southern latitudes, just south of the equator.

However, Japanese tuna long-line fishery data (Anon, 1959) indicate that during certain months (March, April and May) albacore may occur in catches a few degrees north of the equator also. Throughout the year, the albacore was found to occur in appreciable abundance between latitudes 1°N and 12° to 15°S and from 52°E to 120°E. Even within this area, the seas southwest of Sumatra and south of Java were found to yield the maximum catch of albacore, in one sector the maximum rate of catch being over 11 per 100 hooks used.

No attempts have been made to study albacore populations in the Indian Ocean. Some workers have treated the Atlantic albacore as alalunga and the Pacific as germo, but hitherto no detailed comparisons have been instituted and even so it is highly doubtful from available data whether more than one species of albacore exist.

Hiyama and Kurogane (1961) opine that in the Indian Ocean south of Sunda Islands the albacore belong to the same population as the ones from the equatorial areas of the Indian Ocean. They find marked differences between albacore from the Indian Ocean and from the Pacific in head length and relative positions of fins. Also the relative growth rate of the Indian albacore is more than that of the Pacific. The Indian albacore differs from those of the northwest Pacific in having larger head and more posteriorly positioned fins and these differences along with their disjunct distribution have led them to consider albacore from both these areas as belonging to two distinct populations. Since samples from the Indian Ocean and southwest Pacific show greater agreement in morphometric characters they suspect that albacore from these two areas may be the same with possibilities of regular mixing.

Mimura (1957) draws attention to the two fishing grounds for albacore in the Indian Ocean, one along the equator (April-September) and the second south of 8°S (January-March). From the southern waters of Sunda Islands (Indian Ocean) Ueyanagi (1955) obtained two albacores, one with ripe ovaries and the second with nearly ripe ones from an examination of which he deduces that the spawning of albacore takes place in that area "in February at least in part". Yabe et al (1958) report the occurrence of a juvenile

albacore 258 mm (vertebral length) from the stomach of a female shortnosed spearfish 130 cm long collected on 20.3.1957 at 25°13'S and 99°43'E. Suzuki et al (1958) give data for 20 specimens of albacore collected from the eastern Indian Ocean for investigations on the blood groups of albacore. Shimadu and Higasa (1960) have studied the riboflavins in the liver and kidney of albacore from the eastern Indian Ocean. Watanabe (1960) has given data regarding the composition of food in 21 specimens of albacore from the eastern Indian Ocean. For experimental fishing for albacore and other tuna reference should be made to Kataoka (1957).

The optimum temperature for albacore is 18°C - 21°C while the species may be present in water 10°C - 28°C. Williams (1962) records the albacore for the first time from East African waters, his material consisting of a single female, ripe running to partly spent (VI-VII) measuring 1065 mm caught by longline off Mafia Island in July 1959.

12 BIGEYE TUNA (Thunnus (Parathunnus) obesus sibi Temminck and Schlegel 1844)

12.1 Synonyms

Thynnus sibi Temminck and Schlegel 1844
Orcynus sibi Kitahara, 1897
Thunnus sibi Jordan and Snyder, 1901
Germo germo (nec Lacépède) Jordan and Evermann, 1905
Thunnus mebachi Kishinouye, 1915
Parathunnus mebachi Kishinouye, 1923
Parathunnus sibi Jordan and Hubbs 1925
Parathunnus obesus mebachi Jones and Silas, 1960
Thunnus obesus (partim) Collette, 1961

12.2 References from Indian Ocean and contiguous waters

de Beaufort (1951); Maeda (1955); Kataoka (1957); Mimura, (1957); Yabe, Ueyanagi, Kikawa and Watanabe, (1958); Fujii and Higasa, (1959); Fujii, Mimota and Higasa, (1959); Nakagome, (1959b); Jones and Silas, (1960, 1962a); Suzuki and Morio (1960); Watanabe, (1960); Hiyama and Kurogane, (1961); Talbot, (1962).

12.3 Distribution

General: Indo-Pacific

12.4 Remarks

The authors agree with Fraser-Brunner (1950); Rivas (1961); Collette (1961) and others that only one species of bigeye tuna may be recognised from the Atlantic and the Indo-Pacific. Although the specific names sibi and mebachi have been applied to the Pacific bigeye tuna and Jones and Silas (1960) have used the name mebachi, the authors tentatively recognise sibi (the oldest name) as representing the Indo-Pacific subspecies of T. (P.) obesus. Comparison of samples from the Indian Ocean with those from the Atlantic is wanting. A specimen of bigeye examined by Jones and Silas (1960) shows characters more akin to the Atlantic T. obesus than to P. mebachi figured by Godsil and Byers (1944). The latter appears to have a markedly longer pectoral. Roedel and Fitch (1961) have drawn attention to the desirability of making a comparative examination of the livers of the bigeye tunas from the Atlantic and the Pacific since the description of the nature of the striations on the liver given by Mather (1959) and Godsil and Byers (1944) indicates likely differences.

Hiyama and Kurogane (1961) found that morphometrical comparison of bigeye tuna from the Indo-Pacific based on samples taken from various fishing grounds did not lead to any conclusive results since the samples were inadequate. However, certain trends are indicative, such as, "Among the bigeye tuna from the equatorial area of the Indian Ocean, as well as the yellowfin tuna, the eastern fish differ from the western fish in having larger heads and more posteriorly positioned fins. The fish from the waters south of the lesser Sundas differ greatly from those from the equatorial area. The former have a shorter head and more anteriorly positioned fins than the latter. The differences between the fish from the area south of the lesser Sundas and from the Banda Sea and the Palao area are not so great as we saw between the former and equatorial Indian Ocean ones".

For biochemical studies on bigeye tuna based on material from Indian Ocean reference may be made to Fujii and Higasa (1959) and Fujii, Mimoto and Higasa (1959).

Serological studies have been attempted by Suzuki and Morio (1960), while Mimura (1957), Kataoka (1957), Nakagome (1959b) and others have given data on bigeye tuna from parts of the Indian Ocean dealing with length frequencies; annual and periodic variations in fishing conditions etc.

13 NORTHERN BLUEFIN (Kishinoella tonggol Bleeker 1851)

13.1 Synonyms

?Thynnus argentivittatus Cuvier, 1831 (lectotype as selected by Schaefer and Walford, 1950: type locality; Malabar Coast, India)
Thynnus tonggol Bleeker, 1851
Neothunnus rarus Kishinouye, 1923
Deraniyagala, 1933
Kishinoella rara Jordan and Hubbs, 1925
Neothunnus tonggol Jordan and Evermann, 1926
Thunnus maccoyi (partim) McCulloch, 1929
Thunnus rarus Delsman and Hardenberg, 1934
Thunnus nicholsoni Whitley, 1936
Thunnus tonggol Tortonese, 1939
Kishinoella tonggol Serventy, 1942
Thunnus (Kishinoella) tonggol Fraser-Brunner, 1950
?Thunnus argentivittatus Rivas, 1961

13.2 References from Indian Ocean and contiguous waters

Günther (1860); Deraniyagala (1933, 1952); Tortonese (1939); Delsman and Hardenberg (1934); Serventy (1941, 1956); Whitley (1947, 1962); Fraser-Brunner (1950); Rosa (1950); de Beaufort (1951); Munro (1955); Jones, Silas and Dawson (1960); Jones and Silas (1960, 1962a); Ranade (1961); Rosa and Laevastu (1961); Rao (1962); Silas (1962b); Jones (1962).

13.3 Distribution

General: Indian Ocean, central and stern Pacific.

In Indian Ocean and contiguous waters: Somalia coast, Gulf of Aden, Karachi coast (of Pakistan), west coast of India from Kutch to Cape Comorin, Gulf of Mannar and southeast coast of India, Ceylon, Laccadives, Maldives, Andamans, Malay coast, Singapore, Sunda Archipelago and west coast of Australia.

13.4 Remarks

The history of Thunnus argentivittatus has been ably summarised by Rivas (1961) who following the suggestion put forward by Schaefer and Walford (1950) recognises it as the Indian yellowfin tuna. The authors have given elsewhere reasons for considering Cuvier's T. argentivittatus, the lectotype of which was designated by Schaefer and Walford (1950) and examined and reported on by Rivas (1961) as probably more akin to Kishinoella tonggol than to the yellowfin. Briefly stated, the reasons are: (1) K. tonggol is quite common along the Malabar coast during certain seasons when it is caught in appreciable numbers in drift net and hook and line while the yellowfin is only rarely caught in coastal waters; (2) the gill raker count of the lectotype, namely, 8 + 18 = 26, falls well within the range for K. tonggol from Indian waters as shall presently be shown, but the number is too low for the yellowfin which has a total count of about 29-32 rakers. (3) Rivas (1961) has given additional gill raker counts for three specimens (topotypes) of T. argentivittatus from the Karachi coast as 6 + 17 = 23. Here again the gill raker counts are too low for a yellowfin. Actual examination of the lectotype may further aid in confirming our viewpoint and as mentioned by the authors the specific name T. argentivittatus may have priority over T. tonggol. If so it is desirable to supress the lesser known name T. argentivittatus. Some authors (Rosa, 1950; Collette, 1961) consider Kishinoella zacalles Jordan and Evermann from Hawaiian waters as a doubtful synonym or absolute synonym of K. tonggol, though the former species was described with "9 + 21 = 30"gill rakers. Serventy (1956) gives the total gill raker counts for Australian specimens of K. tonggol as 19-25 with the mode at 22 and Silas (1962b) gives the counts for K. tonggol taken on troll line in the Gulf of Mannar as 22-27 (6-8+16-19) with the mode at 7+18 = 25. These counts are much on the lower side when compared with that known for K. zacalles. Strangely enough there appears to be no

records of K. zacalles after its original description to help solve the problem as to whether there exists such a species at all. The absence of air bladder is perhaps an important character which prompted Jordan and Evermann (1926) to place zacalles under the genus Kishinoella. However, the colour pattern for the species, as well as the gill-raker counts show much in common with the Pacific yellowfin T. (Neothunnus) albacares macropterus. Jones and Silas (1962a) suggest that it could be a synonym of that species or even bigeye tuna (T. (Parathunnus) obesus sibi) rather than of K. tonggol.

K. tonggol contributes to a seasonal minor fishery along the west coast of India and in the Gulf of Mannar. The synopsis of biological data on the species from the Indian Ocean (Jones, 1962) summarises the knowledge about it from this area.

14 YELLOWFIN TUNA (Thunnus (Neothunnus) albacares macropterus Temminck and Schlegel 1844)

14.1 Synonyms

Albacores or Thynni Sloane, 1707
Scomber albacares Bonnaterre, 1788
Scomber albacorus Lacepède, 1800
Scomber sloanei Cuvier, 1831
Thynnus albacora Lowe, 1839
Thynnus macropterus Temminck and Schlegel, 1844
Thynnus argentivittatus South, 1845 (nec Cuvier)
Orcynus macropterus Kitahara, 1897
Germo macropterus Jordan and Snyder, 1901
Thunnus macropterus Jordan, Tanaka and Snyder, 1913
Neothunnus macropterus Kishinouye, 1923
Thunnus albacora (partim) Fraser-Brunner, 1950
Thunnus (Neothunnus) argentivittatus Deraniyagala, 1952

14.2 References from Indian Ocean and contiguous waters

Serventy (1941); Molteno (1948); Smith (1949, 1961); de Beaufort (1951); Deraniyagala (1952); Hirano and Tagawa (1952); Wheeler and Ommanney (1953); Royce (1953, 1961); Maeda (1955); Munro (1955); Tsuruta (1955, 1961, 1962); Fourmanoir (1957); Kataoka (1957); Kurogane and Hiyama (1958); Mimura (1958, 1962); Nakagome(1958, 1962); Jones (1959); Jones and Silas (1960, 1962a); Tsuruta and Tsunoda (1960); Watanabe (1960); Yabatu, Yukinawa and Warshina (1960); Hiyama and Kurogane (1961); Baissac (1962); Fourmanoir and Crosnier (1962); Jones and Kumaran (1962); Jonklaas (1962); Silas (1962b); Silas and Ummerkutty (1962); Talbot (1962); Thomas (1962 a b) Whitley (1962); Williams (1962).

14.3 Distribution

General: Tropical and temperate waters of Indo-Pacific.

In Indian Ocean and contiguous waters: East coast of South Africa from Cape Sea northwards to Somalia coast; Gulf of Aden; off west coast of India; Gulf of Mannar; Ceylon; Laccadives; Maldives; Chagos Archipelago; Seychelles - Mauritius; Madagascar; Reunion; Andamans; South Sunda Sea; off west coast of Australia and in the high seas of tropical and temperate Indian Ocean and from several other localitites.

14.4 Remarks

Over 30 references given above cover aspects of the taxonomy, biology and fishery of the yellowfin from the Indian Ocean. On the basis of morphometric studies of yellowfin from the Indo-Pacific, Royce (1961) found that ".... the yellowfin from the Pacific show a continuous cline in morphology along the Pacific equator, whereas, the samples removed from the equator differ erratically from the equatorial cline. However, the dimensions are within the range of characters in the cline or are so close to one end or other of the cline that there appears to be no evidence of genetically isolated stocks in the Pacific". Further from the Indian Ocean he found the sample from off Somaliland (northeast Africa) to be the most diverse one when compared to 23 other samples from various parts of the Indo-Pacific and one from Angola, Africa. According to him "It is similar to one or more central Pacific equatorial samples in head length, snout to

insertion of first dorsal but has very short pectoral, second dorsal, and anal fins. Somaliland fish also have a very long distance from the snout to the insertion of the anal, an especially deep body, and a long distance from the snout to the insertion of the ventrals. It is very different from the sample from the other side of Africa near Angola,.....". However, the specimens having been drawn from a smaller size group and the sample itself inadequate, it is not known whether yellowfin from the northeast coast of Africa constitute a distinct population.

Tsuruta (1961) found greater similarities in morphometrical characters between yellowfin from southwest of Madagascar (southwest Indian Ocean) and Angola (southeast Atlantic).

Hiyama and Kurogane (1961) are of the opinion that there are a number of independent or semi-independent populations of yellowfin within each ocean distributed in rather localised waters, intermingling with each other, "because of the positive differences of morphometrical features between the adjoining populations". They find that the yellowfin from the equatorial area of the Indian Ocean show differences as follows ".... the eastern fish have a larger head, more posteriorly positioned ventral and pectoral fins, and longer fins than the western. The yellowfin tuna from the areas south of the lesser Sunda Islands differ from the equatorial ones in having a shorter head and more anteriorly, positioned fins. The specimens from the Lesser Sundas are rather similar to those from the vicinity of the Andaman Islands, with respect to the length of the second dorsal and anal fins. Accordingly, it is probable that the yellowfin tuna inhabiting the waters adjacent to the Lesser Sundas belong to a population distinct from that of the equatorial Indian Ocean, and that the western equatorial ones are somewhat different from the eastern equatorial ones, with some intermingling between them".

These draw attention to the need for more intensive study on populations of yellowfin tuna from the Indian Ocean as the picture is far from clear.

As regards the species, the authors feel it desirable to denote the yellowfin from the Indian Ocean also as a subspecies of T. albacares, namely T. a. macropterus, the same as the one in the Pacific.

The authors have shown earlier that T. argentivittatus Cuvier (1831) et Schaefer and Walford (1950) et Rivas (1961) could in fact be nothing other than Kishinoella tonggol. However, the specific name argentivittatus has at one time or another been used to denote yellowfin from this area (Deraniyagala, 1952) the Atlantic (South 1845; Rivas 1951; Beebe and Tee-Van, 1936) and the east Pacific (Nichols and Murphy, 1922).

15 Thunnus (Neothunnus?) itosibi Jordan and Evermann, 1926

15.1 Synonyms

Neothunnus itosibi Jordan and Evermann, 1926
Somathunnus guildi Fowler, 1933
Thunnus macropterus (partim) Delsman and Hardenberg, 1934; de Beaufort, 1951
Semathunnus itosibi Tinker, 1944
Neothunnus albacora (partim) Barnard, 1947
Germo itosibi Smith, 1949
Thunnus (neothunnus) albacora (partim) Fraser-Brunner, 1950
Thunnus albacores (partim) Rivas, 1961

15.2 References from Indian Ocean and contiguous waters

Smith (1935, 1949, 1961); Barnard (1939, 1947); Molteno (1948); Jones and Silas (1960, 1962a); Talbot (1962).

15.3 Distribution

General: Indo-Pacific.

Indian Ocean and contiguous waters: From coast of southeast Africa; Madras coast; Andamans; seas around Sunda Archipelago.

15.4 Remarks

The authors have not relegated this species to the synonym of the Indo-Pacific yellowfin tuna since the available data is not conclusive in showing that they are one and the same, merely representing different growth stages. Data obtained from Andaman waters indicate that specimens of "yellowfin" about 120 cm show both the elongate itosibi type of second dorsal and anal fins while some have short fins. More information is needed and until such time this species is given tentative recognition only.

16 SLENDER TUNNY (Allothunnus fallai Serventy, 1948)

16.1 Synonyms

Allothunnus fallai, Serventy, 1948

16.2 References from Indian Ocean and contiguous waters

Talbot (1962).

16.4 Remarks

First described by Serventy (1948) from Timaru, South Island, New Zealand, the species has since been reported from the south and southeast coasts of Tasmania (Whitley 1962) and from South African waters (Talbot, 1952). The known distributional range indicates it to have only a subtropic distribution, and its disjunct occurrence at present is interesting.

Nothing is known about the biology or habits of this species. Phylogenetically it would appear to be more allied to the genera Katsuwonus and Euthynnus (Serventy, 1948).

17 LITTLE TUNNY (Euthynnus affinis affinis Cantor, 1850)

17.1 Synonyms

Thynnus affinis Cantor, 1850
Thynnus thunnina (nec Cuvier) Bleeker, 1852; Day, 1878
Euthynnus alletteratus Deraniyagala, 1933 (nec Rafinesque) Serventy, 1941 (nec Rafinesque)
Euthynnus alletteratus affinis de Beaufort, 1951
Wanderer wallisi Whitley, 1962
Euthynnus affinis affinis Fraser-Brunner, 1949
Euthynnus (Euthynnus) affinis Fraser-Brunner, 1950
Euthynnus wallisi Whitley, 1962

17.2 References from Indian Ocean and contiguous waters

Cantor (1850); Bleeker (1852); Günther (1860); Day (1878, 1889); Maxwell (1921); Deraniyagala (1933, 1952); Fowler (1934); Serventy (1941); Fraser-Brunner (1949a, b, 1950); de Beaufort (1951); Wheeler and Ommanney (1953); Fourmanoir (1954, 1957, 1962); Morrow (1954); Munro (1955); Steinitz and Ben-Tuvia (1955); Smith (1956, 1960); Williams (1956, 1962); Blanc and Postel (1958); Nayar (1958); Jones et al (1960); Jones and Silas (1960, 1962a); Baissac (1962); Jonklaas (1962); Silas (1962b); Whitley (1962).

17.3 Distribution

General: Indian Ocean and western Pacific where it presumably merges with another subspecies E. a. yaito.

In Indian Ocean and contiguous waters: Widespread from entire coast of Africa, Gulf of Aden, Karachi coast of Pakistan, west and east coasts of India, Ceylon, Andaman, Burma coast; Malaya and Indonesian waters, south of Java, Western Australia and from the Laccadives, Maldives, Seychelles, Aldabra, Madagascar, Mauritius and Reunion.

17.4 Remarks

This is by far the most common tuna entering the coastal waters and forming a seasonal fishery at certain locations. (Nayar, 1958; Bennett, 1962; Ogilvie et al 1954; Anon, 1953). Juvenile stages have been described by Jones (1960) and distributional pattern of larvae discussed by Jones and Kumaran (1962a, b). Some observations on the food of juveniles have been made by Kumaran (1962).

It is the authors' opinion that both E. yaito (Kishinouye 1923) and E. affinis are conspecific, the differences between the

two being at most of subspecific importance. There could be regular mixing between these two forms at present restricted to the central and western Pacific (yaito) and the Indian Ocean (affinis). Incidentally, Smith (1961) records E. alletteratus from Delgoa Bay to East London, southeast coast of Africa, from where E. affinis has also been caught on occasion, showing this to be an area of overlap in distribution of these two species.

18 OCEANIC SKIPJACK (Katsuwonus pelamis Linnaeus, 1758)

18.1 Synonyms

Scomber pelamis Linnaeus, 1758
Scomber pelamides Lacépède, 1803
Thynnus vagans Lesson, 1828
Thynnus pelamis Cuvier, 1831
Gymnosarda pelamys Barnard, 1925
Euthynnus pelamis Deraniyagala, 1933
Euthynnus (Katsuwonus) pelamis Fraser-Brunner, 1950
Euthynnus (Katsuwonus) pelamys Fourmanoir, 1960

18.2 References from Indian Ocean and contiguous seas

Günther (1860); Day (1878, 1899); Gilchrist (1902); Barnard (1925); Deraniyagala (1933, 1952); Serventy (1941); Molteno (1948); Fraser-Brunner (1950); Rosa (1950); Mendis (1954); Munro (1955, 1958); Fourmanoir (1957, 1960); Jones and Kumaran, (1959); Jones and Silas (1960, 1962a, b); Jonklaas (1962); Raju (1962, a, b); Smith (1961); Talbot (1962); Thomas (1962, a, b); Whitley (1962); Williams (1962).

18.3 Distribution

General: Atlantic, Mediterranean and Indo-Pacific.

In Indian Ocean and contiguous waters: Off south and east coasts of Africa; Gulf of Aden; Red Sea; Laccadives; Maldives; Gulf of Mannar; Seychelles; Mauritius; Reunion; Madagascar; seas around the Sunda Archipelago; Western Australia. Larvae have been collected in the open seas from several localities.

18.4 Remarks

The synopsis of biological data for this species from the Indian Ocean (Jones and Silas, 1962b) summarises available information about it from this area. There can be hardly any doubt that the skipjack throughout the world is referable to only a single species.

19 GENERAL CONSIDERATIONS

Existing information on the taxonomy and biology of tunas and related species from the Indian Ocean poses many problems, the elucidation of which will involve in several cases international cooperation. Recent years have seen a worldwide interest for more knowledge on tunas and other scombroid fishes resulting in the holding of three important conferences on the biology and fishery of these fishes (Dakar, Senegal, December 1960; Honolulu, Hawaii, August 1961; and Mandapam Camp, India, January 1962) culminating in the World Scientific Meeting on the Biology of Tunas and Related Species under the auspices of the Food and Agriculture Organization of the United Nations.

The Proceedings and recommendations of the earlier meetings amply draw attention to the need for more intensive studies on the systematics and biology of tunas and related fishes for a proper understanding of our potential resources. Use of new techniques such as blood typing in taxonomic studies, the proper collection of biometric data, studies on population dynamics involving assessment of fishable stocks and estimation of magnitude of the resources, and other aspects such as studies on age determination, migrations, behaviour in relation to environmental conditions etc. call for more intensive investigations. It is hoped that the present Meeting will pave the way for the initiation of such studies on a global basis.