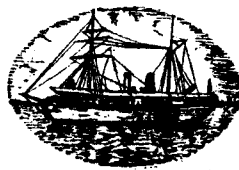
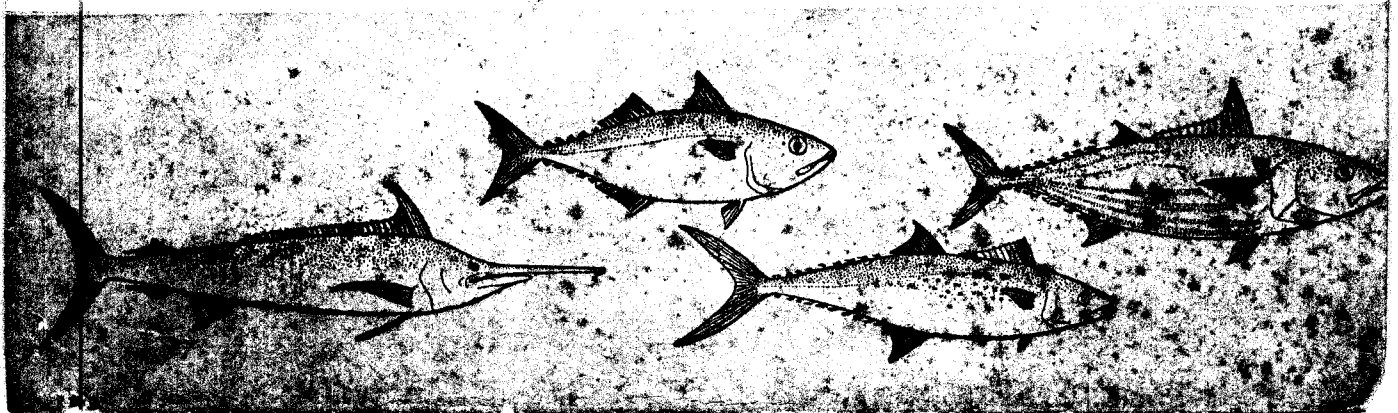


SYMPOSIUM ON SCOMBROID FISHES

PART III



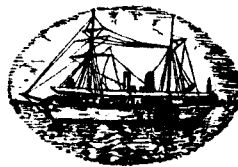
**MARINE BIOLOGICAL ASSOCIATION OF INDIA
MANDAPAM CAMP
S. INDIA**



PROCEEDINGS OF THE
SYMPOSIUM
ON
SCOMBROID FISHES

HELD AT MANDAPAM CAMP FROM JAN. 12-15, 1962

PART III



SYMPOSIUM SERIES I
MARINE BIOLOGICAL ASSOCIATION OF INDIA
MANDAPAM CAMP
S. INDIA

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**SYNOPSIS OF BIOLOGICAL DATA ON THE
FISHES OF THE
GENUS *RASTRELLIGER* JORDAN AND STARKS 1908
WITH AN ANNOTATED BIBLIOGRAPHY**

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INTRODUCTION

AN annotated bibliography of *Rastrelliger* was under preparation by one of us (S. Jones) since 1954, more or less in line with the tuna bibliographies published in the Fishery Bulletin Nos. 58 and 111 of the U.S. Fish and Wildlife Service. While this was being got ready for the Symposium on Scombroid Fishes the idea of preparation of a synopsis was suggested by the other author (H. Rosa Jr.) who had already contributed a provisional one for the Indo-Pacific Fisheries Council *Rastrelliger* Sub-committee Meeting held in Penang in 1956. It was therefore decided to combine the two to come under the present title. The synopsis part has subsequently been taken out and published separately as FAO Fisheries Synopsis No. 29 (1965). Therefore in the proceedings of the symposium only a short version is given omitting the details in Sections 3 and 4. Similarly the figures and photographs are left out to avoid duplication and reference is made at appropriate places to those in the contribution entitled 'Mackerel from the Andaman Sea' by S. Jones and E. G. Silas published in part I (Pages 255-282) of the proceedings of this symposium. Readers are requested to refer to the above paper for the relevant figures.

The publication of the proceedings has been delayed and in the meanwhile a number of references relating to *Rastrelliger* have appeared and an annotated list of these with a subject index is given as appendix at the end.

Considerable help and assistance have been given by Mr. P. T. Thomas and Dr. P. S. B. R. James in the preparation of the Annotated Bibliography and Synopsis and the authors wish to record their grateful thanks to them for the same. Their thanks are also due to Mr. K. V. Narayana Rao for the preparation of the Addendum and to Mr. M. Kumaran for going through the manuscript critically and checking up the references.

**SYNOPSIS OF BIOLOGICAL DATA ON THE SPECIES OF THE GENUS
RASTRELLIGER JORDAN AND STARKS 1908**

1. IDENTITY

1. 1 *Taxonomy*

1. 1. 1 Definition

Phylum VERTEBRATA

Subphylum Craniata

Superclass Gnathostomata

Series Pisces

Class Teleostomi

Subclass Actinopterygii

Order Perciformes

Suborder Scombroidei

Superfamily Scombroidae

Family Scombridae

Genus *Rastrelliger* Jordan and Starks 1908

Species *Rastrelliger kanagurta* (Cuvier) 1817

Rastrelliger brachysoma (Bleeker) 1851

Jordan and Hubbs (1925) place the genus *Rastrelliger* under a separate subfamily *Rastrelligerinae* while they include only *Scomber* and *Pneumatophorus* under the subfamily *Scombrinae*.

1. 1. 2 Description

—Genus *Rastrelliger* Jordan and Starks 1908 *Proc. U.S. Nat. Mus.*, **34** : 607 (Type : *Scomber kanagurta* Cuvier 1817)

The Genus *Rastrelliger* is described by Jones and Silas (1962a) as follows : ' Body compressed from side to side ; body and cheek covered with small scales, eyes with well developed adipose eyelid, mouth large, maxillary reaching nearly vertical below posterior edge of eye ; teeth small, present in jaws ; vomer and palatine edentulous ; gill rakers long, numerous and feather-like and visible when mouth is opened. Spinous first dorsal and soft rayed second dorsal separated by distance equalling length of base of former ; anal devoid of spines ; five or six dorsal and anal finlets ; pectorals short with broad base ; pelvics with spine and 5 rays ; caudal deeply forked '.

Distribution.—Tropical Indian and West Pacific Oceans from the east coast of South Africa to North Australia and as far as Micronesian and Polynesian Islands.

1. 2 Nomenclature

1. 2. 1 Valid scientific names

De Beaufort (1951) lists three species of *Rastrelliger* but Jones and Silas (1962a, 1962b) recognise only two species viz., *R. kanagurta* (Cuvier) 1817 and *R. brachysoma* (Bleeker) 1851 whereas the third species viz., *R. neglectus* for reasons stated in Jones and Silas (1962b) is relegated as a synonym of *R. brachysoma*. They give the following distinguishing characters for the two species (See plate I in Jones and Silas 1962b ; 1964b appendix).

Length of head distinctly greater than depth of body ; latter 23% to 27% in fork length ; snout pointed ; dark stripes or rows of dusky spots along upper half of body ; outer margin of first dorsal dusky.....*Rastrelliger kanagurta* (Cuvier)

Length of head distinctly shorter than depth of body ; latter 28.5% to about 34% in fork length ; snout short and bluntly rounded ; no dark stripes or regular rows of dusky spots along upper half of body ; outer margin of first dorsal black.....*Rastrelliger brachysoma* (Bleeker)

1. 2. 2 Synonyms

Rastrelliger kanagurta (Cuvier) 1817

Scomber kanagurta Cuvier, *Règne Animal*, II, 1817, p. 313 (footnote)

Scomber canagurta Cuvier, *Règne Animal*, ed. 2, II, 1829, p. 197 (footnote)

Scomber kanagurta Cuvier and Valenciennes, *Hist. Nat. Poissons*, VIII, 1831 p. 49

Scomber chrysosoma Rüppell, *Neue Wirbelthiere. Fische des Rothen Meeres*. 1835, p. 37

Scomber microlepidotus Rüppell, *Ibid.*, p. 38

Scomber moluccensis Bleeker, *Acta Soc. Indo-Neerl.*, 1, 1856, p. 40

Scomber reani Day, *Proc. Zool. Soc. London*, 1870, p. 690

Scomber lepturus Agassiz, *Pisces Celebes*, 1874, Tab. 2

- Rastrelliger brachysomus* (nec. Bleeker) Jordan and Dickerson, *Proc. U.S. Nat. Mus.*, XXXIV, 1908, p. 190
Rastrelliger kanagurta Jordan and Starks, *Ann. Carnegie Mus.*, XI, No. 3-4, 1917, p. 440
Rastrelliger chrysozonus Kishinouye, *J. Coll. Agric. Tokyo*, VIII, No. 3, 1923, p. 406
Rastrelliger serventyi Whitley, *Austr. Zool.*, X, 1944, 252-273

Rastrelliger brachysoma (Bleeker) 1851

- Scomber brachysoma* Bleeker, *Nat. Tijdschr. Ned. Indie*, I, 1851, p. 356
Scomber neglectus Van Kampen, *Bull. Depart. de l'Agric Indes Neerl.*, VIII (Zool. ii), 1907, p. 7
Rastrelliger brachysomus Barnard, *Ann. S. African Mus.*, XXI, Part 2, 1927, p. 796

1. 2. 3 Standard common and vernacular names

R. brachysoma—India (Andaman Is.) Chappata Bangadi 'Hindi'.

Indochina (Ca bao ma, Plathu).

Indonesia (Kembung perempuan).

Malaysia (Kembong).

Philippines (Short-bodied mackerel

Chub mackerel; Kabalyas 'Tagalog'

Aguma -a, Kabalyas 'Bikol',

Luman 'Kuyano and Tagbanwa',

Asa-asa 'Pampango' Aguma-a

'Visayan' Hasa-hasa

'Visayan Banton' Hasa-hasa

'Tagalog' Linachay (immature)

Masangi, Tulay).

R. kanagurta—Burma (Indian mackerel)

Ceylon (Indian mackerel; Kumbalava, Maha kara bolla 'Sinhalese'; Ailai, Karung kuluttan, kumbala 'Tamil').

India (Indian mackerel; Bangada 'Canarese'; Bangadi 'Hindi' (Andaman Is.); Kaulagedar 'Marathi'; Ayila, Ayala, 'Malayalam'; Oibiagedor 'Sindhi'; Ayalai, Kumla, Kanangeluthi, 'Tamil'; Kannangadatha, Kanagurta 'Telugu'; Karan-kita 'Oriya').

Indochina (Ca bac ma, Ca be lau, Trey kamong, Ca nung nuc).

Indonesia (Kembung, Banjar, Kembunglelaki).

Federation of Malaya (Kuala muda, Kedah, Kembong).

Japan (Gurukunmuchji, Naha, Agifurakiya).

Pakistan west (Surmai).

Philippines (Striped mackerel, Chub mackerel; Alumahan, Lumahan 'Tagalog'; Burau 'Bikol' Salimburaw 'Kuyano and Tagbanwa'; Bunatan 'Ilokano'; Kabalyas 'Pangasinan'; Buyaw 'Visayan-Banton'; Mataan 'Ilokano'; Hasa-hasa Mataan).

Singapore (Kembong).

Saudi Arabia (Bagha).

Thailand (Pla-long) *Somalia* (Bagha 'Mij'; Burei 'Kism'; Garmu, Nums 'Baj').

1. 3 General variability

1. 3. 1 Subspecific fragmentation (races, varieties, hybrids) (See Plate II and fig. 3 a & b (page 270) and fig. 4 (page 261) in Jones and Silas 1962b; 1964b appendix)

Racial studies on *Rastrelliger* have been in progress in the Philippines and India but have not resulted in any tangible conclusions. A critical study of *R. kanagurta* and *R. brachysoma* of Andaman sea by Jones and Silas (1962) presented at this Symposium is perhaps the most significant contribution in this line and might serve as a preliminary lead for the taxonomical studies on this genus.

2 DISTRIBUTION

2. 1 Delimitation of the total area of distribution and ecological characterization of this area (Text fig.1)

R. brachysoma—Tropical Indo-Pacific

—Indian Ocean : Rarely found in waters of the Union of South Africa around Durban ; Andaman Is.

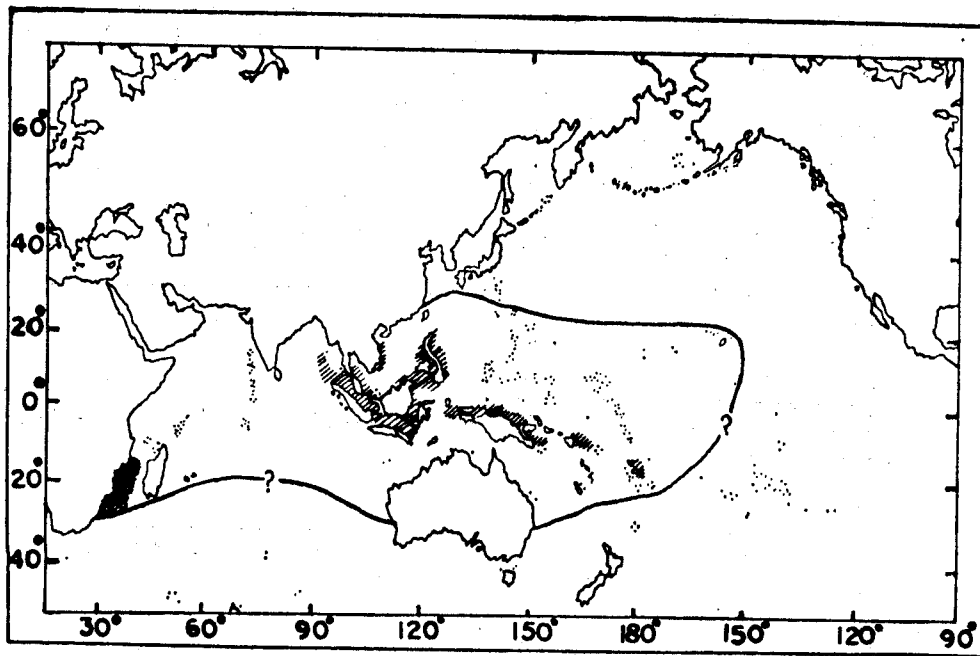


FIG. 1. World distribution of fishes of the genus *Rastrelliger*.

- Distribution of *Rastrelliger kanagurta*.
- /// Distribution of *Rastrelliger brachysoma*.
- *Rastrelliger brachysoma*, doubtful occurrence.

Central Indo-Pacific

—Malaya, Singapore, Thailand, Philippines, British North Borneo, Indonesia, New Guinea, Fiji and Solomon Is.

R. kanagurta—Tropical Indo-Pacific

—Indian Ocean : Persian Gulf, Trust Territory of Somalia, Seychelles Is., Mozambique in Delagoa bay, Coast of the Union of South Africa around Durban, Pakistan, India, Andaman and Nicobar Is., Ceylon, Burma.

Central Indo-Pacific

—Malay Peninsula, Thailand, Indochina, Philippines, Indonesia, Borneo, Australia along the coast of Queensland, New Guinea, widely distributed in Melanesia, Micronesia and Polynesia and reported from the island of Bougainville, Solomon, New Hebrides, Fiji, Samoa and others; Coast of China, Formosa Is., Hong Kong, Ryukyu Is., Hawaiian Is.

2. 2 *Differential distribution*

2. 2. 1 Areas occupied by eggs, larvae and other junior stages: Annual variations in these patterns, and seasonal variation for stages persisting over two or more seasons

—*Eggs*:

Information available on the eggs and their distribution is very fragmentary and hardly confirmatory. They, as in other scombroids, should be pelagic and the species being not oceanic, spawning should be taking place in waters within the continental shelf. The earliest reference to eggs of *Rastrelliger kanagurta* is by Delsman (1926) from the Java Sea, but subsequently he expressed doubts (Delsman 1931) on their identity and suggested that they could belong to *Thunnus thunnina* (= *Euthunnus affinis*).

It has been recorded in the Administrative Report of the Madras Fisheries Department (1937) that eggs suspected to be those of mackerel were obtained from plankton collected off West Hill, Calicut. Devanesan and John (1940) record the collection of 405 eggs in different stages of development on 5th June 1937, 5 miles from the shore off Chaliyam, south of Calicut on the west coast of India.

Balakrishnan (1957) says that 'Hauls made in the 18-25 fathom area off Vizhingam during all the months from March to May showed a few eggs of 0.84-1.009 mm. diameter which are tentatively assigned to mackerel'. No figures or description of eggs are available.

—*Larvae*:

Kuthalingam (1956) refers to the collection of postlarvae measuring 5 mm to 6 mm which 'resembled the juveniles in general form and were collected mainly from the plankton samples brought to the laboratory'. No figures or descriptions are available.

The only reference to the very early larvae of the Indian mackerel is the following statement of their occurrence off Vizhingam on the Kerala coast. 'Plankton hauls made on the 23rd May 1956 on the spot where the fishermen were engaged in fishing showed prolarvae measuring 2.8 mm and 5 mm' (Balakrishnan 1957). However, no figures or descriptions are given. It may be stated here that 5 mm appears to be too large a size to be a prolarva.

—*Juveniles*:

Juveniles have been reported from the west coast of India off the coast of Ratnagiri (George and Annigiri 1960), Karwar (Pradhan 1956), Mangalore (Rao 1962), Calicut (Madras Fisheries Administrative Report for 1940, Bhimachar and George 1952, Quarterly Scientific Reports of the Central Marine Fisheries Research Institute—June-December 1961) Cochin/Ernakulam (Rao 1962) and Vizhingam (Balakrishnan 1957, Jones and Kumaran 1962), from the south coast of Ceylon (de Zylva 1956), from the east coast of India off Madras (Rao and Basheeruddin 1953, Kuthalingam 1956, Basheeruddin and Nayar 1962,)

and Lawson's Bay (Satyanarayana as cited by Rao 1962) Visakhapatnam (Rao and Basheeruddin 1953 and Rao and Rao 1957) and from the Andaman sea near Port Blair (Rao 1962). All the information available hitherto have been compiled and summarised by Rao (1962) and presented at this Symposium. Reference is invited to the above for details.

The records of juveniles hitherto have been from coastal waters caught in shore seines and boat seines along with other fishes. Often commercial catches of mackerel are constituted by juveniles only.

2. 2. 2 Areas occupied by adult stages, seasonal and annual variations of these.

Records so far have been from coastal waters from within the continental shelf. On the west coast of India it is found practically all the year round, the main season being from August to March. Along the coast of Ceylon and on the east coast of India it is caught in stray numbers. Catches are not high in the Andaman Seas but little is known about the fishery resources of this area since there is only very restricted fishing activity there. Both species occur along the Malayan coast and Indonesia but *R. kanagurta* is the dominant one. In the Philippines both the species occur in coastal waters and here also *R. kanagurta* appears to be the dominant species.

2. 3 Behaviouristic and ecological determinants of the general limits of distribution and of the variations of these limits and of differential distribution

Hardenberg (1955) states : ' *Rastrelliger* species are pelagic fish moving in schools, whose size is determined probably by local conditions in sea. There are at least two species forms or races, one an oceanic form and the other a more neritic one. How far the oceanic form ventures out at sea is not known at present, or at least has not yet been published. So it is not yet certain whether this oceanic form, or species, is found so far away from the nearest coast as for instance the true, Atlantic mackerel. It is still not certain therefore whether they occur in quantities more than 50-60 nautical miles from shore, which is about the limit for practical fisheries in the countries most concerned with *Rastrelliger* fisheries '.

' The neritic form lives in shallow water, often of depth not more than 15 meters, at least according to my own experience. It is probable, however, that depth is not the only determining factor. Hydrological conditions will have something to do about it too. The neritic form seems to prefer a muddy or clayish bottom, but whether this always holds true I cannot say. Clear water of a salinity of more than 32.5‰ seems to be avoided. So are the vicinities of coral reefs. On the other hand a muddy sea is avoided too. The exact degree of silt turbidity avoided is thus far unknown '.

' The oceanic form lives in the clear waters of the open sea with a salinity of 32‰ and more and it seems at least in the Java Sea—that a depth of 20 meters and more is preferred. I have often found a kind of no-man's-land between the two forms. Indonesian fishermen often maintain that the oceanic mackerel prefers a sandy bottom. This is certainly not always true.'

Manacop (1955) states that *R. brachysoma* is evidently a coastal or inshore form feeding mainly on microplankton, and *R. kanagurta* is apparently an open sea form and feeds mainly on macroplankton such as larval shrimps and fishes.

Pradhan (1956) writes that ' Records show that mackerel can withstand the low salinities even down to 2.04‰.'

According to Pradhan and Gangadhar Reddy, (*Indian J. Fish.*, 9(1), 1962 in press) increase in temperature and salinity has been found to affect adversely mackerel catches, whereas

their low values exerted a less pronounced effect. Mackerel appears to be more susceptible to changes in temperature than salinity and the tolerance ranges of these factors seem to depend on the size of the fish. Large fish (19-21 cm.) appear to tolerate increase in temperature and salinity whereas smaller fish usually occur in large numbers during June to September period (at Kozhikode) when low levels of temperature and salinity prevail. One of the criteria for good mackerel season may be the degree of variation of temperature and salinity should be within the tolerance ranges of these two hydrographical factors. High pH may have an added adverse effect on the fishery. Probable effects of wind force and rainfall on the fluctuations in mackerel landings at Kozhikode are also briefly considered.

'Mackerel are known to enter estuarine waters of Kali river and ascend along the tidal current upto a distance of about $1\frac{1}{2}$ miles during April and May when the range of salinity of river water is between 29.73 and 34.6‰.'

Mackerel have also been recorded in Netravati eastuary and Cochin backwaters.

The species of the genus *Rastrelliger* are distributed only in the Tropical Indo-West-Pacific Faunistic Region. It does not go eastward to the East-Pacific Barrier.

The faunistic region is characterized by :

1. The occurrence of reef-building corals.
2. The fish fauna of the shelf of the region is very much richer in species than that of the rest of the main tropical regions.

Oceanographically, the distribution coincides with the Indo-Pacific equatorial current regions. In general, these regions are characterized by

1. High temperature of the surface waters, (the distribution of *Rastrelliger* is inside the area where the temperature at 200 m. depth is 15°C. or where the surface temperature does not fall below 17°C. in any season).
2. Predominant East-Westerly surface currents.
3. Medium basic organic production.
4. Relatively low degree of seasonal variations.

The natural regions where *Rastrelliger* is distributed can be grouped into four and characterized on the basis of similarity. The general characteristics of the groups are the following :

Group I—Monsoon regions—

(1.1 Arabian Sea, 1.2 Bay of Bengal, 2.4. South China Sea with Malayan Archipelago).

1. Relatively large continental shelf
2. Monsoon winds
3. Medium to high precipitation and runoff
4. Surface temperatures 20-30°C.
5. Surface currents changing with the change of monsoons
6. Seasonal variations : medium
7. Basic organic production : medium to low
8. Presence of subsurface O_2 minimum layer

Group II—*Equatorial current regions—N. and S.*

(1.3 Indian N.— 4. Pacific N.—1.5. Indian S.—4.9 Pacific S.—Equatorial current regions).

1. Very small continental shelves ; mainly deep oceanic areas
2. Trade winds (except in 1.3 which is influenced by monsoons)
3. Medium precipitation, low runoff
4. Surface temperatures 25-28°C.
5. Easterly surface currents
6. Low degree of seasonal variations
7. Low organic production

BIONOMICS AND LIFE HISTORY

3. 1 *Reproduction*

3. 1. 1 Sexuality (hermaphroditism, heterosexuality, intersexuality).

Heterosexual. Instances of hermaphroditism recorded in Indian mackerel (Prabhu and Antony Raja 1959, Rao, 1962 and Thomas and Raju 1962).

3. 1. 2 Maturity (age and size).

The minimum size at maturity has been found to be 20 cm. by Chidambaram and Venkataraman (1946) and 22.4 cm. by Pradhan (1956). The fish is known to attain a length of 19-21 cm. at the end of second year. It is possible to distinguish sex in fish above 12 cm. total length.

It has been indicated that there is a decrease in the rate of growth after a certain length (standard) has been reached, and it has been suggested that the point of inflexion on the growth curve indicates the length at which full maturity is attained.

Sexual maturity studies indicate that in Manila Bay *Rastrelliger brachysoma* of both sexes mature at a minimum size range of 15.0-16.9 cm. In the range 16.0-16.9 cms. long, all fish examined of both sexes were invariably mature.

The *Rastrelliger kanagurta* from Northern Palawan, on the other hand, matures in the minimum size range of 21.0-21.9 cms. and to a maximum size range of 24.0-24.9 cm. (Philippines Fisheries Handbook, 1952).

3. 1. 3 Mating (monogamous, polygamous, promiscuous)
Polygamous3. 1. 4 Fertilization (internal, external)
External

3. 1. 5 Fecundity

Relation of gonad size and egg number to body size and to age.

A key has been prepared by Pradhan and Palekar (1956) to help in the interpretation of the maturity stages of the gonads, male and female, of the Indian mackerel. The maturity scales used by the International Council for the Exploration of the Sea for Herring has been adopted up to Stage V inclusive. The Stage VI was divided into Stage VI (a) and VI (b) due to peculiar ripening of ova in batches giving an appearance to the ovary described as 'plum-pudding stage.'

The key is reproduced below excluding the description of the general appearance of the ovaries and testes, and appearance of ova under the microscope.

Key to the stages of sexual maturity of the Indian Mackerel—*Rastrelliger canagurta* (C.) (Female)

| Extent of ovary in the body cavity | Range of ova | State of maturity | Maturity stage |
|---|-------------------------|-------------------|----------------|
| Ovaries less than half the length of the body cavity | 0.038-0.13 0.14-0.27 | Im | I |
| Ovaries slightly more than half the length of the body cavity | 0.28-0.37 | m | II |
| Ovaries extending to about 2/3 the length of the body cavity | 0.37-0.46 | m | III |
| Ovaries extending a little over 2/3 the length of the body cavity | 0.46-0.56 | m | IV |
| Ovaries extending over the entire length of the body cavity | 0.57-0.81 | M | V |
| Do. | Do. | M | VI(a) |
| Do. | Do. | M | VI(b) |
| Shrunken ovaries about $\frac{1}{2}$ the length of abdominal cavity | .. | S | VII |

Key to the stages of sexual maturity of the Indian Mackerel—*Rastrelliger canagurta* (C.) (Male)

| Extent of testes in the body cavity | State of maturity | Maturity stage |
|--|-------------------|----------------|
| Testes less than half the length of the body cavity | Im | I |
| Testes slightly more than half the length of the body cavity | m | II |
| Testes extending to about 2/3 the length of the body cavity | m | III |
| Testes more than 2/3 of the length of the body cavity | m | IV |
| Testes extending over the entire length of the body cavity | M | V |
| Do. | M | VI |
| Testes comparatively much reduced in size | S | VII |

Im—Immature ; m—Maturing ; M—Mature ; S—Spent fish.

—Coefficient of fecundity

Devanesan and John (1940) estimate an average of 94,000 eggs in the Indian Mackerel.

3. 1. 6 Spawning

—Spawning seasons (beginning, end, peak)

The spawning season in India appears to be from March to September.

—Number of spawnings per year, frequency

It spawns in succession over a prolonged period and only a small percentage of ova mature each time giving that stage a speckled appearance described as 'plum-pudding' stage. The

number of batches discharged in a spawning season is not known, which makes it difficult to determine the number of eggs spawned during a season.

—Spawning time of day

It is believed that mackerel spawn at night.

3. 1. 7 Spawning grounds

—Coastal (surface, vegetation, shore, shoal, sand, shelter) ; bottom

Spawning grounds appear to be in deeper waters off Vizhingam (see 2. 2).

3. 1. 8 Egg : Structure, size, hatching type, parasites and predators.

Range of ova diameters in mm. : 0.038-0.27 immature ; 0.28-0.56 maturing ; 0.57-0.81 mature. The mature ova is transparent measuring up to 0.88 mm.-0.90 mm. in diameter usually with a large oil globule (Pradhan and Palekar 1956). The oil globule measures 0.23 mm. in diameter. Sometimes 3-4 oil globulets may be present.

3. 2 Larval history

3. 2. 1 —Account of embryonic and juvenile life (prelarva, larva, postlarva, juvenile)

—Feeding

Bhimachar and George (1952) examined the gut content of a large number of young mackerel of sizes from 5.5 to 7.5 cm. and found that their food did not differ radically from that of the adult.

3. 3 Adult history

3. 3. 1 Longevity

Probability of a fourth year-class is indicated from length frequency studies, in Indian waters. Larger specimens (25-27 cm. total length) which are caught in small numbers may be attributed to the fourth year-class.

3. 3. 2 Hardiness

(see 2. 3)

3. 3. 3 Competitors

The oil sardine *Sardinella longiceps* on the west coast of India may be considered as competitor for food, as both are plankton feeders grazing on the same patches of plankton in inshore waters. Both are migratory fishes moving in inshore waters in the same season.

3. 3. 4 Predators

Sharks, Seer fish, Ribbon fish, Tunas and Porpoises.

Mackerel shoals when attacked by seer fish scatter and when chased by sharks submerge with the head downwards in a compact mass. On porpoise attack they dive and scatter.

3. 3. 5 —Parasites and diseases

Trematode, cestode and copepod parasites were recorded from Indian mackerel (Srivastava 1936 a & 1936 b ; Chauhan 1945 ; Yamaguti 1953 ; Pillai 1962 ; Rao 1962 ; Silas 1962 b, Silas and Ummerkutty 1962).

3. 3. 6 Greatest size

Largest specimen recorded from Karwar was 307 mm. (January 1955).

3. 4 Nutrition and growth

3. 4. 1 Feeding (time, place, manner, season)

Chidambaram and others (1952) studying the intensity of feeding in different size groups of Indian mackerel, found for all size groups two periods of intense feeding ; one in October-December and the other in March-April. The absence of data for various sizes of fish in June, July and August did not allow the authors to draw any conclusion with regard to feeding habits during the spawning season.

The same authors found a distinct correlation between the maturity of the fish and its feeding intensity. From February to the middle of April when the mackerel were maturing, the feeding intensity is high. From the middle of April to June when the fish was advancedly mature, the feeding was low.

3. 4. 2 Food (type, volume)

Mackerel has been found to subsist mainly on phytoplankton and zooplankton, the common items of the food being *Coscinodiscus*, *Dinophysis*, *Peridinium*, *Pleurosigma*, *Chaetoceros* sp., *Fragilaria oceanica*, *Thalassiothrix frauenfeldi*, *Nitzschia seriata*, *Skeletonema costatum*, *Thalassionema* among the phytoplankters and tintinnids *Evadne*, *Penilia*, *Cypris* larvae, cladocerans, dinoflagellates, copepods like *Oithona* spp., *Acrocalanus* spp., *Temora turbinata*, *Schmackeria serricaudata*, *Euterpina acutifrons*, *Labidocera*, *Acartia*, *Eucalanus* and *Squilla* larvae, *Alima*, gastropod larvae, bivalve larvae and fish post-larvae among the zooplankters.

3. 5 Behaviour

3. 5. 1 —Migration and local movements

In Karwar, India (Pradhan—1956), with north-easterly winds shoals enter inshore waters.

Shoals usually move along the current of water at high tide. When there is a strong wind in easterly direction mackerel shoals come close to the shore through deeper layers of waters.

It was observed that mackerel shoals move in semicircular or arrow-head formations.

It may be inferred that mackerel shoals move at a speed of about 8 to 10 miles per hour. In Malaya shoals move at 3 knots per hour.

Hardenberg (1955) states that the mackerel tend to follow the highest densities of plankton as has been indicated along the West coast of Borneo and probably along the West coast of Malacca.

Indonesia—Hardenberg gives the following information : ' In the case of the oceanic mackerel one instance of migration is fairly well-known and this is in the Java Sea where the situation is

briefly as follows : ' At the end of the West Monsoon a stock of oceanic *Rastrelliger* is present. At the beginning of the East Monsoon the waters of the Java Sea begin to flow in a westerly direction and the *Rastrelliger* moves off in a westerly direction and disappears. After some weeks a new stock enters the Java Sea through its eastern entrance. At the end of the East Monsoon the reverse happens and two new stocks enter the Java Sea, one from the North West out of the South China Sea and one from the South West out of the Indian Ocean.'

' This study was based on the migration of *Decapterus* but mackerels closely follow the same pattern, generally being one to two weeks behind.'

The possibility of actual spawners moving out of the intensely fished area is indicated by observations at Porto Novo. Appearance of mackerel in inshore waters depends to some extent on the availability of the food elements in the inshore plankton and one of the contributing factors responsible for the failure of the mackerel fishery in the year 1961-1962 at Karwar may be the scarcity of food elements in plankton. During September-January moderate temperature, pH and salinity prevail in the inshore waters (Karwar) during which time mackerel appears in shoals along coast line. A survey of *R. V. Varuna* in the Mangalore-Calicut zone in February 1962 revealed traces of shoals in waters upto 20 metres depth, but beyond this range there were no traces.

During 1961-1962 season occurrence of mackerel was recorded in the trawl catches off Bombay and Saurashtra coasts in November and December.

3. 5. 2 —Schooling

In Karwar, India, (Pradhan 1956) the range size in a single mackerel shoal is very small and the individuals collectively present a striking uniformity of size. This suggests that mackerel of different size groups move in shoals separately and the range of size in the same shoal is not significantly large.

A record catch of 21,00,000 mackerel in one net was noticed on 1-12-1957 at Karwar.

3. 5. 3 Reproductive habits

No segregation of sexes

4. POPULATION (STOCK)

4. 1 Structure

4. 1. 1 Sex ratio

Generally, males and females were about equal in number in the commercial catches (data from 1955-61 from the west coast of India *Cen. Mar. Fish. Res. Inst., India*).

4. 1. 2 Age composition

Mackerel of the first, second and third year-classes are represented in the commercial catches. Fish of the fourth year-class are rarely represented. Scale studies, at Karwar, have indicated (Seshappa 1958*) the existence of clear rings in the specimens measuring 23 cm and above. These rings are believed to be spawning marks which may prove useful in age studies.

*By mistake it was stated in Jones and Rosa (1965) that "studies at Mandapam (1957-1968) indicated that individuals below 22 cm. showed clear annual rings." It should read : Studies at Karwar (Seshappa 1958) indicated that individuals above 23 cm, showed clear rings in the scales." The error is regretted.

4. 2 *Size and density*4. 2. 1 Average size
(See 4. 2. 2 below)

4. 2. 2 Changes in size

Karwar (India)—Pradhan (1956).

1948-1949 season—Dominant size-class from December 1949 was 20.5 cm.

1949-1950 „ —Three dominant classes, 17.5 cm. ; 18.5 cm and 19.5 cm constituted the fishery at various intervals. The 19.5 cm group persisted throughout the season with exception of October and December.

1950-1951 „ —October 1950 : Dominant size-group, 19.5 cm entered the fishery ; in November, increased to 20.5 cm and disappeared in December. The second group entered the fishery in November 1950 and the dominant size-class was then 17.5 cm, increased to 20.5 cm, in December, 21.5 cm in January 1951 and 22.5 cm in February and March.

1951-1952 „ —Dominant size-class in October 1951 was 19.5 cm, increased to 20.5 cm in November and persisted throughout the season.

1952-1953 „ —Dominant size-class in October was 17.5 cm which increased to 19.5 cm. in November and persisted till March 1953. The larger group 22.5 cm which entered the fishery in October increased to 23.5 cm in November and persisted in small number until December.

West coast of India (*Cen. Mar. Fish. Res. Inst., India*, (1953-1962).

1953-1954 season—The 19.5 cm size-class was dominant.

1954-1955 „ —The total size range was 11.3-23.0 cm.

1955-1956 „ —Size range was 19.0-25.0 cm.

1956-1957 „ —Size range was 9.8-26.2 cm the dominant groups being 14-15 cm, 18 cm, 16-19 cm, 19-21 cm and 23 cm, at various places.

1957-1958 „ —The dominant size groups were 13 cm, 18 cm, 20.5 cm, 21.5 cm and 23 cm in different months at different places. Young mackerel (3-6 cm) were caught.

1958-1959 „ —The total size range was 4.0-24.5 cm. Prominent size groups were 19.0-20.0 cm and 21.5 cm.

1959-1960 „ —Size composition varied from 4.5-29.5 cm at different places. Dominant size groups were 18.0 cm 19.0 cm 20 cm 20.0-21.0 cm. Juveniles were recorded (4.5-7.0 cm).

1960-1961 „ —Total size range was 4.5-28.0 cm. with the 12.0 cm, 13.0 cm, 16.0 cm, 19.0 cm, 20.0 cm and 21.0 cm. groups predominating.

1961-1962 „ —Size range was 3.5-27.0 cm. The 16.5 cm 18.5 cm and 22.5 cm groups were dominant.

Monacop (1955) states that *R. brachysoma* reaches a maximum length in the Philippines of 22.0 cm and a weight of about 200 grams. The average size commercially taken is about 18.0 cm and the average weight 100 grams. The average size of the commercial catch of *R. kanagurta* is about 25.0 cm and 230 grams with a maximum of about 30.0 cm and 380 grams.

4. 2. 3 Average density

The average density of mackerel at Karwar on annual basis is 57.41 lb. and on monthly basis is 44.33 lbs. per unit effort during the period 1948-58. (Banerji and Chakraborty 1962).

4. 2. 4 Changes in density

The density of the mackerel in the foreshore waters at Karwar varies markedly not only within the season, but also between the seasons, as is evident from the indices of abundance given by Banerji and Chakraborty (1962).

5 EXPLOITATION

5. 1 Fishing equipment

5. 1. 1 Fishing gear

Philippines—

Adult chub mackerels (*R. brachysoma* and *R. kanagurta*) are caught mainly by fish corral (Ibaklad') in Malampaya Sound and by purse seines (Italakop') in Manila Bay. The basnig, sapyaw and sinsoro, which capture fish with the aid of light, are also extensively used for catching juvenile and intermediate sizes. Explosives are effectively used in the catching of alumahan *R. kanagurta* on the offshore reefs and shoals by naked divers working from a 'mother' fish-carrier vessel. (Philippines Fisheries Handbook, 1952).

India—

West coast

| Fishing area | Type of boat | Type of net | Vernacular name |
|-------------------|--|--------------------------------------|--|
| Konkan area | <i>Pandi</i> ; <i>Hodi</i> —both are provided with an out-rigger equipment | Shore Seine Drift net Cast net | <i>Rampan net</i> <i>Pettle bale</i> <i>Pag</i> |
| North Canara area | <i>Pandi</i> ; <i>Doni</i> —similar to above with out-rigger | Shore Seine Drift net Cast net | (i) <i>Rampan net</i> (ii) <i>Yendi</i> or <i>Payawada</i> <i>Patta bale</i> <i>Pag</i> |
| South Canara area | <i>Pandi</i> (with out-rigger) | Shore Seine Drift net Cast net | <i>Rampan net</i> <i>Pattae balai</i> <i>Deb balai</i> |
| Malabar area | Dugout canoes | Seine net Gilling net | (i) <i>Odam vala</i> , also called <i>Peru vala</i> and <i>Paithu vala</i> (ii) <i>Aiyla kollivala</i> <i>Aiyla chala vala</i> |

East coast

| Fishing area | Type of boat | Type of net | Vernacular name |
|--------------|--|-------------|---|
| Andhra coast | 'Masula boat' | Shore seine | <i>Peddavala</i> |
| | Catamaran | Seine net | <i>Iragavala</i> |
| | | Gill net | <i>Oddivala</i> |
| Madras coast | 'Masula boat' | Shore seine | <i>Karavalai,</i> <i>Periyavalai</i> |
| | Catamaran | Seine net | <i>Vellavalai</i> <i>Thurivalai</i> |
| | Catamaran mostly but occasionally a boat especially in the Gulf of Mannar area | Gill net | ' <i>Valavalai</i> ' |

Thailand and Cambodia—

As stated by Durand (1949) large quantities of Indian Mackerel are caught in fixed traps, established on the muddy bottom in depths varying from four to fifteen metres.

The slender variety in Ceylon is known as kumbala and the wider bodied variety as bolla. It has not yet been possible to determine to which of these groups the juvenile forms belong. The juvenile forms often have other local names. The catches of bolla are higher along the south coast. In general, the heaviest landings are made with the beach seine but a great deal of angling with hand lines, bearing from 15 to 25 hooks in a cluster is carried on off the south coast from boats which hover over the shoals of bolla for the purpose. Brightly shining artificial lures, often made of lead, are utilised. They are also taken on rod and line using a little drop-shaped bead of lead with a barb as lure. De Zylva (1956).

5. 1. 2 Fishing boats

India :

See Table under 'Fishing gear.' The Pandi carries only the Rampan net and a crew of 16 to 20 and its size is $45 \times 10 \times 4$ feet. The Doni is a smaller boat used as a scout boat for sighting mackerel shoals or for removing mackerel from an impounded area. Manned by a crew of 6 to 8 and propelled with both oars and sail ; its size is $24 \times 3 \times 2$ feet.

5. 2 *Fishing areas*

5. 2. 1 General geographic distribution

—*Somalia*—*Rastrelliger kanagurta* is often found in large schools at the surface.

—*India*—West Coast—The most important economic food fish of this coast from Ratnagiri in the north to Quilon in the south.

Pradhan (1951) divides the important mackerel fishing areas on the west coast into four zones according to the different types of boats and nets employed to suit the physical characters of the coast-line. These areas from north to south are :—

(1)Konkan—from Rajewade in the Ratnagiri District to the mouth of Terkhol creek ; (2) North Canara—from Majali on the southern boundary of Goa to Bhatkal, near the southern-most coastal limit of the Bombay State ; (3) South Canara—from the southern boundary of the Bombay State to the mouth of Baliapatam river near Cannanore and (4) Malabar—from Cannanore in the north to the southern part of Travancore. The chief mackerel fishing centres on the west coast are—Ratnagiri, Malavan, Karwar, Malpe, Tellichery, Calicut, and Cochin.

—India—East Coast—The northern limit of the occurrence of this species is as far as Ganjam. Pradhan (1951) states that 'except for the sporadic occurrence of mackerel, there is no regular fishery of this fish on the East Coast.'

—Ceylon—Coastal waters, Gulf of Mannar and trawling grounds.

—Cambodia—Neighbourhood of the Bay of Kampong-Som, Cone Island and Kaskapik.

—Indonesia—Southern coast of Borneo and Northern coast of Sumatra.

—Japan—Neighbourhood of the Ryukyu islands.

—Philippines—The principal fishing of the young and adult of *Rastrelliger kanagurta* are : Eastern and north-western Palawan and vicinities ; northeastern Palawan, including Cuyo group ; southern Zamboanga and Sulu Archipelago ; Visayan Sea. Of *Rastrelliger brachysoma* are : Manila Bay, Ragay Gulf South-western Samar, Estancia, Iloilo, Gigantes and Bantayan Is., Northern Negros, Malampaya Sound and vicinity ; Pantao and Malakbala, Albay Province ; Mercedes, Camarines Norte.

5. 2. 3 Depth ranges

Mackerel fishery is usually confined to inshore waters but fish have been recorded in the trawl catches off Bombay and Saurashtra coasts, in November and December during the 1961-62 season. Stray specimens have been caught by trawl over the Wadge Bank (Sivalingam 1955 ; John 1959). A survey of R. V. Varuna in the Mangalore-Calicut zone in February 1962 revealed traces of shoals in waters upto 20 metres depth but beyond this range there were no traces.

Generally, the changes in depth at which mackerel are caught depend on the nature of coastline, the time or season of fishing and the type of net operated. The depth may vary from 2 to 12 fathoms or even more. Mackerel were caught even in deeper waters off Porbandar in trawl operation. Along the Canara and Konkan coast up to Ratnagiri, where the bottom of inshore waters is sandy or muddy, the shore-seine, Rampan net is operated in 2-4 fathoms or within a range of a mile and a half. During the rainy season a smaller shore-seine is operated in 1 or 2 fathoms. The gill nets and the boat-seines, on the Malabar coast in particular are not usually operated so close to the shore or in the shallow waters.

5. 3 Fishing seasons

5. 3. 1 General pattern of fishing season

The mackerel season, whether good or poor depends on the density or concentration of mackerel shoals in inshore waters in which they are intercepted and caught. The fishery is thus subject to great fluctuations.

5. 3. 2 Duration of fishing season

Chidambaram and Venkataraman (1946) state that the Indian mackerel fishery on the west coast of India extends from September to April, prior to the outbreak of the south-west monsoon. At Karwar and along the Canara coast as indicated by Pradhan (1956) it is from October to February and may, at times, extend to March. The mackerel shoals subsequently break up, resulting in poor catches in April, and practically disappear from the shores of Karwar during May. In the rainy season, June to end of September, they are occasionally caught in small numbers in inshore waters within a range of about half a mile from the shore. Thus the duration of fishing season may vary from coast to coast. On the Malabar coast, it may be 5-7 months

and on the Canara and Konkan coast up to Ratnagiri, 4-6 months. In general it may be stated that the season starts early on the Malabar coast and closes late in February or March. On the Canara and Konkan coast, it may commence sometime in October and come to an end in February-March.

5. 3. 3 Dates of beginning, peak and end of season

—India

On the Malabar coast, the season begins in August-September, with a peak in November-December and ends in February or March. On the Canara coast, it may begin sometime in October with a peak in November-December closing abruptly in February-March. A secondary peak of a short duration was noted towards the end of the season—February-March on the West coast.

—Cambodia

As indicated by Durand (1949), the mackerel appears on the coast towards the end of October in the neighbourhood of the Bay of Kampong-Som; a month later near Cone Island and Kas-kapik. It remains there until February, a period when the females are ripe and ready to spawn.

—Philippines

The principal fishing areas and seasons of the young and adult 'hasa-hasa' (*R. brachysoma*)

| Fishing Areas | Fishing Seasons | |
|---|---------------------|------------------|
| | Young | Adult |
| Manila Bay | Throughout the year | May to December |
| Ragay Gulf | March to September | December to May |
| Southwestern Samar | November to January | February to May |
| Estancia Iloilo | March to June | May to October |
| Gigantes and Bantayan Is..... | March to May | April to October |
| Northern Negros | May to June | June to August |
| Malampaya Sound and vicinity..... | April to May | May to September |
| Pantao and Malakbala, Albay Province..... | April | October to May |
| Mercedes, Camarines Norte | | May to September |

The principal fishing areas and seasons of the adult 'alamahan' (*R. kanagurta*)

| Fishing areas | Fishing seasons |
|--|-------------------|
| Eastern and northwestern Palawan and vicinities..... | December to June |
| Northeastern Palawan, including Cuyo group..... | April to November |
| Southern Zamboanga and Sulu Archipelago..... | December to May |
| Visayan Sea | April to October |

—Ceylon

Large shoals of *R. kanagurta* normally occur on the west coast of Ceylon where they are caught in considerable numbers in the beach seine in the November-February period, and on the east coast almost throughout the year with peaks in September and December-April. Catches of the inshore species are highest on the south coast in the December-February period.

5. 3. 4 Variation in time or duration of fishing season

In some years the season was very short lasting for 3-4 months.

5. 3. 5 Factors affecting fishing season

The monthly total catch of mackerel appears to be more influenced or governed in Karwar (Pradhan 1956), by the dominant size-class or classes, than by the actual number of pieces of Rampan net in operation during the month. In other words, the frequency of appearance of mackerel shoal in inshore waters and probably the size of a shoal itself, appear to be related in some unknown manner to the dominant size-class of the month or season.

The following points are noteworthy with respect to Indian mackerel :

- (a) High mortality of eggs.
- (b) Removal of potential spawners and the consequent effect on recruitment.
- (c) Scarcity of edible forms of planktonic organisms which constitute the major food elements of mackerel.
- (d) Hydrographical factors like, temperature or sea water, salinity , pH etc.
- (e) Movement of mackerel of different size groups in inshore waters has been found to be in direct relation to hydrographical factors. Small size groups (12-16 cm) are usually abundant in the period of low salinity and temperature (July-September) whereas larger fish can adopt themselves to higher temperature and salinity.

5. 4 *Fishing operations and results*

5. 4. 1 Effort and intensity

At Karwar the input of effort during the peak season is not commensurate with the abundance of mackerel. Therefore the index of intensity of fishing is not significantly higher than one (Banerji and Chakraborty 1962)

5. 4. 3 Catches

Particulars of total annual yield of mackerel in India during 1950-1961 are given below.

| Year | Catch (metric tons) | | |
|------|------------------------|----|---------|
| 1950 | .. | .. | 89,163 |
| 1951 | .. | .. | 104,900 |
| 1952 | .. | .. | 78,014 |
| 1953 | .. | .. | 70,754 |
| 1954 | .. | .. | 28,258 |
| 1955 | .. | .. | 22,795 |
| 1956 | .. | .. | 16,426 |
| 1957 | .. | .. | 89,006 |
| 1958 | .. | .. | 123,282 |
| 1959 | .. | .. | 62,198 |
| 1960 | .. | .. | 133,655 |
| 1961 | .. | .. | 34,485 |

ANNOTATED BIBLIOGRAPHY

- AGASSIZ, J. L. R. 1874. *Pisces Celebes. Icones Piscium*, London.
Scomber lepturus: occurrence.
- AH KOW, T. 1950. The food and feeding relationships of the fishes of Singapore straits. Colonial Office Fish. Pub., London, 1 (1): 1-35.
Rastrelliger brachysoma, *R. neglectus*, *R. kanagurta*: feeding habits; seasonal variation of food of *R. kanagurta*.
- ANONYMOUS, 1949. Marine Fisheries of India. *Proc. Indo-Pacif. Fish. Coun.*, 1st Meeting, Singapore: 73-80.
Mackerel fishery at Karwar (India-west coast).
- . 1955a. Fishing gear in Indonesia. *Indo-Pacif. Fish. Coun.*, 6th Session, Tokyo, Japan, 1955, IPFC/C55/Tech. 23 (06): 1-28.
Rastrelliger kanagurta, *R. neglectus*: gear—seines, driftnets, encircling gill nets, set gill-nets, traps-craft; localities.
- . 1955b. Pelagic Neritic Fisheries—Thailand. *Indo-Pacif. Fish. Coun.*, *Rastrelliger sub-Committee Meeting*, Malaya, March 1955, Working Paper 1: 1-3.
Rastrelliger chrysozonus, *R. brachysoma*: statistics, fishing conditions, fishing methods and gear, migrations, spawning, marketing.
- . 1955c. Pelagic Neritic Fisheries—Malaya. *Indo-Pacif. Fish. Coun.*, *Rastrelliger Sub-Committee Meeting*, Malaya, March 1955, Working Paper 2: 1-2.
Rastrelliger: statistics, fishing methods and gear, location of shoals by bioluminescence, marketing.
- . 1955d. Pelagic Neritic Fisheries—Philippines. *Indo-Pacif. Fish. Coun.*, *Rastrelliger Sub-Committee Meeting*, Malaya, March 1955, Working Paper 5: 1-6.
Rastrelliger brachysoma, *R. chrysozonus*: synonyms, food, larval stages, systematics, racial studies, length-weight relationship, size composition, sexual maturity, statistics.
- . 1955e. Neritic Pelagic Fisheries—Australia. *Indo-Pacif. Fish. Coun.*, *Rastrelliger Sub-Committee Meeting*, Malaya, March 1955. Working Paper 7: 1-3.
Rastrelliger kanagurta, *R. serventyi*: no fishery; *R. kanagurta* recorded from New Guinea and Queensland; *R. serventyi* from north-western Australia.
- . 1955f. Neritic Pelagic Fisheries—Netherlands. *Indo-Pacif. Fish. Coun.*, *Rastrelliger Sub-Committee Meeting*, Malaya, March 1955, Working Paper 9: 1.
Rastrelliger kanagurta: fishery in Netherlands, New Guinea; gear, localities, season.
- . 1955g. Report of the Sub-Committee on neritic pelagic fisheries. *Indo-Pacif. Fish. Coun.*, *Rastrelliger Sub-Committee Meeting*, Malaya, March 1955, Working Paper 11: 1.
Rastrelliger kanagurta: commercially important species; integrated programme for taxonomic assessment recommended; notations on maturity stages to be revised.
- . 1955h. Study on pelagic-neritic fishes. *Indo-Pacif. Fish. Coun.*, *Rastrelliger Sub-Committee Meeting*, Malaya, March 1955, Working Paper 12: 1-2.
Rastrelliger kanagurta, *Rastrelliger* sp: investigations in member countries; exchange of conclusions derived on methodology proposed.
- . 1958. Guide to the Fisheries of Ceylon. Dept. Fisheries, Ceylon. *Fisheries Research Station Bull.*, 8.
Rastrelliger kanagurta: listed and figured, local names.
- . 1961. Aquatic Resources Appraisal. *Proc. Indo-Pacif. Fish. Coun.*, 9th Session, Karachi, January 1961, 1: 39-42.
Rastrelliger kanagurta: investigations conducted in Ceylon, India, Indonesia, Malaya and Philippines.
- AVERY, A. C. 1950. Fish processing hand book for the Philippines. *U.S. Fish Wildl. Serv., Res. Rep.*, 26: 1-149.
Rastrelliger brachysomus (short bodied mackerel), *R. chrysozonus* (striped mackerel): listed among important fish for canning; local names, fishing areas, figure.
- BALAKRISHNAN, V. 1957. Occurrence of larvae and young mackerel *Rastrelliger canagurta* (Cuvier) off Vizhin-gam near Trivandrum. *Curr. Sci.*, 26(2): 57-58.
Rastrelliger canagurta: larvae and young-occurrence at Vizhingam (India West Coast); spawning ground indicated.

- . 1962a. Studies on the fin ray counts in the median fins of the Indian mackerel, *Rastrelliger kanagurta* (Cuvier). (Ms.)
Rastrelliger kanagurta : variability in number of rays on dorsal and anal fins.
- . 1962b. Spawning, rate of growth and age groups of *Rastrelliger kanagurta* (Cuvier) as observed at Vizhingam during 1955-57. (Ms.)
Rastrelliger kanagurta : spawning ground, spawning season, rate of growth.
- . 1962c. Size composition of *Rastrelliger kanagurta* (Cuvier) occurring at Vizhingam. (Ms.)
Rastrelliger kanagurta : size composition, catch statistics.
- BANDUKHUL, S. and S. RUAMRAKSA. 1961. Rastrelliger Tagging Experiment. *Proc. Indo-Pacif. Fish. Coun.*, 9th Session, January 1961, 1 : 81-83.
Rastrelliger : experiments with dart tag conducted with success.
- BANERJI, S. K. 1958. Fishery Survey and Statistics. Fisheries of the West Coast of India, Mandapam Camp : 68-73.
Mackerel : average annual landings in India for 1950-57, tabular statement.
- . 1962. Some considerations in the study of pelagic fish stocks with special reference to Indian mackerel. *Symposium on scombroid fishes*. Marine Biological Association of India, Mandapam Camp, Jan. 1962. (Ms.)
Indian mackerel : the effect of fishery on mackerel stocks.
- BANERJI, S. K. and D. CHAKRABORTY. 1962. Examination of the efficiency of mackerel fishing. *Indian J. Fish.* 9(2) : 499-505.
Efficiency of mackerel fishing at Karwar.
- BARNARD, K. H. 1927. Monograph of the Marine Fishes of South Africa. *Ann. S. African Mus.*, 21(2) : 796.
Rastrelliger brachysomus, *R. microlepidotus* : occurrence.
- BASHEERUDDIN, S. and K. NAGAPPAN NAYAR. 1961. A preliminary study of the Juvenile Fishes of the Coastal waters off Madras City. *Indian J. Fish.*, 8(1) : 169 : 88.
Rastrelliger kanagurta : occurrence of Juveniles and food habits.
- BEAN, B. A. and A. C. WEED. 1912. Notes on a collection of fishes from Java, made by Owen Bryant and William Palmer in 1909, with description of a new species. *Proc. U.S. Nat. Mus.*, 42 : 587-611.
Scomber kanagurta : occurrence.
- BENNET, P. S. 1962. *Euthynnus affinis* in the Vizhingam fisheries. *Symposium on Scombroid fishes*. Marine Biological Association of India, Mandapam Camp. Jan. 1962. (Ms.)
Rastrelliger kanagurta : mentioned as food of *Euthynnus affinis affinis* at Vizhingam (India—west coast).
- HIMACHAR, B. S. and P. C. GEORGE. 1950. Abrupt set backs in the fisheries of the Malabar and Kanara Coasts and Red Water Phenomenon as their probable cause. *Proc. Indian Acad. Sci.*, 31B(6) : 339-50.
Effect of 'red water' on mackerel fishery.
- . 1952. Observations on the food and feeding of the Indian Mackerel, *Rastrelliger kanagurta* (Cuvier). *Ibid.*, 36B(3) : 105-118.
Rastrelliger kanagurta : stomach contents analysed ; plankton feeders ; seasonal variations in food elements ; selective feeding ; maximum feeding at 16-20 cm. size.
- BLANCO, 1938*. *Philippine J. Sci.*, 66 : 507.
Scomber microlepidotus : from Cagayan Province, north eastern Luzon.
- BLEEKER, P. 1845. Bijdragen tot de geneeskundige Topographie van Batavia. Generisch overzicht der Fauna. *Nat. Geneesk. Arch. Ned. Ind.*, 2 : 505-28.
Scomber kanagurta : collected from Batavia, Java.
- . 1851. Over eenige nieuwe geslachten en soorten van Makreelachtige vischeur van den Indischen Archipel. *Nat. Tijds. Ned. Ind.*, 1 : 341-72.
Scomber brachysoma : occurrence.
- . 1852. Bijdrage tot de kennis Makreelachtige van den soenda—Molukscheur Archipel. *Verh. Bat. Gen.*, 24 : 1-93.
Scomber kanagurta, *S. loo* : description.

- BLEEKER, P. 1856. Beschrijvingen van nieuwe of wienig bekende vischsoorten van Menado en Makassar grootendeels verzameld op eene reis naar den Molukschen Archipel in het gevolg van den Gouverneur-General. Duymac van Twist. *Act. Soc. Sci. Indo-Neerl.*, 1 : 1-80.
Scomber moluccensis : description.
- . 1960a. Achtste bijdrage tot de kennis der vischfauna van Sumatra. Visschen van Benkoelen, Priamen, Tandjong, Palembang in Djambi. *Act. Soc. Sci. Indo-Neerl.*, 8 : 1-88.
Scomber kanagurta : description.
- . 1860b. Dertiende bijdrage tot de kennis der vischfauna van Celebes. Visschen van Bonthain Badjoa, Sindjai. Lagoesi en Pompenoea. *Acta. Soc. Sci. Indo-Neerl.*, 8 : 1-60.
Scomber kanagurta : occurrence.
- . 1868. Notice sur la faune ichthyologique de l'île de Waigion. *Versl. Akad. Amsterdam*, (2) 2 : 295-301.
Scomber loo : recorded from Waigiu (New Ireland).
- . 1878. Quatrieme memoire sur la faune ichthyologique de la Nouvelle Guinee. *Arch. Neel. Sci. Nat.*, 13 : 35-66.
Scomber loo : recorded from Dutch New Guinea.
- BLEGVAD, H. 1944. Fishes of the Iranian Gulf. Danish Scientific Investigations in Iran, Part III. Einar Munksgaard, Copenhagen : 159-60.
Scomber microlepidotus : description, localities, local name, figure.
- BURDON, T. W. and M. L. PARRY. 1954. Malayan Fishing Methods. *J. Malay. Br. Asiat. Soc.*, 27(2) : 1-180.
Rastrelliger spp : gear employed—large gill nets and purse seines operated during dark nights taking advantage of bioluminescence, liftnet, beach seines ; boat figured.
- CANAGARATNAM, P. and J. C. MEDCOF. 1956. Ceylon's Beach Seine Fishery. Dept. Fisheries, Ceylon. *Fisheries Research Station Bull.*, 4 : 1-32.
Occurrence of mackerel in beach seine catches ; English, Sinhalese and Tamil names ; mean length of fish in samples ; length at first maturity.
- CENTRAL MARINE FISHERIES RESEARCH INSTITUTE. 1954. Annual Report for the year ending 31st March 1953. *Indian J. Fish.*, 1 : 377-401.
Rastrelliger kanagurta : composition in regionwise landings along the coasts of India ; fishery and investigations at Karwar (India—west coast).
- . 1955a. Neritic Pelagic Fisheries of India. *Indo-Pacif. Fish. Coun., Rastrelliger Sub-Committee Meeting*, Malaya, March 1955, Working Paper 6 : 1-9.
Rastrelliger kanagurta : statistics, fishing areas, craft, gear, size—composition, seasons, migrations, spawning young stages, marketing.
- . 1955b. Annual Report for the year ending 31st March 1954. *Indian J. Fish.*, 2(2) : 373-404.
Rastrelliger kanagurta : composition of catches along the east and west coasts of India, mackerel fishery at Karwar and along Malabar coast (west coast).
- . 1956. Annual Report for the year ending 31st March 1955. *Indian J. Fish.*, 3(2) : 387-436.
Rastrelliger kanagurta : percentage composition ; estimated landings in Rameswaram Island (India—east coast) and Malabar coast (India—west coast) ; early juveniles at Vizhingam (India—west coast) ; mackerel fishery and investigations at Karwar ; zonal catches.
- . 1957. Annual Report for the year ending 31st March 1956. *Indian J. Fish.*, 4(2) : 387-418.
Indian mackerel : raciation studies, very young mackerel at Vizhingam (India—west coast) ; failure of mackerel fishery at Karwar (India—west coast).
- . 1958. Annual Report for the year ending 31st March 1957. *Indian J. Fish.*, 5(2) : 402-39.
Indian mackerel : investigations on the biology conducted at Mandapam, Waltair (India—east coast) ; Vizhingam, Kozhikode, Karwar (India—west coast) ; length frequency, spawning, occurrence of young fish ; annual landings in 1955 and 1956.
- . 1959. Annual Report for the year ending 31st March 1958. *Indian J. Fish.*, 5(2) : 416-60.
Indian mackerel : spawning marks on scales ; percentage composition of catch at Kozhikode, Karwar, Mangalore (India—west coast) ; partially spent, spent, recovering fish recorded.
- . 1960. Annual Report for the year ending 31st March 1959. *Indian J. Fish.*, 7(1) : 187-232.
Mackerel : fishery, spawning season, scale rings, maturity.

- . 1961. Annual Report for the year ending 31st March 1960. *Indian J. Fish.*, 7(2) : 496-552.
Indian mackerel : biology, morphometry, fishing season, occasional capture by handlines.
- CHACKO, P. I. 1949. Food and feeding habits of the fishes of the Gulf of Mannar. *Proc. Indian Acad. Sci.*, 29B(3) : 83-97.
Rastrelliger kanagurta : feeding habits.
- . 1954. Fish statistics of West Coast of Madras State for 1931-32. *Madras Fisheries Statistical Rep.*, 1, Govt. Press, Madras.
Mackerel : weight, value and quantity landed.
- . 1955a. Fish statistics of the East Coast (North section) of Madras State for the years 1939-40 to 1949-50 (in 11 parts). *Madras Fisheries Statistical Rep.*, Govt. Press, Madras.
Mackerel : weight, value and quantity landed.
- . 1955b. Fish statistics of East Coast (South section) of Madras State for the years 1939-40 to 1949-50 (in 11 parts). *Madras Fisheries Statistical Rep.*, Govt. Press, Madras.
Mackerel : weight, value and quantity landed.
- . 1955c. Fish statistics of West Coast of Madras State for the years 1939-40 to 1949-50 (in 18 parts). *Madras Fisheries Statistical Rep.*, Govt. Press, Madras.
Mackerel : weight, value and quantity landed.
- CHARI, S. T. 1948. Nutritive value of some West Coast food fishes of the Madras Province. *Indian J. Med. Res.*, 36 : 253-59.
Rastrelliger kanagurta : average weight, size ; percentage of edible portion, ash, iron, phosphorus.
- CHAUHAN, B. S. 1945. Trematodes from Indian Marine Fishes. Part I. On Some New Monogenetic trematodes of the sub-orders *Monopisthocotylea* Odhner, 1912 and *Polyopisthocotylea* Odhner, 1912. *Proc. Indian Acad. Sci.*, 21(3) : 147-49.
Scomber microlepidotus from Bombay (India-west coast) : monogenetic trematode parasite from gill—*Prices microcotylae*—described, figured.
- CHIDAMBARAM, K. 1944. Food of the Indian Mackerel (*Rastrelliger kanagurta* Russell) of the west coast of Madras Presidency. *Curr. Sci.*, 13(8) : 214-15.
Rastrelliger kanagurta : food preferences ; young carnivorous ; correlation between mackerel fishery and plankton production.
- CHIDAMBARAM, K. and M. DEVIDAS MENON. 1945. The correlation of the west coast (Malabar and South Kanara) fisheries with plankton and certain oceanographic features. *Proc. Indian Acad. Sci.*, 22B(6) : 365-67.
Mackerel : catch in relation to plankton production and oceanographic conditions.
- CHIDAMBARAM, K. and C. G. KRISHNAMURTHY. 1951. Growth rings of the otoliths of the Indian mackerel, *Rastrelliger kanagurta* (Russel). *Proc. 38th Ind. Sci. Cong., Bangalore* Part III : 223.
Number of growth rings of the otoliths observed at different sizes of fish.
- CHIDAMBARAM, K. and R. S. VENKATARAMAN. 1946. Tabular statements on the natural history of certain Marine Food fishes of the Madras Presidency—West Coast. Govt. Press, Madras : 1-26.
Rastrelliger kanagurta : fishery, landings, value, description, size, food, spawning, gear, fishing grounds, statistics for 1939-42.
- CHIDAMBARAM, K. *et al.* 1952. Studies on mackerel : Fat variations—And certain Biological aspects. *Proc. Indian Acad. Sci.*, 35B(2) : 43-68.
Rastrelliger kanagurta : fat variations in relation to size and feeding intensity.
- CUVIER, G. and A. VALENCIENNES. 1831. *Histoire naturelle des poissons*. Paris. 8 : 38.
Scomber loo : recorded from Praslin, Waigeu, Dorey harbour, New Guinea.
- DAY, F. 1865. Fishes of Malabar : 68-69.
Scomber kanagurta : description, synonymy, average size, disposal of catches, curing, habitat.
- . 1870. On the fishes of the Andaman Islands. *Proc. Zool. Soc. London* : 677-705.
Scomber reani : recorded from Andamans.
- . 1878. Fishes of India. Bernard Quaritch, London : 250-59.
Scomber microlepidotus, *S. brachysoma* : description, synonymy, distribution, figures.
- . 1889. Fishes. Fauna of British India, 2 : 203-05. Taylor and Francis, London.
Scomber microlepidotus, *S. brachysoma* : description.

- DE BEAUFORT, L. F. 1951. Fishes of the Indo-Australian Archipelago. E. J. Brill, Leiden, 9 : 204-36.
Rastrelliger brachysoma, *R. neglectus*, *R. kanagurta* : key, synonymy, description, distribution.
- DE JONG, J. K. 1940. A preliminary investigation of the spawning habits of some fishes of the Java Sea. *Treubia*, 17 : 307-10.
Rastrelliger kanagurta : maturation of eggs and spawning habits.
- DELSMAN, H. C. 1926. Fish eggs and larvae from the Java Sea. 9. *Scomber kanagurta* C.V. *Treubia*, 8(3-4) : 395-99.
Scomber kanagurta : embryonic and early stages presumed to be of this species. (considered subsequently of *Euthynnus affinis*—vide Delsman, 1931).
- DELSMAN, H. C. and J. D. F. HARDENBERG. 1934. De Indische Zeevisschen en Zeevisscherij. N. V. Boekhandel en Drukkerij Visser Co., Batavia : 330-33.
Scomber kanagurta, *S. neglectus* : distinction based on colouration, body depth and gill rakers ; local names.
- DERANIYAGALA, P. E. P. 1933. Names of some fishes from Ceylon. *Ceylon J. Sci.*, (c) 5 : 79-111.
- , 1952. A coloured atlas of some vertebrates from Ceylon I. Fishes. Ceylon Govt. Press, Colombo : 1-96.
Rastrelliger : mentioned in the key.
- DEVANESAN, D. W. 1942. Plankton studies in the fisheries branch of the Department of Industries and Commerce, Madras. *Curr. Sci.*, 11(4) : 142-43.
Rastrelliger kanagurta : food ; eggs in plankton at Quilandi (India—west coast) in association with *Noctiluca* swarms.
- DEVANESAN, D. W. and V. JOHN. 1940. On the natural history of *Rastrelliger kanagurta* (Russell) with special reference to its spawning season and eggs. *Curr. Sci.*, 9(10) : 462-64.
Rastrelliger kanagurta : economic importance, length at first maturity, food, spawning season, ova diameter, collection of eggs from Calicut (India—west coast).
- DEVANESAN, D. W. and K. CHIDAMBARAM. 1948 (reprint 1953). The common food-fishes of the Madras Presidency. Govt. Press, Madras : 32-34.
Rastrelliger kanagurta : bionomics, economic importance and catch statistics ; figure in 1953 reprint.
- DE ZYLVA, E. R. A. 1956. *Rastrelliger*. (MS.) Appendix 7 (IV) of summary record of the Sub-Committee Meeting as 'Synopsis of data on the species of the genus *Rastrelliger* Jordan and Starks, 1908.'
Rastrelliger kanagurta : Occurrence, local names, fishing methods, catch statistics.
- DOMANTAY, J. S. 1940a. The Fishing Industry of Zamboanga. *Philippine J. Sci.*, 71 : 81-109.
Rastrelliger chrysozonus : local names.
- , 1940b*. *Philippine J. Sci.*, 72 : 379.
Rastrelliger brachysomus : occurrence.
- DURAND, J. 1949. *Rastrelliger kanagurta* (Rüppell) Its Fishery and Biology, Summary of our knowledge—study programme. *Proc. Indo-Pacif. Fish. Coun.*, 1st Meeting, Singapore : 94-96.
Rastrelliger kanagurta : synonymy, local names, geographic distribution, seasonal occurrence in Indo-Pacific, fishing, methods of preservation.
- EVERMANN, B. W. and A. SEALE. 1906. Fishes of the Philippine islands. *Bull. Bur. Fish.*, 26 : 49-110.
Scomber brachysomus, *S. microlepidotus* : occurrence.
- FIELDER, R. H. 1951. The fisheries of Indonesia. *Fish. Leaflet*, U.S. Fish. Wildl. Serv., 396 : 1-60.
- FOWLER, H. W. 1904. A collection of fishes from Sumatra. *J. Acad. Nat. Philadelphia*, (2), 12 : 495-560.
Scomber kanagurta : description, figure.
- , (1904) 1905. New, rare or little known scombroids. *Proc. Acad. Nat. Sci. Philadelphia*, 56 : 757.
Scomber kanagurta : description, occurrence.
- , 1918. A list of Philippine fishes. *Copeia*, 58 : 62-65.
Scomber microlepidotus : occurrence in Philippines.
- , 1925. Notes and descriptions of Indian fishes. *J. Bombay nat. Hist. Soc.*, 30(2) : 316.
Scomber microlepidotus : morphometric description.

- . 1927.* *Proc. Acad. Nat. Sci. Philadelphia*, **79** : 267.
Scomber microlepidotus : recorded from Orion, Bataan Province, Luzon, Philippines.
- . 1928. The Fishes of Oceania. *Mem. Bishop Mus.*, **10** : 132.
Rastrelliger brachysoma, *scomber kanagurta* : morphometric description ; from Fate, New Hebrides and Shortland Island.
- . 1934. The Fishes of Oceania. Supplement II. *Mem. Bishop Mus.* **11** (6) : 385-466.
Scomber kanagurta : from Gizo, Solomons ; *R. brachysoma* : key to the species, general distribution, figures.
- . 1935.* *Proc. Acad. Nat. Sci. Philadelphia*, **87** : 138.
Rastrelliger kanagurta : occurrence.
- . 1936a. South African fishes received from Mr. H. W. Bell-Marley in 1935. *Proc. Acad. Nat. Sci. Philadelphia*, **87** : 361-408.
Rastrelliger kanagurta : occurrence.
- . 1936b.* *Hong Kong Naturalist*, **7** : 65.
Rastrelliger kanagurta : occurrence.
- FOWLER, H. W. and T. H. BEAN. 1922.* *Proc. U.S. Nat. Mus.*, **62** : 18.
Scomber kanagurta : occurrence.
- FRASER-BRUNNER, A. 1950. The Fishes of the Family Scombridae. *Ann. Mag. nat. Hist., Ser. 12*, **3**(26) : 131-163.
- GEORGE, P. C. 1962. On current knowledge on the nutrition of the Indian mackerel, *Rastrelliger kanagurta* (Cuvier) with suggestion for an effective study of the ecology of feeding in plankton feeding fishes. *Symposium on scombroid fishes*. Marine Biological Association of India, Mandapam Camp, Jan. 1962. (Ms.)
Rastrelliger kanagurta : food and feeding habits reviewed.
- GEORGE, P. C. et al. 1959. Observation on the mackerel fishery of the Netravati Estuary, West Coast of India, *J. Bombay nat. Hist. Soc.*, **56**(1) : 32-38. *Rastrelliger kanagurta* : unusual fishery.
- GEORGE, P. C. and G. G. ANNIGERI. 1960. On the occurrence of small sized mackerel *Rastrelliger kanagurta* (Cuvier) off Ratnagiri Coast. *Curr. Sci.*, **29** : 319-20.
Rastrelliger kanagurta : small sized mackerel above 62 mm. from Ratnagiri (India—west coast) ; food.
- GNANAMUTHU, J. C. and G. SESHAPPA. 1962. On the Osteology of *Rastrelliger kanagurta* (Cuvier). (Ms.)
Rastrelliger kanagurta : osteology.
- GOPINATH, K. 1950. The Malayan purse seine (Pukat Jerut) Fishery. *J. Malay. Br. Asiat. Soc.*, **23**(3) : 74-96.
Scomber kanagurta : purse seine operation, location of shoals by bioluminescence at night, methods of preservation and marketing.
- GOVERNMENT OF INDIA. 1951. Preliminary guide to Indian Fish, Fisheries, methods of fishing and curing. *Agri. Mktg. India, Mktg. Series*, **66** : 1-137.
Scomber microlepidotus : description, figure, average length and weight, local names, salt-curing, canning.
- GOVERNMENT OF MADRAS. 1929a. Fish curing yards. The Madras Fisheries Manual, Part 2. Govt. Press, Madras.
Mackerel : instructions for taking catch statistics ; proportion of salt for curing.
- . 1929b. The Madras Fisheries Committee, Evidence. Govt. Press, Madras : 1-431.
Mackerel : as second important fish, fluctuations in fishery, introduction of rampani net in South Kanara Coast.
- . 1929c. Report of the Committee on Fisheries in Madras. Govt. Press, Madras : 1-266.
Mackerel : new experiments in pickling, proportion of salt in curing ; mackerel paste ; experiments in commercial canning in oil and in tamarind.
- GOVINDAN, V. 1916. Fishery statistics and information, West and East Coasts, Madras presidency. IV. Methods of curing Fish. *Madras Fish. Bull.*, **9** : 31-43.
Scomber microlepidotus : Colombo method of curing ; availability of good catch of mackerel from November to March from Gangoli to Cochin (India—west coast).
- GREEN, L. B. 1941. Report on the Fisheries of Madras for the year ended 30th June 1941. Department of Industries and Commerce, Madras.
Mackerel : spawning, food.

- GÜNTHER, A. 1860. Catalogue of the fishes of the British Museum, 2. London : 355-61.
Scomber kanagurta, *S. brachysoma*, *S. microlepidotus*, *S. chrysozona* : classification, description, distribution, synonymy.
- . 1876. Fische der Sudsee, *J. Mus. Godeffroy*, 2 : 149.
Scomber kanagurta : from Pelew Islands, Fiji, Indian Ocean.
- HARDENBERG, J. D. F. 1931. The fish fauna of the Rokan mouth. *Treubia*, 13 (1) : 81-168.
Scomber neglectus : from jeremal collected by De Waart in 1922.
- . 1934. Additional notes to my paper 'The fish fauna of the Rokan mouth.' *Treubia*, 14(3) : 299-312.
Rastrelliger neglectus : De Waart's collection in 1922.
- . 1938. Marine Biological fishery problems in the tropics. *Arch. Neerlandaises Zool.*, 3, Supplement : 65-73.
Scomber neglectus : caught in bamboo traps (sero) along the coast. *Scomber kanagurta* : caught from the open sea in 'Pajang.'
- . 1949. Development of pelagic fisheries. *Proc. Indo-Pacif. Fish Coun.*, 1st Meeting, Singapore : 138-43.
Scomber neglectus : coastal species preferring lower salinity ; *S. kanagurta* : often captured along with *Decapterus* from shelf areas and deeper waters.
- . 1950. Synopsis of the species of *Scomber* and *Rastrelliger* from Indo-Australian Seas (After Dr. de Beaufort). Report prepared for the Indo-Pacific Fisheries Council, 2nd Meeting, Cronulla, Australia, April 1950, 1-7. Mimeo.
Scomber and *Rastrelliger* : Systematics.
- . 1955. A review of current knowledge of *Rastrelliger*. *Proc. Indo-Pacif. Fish. Coun.*, 6th Session, Tokyo, Japan, I.P.F.C/C. 55 (WKP. 25), Agenda item 14, 25 : 1-10.
Rastrelliger : Behaviour, ecology, food, growth, migration, reproduction, systematics, synonymy and distribution.
- HERRE, ALBERT, W. C. T. 1927. Fishery resources of the Philippine Islands. Bureau of Science, Manila : 26 and 50.
Scomber microlepidotus : large quantities caught by nets or in fish corrals; description and local names.
- . 1933.* *J. Pan Pacific Research Inst.*, 8 : 3 and 7.
Rastrelliger brachysoma : recorded from Sandakan, British North Borneo ; *R. loo* recorded from Dumaguete, Oriental Negros Province.
- . 1934. Fishes. 1931. Philippines Exped., 33.
Rastrelliger brachysoma, *R. kanagurta* : occurrence and distribution in Philippines.
- . 1936*. *Field Mus. Nat. Hist. Zool. Ser.*, 21 : 104.
Rastrelliger brachysoma : recorded from Sura, VitiLeru Island and Fiji.
- . 1936-37. Fishes of the Crane Pacific Expedition. *Field. Mus. Nat. Hist.*, Zool. Ser. 21(2) : 1-164
Rastrelliger kanagurta : recorded from several places in Philippines.
- . 1940-41.* 1940-41 Expedition.
Rastrelliger chrysozona, *R. kanagurta* : recorded from several places in Philippines.
- . 1941. A list of fishes known from the Andaman Islands. *Mem. Indian Mus.*, 13(3) : 348-49.
Scomber microlepidotus, *Rastrelliger kanagurta*, *R. brachysoma* : recorded.
- . 1953. Check list of Philippine Fishes. *U.S. Fish Wildl. Serv., Res. Rept.*, 20 : 242-44.
Rastrelliger kanagurta, *R. brachysoma* and *R. chrysozonus* : synonymy, bibliography, distributional records.
- HORNELL, J. 1910a. Report on the feasibility of operating deep sea fishing boats on the coasts of the Madras, Presidency with special reference to the selection of fishing centres and harbours of refuge. *Madras Fish. Bull.*, 4 : 61-64.
Mackerel : heavy catches in newly introduced rampan nets at Malpi.
- . 1910b. Report on the results of a fishery cruise along the Malabar coast and to the Laccadive Islands in 1908. *Madras Fish. Bull.* 4 : 87-108.
Scomber microlepidotus : migrations ; quantity handled by fish curing yards ; description, distribution, seasons ; nets ; abundance, food ; improvement of fishery.

- . 1917. A statistical analysis of the fishing industry of Tuticorin (South India). *Madras Fish. Bull.*, 11 (3) : 85-116.
Scomber microlepidotus : price, vernacular name, catch statistics for 1911-1915.
- . 1924. Madras Fisheries Department. Administrative Report for the year 1922-23. *Madras Fish. Bull.*, 18 : 7-65.
Mackerel : scarce when sardines abundant ; gear ; recent investigations.
- . 1937. The fishing methods of the Madras Presidency : Part II. The Malabar Coast. *Madras Fish. Bull.*, 27 (1) : 1-264.
Mackerel : fishing methods-stringed cast nets, rampani, aila kolli vala, aila chala vala ; catch statistics for the years 1928-1931.
- JOHN, C. C. 1959. Fish and Fisheries of the Cape Comorin Bank. *Bull. Res. Inst., Univ. Kerala*, Series C, 7(1) : 65-145.
Rastrelliger kanagurta : recorded in the trawl catches from the Wadge Bank off Cape Comorin, India.
- JOHN, C. C. and M. A. S. MENON. 1942. Food and feeding habits of oil sardine and mackerel. *Curr. Sci.*, 11(6) : 234-44.
Mackerel : food in relation to plankton distribution.
- JOHN, V. *et al.*, 1959. Report on Fishing Experiments in the offshore waters of Madras State. *Fisheries Station Reports and Year Book*. Madras, 1955-56 : 137.
Fish meal from mackerel.
- JONES, S. 1958. Progress of Marine Fisheries Research. Fisheries of the West Coast of India, Mandapam Camp : 8-17.
Rastrelliger kanagurta : fishery in general and researches in progress.
- . 1962a. The Mackerel Fishery of Pangkor, Malaya, *Symposium on scombroid fishes*. Marine Biological Association of India, Mandapam Camp, Jan. 1962 (Ms.).
Rastrelliger kanagurta : growth and present condition of the mackerel fishing industry at Pangkor, Malaya ; purse seining aided by bioluminescence during dark nights ; marketing of fresh, chilled, and cured fish, economic condition of the industry.
- . 1962b. The Scombroid fishery of India—present and future. *Symposium on scombroid fishes*. Marine Biological Association of India, Mandapam Camp, Jan. 1962. (Ms.).
Rastrelliger kanagurta : fishery.
- JONES, S. and M. KUMARAN. 1962. Larvae and juveniles of Indian Scombroid fishes. *Symposium on scombroid fishes*. Marine Biological Association of India, Mandapam Camp, Jan. 1962. (Ms.).
Rastrelliger kanagurta : juveniles from Indian Ocean, description, figure.
- JONES, S. and E. G. SILAS. 1962a. A systematic review of the scombroid fishes of India. *Symposium on scombroid fishes*. Marine Biological Association of India, Mandapam Camp, Jan. 1962. (Ms.).
Rastrelliger kanagurta, *R. brachysoma* ; description, key, figure.
- JONES, S. and E. G. SILAS. 1962b. Mackerel from the Andaman Sea. *Symposium on scombroid fishes*. Marine Biological Association of India, Mandapam Camp, Jan. 1962. (Ms.).
Rastrelliger kanagurta, *R. brachysoma* : description, morphometric, comparison, ecological notes ; *R. neglectus* as synonym of *R. brachysoma* ; key for identification of mackerel and mackerel like fishes from Andaman Sea.
- JONES, S., *et al.*, 1960. New records of Scombroid fishes from the Andaman-Nicobar waters. *J. Mar. biol. Ass. India*, 2 (1) : 136-37.
Rastrelliger kanagurta : listed.
- JORDAN, D. S. and M. C. DICKERSON. 1908. On a collection of fishes from Fiji with notes on certain Hawaiian fishes. *Proc. U.S. Nat. Mus.*, 34 : 603-17.
Rastrelliger brachysomus : description, occurrence, figure.
- JORDAN, D. S. and B. W. EVERMANN. 1903. Notes on a collection of fishes from the island of Formosa. *Proc. U.S. Nat. Mus.*, 25 : 315-68.
Scomber kanagurta : occurrence.
- JORDAN, D. S. and R. E. RICHARDSON. 1908. Fishes from islands of the Philippine archipelago. *Bull. U.S. Bur. Fish.*, 27 : 233-87.
Scomber microlepidotus : recorded from Manila, Luzon.

- JORDAN, D. S. AND R. E. RICHARDSON. 1909. A catalogue of fishes of the Island of Formosa or Taiwan based on the collection of Dr. Hans Santer. *Mem. Carnegie Mus.*, 4 : 159-204.
Scomber kanagurta : listed.
- JORDAN, D. S. and A. SEALE. 1907. Fishes of the islands of Luzon and Pany. *Bull. U.S. Bur. Fish.*, 26 : 1-48.
Scomber microlepidotus : occurrence in Cavite, Cavite Province, Luzon.
- JORDAN, D. S. and F. C. STARKS. 1908. On *Rastrelliger*. in : On a collection of fishes from Fiji with notes on certain Hawaiian fishes by Jordan, D. S. and M. C. Dickerson (1908). *Proc. U.S. Nat. Mus.*, 34 : 603-17.
Rastrelliger : definition of genus.
- . 1917.* *Ann. Carnegie Mus.*, 11 : 440.
Rastrelliger kanagurta : occurrence.
- KAIKINI, A. S. 1960. The fisheries of Malwan. *Indian J. Fish.*, 7 (2) : 348-68.
Mackerel : gear, season, fishery.
- KESTEVEN, G. L. 1949. Fish marketing in Batavia. *Proc. Indo-Pacif. Fish. Coun.*, 1st Meeting, Singapore : 54-60.
Scomber neglectus : method of capture.
- KESTEVEN, G. L. and T. W. BURDON. 1952. An introduction to the fisheries of Singapore with a consideration of the methodology employed. *Fisheries Survey Report 1.*, *Fish. Bull.*, 2, Fisheries Dept., Singapore.
Rastrelliger sp. : total landings, variations with lunar cycle ; fluctuation in prices.
- KHIN, U. 1948. Fisheries in Burma. The mackerels and the perches group. Government Press, Rangoon : 18-159.
Rastrelliger kanagurta : description, fishery, fishing methods, marketing, figure.
- KI, C. M. 1949. Korean Fisheries. Their present and future. *Proc. Indo-Pacif. Fish. Coun.*, 1st Meeting, Singapore : 83-93.
Mackerel : catch statistics for 1937 and 1948.
- KISHINOUE, K. 1893. Japanese mackerel and mackerels from Europe and America. (Japanese) *J. Imp. Fish. Bur.*, 2.
Mackerels : comparative study.
- . 1895. Food of fishes of the mackerel family. (Japanese) *J. Imp. Fish. Bur.*, 4.
Mackerel : food described.
- . 1915. Contributions to the study of mackerels, seer fishes and tunnies. (Japanese) *Suisan Gakkwai ho.* (*Proc. Sci. Fish. Ass.*), 1 : 1-24. *Rastrelliger chrysozonus* : listed.
- . 1923. Contributions to the comparative study of the so-called Scombroid fishes. *Tokyo. Coll. Agric. J.*, 8 : 406.
Rastrelliger chrysozonus : classification, synonymy, description, distribution, figure.
- KITAHARA, T. 1897. Scombridae of Japan. *J. Imp. Fish. Bur.*, 6 : 1-3.
Scomber kanagurta : listed and figured.
- KLUNZINGER, C. B. 1871. Synopsis der Fische des Rothen Meeres. II Theil. *Verh. Zool. Bot. Ges. Wien*, 21 : 441-668.
Scomber kanagurta, *S. microlepidotus* : description, occurrence.
- . 1884. Die Fische des Rothen Meeres. 1 : 109.
Scomber kanagurta, *S. microlepidotus* : recorded.
- KNER, R. 1865-67. Reise der österreichischen Fregatte 'Novara' um die Erde in den Jahren 1857-1859, unter den Befehlen des commodore B. von Wüllerstorff-Urbain, Wien, 1865-67. Zoologischer Theil, Fische. 1 : 142-43.
Scomber kanagurta, *S. loo*, *S. microlepidotus* : description, occurrence in Manila.
- KRISHNA PILLAI, N. 1962. On a new species of *Bomolochus* (Copepoda) with remarks on *Urbicola* Shaw. *J. of Parasitology*, 48 (4) : 610-61.
Rastrelliger kanagurta : A new species of Copepod parasite from opercle.
- KUTHALINGAM, M. D. K. 1956. Observations on the food and feeding habits of the Indian mackerel *Rastrelliger kanagurta* (Russell). *J. Zool. Soc. India*, 8(2) : 99-106.
Rastrelliger kanagurta : food and feeding habits of postlarvae, juveniles, adults.

- KUTTY, M. N. 1962. On an unusual trawl catch of the Indian mackerel, *Rastrelliger kanagurta* (Cuvier). (Ms.) *Rastrelliger kanagurta* : occurrence in trawl catch off Bombay coast.
- KYAW, U. B. 1955. A glimpse of the fisheries in Burma. *Indo-Pacif. Fish Coun.*, 6th Session, Tokyo, Japan, 1955. IPFC/C. 55/Tech. 41 (Misc.) : 1-4.
Rastrelliger : listed ; preservation method.
- LAHIRY, N. L. *et al.*, 1961a. Studies on dry-salting and sun-drying of mackerel (*Rastrelliger kanagurta* (Cuv.)). Effect of varying proportions of salt to fish on the quality of sundried mackerel. *Food. Sci.*, 10 (5) : 139-43.
Rastrelliger kanagurta : dry-salting and sun-drying.
- . 1961b. Studies on dry-salting and sun-drying of mackerel (*Rastrelliger kanagurta* (Cuv.)). Effect of incorporation of different chemicals into curing salt on the texture and cooking quality of the product. *Food Sci.*, 10 (5) : 144-48.
Rastrelliger kanagurta : curing-chemicals added to salt for softening.
- LESSON, R. P. 1829.* Dictionnaire classique d'histoire naturelle, 15 : 277.
Scomber loo : listed from Port Praslin.
- . 1930. Voyage autour du monde, Execute per Ordre du Roi sur la Corvette de sa Majeste, 'La Coquille', pendant les anness 1822, 1823, 1824 et 1825 per M.L.I. Duperrey. *Zool.*, 2(1), 10 Poissons: 66-238.
Scomber loo : listed from Waigau (New Ireland), figure.
- LUCAS, W. H. 1910. Report on the improvement of fisheries in the Bombay Presidency 1908-10. Govt. Central Press, Bombay.
- LIN, S. Y. 1934.* *Lingou Sci. J.*, 13 : 674.
Rastrelliger chrysozonus : occurrence.
- LING, S. W. (Edited by) 1954. A general account of the fisheries of Thailand. Thai Department of Fisheries, Bangkok : 1-51.
Rastrelliger : occurrence of two species in Thailand ; local names, fishing methods, curing statistics of gear and landings.
- MACLEAY, W. 1883. Contribution to a knowledge of the fishes of New Guinea. Parts 1-3. *Proc. Linn. Soc. N.S.W.*, 7(2) : 224-50 ; (3) : 351-66 ; (4) : 585-98.
Scomber loo : listed from Port Morseby.
- . 1884a. Contribution to a knowledge of the fishes of New Guinea. Part 4. *Proc. Linn. Soc. N.S.W.*, 8(2) : 252-80.
Scomber loo : listed from Pit Bay.
- . 1884b. Supplement to the descriptive catalogue of the fishes of Australia. *Proc. Linn. Soc. N.S.W.*, 9 : 2-64.
Scomber kanagurta : listed.
- MADRAS FISHERIES DEPARTMENT. 1923. Administration Report for the year 1921-22. *Madras Fish. Bull.*, 17 (1) : 1-44.
Mackerel : life history studies at Calicut (India—west coast).
- . 1925. Administration report for the year 1923-24. *Madras Fish. Bull.*, 19(1) : 1-58.
Mackerel : output, sale, absence of large shoals, investigations at Calicut (India—west coast).
- . 1926. Administration Report for the year 1924-25. *Madras Fish. Bull.*, 20(1) : 1-78.
Mackerel : data relating to migration, food, growth and life history.
- . 1927. Administration Report for the year 1925-26. *Madras Fish. Bull.*, 21(1) : 1-94.
Mackerel : curing, statistical information ; investigations at Calicut (India—west coast).
- . 1928. Administration Reports for the year 1926-27. *Madras Fish. Bull.*, 22(1) : 1-99.
Mackerel : investigations at Calicut (India—west coast).
- . 1929. Administration Report for the year 1927-28. *Madras Fish. Bull.*, 23(1) : 1-86.
Mackerel : routine studies on migration and food habits ; tabular statements of mackerel landing in different centres, depth of capture, market price.
- . 1930. Administration report for the year 1928-29. *Madras Fish. Bull.*, 24(1) : 1-103.
Mackerel : investigations at Calicut (India—west coast).

- MADRAS FISHERIES DEPARTMENT. 1931. Administration Report for the year 1929-30. *Madras Fish. Bull.*, **25**(1) : 1-104.
Mackerel : investigations at Calicut (India—west coast).
- . 1932. Administration Report for the year 1930-31. *Madras Fish. Bull.*, **26** : 7-11.
Mackerel : operation of British drift nets suggested.
- . 1933. Fishery Reports for 1930. *Madras Fish. Bull.*, **28**(1) : 6-129.
Mackerel : investigations at Calicut (India—west coast) ; landings ; price 1925-'29 : fishery ; improvement of nets.
- . 1936. Administration Report for the year 1934-35. *Madras Fish. Bull.*, **29**:8.
Mackerel : investigations along the west coast of India during 1934-35.
- . 1937a. Administration Report for the year 1935-37. *Madras Fish. Bull.*, **30** : 9-10.
Mackerel : breeding, egg counts, length frequency, growth rings on scales.
- . 1937b. Administration Report for the year 1936-37. *Madras Fish. Bull.*, **31** : 8-10.
Indian mackerel : breeding ground, eggs in plankton off Chaliyam (India—west coast).
- . 1938. Administration Report for the year 1937-38. *Madras Fish. Bull.*, **32** : 8-9.
Indian mackerel : length frequency, food, gonad, spawning.
- . 1940a. Administration Report for the year 1938-39 : 9-11.
Indian mackerel : length frequency, food, gonad, spawning.
- . 1940b. Administration Report for the year 1939-40 : 7-9.
Mackerel : studies on length frequency, maturity, food.
- . 1941. Report on the fisheries of Madras for the year ended 30th June 1941 : 7-9.
Mackerel : length frequency, food.
- . 1952. Administration Report of the Department of Fisheries—Madras, for the year ending 31st March 1951 : 8-29.
Mackerel : length frequency, maturity, otolith and scale studies ; seasonal variations in chemical composition ; bacteriology, 'pink eye' in salted fish.
- . 1955. Administration Report for the year 1953-54 : 2.
Mackerel : investigations at West Hill Biological Station, Calicut (India—west coast).
- . 1959. Annual Report of the Marine Biological Station, West Hill, Malabar Coast for the year 1955-56. *Fisheries Station Reports and year book*, Madras, 1955-1956 : 3.
Mackerel : feeding habits, length frequency.
- MALPAS, A. H. 1926. The marine Biological survey of the littoral waters of Ceylon. *Ceylon J. Sci.*, (c) **2** : 13-166.
- MANACOP, P. R. 1955. A preliminary systematic study of the Philippine chub mackerels, family Scombridae, Genera *Pneumatophorus* and *Rastrelliger*. *Indo-Pacif. Fish. Coun.*, 6th Session, Tokyo, Japan, 1955, IPFC/C55/Tech. 50 (Sea) : 1-18.
Rastrelliger brachysoma, *R. chrysozonus* : synonyms, description key to the identification, food, fishery, localities, local names, juveniles, biometry.
- MARUKAWA, H. 1939. Fisheries of the South Sea Islands. Natural food of skipjack and tunas. *South Sea Fish.*, **5**(7) : 12-14.
Scomber kanagurta : listed as food of yellowfin tuna.
- MENDIS, A. S. 1954. Fishes of Ceylon. *Fisheries Research Station Ceylon, Bull.*, **2** : 148.
Rastrelliger kanagurta : recorded ; local names.
- MEYER, A. B. Catalogue de los peces recolectados en el archipelago de las Indias Orientales durante los años 1870 a 1873. *Ann. Soc. Espana. Hist. Nat. Madrid*, **14** : 5-49.
Scomber microlepidotus : listed.
- MUNRO, I. S. R. 1955. The marine and freshwater fishes of Ceylon. Dept. Ext. Affairs, Canberra.
Rastrelliger kanagurta : description, distribution in Ceylon waters, figure.
- . 1958. The Fishes of the New Guinea Region. *Papua and New Guinea Agri. J.*, **10**(4) : 97-369.
Rastrelliger canagurta, *R. brachysoma* : distribution in the New Guinea region, bibliography, particulars of 'Fairwind' collections.

- . 1961. Handbook of Australian Fishes. *Fish. Newsletter*, 17(9) : 11-12.
Rastrelliger canagurta : description ; occurrence.
- NAIR, R. V. and K. CHIDAMBARAM. 1951. A review of the Indian oil sardine fishery. *Proc. Nat. Inst., Sci. India*, 17(1) : 71-85.
Mackerel : table showing annual landings in South Kanara and Malabar coasts (India—west coast) from 1925 to 1949.
- NICHOLSON, F. A. 1909. The preservation and curing of fish. *Madras Fish. Bull.*, 3 : 56-103. (reprinted 1930).
Mackerel : methods of curing.
- . 1915. Papers from 1899 relating chiefly to the development of the Madras Fisheries Bureau. *Madras Fish. Bull.*, 1 : 46-228.
Mackerel : methods of curing ; general condition of fish during different seasons, landing data for 1906, *Scomber microlepidotus* and *S. brachysoma*, mentioned.
- NOBLE, A. 1962. Food and feeding habits of the Indian mackerel *Rastrelliger kanagurta* (Cuvier) at Karwar. (MS.).
Rastrelliger kanagurta : stomach contents.
- Ogilby, J. D. 1916. (Revised 1954). The commercial Fishes and Fisheries of Queensland. (Revised and illustrated by Tom C. Marshall). Govt. Press, Brisbane.
Rastrelliger kanagurta : recorded from the northern waters of Queensland.
- PANIKKAR, N. K. 1949. A survey of the Pelagic Fisheries of the World. Part II. The biology of Pelagic fishes. The mackerel. *Proc. Indo-Pacif. Fish. Coun. 1st Meeting*, Singapore : 126-27.
Rastrelliger kanagurta : importance, fishery and biology. *Scomber neglectus*, *S. brachysoma* : recorded.
- . 1951. Problems of marine and estuarine fisheries. Handbook of Indian Fisheries. Ministry of Agriculture, New Delhi : 79-87.
Rastrelliger kanagurta : occurrence in enormous shoals on the west coast of India ; fishery importance.
- . 1952. Fisheries Research in India. Part I. *J. Bombay nat. Hist. Soc.*, 50(4) : 764-65.
Indian mackerel : general account
- . 1956. Marine Fisheries Research in India. Progress of Fisheries Development in India. Metropolitan printing and publishing House Ltd., Calcutta : 22-25.
Rastrelliger kanagurta : average composition of catch for 1950-54 ; general aspects of fishery.
- PANIKKAR, N. K. and R. JAYARAMAN. 1956. Some aspects of productivity in relation to fisheries of Indian neritic waters. *Proc. 8th Pacific Sci. Congr.*, 3A, 1111-22.
Mention records of captures of mackerel off Gujarat coast.
- PATAKOOT, R. S. *et al.*, 1950. Fat contents of the muscles of some marine fishes of Bombay. *J. Univ. Bombay*, 18 : 3-6.
- PATHANSALI, D. 1961. A preliminary report on the *Rastrelliger* Fishery in Malaya. *Proc. Indo-Pacif. Fish. Coun.*, 9th Session, Karachi, 1961, 2 : 37-48.
Rastrelliger canagurta : description of the fishery at Pangkor Island, Perak, Malaya.
- PETERS, W. C. H. 1876. Ueberseht der während der von 1874 bis 1876 unter dem Commando des Hrn. Capitän Z. S. Freiherrn von Schleinitz ausgeführten Reise S.M.S. 'Gazelle' gesammelten und von der Wissenschaften übersandten Fische. *Monatsb. Akad. Wiss.*, Berlin : 831-54.
Scomber chrysozonus : recorded from Bogainville Island.
- PHILIPPINE BUREAU OF FISHERIES. 1952. Philippine Fisheries. Handbook prepared by the Bureau of Fisheries, Manila.
Rastrelliger brachysoma, *R. chrysozona* : curing, chemical composition, food value, fishing method, statistics.
- PRABHU, M. S. and ANTONY RAJA. 1959. An instance of hermaphroditism in the Indian mackerel *Rastrelliger canagurta* (Cuvier). *Curr. Sci.*, 28 : 73-74.
Rastrelliger canagurta : hermaphroditism recorded.
- PRADHAN, L. B. 1951. Mackerel Fishery. Handbook of Indian Fisheries, Ministry of Agriculture, New Delhi : 57-59.
Rastrelliger canagurta : fishery, fishing season, craft and gear, methods of curing.

- PRADHAN, L. B. 1956. Mackerel Fishery of Karwar. *Indian J. Fish.*, 3(1) : 11-82.
Rastrelliger kanagurta : fisheries in Karwar (India—west coast) ; seasonal fluctuation, annual catch, feeding habits, spawning season, sex composition, weight-length relationship, salinity tolerance.
- PRADHAN, L. B. and V. C. PALEKAR. 1956. Key to the stages of sexual maturity of *Rastrelliger kanagurta* (C). A pendix I to paper by Pradhan, L. B. on the 'Mackerel Fishery of Karwar' 1956. *Indian J. Fish.*, 3(1) : 183-85.
Rastrelliger kanagurta : maturity stages defined.
- PRADHAN, L. B. and K. VIRABHADRA RAO. 1958. The Mackerel. Fisheries of the West Coast of India, Mandapam Camp, 38-44.
Rastrelliger kanagurta : fishery, distribution, feeding habits, spawning season, methods of curing.
- PRADHAN, L. B. and C. V. G. REDDY. 1962. Fluctuations in mackerel landings at Calicut in relation to hydrographical factors. (Ms.)
 Indian mackerel : probable influence of hydrographical factors on catches.
- PRADHAN, L. B. et al., 1951. Thiamine and Riboflavin content in the tissues of some salt water fishes in Bombay. *Indian J. Med. Sci.*, 5(11) : 645-48.
- PRASAD, R. R. 1954. Observations on the distribution and fluctuation of planktonic larvae off Mandapam. Symposium on Marine and freshwater plankton in the Indo-Pacific. *Proc. Indo-Pacif. Fish. Coun.*, 5th Meeting, Bangkok, 1954, 3 : 21-24.
 Mackerel : breeding habits ; doubt expressed on Dr. Devanesan's views.
- RADHAKRISHNAN, N. 1958. Observations on mackerel fishery at Karwar for the seasons 1954-55 and 1955-56. *Indian J. Fish.*, 5(2) : 258-67.
Rastrelliger kanagurta : landings at Karwar (India—west coast) for 1954-55 and 1955-56 ; size groups ; red water and jelly fishes as contributory factors for poor landings in 1955-56.
- . 1962a. Observations on the maturity and spawning of the Indian mackerel, *Rastrelliger kanagurta* (Cuvier) at Karwar (Ms.).
Rastrelliger kanagurta : maturity, spawning—period, eggs, young.
- . 1962b. Catch analysis of mackerel at Karwar and the nearby centres during the seasons 1956-57, 1957-58 and 1958-59. (Ms.)
 Indian mackerel : catch statistics.
- RASALAN, S. B. and B. DATINGALING. 1955. Observations on fishing with light in the Philippines. *Indo-Pacif. Fish. Coun.*, 6th Session, Tokyo, Japan, 1955 (IPFC/C55/TECH 54(CG) : 1-3.
Rastrelliger spp. listed.
- RAO, K. VIRABHADRA. 1962. The distribution of juvenile stages of the mackerel *Rastrelliger kanagurta* (Cuvier) in the Indian inshore waters. *Symposium on scombroid fishes*. Marine Biological Association of India, Mandapam Camp, Jan. 1962. (Ms.).
Rastrelliger kanagurta : occurrence of juveniles along the coast of India—localities, periods, size, food, spawning season.
- RAO, K. VIRABHADRA and S. BASHEERUDDIN. 1953. Occurrence of young mackerel, *Rastrelliger kanagurta* (Cuvier) off Madras coast. *Curr. Sci.*, 22 : 182-83.
Rastrelliger kanagurta : occurrence of young mackerel 4.9 cm. to 10.3 cm. off the Madras (City) coast in March 1953.
- RAO, K. V. NARAYANA. 1960. A short account of the wahoo, *Acanthocybium solandri* (Cuvier and Valenciennes). *J. Mar. Biol. Ass. India*, 2(1) : 132-35.
Rastrelliger kanagurta : formed one of the food items of wahoo from Vizhingam (India—west coast).
- . 1962a. Observations on the bionomics of the Indian mackerel *Rastrelliger kanagurta* (Cuvier) caught in the Lawson's Bay near Waltair, Andhra coast. *Symposium on scombroid fishes*, Marine Biological Association of India, Mandapam Camp, Jan. 1962 (Ms.).
Rastrelliger kanagurta : rate of growth of juveniles, food, growth of ova, spawning, parasites.
- RAO, K. V. NARAYANA and K. PAMPAPATHI RAO. 1957. Difference in the food of the young and the adult Indian mackerel, *Rastrelliger kanagurta* (Cuv.) *Nature*, 180 : 711-12.
Rastrelliger kanagurta : differences in feeding habits of juveniles and adults ; selectivity in feeding in different size groups ; feeding habits and relative length of the alimentary canal in proportion to body length.

- RAO, P. VEDAVYASA. 1962. Line fishery for *Rastrelliger kanagurta* (Cuvier) along the North Kanara Coast. (Ms.)
Rastrelliger kanagurta : line fishery, size composition, bait.
- RAO, V. RAMAMOHANA. 1962. A note on a hermaphrodite gonad in the Indian mackerel *Rastrelliger kanagurta* (Cuvier). *J. Mar. biol. Ass. India*, 4 (2) : 241-242.
Rastrelliger kanagurta : Hermaphroditism.
- RAO, V. RAMAMOHANA. 1962. Studies on the food and feeding habits of the mackerel *Rastrelliger kanagurta* (Cuvier) in the Mangalore zone. (Ms.)
Rastrelliger kanagurta : volume of stomach contents in relation to size of fish.
- RAO, V. RAMAMOHANA *et al.* 1962. On the mackerel fishery of the Mangalore area during the period 1957-1961. (Ms.)
Rastrelliger kanagurta : catch statistics, size composition, maturity.
- ROSA, H. JR. 1950. Scientific and common names applied to tunas, mackerels and spear fishes of the world with notes on their geographic distribution. Food and Agric. Org., Washington D.C.
Rastrelliger kanagurta, *R. brachysoma*, *R. neglectus* : synonymy, geographic distribution, common names by country.
- . 1956. Synopsis of data on the species of the genus *Rastrelliger* Jordan and Starks 1908. *Indo-Pacif. Fish. Coun., Rastrelliger Sub-Committee meeting*, Malaya, September 1956. Appendix 7(4) : 1-18.
Rastrelliger brachysoma, *R. neglectus*, *R. kanagurta* : nomenclature, common names, distribution, ecological factors limiting distribution, bionomics and life history ; reproduction : maturity, fecundity, fertilization, larval history ; adult history ; maturation and growth ; behaviour ; population structure : size and density of population ; fishing areas, fishing equipment, fishing seasons, and factors affecting fishing season.
- RÜPPELL, W. P. E. S. 1828. Atlas zn der Reise in nordlichen Afrika. Zoologie. Fische des Rothen Meeres : 93.
Scomber kanagurta : recorded from Gomfuda, Red Sea.
- . 1835. Neue Wirbelthiere. Fische des Rothen Meeres : 10-38. *Scomber kanagurta* : description, occurrence.
Rastrelliger microlepidotus : description, figure. *Scomber chrysozonus* : occurrence, figure.
- RUSSELL, P. 1802. Fishes of Vizagapatnam, 2 : 1-28.
The first description and figure of the Indian mackerel under its local name from Vizagapatam (India—east coast).
- SCHMELTZ, J. D. E. 1881. Ein Beitrag zur kunde der Sudsee—Volker. Ethnographische Abtheilung. *Ethno-Anthrop. Aloth. Museum Godeffroy*, Hamburg, Catalog 8 : 1-6.
Scomber kanagurta : recorded from New Britain.
- SCOTT, J. S. 1959. An introduction to the Sea fishes of Malaya. Govt. Press, Kuala Lumpur : 112.
Rastrelliger kanagurta : general description, local names, importance, fishing areas, fishing methods.
- SEALE, A. 1906. Fishes of the South Pacific. *Occ. Pap. Bishop Mus.*, 4(1) : 1-89.
Scomber brachysoma : recorded from Shortland Island.
- . 1908. The fishery resources of the Philippine islands. Part I commercial fishes. *Philippine J. Sci.*, 3A : 513-29.
Scomber microlepidotus : recorded from Manila Bay, Philippines.
- . 1910. Fishes of Borneo, with descriptions of four new species. *Philippine J. Sci.*, 5D : 270.
Rastrelliger brachisomus : occurrence.
- SEALE, A. and B. A. BEAN. 1907. On a collection of fishes from the Philippine islands made by Maj. Edgar A. Mearns, Surgeon, U.S. Army, with descriptions of seven new species. *Proc. U.S. Nat. Mus.*, 33 : 229-48.
Scomber microlepidotus : recorded from Zamboanga, Mindanao.
- SEKHARAN, K. V. 1958. On the South Kanara Coastal fishery for the mackerel, *Rastrelliger kanagurta* (Cuvier) together with notes on the biology of the fish. *Indian J. Fish.*, 5(1) : 1-31.
Rastrelliger kanagurta : 1954-56 landings at Malpe (India—west coast), size composition, growth, maturity, spawning ; general discussions on the biology.
- . 1962. On the mackerel fishery of the Mandapam area during the years 1952-1956. (Ms.)
Indian mackerel : gear, size-composition, maturity, length-weight relationship, night catches.

- SEN, D. P., *et al.*, 1961a. Studies on dry-salting and sun-drying of mackerel (*Rastrelliger canagurta* (Cuv.). Different conditions of drying and their effect on the quality of dry-cured product. *Food Sci.*, **10**(5) : 123-31.
Rastrelliger canagurta : effect of sun-drying on the quality of mackerel.
- , 1961b. Studies on dry-salting and sun-drying of mackerel (*Rastrelliger canagurta*) (Cuv.) Effect of Chlorotetra cycline, sorbic acid, sodium propionate, sodium benzoate and sodium acid phosphate on the keeping quality of sun-dried salted mackerel. *Food Sci.*, **10**(5) : 132-38.
Rastrelliger canagurta : deteriorative changes in stored market samples, efficacy of bacteriostatic and fungicidal substances on the keeping quality.
- , 1961c. Studies on the storage characteristics and packaging of sun-dried salted mackerel (*Rastrelliger canagurta*) (Cuv.) *Food Sci.*, **10**(5) : 148.
Rastrelliger canagurta : packaging and storage studies on sundried salted mackerel.
- SESHAPPA, G. 1958. Occurrence of growth checks in the scales of the Indian mackerel, *Rastrelliger canagurta* (Cuvier). *Curr. Sci.*, **27** : 262-63.
Rastrelliger canagurta : rings on scales of adult as spawning marks.
- , 1962. On the problem of age-indicators in the scombroid fishes with special reference to *Rastrelliger kanagurta* (Cuvier). (Ms.)
Rastrelliger kanagurta : age.
- SETNA, S. B. *et al.*, 1944. Nutritive values of some marine fishes of Bombay. *Indian J. Med. Sci.*, **32**(2) : 171-76.
- SILAS, E. G. 1962a. Bioluminescence and mackerel fishery. *Symposium on Scombroid Fishes*. Marine Biological Association of India, Mandapam Camp, Jan. 1962. (Ms.)
Indian mackerel : desirability of using purse seines at night ; possibility of scouting shoals by bioluminescence.
- , 1962b. Parasites of Scombroid fishes. Part I. Monogenetic Trematodes, Digenetic Trematodes, Cestodes. *Symposium on Scombroid fishes*. Marine Biological Association of India, Mandapam Camp, Jan. 1962 (Ms.).
Rastrelliger kanagurta : trematode and cestode parasites.
- SILAS, E. G. and A. N. P. UMMERKUTTY. 1962. Parasites of Scombroid fishes. Part II. Parasitic Copepoda *Symposium on Scombroid fishes*. Marine Biological Association of India, Mandapam Camp, Jan. 1962. (Ms.)
Rastrelliger kanagurta : copepod parasites.
- SIVALINGAM, S. 1955. Wadge Bank Trawl Fishing—1955. Dept. Fish. Ceylon, Fisheries Station. *Progress Reports Biological and Technological*, **2** : 2-3.
Rastrelliger canagurta : recorded in trawl catches from Wadge Bank off the Coast of India.
- SMITH, J. L. B. 1949. The Sea Fishes of Southern Africa. Central News Agency, Cape Town : 299-300.
Rastrelliger kanagurta, *R. brachysoma* : described ; figured.
- , 1956. The fishes of Aldabra. Part V. *Ann. Mag. nat. Hist.*, (12) **9** : 721-29.
Rastrelliger kanagurta : recorded.
- SOESANTO, V. 1961. Some problems of fisheries research with special reference to the *Rastrelliger* fishery. *Proc. Indo-Pacif. Fish. Coun.*, 9th Session, Karachi, **3** : 71-78.
Rastrelliger : research conducted in Indonesia for the development of the fishery.
- SORLEY, H. T. 1938. The Marine Fisheries of the Bombay Presidency. Yavada prinson Press, Poona : 33-164.
Mackerel : fishing ; reference to *Rastrelliger kanagurta* as an important fish along Bombay coast.
- SRIVASTAVA, H. D. 1936a. New Allocreadiids (Trematoda) from Indian Marine Fishes. Part I. New Parasites of the genus *Halicometrina* Linton. *Proc. Nat. Acad. Sci. India*, **7**(3) : 179-85.
Scomber microlepidotus : parasites.
- , 1936b. New Allocreadiids (Trematoda) from Indian Marine Fishes. Part II. New Parasites of the genus *Decemtestis* Yamaguti. *Proc. Nat. Acad. Sci. India*, **7**(3) : 187-95.
Scomber microlepidotus : Parasites.
- STEINDACHNER, F. 1868. Ichthyologische Notizen. VII. *Sitzber Akad. Wiss. Wien.*, **57** : 965-1008.
Scomber microlepidotus, *S. loo* : occurrence.

- SULIT, J. I. *et al.*, 1961. Effectiveness of Biostat (Oxytetracycline Hydrochloride) in maintaining the freshness of Hasa-Hasa (*Rastrelliger brachysomus* Bleeker). *Indo-Pacif. Fish. Coun.*, 9th Session, Karachi, 1961. Tech. Paper 9.
Rastrelliger brachysomus : prolongation of freshness by dipping the fish in 50 parts per million of Biostat.
- THOMAS, H. S. 1870. Report on pisciculture in South Canara, Madras.
Scomber kanagurta : suggestion for protection of undersized fish ; spawning season in South Canara (India—west coast).
- THOMAS, P. T. and G. RAJU. 1962. Gonadal abnormalities in scombroid fishes. *Symposium on scombroid fishes*. Marine Biological Association of India, Mandapam Camp, Jan. 1962. (Ms.)
Rastrelliger kanagurta : hermaphroditism.
- THURSTON, E. 1900. The Sea Fisheries of Malabar and South Canara. *Bull. Madras Govt. Mus.* 3(2) : 93-183.
Scomber microlepidotus : fishing gear, statistics, cost, curing, as manure.
- UMALI, A. F. 1936a.* *Philippine J. Sci.*, 54 : 369.
Rastrelliger brachysomus, *R. chrysozonus* : occurrence.
- . 1936b. Edible fishes of Manila : 97-98.
Rastrelliger brachysomus, *R. chrysozonus* : occurrence, fishery.
- . 1937*. *Philippine J. Sci.*, 63 : 234.
Rastrelliger brachysomus, *R. chrysozonus* : occurrence.
- . 1938.* *Philippine J. Sci.*, 65 : 182.
Rastrelliger brachysomus, *R. chrysozonus* : occurrence.
- . 1950. Key to the families of common commercial fishes in the Philippines. *U.S. Fish. Wildl. Serv., Res. Rept.*, 21 : 1-47.
Rastrelliger brachysomus, *R. chrysozonus* : localities of occurrence listed.
- VAN KAMPEN, P. N. 1907. Über Zwei *Scomber*—*Are in des indischen Archipels*. *Bull. Dept. Agric. Indes Neerl.*, 8 (Zool. 2) : 1-8.
Scomber neglectus, *S. kanagurta* : description, comparison of the species.
- VENKATARAMAN, G. 1960. Studies on the food and feeding relationships of the inshore fishes off Calicut on the Malabar coast. *Indian J. Fish.*, 7(2) : 275-306.
Rastrelliger kanagurta : food-zooplankton and phytoplankton.
- VENKATARAMAN, R. and S. T. CHARI. 1951. Seasonal variation in the chemical composition of mackerel (*Rastrelliger kanagurta*). *Proc. Indian Acad. Sci.*, 33(B) : 126-34.
Rastrelliger kanagurta : seasonal variation in chemical composition of flesh.
- . 1953. Studies on mackerel fat variations : Correlation of plankton fat with fat of fish. *Proc. 39th Indian Sci. Cong. Ass.*, 3 Abstracts : 1-329 (Also *Proc. Indian Acad. Sci.*, 37B : 224-27).
Indian mackerel : fat variations in plankton in relation to fat of fish.
- VENKATARAMAN, R. and A. SREENIVASAN. 1952. A preliminary investigation of the bacterial flora of the mackerel of the West Coast. *Indian J. Med. Res.*, 40(4) : 529-33.
Indian mackerel : eighty-one strains of bacteria reported.
- . 1959. Biological stability of 'Colombo-cured' fish. *Fisheries Station Reports and Year Book*, 1955-1956. Madras : 266-68.
Mackerel : 'Colombo' method of curing ; condition of cured product ; table of bacterial counts in pickled fish and brine.
- VENKATARAMAN, R. and A. G. VASAVAN. 1959. Investigations on the quality of salted fish sold in the market. *Fisheries Station Reports and Year Book*, 1955-1956. Madras : 262-65. Mackerel : percentage of moisture, sodium chloride and total volatile bases in salted fish tabulated.
- VILLADOLID, D. V.. 1937.* *Philippine J. Sci.*, 63 : 215.
Rastrelliger chrysozonus : recorded from Balayan Bay. Bantags Province, Luzon.
- WHITLEY, G. P. New Sharks and fishes from Western Australia. *Australian Zoologist*, 10 : 252-73.

- . 1962. Scombroid fishes of Australia and New Zealand. *Symposium on scombroid fishes*. Marine Biological Association of India, Mandapam Camp, Jan. 1962. (Ms.)
Rastrelliger kanagurta : distribution in Australian waters.
- YAMAGUTI, S. 1953. Parasitic worms mainly from Celebes. Part 3. Digenetic Trematodes of Fishes, II. *Acta Med. Okayama*, 8 (3) : 279-84.
Scomber kanagurta from Macassar, Celebes : digenetic trematode parasites from stomach—*Lecithocladium parviovum* and *L. scombri*, described.

INDEX BY SUBJECTS

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- Cent. Mar. Fish. Res. Inst., India, 1959, 1960.
- George, K. C. 1962.
- Madras Fish. Department, 1937a, 1952.
- Rao, Narayana, 1962a.
- Seshappa, 1962.
- Sekharan, 1958.

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- Kishinouye, 1923.
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- Rao, Vedavyasa, 1962.

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Bibliography

- Herre, 1953.
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- Nicholson, 1915.

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- Chidambaram *et al.*, 1952.
- Madras Fish. Department, 1952.
- Patakoot *et al.*, 1950.
- Philippine Bur. Fish., 1952.
- Pradhan *et al.*, 1951.
- Sen *et al.*, 1961 a., 1961b.
- Venkataraman and Chari, 1951, 1953.
- Venkataraman and Vasavan, 1959.

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- Lahiry *et al.*, 1961a, 1961b.
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- Madras Fish. Department, 1927, 1952.
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- Pradhan, 1941.
- Pradhan and Rao, Virabhadra 1958.
- Sen *et al.*, 1961a, 1961b, 1961c.
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- Venkataraman and Srinivasan, 1959.

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- Madras Fish. Department, 1937a, 1937b.
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- Bhimachar and George, 1950.
- Cent. Mar. Fish. Res. Inst., India, 1954, 1955b, 1956, 1957, 1958, 1959, 1960, 1961.
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- Burdon and Parry, 1954.
- Canagaratnam and Madcof, 1956.
- Cent. Mar. Fish. Res. Inst., India, 1955a, 1961.
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- Madras Fish. Department, 1926, 1929, 1938, 1940a, 1940b, 1941, 1949.
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- Venkataraman and Sreenivasan, 1952, 1959.
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- Canagaratnam and Medcof, 1956.
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- Anonymous, 1955b.
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Rao, Virabhadra, 1962.
Rao, Virabhadra and Basheeruddin, 1953.
Rao, Narayana and Rao, Pampapathi, 1957.

ADDENDUM

- BAISSAC, J. de BOUCHERVILLE. 1964. The scombroid fishes of Mascarene waters. *In Proceedings of the Symposium on Scombroid Fishes*, Marine Biological Association of India, Mandapam Camp, Jan. 1962, Part I : 186, *R. kanagurta* : Occurrence.
- BANDHUKUL, S. 1962. *Rastrelliger* tagging in Thailand. *Proc. Indo-Paci. Fish. Coun.*, 9(2) : 49-54.
Rastrelliger : Tagging programme, tag-recoveries.
- *BANERJI, S. K. 1964. Some considerations in the study of pelagic fish stocks with special reference to Indian mackerel, *Rastrelliger kanagurta*. *In Proceedings of the Symposium on Scombroid Fishes*, Marine Biological Association of India, Mandapam Camp. Jan. 1962, Part I : 565-67.
R. kanagurta : changes in the stocks.
- *BENNET, P. S. 1964. *Euthynnus affinis affinis* (Cantor) in Vizhingam fisheries. *Ibid.* Part II : 710.
R. kanagurta : mentioned as food.
- BLANC, M. and M. L. BANCHOT, 1964. Les Scombroidei (Poissons Teleosteans Perciformes) du Museum National D'Histoire Naturelle de Paris. *Ibid.*, Part I : 450-52.
R. kanagurta : figure ; *R. loo* : figure.
- BOONPRAKOB, U. 1963. Preliminary results of fish egg survey in the Gulf of Thailand. *Proc. Indo-Paci. Fish. Coun.*, 10(2) : 10-19.
Rastrelliger Sp. : planktonic eggs, size, description, figure.
- . 1965. The identification of Pelagic eggs and larvae of Chub-mackerel, *Rastrelliger* sp., in the Gulf of Thailand with additional study on their distribution. *In Reports on mackerel investigations 1963-65. Mar. Fish. Lab., Division of Research & Invest. Dept. of Fisheries, Thailand.* Contr. No. 4 : 115-51.
Rastrelliger sp. figures, descriptions and distribution of eggs and larvae.
- CENTRAL MARINE FISHERIES RESEARCH INSTITUTE, India, 1962. Annual Report of the Director for the year ending 31st March 1962.
Fishery trend, catches, gears, size composition, maturity, spawning season, food.
- . 1963. Annual report of the Director for the year ending 31st March 1963.
Fishery trend, catches, gear, size composition, maturity, food, juveniles.
- . 1964. Annual report of the Director for the year ending 31st March 1964.
Fishery trend, catches, gear, sex composition, maturity, size distribution, food, parasites.
- . 1965. Annual report of the Director for the year ending 31st March 1965.
Fishery, gear, movement of shoals, size composition, sex-ratio, maturity, food.
- . 1966. Annual report of the Director for the year ending 31st March 1966.
Fishery, gear, catches, size composition, sex-ratio, maturity, food.
- . 1967. Tagging of the spiny lobsters, mackerel and oil-sardine. *Souvenir, 20th Aniv., Centr. Mar. Fish Res. Inst., (Appendix) 1967.*
Mackerel (*R. kanagurta*) : released with plastic opercular tags.
- CHIRASTIT, C. 1962. Progress report on tagging experiments of Chub-mackerel (*Rastrelliger neglectus*) in the Gulf of Thailand 1961. *Proc. Indo-Paci. Fish. Coun.*, 10(2) : 202-7.
R. neglectus : tag recoveries, migration and growth.
- CHOMJURAI, V. et. al. 1965. Growth and migration of Chub-mackerel, *Rastrelliger neglectus*, in the Gulf of Thailand. *In Reports on mackerel Investigations 1963-65. Mar. Fish. Lab., Division of Research and Invest. Dept. of Fisheries, Thailand.* Contr. No. 4 : 28-114.
R. neglectus : migration, growth, maximum size and predators.
- DICK, M. MYVANWY. 1964. Scombroid fishes in the Museum of Comparative Zoology, Harvard University. *In Proceedings of the Symposium on Scombroid Fishes*, Marine Biological Association of India, Mandapam Camp, Jan. 1962, Part I : 462.
R. brachysoma ; *R. kanagurta* : synonymy, figure.
- FOURMANOIR, P. and A. CROSNIER. 1964. Rapport sur La compagne de Peche an Thon d la palangre dirivante, Faite par le ' Maran Atha ' dans les environs de Majunga (Cote Nord-Ouest) du 21 Septembre an 15 Octobre 1961. *Ibid.*, Part I : 385.
R. kanagurta : catches.

- GEORGE, P. C. 1964. Our current knowledge on the food and feeding habits of the Indian mackerel, *Rastrelliger kanagurta* (C.) *Ibid.*, Part I : 569-73.
R. kanagurta : Food habits—a review.
- GORBUNOVA, N. N. 1963. Larvae of scombroids (Pisces, Scombriformes) from the Indian Ocean. *Trudy Inst. Oceanol. Acad. Sci.*, 62 : 68-95. (In Russian).
R. kanagurta : figure and description of larva.
- HAMRE JOHANNES *et. al.* 1966. Preliminary Report on tagging the Indian mackerel, *Rastrelliger kanagurta* (Cuvier) and the Lesser sardine, *Sardinella gibbosa* (Val.) off Marmagao Harbour, Union Territory of Goa. *Cent. Inst. Fish. Education Bull.*, No. 3. pp. 1-15.
Methods in handling and tagging live fish, types of tags used, given.
- ISARANKURA, A. P. and P. NAIYANETR. 1965. The point of origin and probable order of appearance of scales in the Indo-Pacific Chub mackerel, *Rastrelliger neglectus* in the Gulf of Thailand. *In Reports on mackerel Investigations 1963-65. Mar. Fish. Lab. Division of Research & Invest. Dept. of Fisheries. Thailand. Contr. No. 4* : 14-27.
R. neglectus : origin and order of appearance of scales, figure.
- *JONES, S. and M. KUMARAN, 1964. Eggs, larvae and juveniles of Indian scombroid fishes, *In. Proceedings of the Symposium on Scombroid Fishes, Marine Biological Association of India, Mandapam Camp, Jan. 1962, Part I* : 364.
R. kanagurta : figure.
- JONES, S. and H. ROSA JR. 1965. Synopsis of biological data on Indian mackerel *Rastrelliger kanagurta* (Cuvier) 1817 and short bodied mackerel *Rastrelliger brachysoma* (Bleeker) 1851. *FAO Fish. Synops.* (29) : 34.
R. kanagurta ; *R. brachysoma* : review on taxonomy, distribution, bionomics and life history, population and exploitation.
- *JONES, S. and E. G. SILAS, 1964a. A systematic review of the scombroid fishes of India. *In Proceedings of the Symposium on Scombroid Fishes, Marine Biological Association of India, Mandapam Camp, Jan. 1962, Part I* : 15.
R. kanagurta ; *R. brachysoma* : systematics, distribution, figure.
- *———. 1964b. Mackerel from Andaman Sea. *Ibid.*, Part I : 255-82.
R. kanagurta ; *R. brachysoma* : systematics, description, key, morphometry length-weight relationship, abnormalities and figures.
- *KUTTY, M. NARAYANAN. 1965 (1962). Observations on the Indian mackerel, *Rastrelliger kanagurta* (Cuvier) from the trawl catches along the Bombay coast. *Indian J. Fish.*, 9 (2) : 590-603.
R. kanagurta : catches, ecology, food sizes.
- LINDSEY, C. C. 1966. Taxonomy of *Rastrelliger* mackerels in the Malayan Region. *Proc. 11th Pacific Sci. Cong.*, Abstract 7.
Rastrelliger : 18 Characters useful in identification of species mentioned. Considered *R. kanagurta* and *R. brachysoma* as valid species.
- LURSINSAP, A. 1965. Analysis of stomach contents of *Rastrelliger neglectus* in the Gulf of Thailand, 1963. *In. Reports on Mackerel Investigations 1963-65. Mar. Fish. Lab. Division of Research & Invest. Dept. of Fisheries, Thailand. Contr. No. 4* : 152-61.
R. neglectus : food.
- MATSUI, T. 1963. The larvae of *Rastrelliger*. *In. Ecology of the Gulf of Thailand and the South China Sea ; A report on the results of the Naga Expedition, 1959-1961. Southeast Asia Research program, the University of California, Scripps Institution of Oceanography, La Jolla, California. SIO Reference 63-6* : 59-69.
Rastrelliger : figures, descriptions and distribution of larvae.
- MENASVETA, D. 1965. Programme of mackerel investigations. *In Reports on mackerel Investigations 1963-65. Mar. Fish. Lab. Division of Research & Invest. Dept. of Fisheries. Thailand. Contr. 4* : 1-13.
Rastrelliger : Programme.
- *NOBLE, A. 1965 (1962). The food and feeding habits of the Indian mackerel, *Rastrelliger kanagurta* (Cuvier) at Karwar. *Indian J. Fish.*, 9 (2) : 701-13.
R. kanagurta : seasonal variation in the food habits correlated with biological environment and maturity condition.
- PRADHAN, L. B. and REDDY, C. V. GANGADHARA. 1964 (1962). Fluctuation in the mackerel landings at Calicut in relation to hydrographical factors. *Ibid.*, 9(1) : 100-9.
R. kanagurta : fluctuations of the landings are correlated with the hydrographical factors.

- RADHAKRISHNAN, N. 1965 (1962). Observations on the maturity and spawning of the Indian mackerel, *Rastrelliger kanagurta* (Cuvier) at Karwar. *Ibid.*, 9(2) : 512-24.
R. kanagurta : spawning periodicity and season, size at first maturity.
- *RAO, K. V. NARAYANA. 1964. Observations on the bionomics of the Indian mackerel, *Rastrelliger kanagurta* (C.) caught in the Lawson's Bay, near Waltair, Andhra Coast. In Proceedings of the Symposium on Scombroid Fishes, Marine Biological Association of India. Mandapam Camp, Jan. 1962, Part II : 574-85.
R. kanagurta : food habits, spawning periodicity and season, rate of growth and age, length-weight relationship and parasites.
- . 1965 (1962). Food of the Indian mackerel, *Rastrelliger kanagurta* (Cuvier), taken by drift net in the Arabian Sea off Vizhingan, South Kerala. *Indian J. Fish.*, 9(2) : 530-41.
R. kanagurta : size composition, food habits, maturity, spawning season.
- *RAO, V. RAMAMOHANA *et al.* 1965 (1962). On the mackerel fishery of the Mangalore area during the period 1957-61. *Ibid.*, 9(2) : 653-78.
R. kanagurta : Fishery, gear, size composition, spawning period, estimates of L_{∞} and K , rate of decrease.
- RAO, K. SRINIVASA. 1964. Observations on the food and feeding habits of *Scomberomorus guttatus* (Bloch & Schneider) and juveniles of *S. lienolatus* (Cuvier and Valenciennes) and *S. commerson* (Lacépède) from the Waltair coast. In Proceedings of the Symposium on Scombroid Fishes Marine Biological Association of India, Mandapam Camp, Jan. 1962, Part II : 592.
R. kanagurta : mentioned as food of adult *S. guttatus*.
- *RAO, P. VEDAVYASA. 1963. On the line Fishery for *Rastrelliger kanagurta* (Cuvier) along the North Kanara coast. *J. Mar. Biol. Assoc. India*, 5(2) : 302-21.
R. kanagurta : Records catches by hook and lines.
- RAO, K. VIRABHADRA. 1964. Distribution of the young stages of the mackerel, *Rastrelliger kanagurta* (Cuvier) in the Indian Inshore waters. In Proceedings of the Symposium on Scombroid Fishes, Marine Biological Association of India, Mandapam Camp, Jan. 1962. Part I : 469-82.
R. kanagurta : distribution, growth, food and spawning habits.
- SEKHARAN, K. V. 1965 (1962). On the mackerel fishery of the Mandapam area. *Indian J. Fish.*, 9(2) : 714-27.
R. kanagurta : fishery, size composition, length-weight relationship, maturity.
- SMITH, J. L. B. 1964. Scombroid fishes of South Africa. In Proceedings of the Symposium on Scombroid Fishes, Marine Biological Association of India, Mandapam Camp, Jan. 1962. Part I :
R. kanagurta : description, common names, figure.
- SUKONTHAMAN, P. and U. SRIRUANGCHEEP. 1965. Survey of catch and effort statistics and compilations of size composition of Chub mackerel in the Gulf of Thailand. In Reports of Mackerel Investigations 1963-65. *Mar. Fish. Lab. Division of Research & Invest. Dept. of Fisheries*, Thailand. Contr. No. 4 : 190-202.
Chub mackerel : Standard forms for compilation of catch, effort and sizes.
- THOMAS DAVIDSON. 1962. Fishing methods of Scombroids in Madras coast. *Madras J. Fish.*, 1 : 138-41.
Rastrelliger kanagurta : local names, landing centres, seasons, gear.
- THOMAS, P. T. and G. RAJU. 1964. Gonadal abnormalities in scombroid fishes. In Proceedings of the Symposium on Scombroid Fishes, Marine Biological Association of India, Mandapam Camp, Jan. 1962. Part II : 720.
R. kanagurta : mentioned under hermaphroditism.
- VANICHKUL, P. and V. HONGSKUL. 1965. Length-weight relationships of Chub mackerel *Rastrelliger* sp. in the Gulf of Thailand. 1963. In Reports on Mackerel Investigations 1963-65. *Mar. Fish. Lab. Division of Research & Invest. Dept. of Fisheries*, Thailand. Contr. No. 4 : 162-89.
R. kanagurta, *R. neglectus* : Length-weight relationship.
- VENKATARAMAN, G. 1967. The Indian mackerel. Souvenir, 20th Aniv. Cent. *Mar. Fish. Res. Inst.* 1967.
 Fishing areas, seasons, statistics, fluctuations, gear, spawning season, growth, age, food, curing, disposal.
- VJAYARAGHAVAN, P. 1965 (1962). Some observations on the spawning behaviour of mackerel. *Indian J. Fish.*, 9(2) : 647-52.
R. kanagurta : Spawning periodicity and behaviour, feeding activity.
- WHITLEY, G. P. 1964. Scombroid fishes of Australia and New Zealand. In Proceedings of the Symposium on Scombroid Fishes, Marine Biological Association of India, Mandapam Camp, Jan. 1962. Part I : 249.
R. kanagurta : description.

Note.—*Referred as (MS.) in the original list.

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