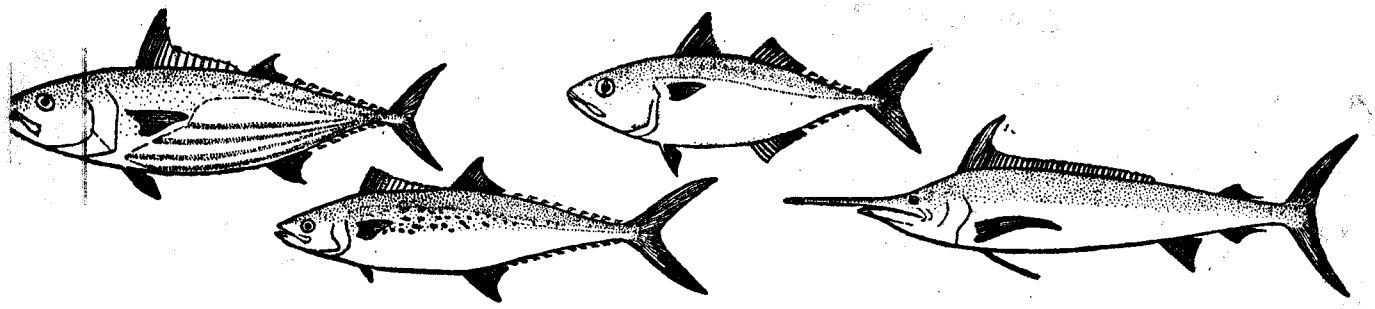
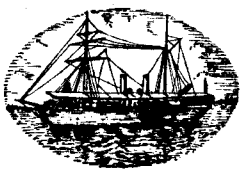


SYMPOSIUM ON SCOMBROID FISHES

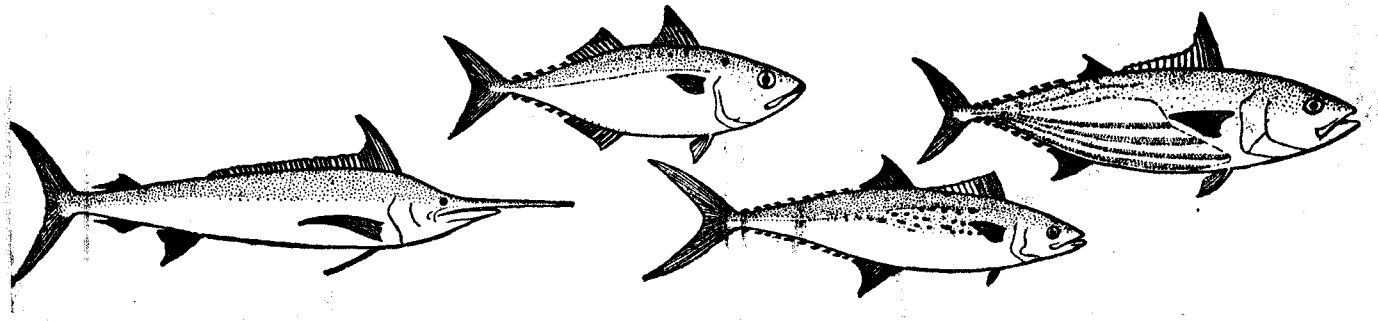
PART II



MARINE BIOLOGICAL ASSOCIATION OF INDIA

MANDAPAM CAMP

S. INDIA

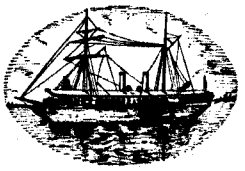


PROCEEDINGS OF THE

SYMPOSIUM
ON
SCOMBROID FISHES

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

PART II



SYMPOSIUM SERIES I

MARINE BIOLOGICAL ASSOCIATION OF INDIA

MANDAPAM CAMP

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A PRELIMINARY SURVEY OF THE COMMON TUNA BAIT FISHES OF MINICOY AND THEIR DISTRIBUTION IN THE LACCADIVE ARCHIPELAGO

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Introduction

It is a recognized fact that the availability of bait fish in sufficient quantities is one of the most important deciding factors in the successful operation of pole-and-line fishing for tuna. In the Indian Union tuna fishing on an organized scale exists only in the island of Minicoy in the Laccadive Archipelago. The main species concerned are the oceanic skipjack *Katsuwonus pelamis* and to a comparatively lesser extent the yellowfin tuna *Neothunnus macropterus*. Fishing is done from country crafts provided with bait wells inside for storing the live bait collected from the lagoon while proceeding to the fishing grounds. The method of collection of bait fish and the tuna fishery in general in Minicoy have already been reported on elsewhere (Jones 1958 and Jones and Kumaran 1959). Since a knowledge of the bait fish resources is essential for the proper development and utilization of the tuna resources of the area, studies were initiated on the biology of bait fishes and their distribution in the Laccadive Sea. The present account deals with a qualitative study made of the fishes commonly used as bait fish in Minicoy and their occurrence in and around other islands in the Laccadives. Observations made on the seasonal fluctuations in abundance of the major bait fishes are being reported on elsewhere (Thomas 1962).

The Laccadive Archipelago (Fig. 1) consists of a group of coral islands off the west coast of India of which Minicoy is comparatively isolated from the rest and is situated in the south between the main Laccadive and Maldive groups of islands. There are in all ten inhabited islands in the Laccadives and a few uninhabited islands and reefs some of which are visited by the islanders in fair weather either for fishing or for collection of coconuts. For further details about these islands accounts given by Gardiner (1903 and 1906), Alcock (1902) and Ellis (1924) and the ' West Coast Pilot ' (British Admiralty 1950) may be referred to.

General fish collections were being made since 1954 from the different islands, first with the help of the Medical Officers stationed there and subsequently by the members of the staff of this institute who were sent there for the purpose. In 1958 and 1959 the author was able to visit all the inhabited islands except Kadamat, make collections and get first hand information on the general conditions there. Based on the material collected during the past eight years it has been possible to get a preliminary idea of the fish fauna in and around the various islands in the Laccadive Archipelago. But their comparative abundance and relative qualities as bait fish remain to be studied.

As stated in the earlier account (Jones 1958) there is no rigid selection in the catch and utilization of bait fishes in Minicoy. Normally, before tuna boats proceed for fishing in the morning bait fish are collected from the lagoon and transferred into the bait wells. This would include in addition to the major species any small-sized fish that would stray into the net at the time of the seining operations. So long as it can survive in the bait well without creating any undue disturbance and is small enough for convenient handling, any fish is welcome. It would appear that hardly any selection is made based on the relative chumming qualities of the different species. However, there are a few species belonging to the families Pomacentridae, Caesiodidae, Dussumieriidae, Apogonidae and Labridae recognised as major bait fishes on the availability of which the success of the tuna fishery depends. When bait fish is scarce the boats return without proceeding to the fishing grounds and any live bait collected is stored in the floating bait baskets which are anchored in the lagoon. Whatever is left over after a day's operation is also stored similarly but only some

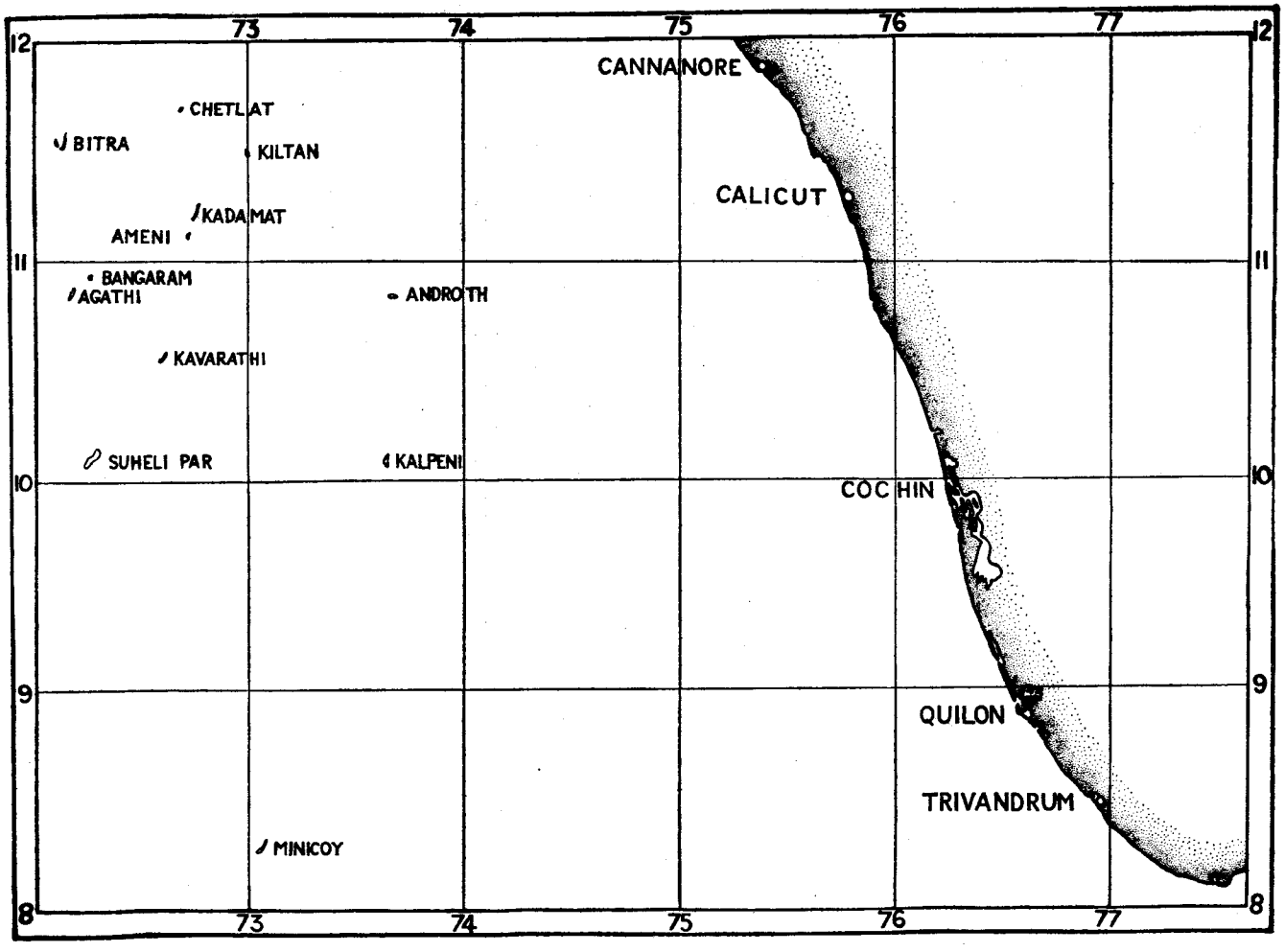

Fig. 1. Southern section of the west coast of India and the Laccadive group of islands.

of the hardy species would survive the confinement in the bait basket for long periods. Occasionally the cyprinodont, *Panchax panchax*, which was introduced into the island several decades ago as a mosquito larvicidal fish is collected and utilised as bait fish with indifferent results. Recently tilapia was introduced to be used as a live bait in view of the encouraging results it gave elsewhere (Brock and Takata 1955, King and Wilson 1957) and the progress of its utilization is awaited with interest. Even if tilapia may not come upto expectations as a bait fish, its introduction will not upset pond life since there are no fishes in the ponds in any of the islands except *Panchax panchax* and occasionally mullets transplanted from the sea.

The species generally used as bait fish are listed below. Some of these may be playing only a very insignificant role as a bait fish while a few others not listed here might occasionally stray into the bait net in the course of the fishing operations and be utilized as bait fish. The 45 species belonging to 30 genera and 19 families listed, which include all the major live bait fishes are figured and references to their original descriptions and in the relevant regional publications are given. An arbitrary key is also provided to facilitate identification.

BAIT FISHES OF MINICOY

Artificial Key to the Families

1. Dorsal fin without spines. 2
   Dorsal fin with spines. 5

2. Head depressed and scaly ; caudal fin rounded..... *Cyprinodontidae.*
   Head compressed, without scales ; caudal fin forked..... 3

3. Mouth inferior ; adipose eyelid almost covers the eye ; lateral line present. .... *Albulidae.*
   Mouth terminal ; lateral line absent. 4

4. Abdominal scutes present ; belly compressed..... *Clupeidae.*
   No abdominal scutes ; belly rounded..... *Dussumieriidae.*

5. Pelvics abdominal. 6
   Pelvics thoracic. 9

6. Lower rays of pectoral filamentous. ..... *Polynemidae.*
   Lower rays of pectoral not filamentous. 7

7. Large fang-like teeth in both jaws ; well developed lateral line ; gill rakers obsolete. .... *Sphyraenidae.*
   Teeth usually small ; lateral line absent or rudimentary ; long and slender gill rakers. 8

8. Dorsal with 5-6 spines ; anal usually with 1 spine ; broad silvery band along the sides. ..... *Atherinidae.*
   Dorsal with 4 spines ; anal with 3 spines ; silvery stripe absent on body. .... *Mugilidae.*

9. Two detached spines anterior to the anal fin. ..... *Carangidae.*
   No detached spines anterior to the anal fin. 10

10. Two barbels behind symphysis of lower jaw. ..... *Mullidae.*
    No barbels behind symphysis of lower jaw. 11

11. Two separated dorsal fins. ..... *Apogonidae.*
    One continuous dorsal fin with spines anteriorly. 12

12. Single nostril on each side. 13
    Two nostrils on each side. 14

13. Anal fin usually with 2 spines. ..... *Pomacentridae.*
    Anal fin with 3 spines. ..... *Cichlidae.*

14. Canine teeth usually at the angle of mouth ; lower pharyngeals ankylosed into a characteristic structure bearing molar teeth. ..... *Labridae.*
    No canines at the angle of mouth ; lower pharyngeals not united and not bearing molars. 15

15. Scaly process in axil of ventrals present ; dorsal fin not notched. 16
    No scaly process in axil of ventrals ; dorsal fin deeply notched. ..... *Kuhliidae.*

16. Teeth on palate well developed, several rows of conical teeth ; mouth not protractile ; scales on lateral line about 50. ..... *Lutianidae.*
    No teeth on palate ; mouth protractile ; scales on lateral line more than 60. 17

17. First dorsal with 14 spines; dorsal deeply notched. ..... *Emmelichthyidae.*
    First dorsal with 10-13 spines; dorsal not notched. ..... *Caesiodidae.*

Family Albulidae

1. **Albula vulpes** (Linnaeus)

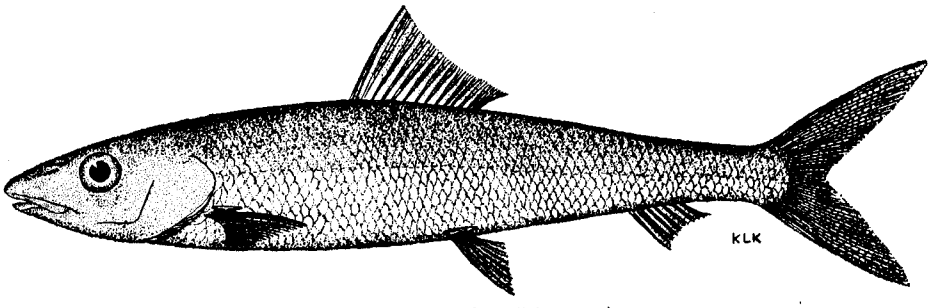

Fig. 2. *Albula vulpes* (Linnaeus).

Esox vulpes Linnaeus, 1758 : 313.
Albula conorhynchus Day, 1878 : 648.
Albula vulpes Weber and de Beaufort, 1913 : 7. Smith, 1949 : 85. Munro, 1955 : 23. Jones and Kumaran, 1959 : 44.

Distribution : A pan-tropical species distributed in all warm shallow seas.

Utility : Collected in small numbers during seining operations for the more common bait fishes. Considered suitable for pole-and-line fishing, especially the small-sized ones.
Local name : Mie mas.

FAMILY DUSSUMIERIIDAE

KEY TO THE SPECIES OF **Spratelloides**

Silvery white lateral band on sides of body ; anal with 13-14 rays, scales in lateral line 40-45.....*Spratelloides japonicus.*

Lateral band absent on sides of body ; anal with 10-11 rays ; scales in lateral line 35-38.....*Spratelloides delicatulus.*

2. **Spratelloides delicatulus** (Bennett)

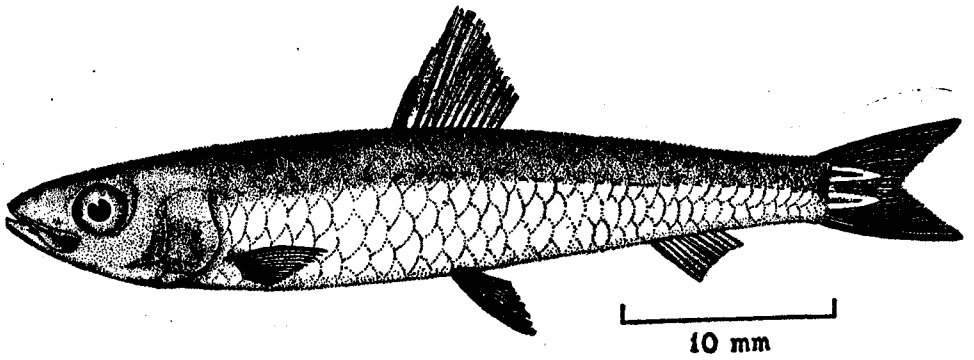

Fig. 3. *Spratelloides delicatulus* (Bennett).

Clupea delicatula Bennett, 1831 : 168.

Spratelloides delicatulus Weber and de Beaufort, 1913 : 20. Smith, 1949 : 89. Jones, 1960a : 103.

Distribution : From Hawaii and Central and South Pacific Islands to the east coast of South Africa. Recent collection of the species from the Laccadive Sea (Jones, 1960a and b) forms its first record from this part of the Indian Ocean. It is found along the reefs and in the open sea between the islands in the Laccadive Sea and invades the lagoons also during certain seasons in large shoals.

Utility : Enters the lagoon in very large shoals before the monsoon and remains there upto about November. This is utilized as bait fish whenever available. The predilection of tuna for this fish is known and in the northern islands of the Laccadive Archipelago it is known as ' tuna sardine ' in the local language. Its potentialities as a bait fish of prime importance in any programme of expansion of pole-and-line fishing for the tunas in the Laccadive Sea appear to be great.

Local name : Hondeli.

3. **Spratelloides japonicus** (Houttuyn)

Atherina japonica Houttuyn, 1872 : 340.

Spratelloides gracilis Weber and de Beaufort, 1913 : 20.

Spratelloides japonicus Munro, 1955 : 28. Jones, 1960b : 267.

Distribution : Japan, Polynesia and Eastern Pacific to Red Sea. Not known from the Central Pacific and East African coast.

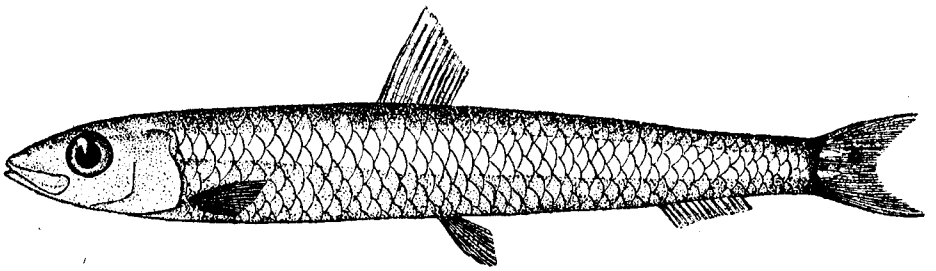

Fig. 4. *Spratelloides japonicus* (Houttuyn).

Utility : Does not appear to be so abundant and well distributed as its congener. Known to occur in small shoals in Minicoy. Its present status as bait fish in the Laccadives is not known. Probably could be made use of if available in sufficient quantities.

Local name : Rahi.

FAMILY CLUPEIDAE

4. **Sardinella melanura** (Cuvier)

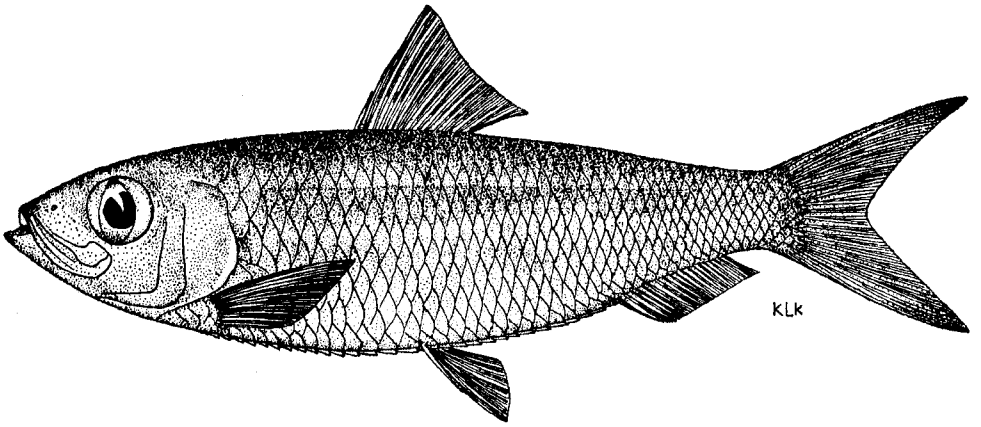

Fig. 5. *Sardinella melanura* (Cuvier).

Clupea melanura Cuvier, 1829 : 318.
Clupea atricauda Day, 1878 : 636.
Clupea (*Harengula*) *atricauda* Weber and de Beaufort, 1913 : 80.
Sardinella melanura Smith, 1949 : 92. Munro, 1955 : 26. Jones and Kumaran, 1959 : 44.

Distribution : Micronesia, Polynesia, China to the east coast of Africa.

Utility : The exact status of this species as a live bait is not known. Small shoals have been reported to enter the lagoon just after the monsoon.

FAMILY CYPRINODONTIDAE

5. **Panchax panchax** (Hamilton-Buchanan)

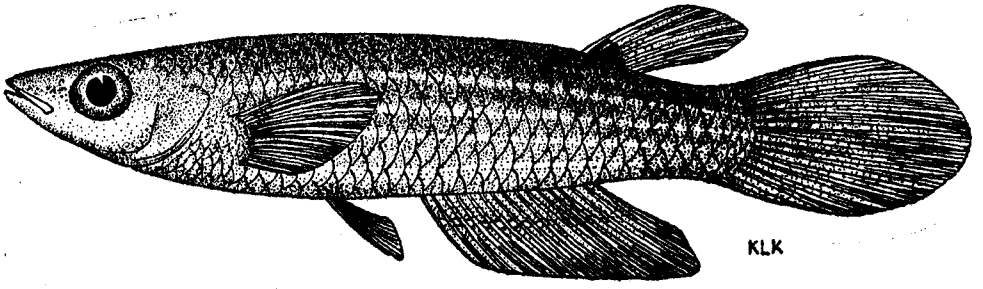

Fig. 6. *Panchax panchax* (Hamilton-Buchanan).

Esox panchax Hamilton-Buchanan, 1822 : 211 and 380.
Haplochilus panchax Day, 1878 : 523.
Panchax panchax Weber and de Beaufort, 1922 : 374. Jones and Kumaran, 1959 : 45.

Distribution : A fresh and brackish water species found from the east coast of India to Malaya and Indonesia as far as Borneo. It is likely that this is the South Indian variety *Panchax danchax blochii* (Arnold). This has been introduced into the islands as a mosquito larvicidal fish during the early part of this century by the inspecting officers under the British Administration.

Utility : Found in fair abundance in ponds and are collected and utilized as bait fish at times of scarcity with fair success.
Local name : Incha mas.

FAMILY SPHYRAENIDAE

6. **Sphyraena obtusata** (Cuvier and Valenciennes)

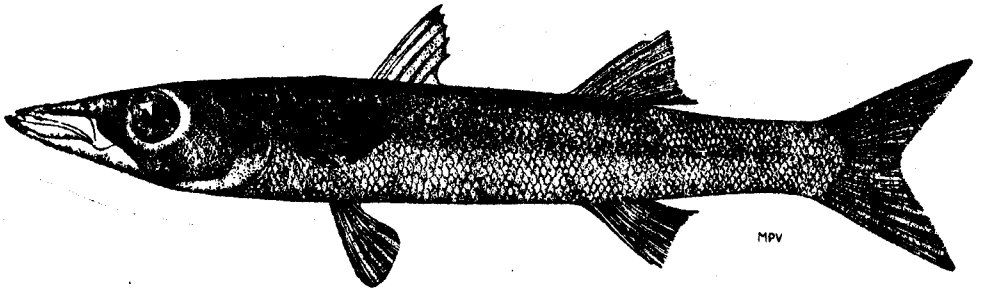

Fig. 7. *Sphyraena obtusata* (Cuvier and Valenciennes).

Sphyraena obtusata Cuvier and Valenciennes, 1829 : 350. Day, 1878 : 343. Weber and de Beaufort, 1922 : 226. Smith, 1949 : 326. Munro, 1955 : 90. Jones and Kumaran, 1959 : 45.

Distribution : From Red Sea and east coast of Africa to Riu Kiu Islands, North Australia, Fiji and New Zealand.

Utility : Juveniles found in small numbers and is of minor importance as a bait fish.

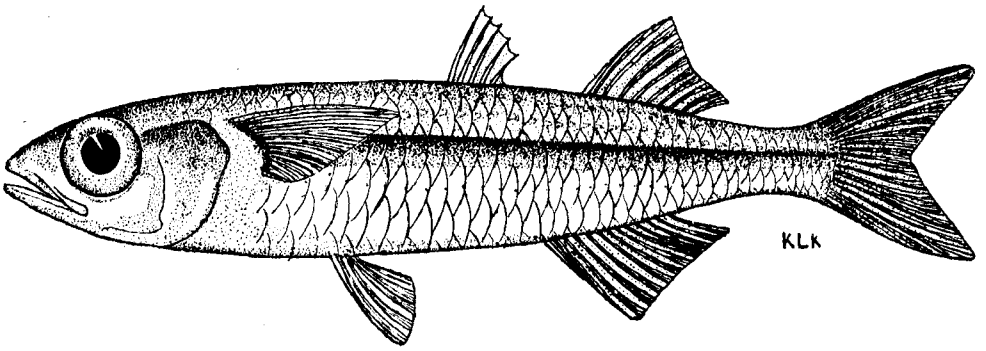

Fig. 11. *Pranesus duodecimalis* (Cuvier and Valenciennes).

Utility : Occurs in shoals though not probably in such numbers as its congener. Hardy and useful as bait fish. The above two species are the dominant ones among the four species of atherinids occurring in the area.

Local name : Phitham.

Family Polynemidae

11. **Polynemus sexfilis** (Cuvier and Valenciennes)

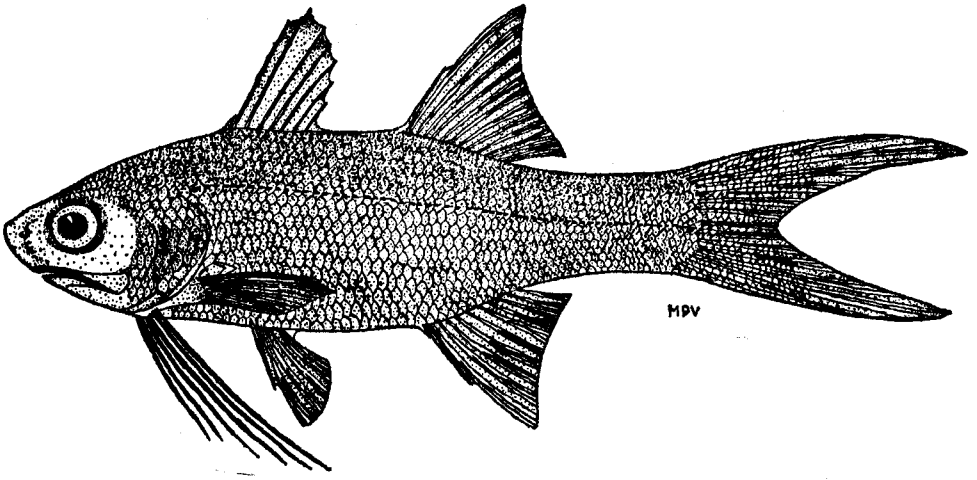

Fig. 12. *Polynemus sexfilis* (Cuvier and Valenciennes).

Polynemus sexfilis Cuvier and Valenciennes, 1831 : 515. Day, 1878 : 178. Munro, 1955 : 97. Jones and Kumaran, 1959 : 45.

Distribution : From Mauritius through Indian Ocean and Central Pacific as far as the Hawaiian Archipelago.

Utility : Small sized specimens suitable as bait fish but do not occur in large numbers.

Local name : Kela.

FAMILY KUHLIIDAE

12. **Kuhlia taeniurus** (Cuvier and Valenciennes)

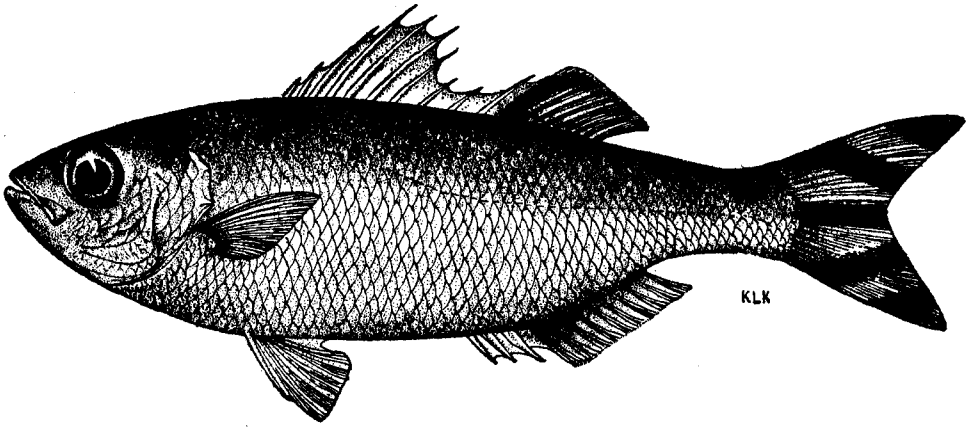

Fig. 13. *Kuhlia taeniurus* (Cuvier and Valenciennes).

Dules taeniurus Cuvier and Valenciennes, 1829 : 114. Smith, 1949 : 187.
Dules argenteus Day, 1878 : 67.
Kuhlia taeniuira Weber and de Beaufort, 1929 : 273.
Kuhlia taeniurus Munro, 1955 : 117. Jones and Kumaran, 1959 : 45.

Distribution : Widespread in the Indian Ocean and as far as the Central Pacific and occurs in fresh water, estuaries and near coral reefs.

Utility : A hardy fish capable of surviving in brackish water and in sea. Suitable for use as bait fish. Occurs in fairly large numbers close to the shore, frequently occurring in the bait fish catches.

Local name : Kattaphuli.

FAMILY ANTHIDAE

13. **Anthias cichlops** (Bleeker)

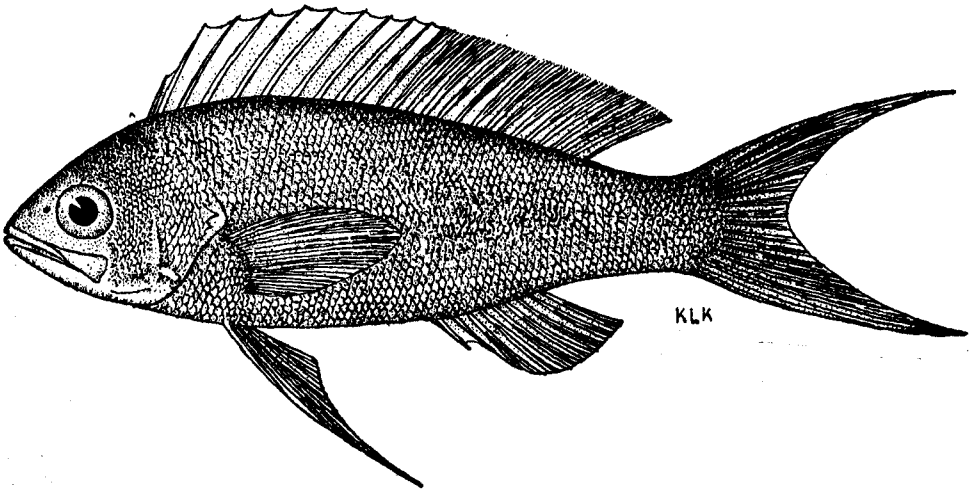

Fig. 14. *Anthias cichlops* (Bleeker).

Serranus cichlops Bleeker, 1853 : 245.
Anthias cichlops Weber and de Beaufort, 1931 : 105. Smith, 1949 : 518.

Distribution : Tropical Indo-Pacific from East Indies and Philippines to the coast of East Africa.

Utility : This species though not regularly found in the lagoon is sometimes caught in large numbers and utilized as bait fish.

Local name : Rye bureki.

Family Apogonidae

Key to the Species of Apogonidae

1. Anal with 13-17 soft rays.....2
   Anal with less than 10 soft rays..... 3
2. Two horizontal dark bands on body ; soft anal rays 12 to 13.....*Archamia buruensis*
   No horizontal bands ; numerous narrow light transverse stripes on body ; soft anal rays 13 to 17.....*Archamia lineolatus*
3. First dorsal with 6 spines, second spine sometimes filamentous.....*Apogon sangiensis*
   First dorsal with 7 spines, second spine not filamentous.....4
4. Preopercular ridge finely serrated ; one stripe on body.....*Apogon frenatus*
   Preopercular ridge smooth or with few spines at angle.....5
5. Dorsal spines weak ; no dark longitudinal bands on body ; dark streak from eye to preopercular angle ; upper part of caudal peduncle dark.....*Apogon bandanensis*
   Dorsal spines strong ; dark longitudinal bands present on body.....6
6. Orbital rim serrated ; two bands on upper part of body.....*Apogon quadrifasciatus*
   Orbital rim not serrated ; usually five longitudinal bands along sides..*Apogon endekataenia*

14. **Archamia buruensis** (Bleeker)

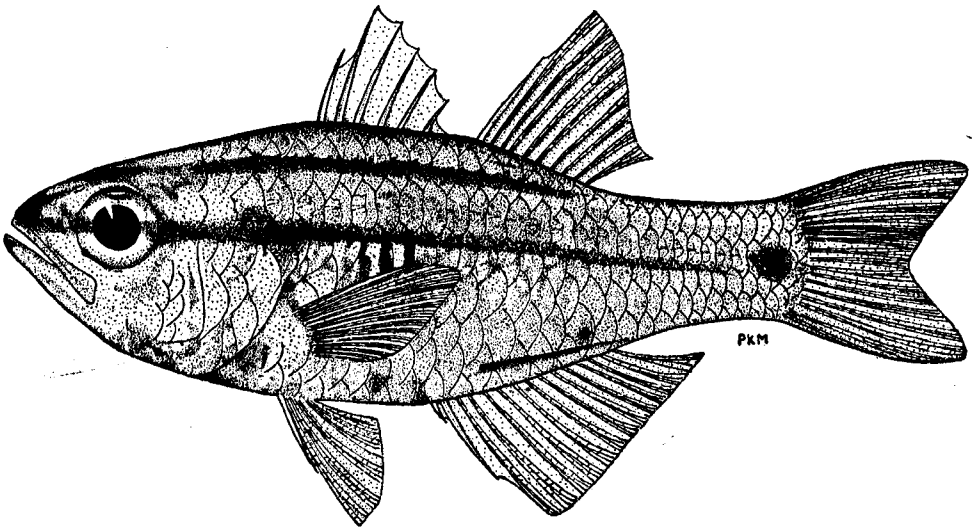

Fig. 15. *Archamia buruensis* (Bleeker).

Apogon buruensis Bleeker, 1856 : 394.
Apogon buruensis Weber and de Beaufort, 1929 : 345.
Archamia buruensis Jones and Kumaran, 1959 : 46.

Distribution : Central Indian Ocean to Indonesia and Philippines ; in brackish water and sea.

Utility : Though not so abundant as *A. lineolatus* this species also occurs in fairly good numbers.

Local name : Bodi.

15. **Archamia lineolatus** (Cuvier and Valenciennes)

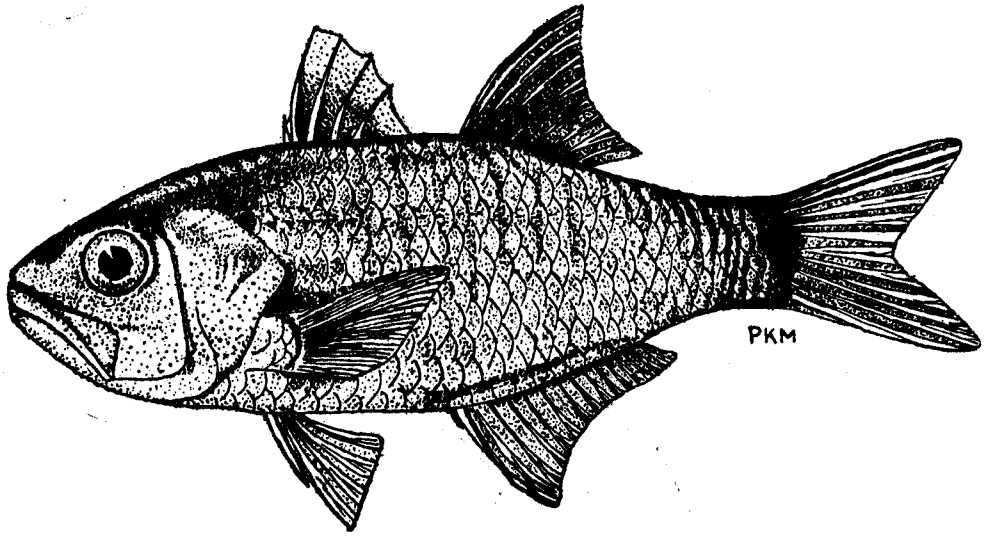

Fig. 16. *Archamia lineolatus* (Cuvier and Valenciennes).

Apogon lineolatus Cuvier and Valenciennes, 1828 : 160. Weber and de Beaufort, 1929 : 347.
Apogon macropterus Day, 1878 : 64.
Archamia lineolata Smith, 1949 : 209.
Archamia lineolatus Munro, 1955 : 119. Jones and Kumaran, 1959 : 46.

Distribution : Warmer parts of the Pacific and Indian Oceans from Japan and Samoa as far as Delagoa Bay on the coast of East Africa.

Utility : This is the most important apogonid among the species occurring in the region. Though sudden fluctuations are seen in their abundance, they form an important bait fish in pole-and-line fishery.

Local name : Rye bodi.

16. **Apogon frenatus** Valenciennes

Apogon frenatus Valenciennes, 1832 : 57. Day, 1878 : 58. Smith, 1949 : 208. Weber and de Beaufort, 1829 : 295. Jones and Kumaran, 1959 : 46.

Distribution : Tropical Indo-Pacific from Natal on the coast of East Africa to the Hawaiian and Tuamotu Islands.

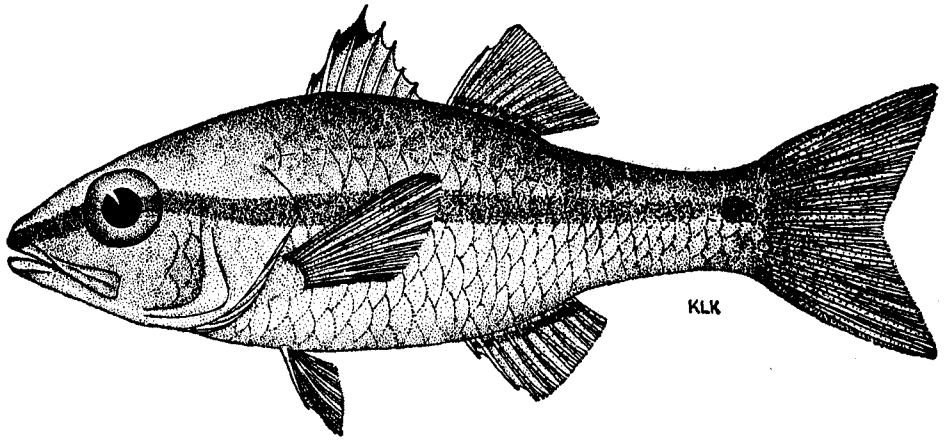

Fig. 17. *Apogon frenatus* Valenciennes.

Utility : This forms only a small percentage of the apogonids in the bait fish catches and its occurrence is not regular.

Local name : Bodi.

17. **Apogon endekataenia** Bleeker

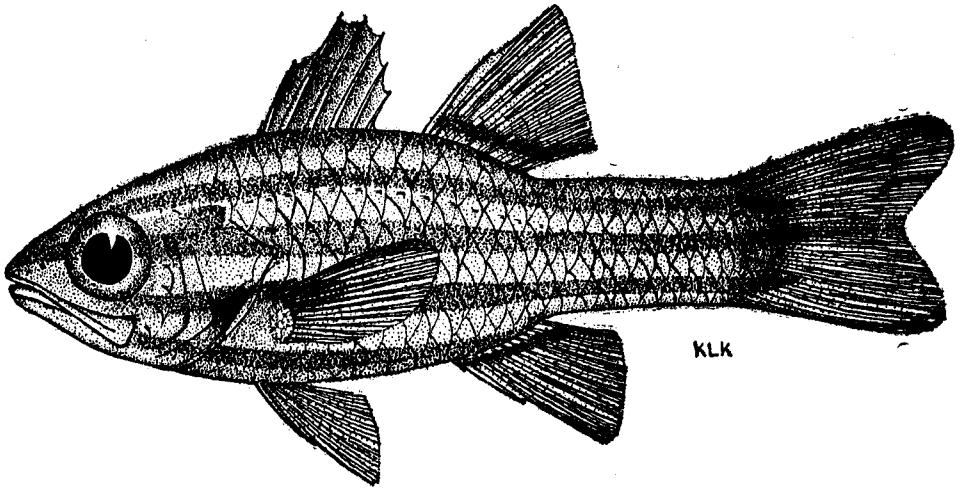

Fig. 18. *Apogon endekataenia* Bleeker.

Apogon endekataenia Beeker, 1852 : 449. Weber and de Beaufort, 1929 : 306. Munro, 1955 : 121.

Distribution : Philippines, coast of Australia, Tasmania, New Hebrides and Fiji Islands in the Pacific to Laccadives in the Indian Ocean.

Utility : Comparatively rare in the bait fish catches.

Local name : Rung bodi.

18. **Apogon bandanensis** Bleeker

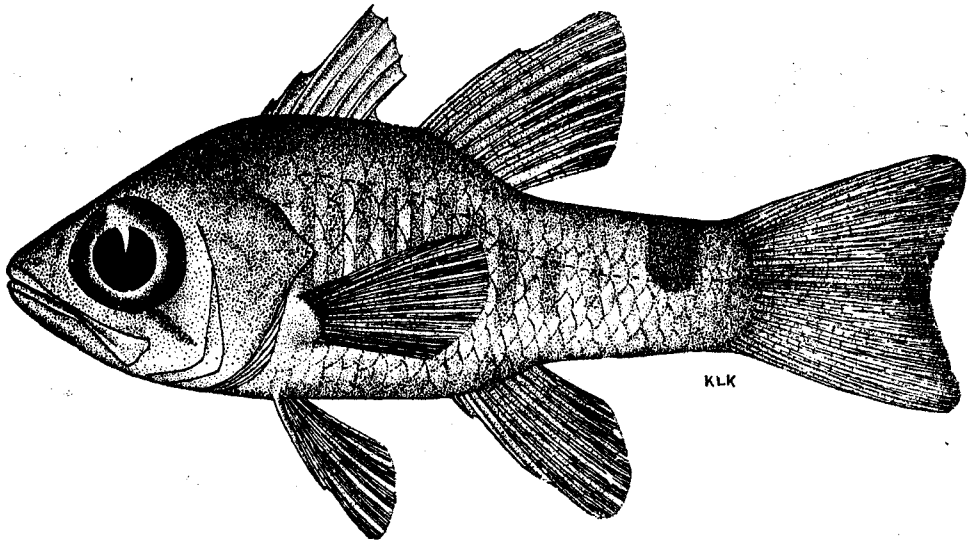

Fig. 19. *Apogon bandanensis* Bleeker.

Apogon bandanensis Bleeker, 1854 : 95. Weber and de Beaufort, 1929 : 317. Smith, 1949 : 207.

Apogon savayensis Day, 1878 : 60.

Distribution : Tropical Indo-Pacific, Riu Kiu Islands, south to Queensland, Australia, east to Micronesia as far as Tuamoto Islands and west to East Africa as far as Delagoa Bay.

Utility : Occurs in the bait fish catches though not regularly.

Local name : Bodi.

19. **Apogon sangiensis** Bleeker

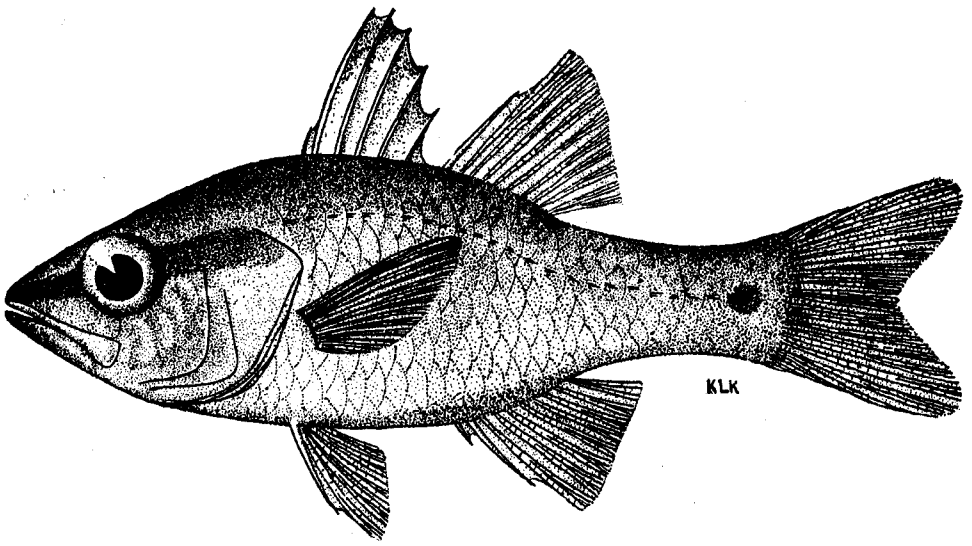

Fig. 20. *Apogon sangiensis* Bleeker.

Apogon sangiensis Bleeker. 1857 : 375. Day, 1878 : 64. Weber and de Beaufort, 1929 : 343. Smith, 1949 : 207.

Distribution : Tropical Indo-Pacific from East Indies and Philippines to the coast of Natal.

Utility : Sometimes caught in great numbers and utilized as live bait.

Local name : Bodi.

20. **Apogon quadrifasciatus** (Cuvier and Valenciennes)

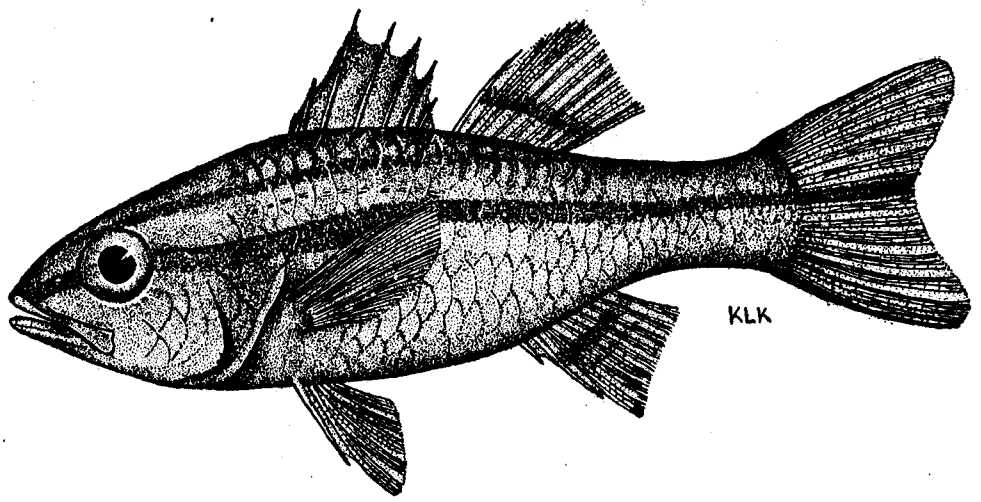

Fig. 21. *Apogon quadrifasciatus* (Cuvier and Valenciennes).

Apogon quadrifasciatus Cuvier and Valenciennes, 1828 : 153. Day, 1878 : 59. Weber and de Beaufort, 1929 : 300. Smith, 1949 : 208. Munro, 1955 : 120.

Distribution : From East Africa and Persian Gulf to Japan, China, New South Wales, eastwards to Fiji islands.

Utility : Occurs in small numbers along with other apogonids.

Local name : Bodi.

Family Carangidae

21. **Trachinotus bailloni** (Lacépède)

Caesiomorus bailloni Lacépède, 1802 : 93.
Trachynotus baillonii Day, 1878 : 233.
Trachinotus bailloni Weber and de Beaufort, 1931 : 288. Smith, 1949 : 223. Munro, 1955 : 131. Jones and Kumaran, 1959 : 46.

Distribution : Widespread in the tropical Indian and Pacific Oceans.

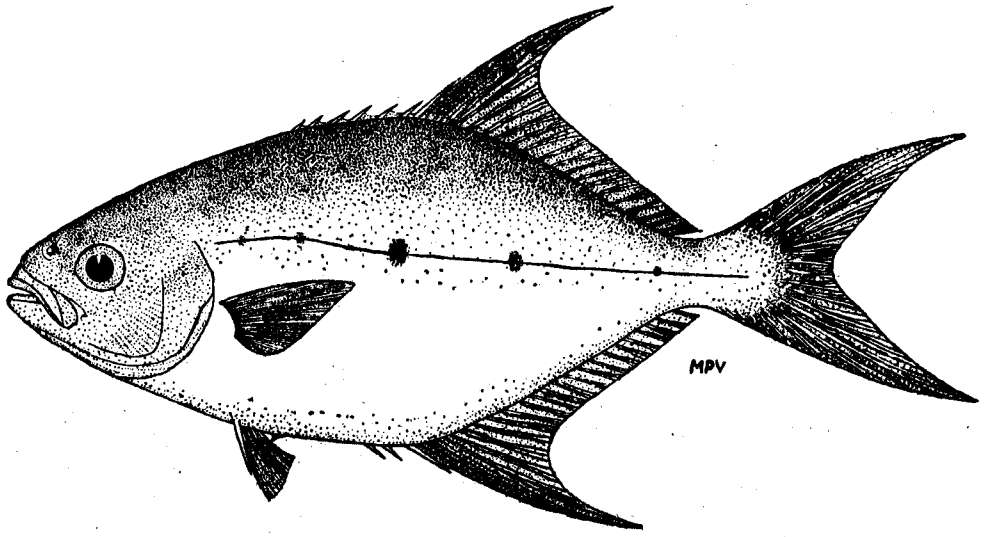

Fig. 22. *Trachinotus bailloni* (Lacépède).

Utility : Though abundant in the lagoon, juveniles are caught in small numbers in bait nets.
Local name : Vali.

Family Lutianidae

22. **Lutianus kasmira** (Forskål)

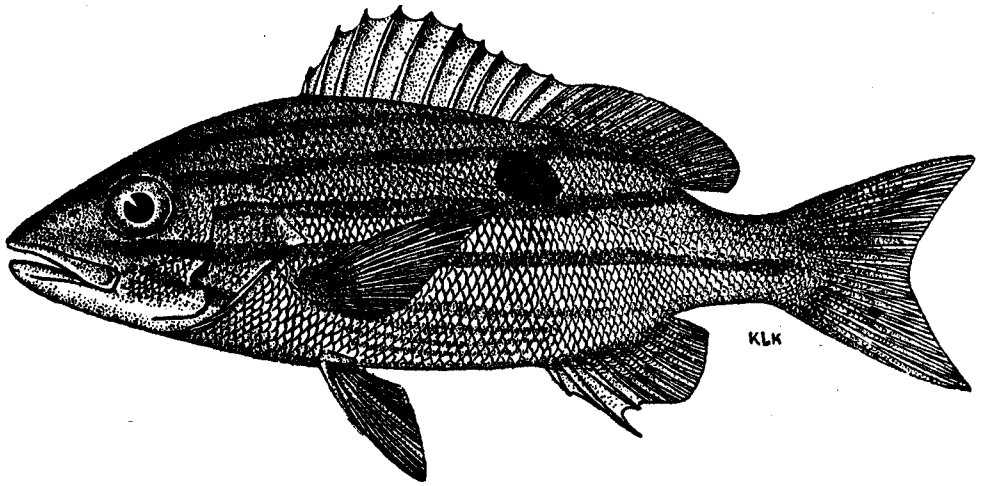

Fig. 23. *Lutianus kasmira* (Forksål).

Sciaena kasmira Forskål, 1775 : 46.
Lutianus bengalensis Day, 1878 : 33.
Lutjanus quinquelinearis Day, 1878 : 46.
Lutjanus kasmira Weber and de Beaufort, 1936 : 256.

Lutianus kasmira Smith, 1949 : 254. Munro 1955 : 137. Jones and Kumaran, 1959 : 46.

Distribution : Warmer regions of Indian and Pacific Oceans from East London on the coast of Africa and Red Sea to Marquesas Islands in the Pacific.

Utility : Occasionally found in bait fish catches.

Local name : Rindu mas.

Family Emmelichthyidae

23. **Dipterygonotus leucogrammicus** Bleeker

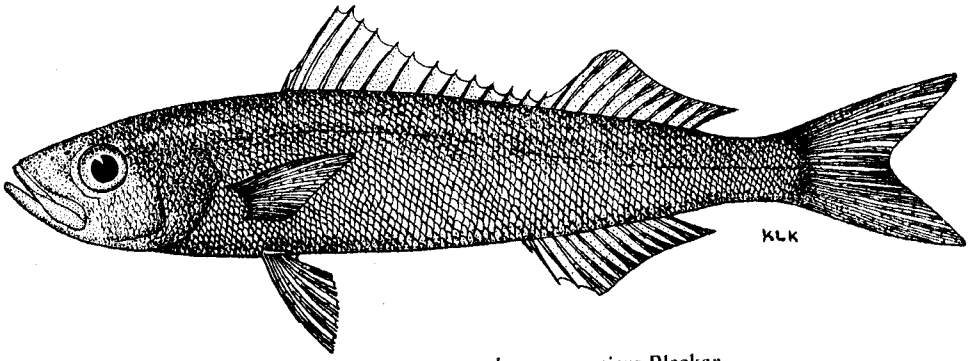

Fig. 24. *Dipterygonotus leucogrammicus* Bleeker.

Dipterygonotus leucogrammicus Bleeker, 1849 : 71. Weber and de Beaufort, 1931 : 180. Munro, 1955 : 133.

Distribution : Central tropical Indo-Pacific from East Indies to the Laccadive Islands.

Utility : Occurs in large numbers and is found to be very effective in chumming the tuna. Its survival rate in the bait well and bait basket seems to be very high.

Local name : Dhandi muguram.

Family Caesiodidae

Key to the Species of Caesiodidae

1. Dorsal with 11-12 spines ; dorsal rays 18-21 ..... *Caesio tile*
   Dorsal with 10 spines ; dorsal rays 15 or less 2
2. Scales on lateral line 52-58 ; caudal yellowish ..... *Caesio erythrogaster*
   Scales on lateral line more than 65 3
3. Tips of caudal lobes black ..... *Caesio chrysozona*
   Black longitudinal band along the caudal lobes ..... *Caesio coerulaureus*

24. **Caesio coerulaureus** Lacépède

Caesio coerulaureus Lacépède, 1802 : 85. Weber and de Beaufort, 1936 : 306. Jones and Kumaran, 1959 : 46.

Caesio caerulaureus Smith, 1949 : 261. Munro, 1955 : 140.

Distribution : Widespread in the tropical Indo-Pacific from the coast of East Africa to Japan, New Hebrides, Australia and Samoa.

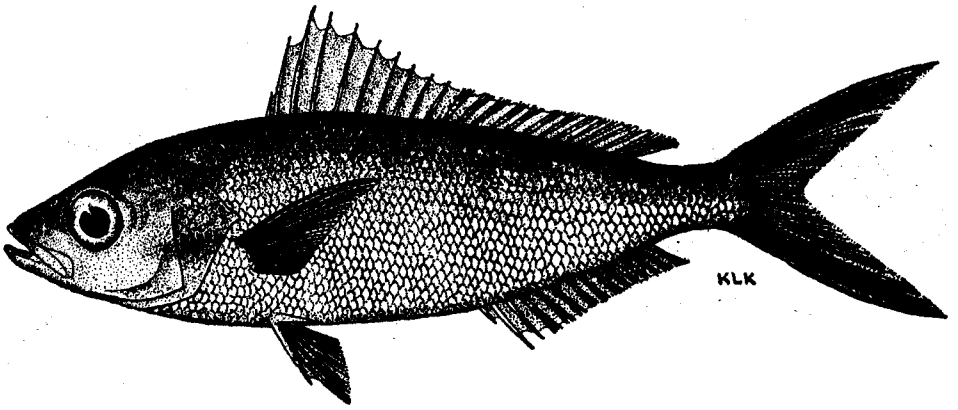

Fig. 25. *Caesio coerulaureus* Lacépède.

Utility : This is the most important species among the caesiodids used as live bait. Juveniles occur in large shoals in the lagoon and near reefs throughout the tuna fishing season. The fish is found to be very effective as a tuna-bait fish. This is a hardy fish having a very high rate of survival in the bait wells.

Local name : Dongio mas.

25. **Caesio chrysozona** Cuvier and Valenciennes

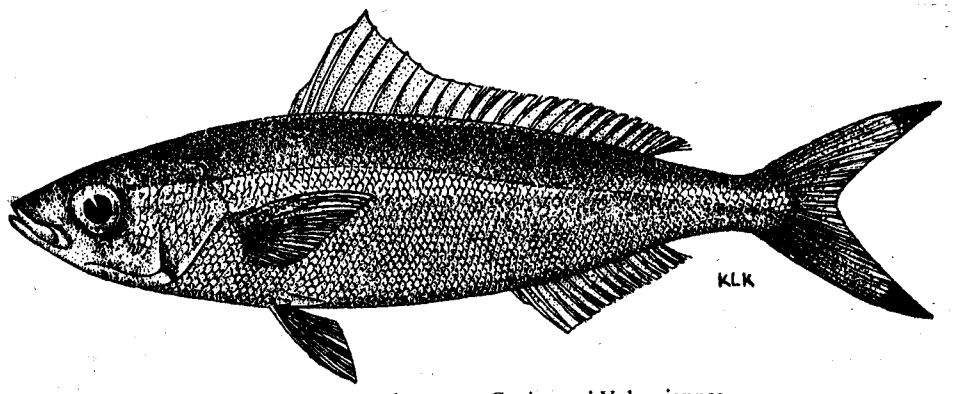

Fig. 26. *Caesio chrysozona* Cuvier and Valenciennes.

Caesio chrysozona Cuvier and Valenciennes, 1830 : 440. Weber and de Beaufort, 1936 : 303.

Caesio chrysozona var *aurolineatus* Day, 1878 : 95.

Caesio chrysozonus Munro, 1955 : 140. Jones and Kumaran, 1959 : 46.

Distribution : Tropical Indian and Pacific Oceans from Red Sea to Japan and Solomon Islands.

Utility : Juveniles of the species are valuable as tuna bait fish. They occur in fairly large numbers throughout the season in the bait fish catches along with the juveniles of *C. coerulaureus.*

Local name : Huden muguram.

26. **Caesio erythrogaster** Cuvier and Valenciennes

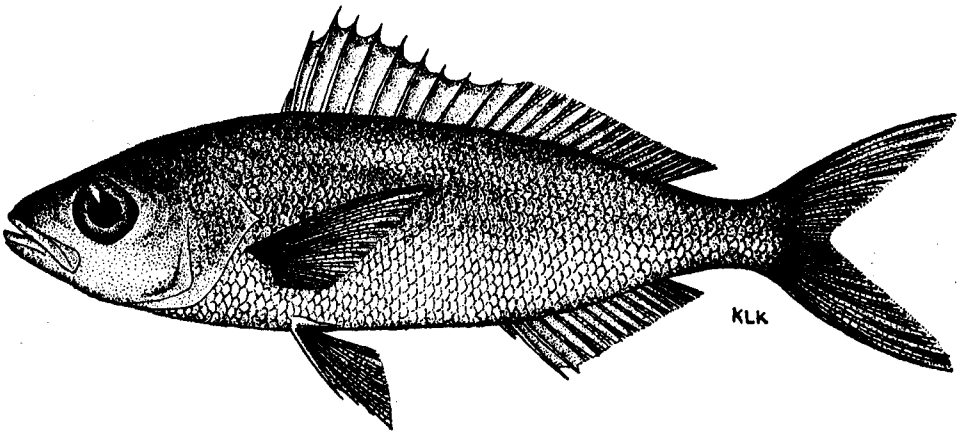

Fig. 27. *Caesio erythrogaster* Cuvier and Valenciennes.

Caesio erythrogaster Cuvier and Valenciennes, 1830 : 442. Weber and de Beaufort, 1936 : 298.

Caesio cuning Day, 1878 : 95.

Distribution : Warmer parts of the Indo-Pacific from the coasts of India to Riu Kiu, Solomon Islands and North Australia.

Utility : Present in the bait fish catches in small numbers but not so important as the two species mentioned earlier.

Local name : Rye muguram.

27. **Caesio tile** Cuvier and Valenciennes

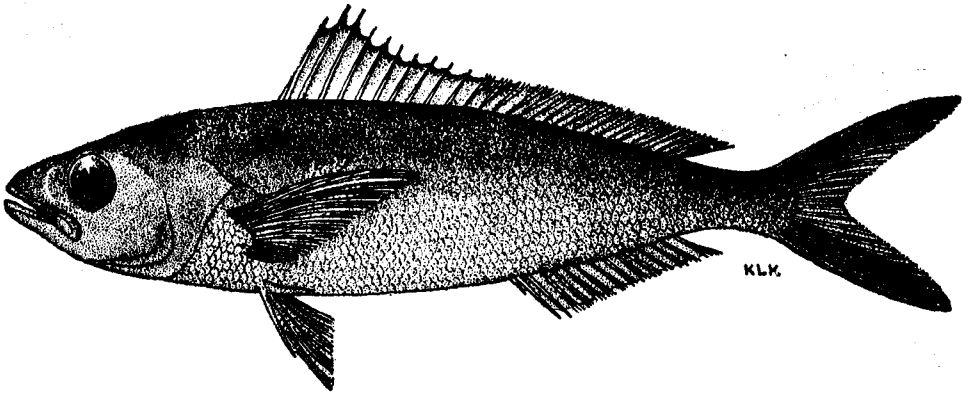

Fig. 28. *Caesio tile* Cuvier and Valenciennes.

Caesio tile Cuvier and Valenciennes, 1830 : 428. Weber and de Beaufort, 1936 : 296. Jones and Kumaran, 1959 : 46.

Distribution : From Laccadives in the Indian Ocean to Philippines, Caroline Islands and Polynesia in the Pacific.

Utility : Juveniles are common in the bait fish catches during certain periods.

Local name : Muguram.

FAMILY MULLIDAE

28. **Mulloidichthys auriflamma** (Forskål)

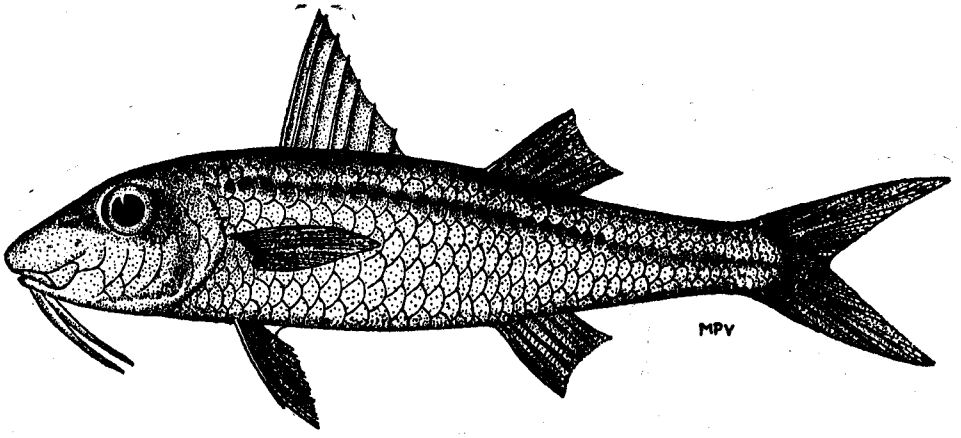

Fig. 29. *Mulloidichthys auriflamma* (Forskål).

Mullus auriflamma Forskål, 1775 : 30.
Mullus flavolineatus Day, 1878 : 122.
Mulloidichthys auriflamma Weber and de Beaufort, 1931 : 376. Munro, 1955 : 163. Jones and Kumaran, 1959 : 47.

Distribution : South African coast to the Marquesas and the Hawaiian islands.

Utility : Small specimens occurring abundantly can be used as live bait fish.
Local name : Thilakanthi.

29. **Parupeneus barberinus** (Lacépède)

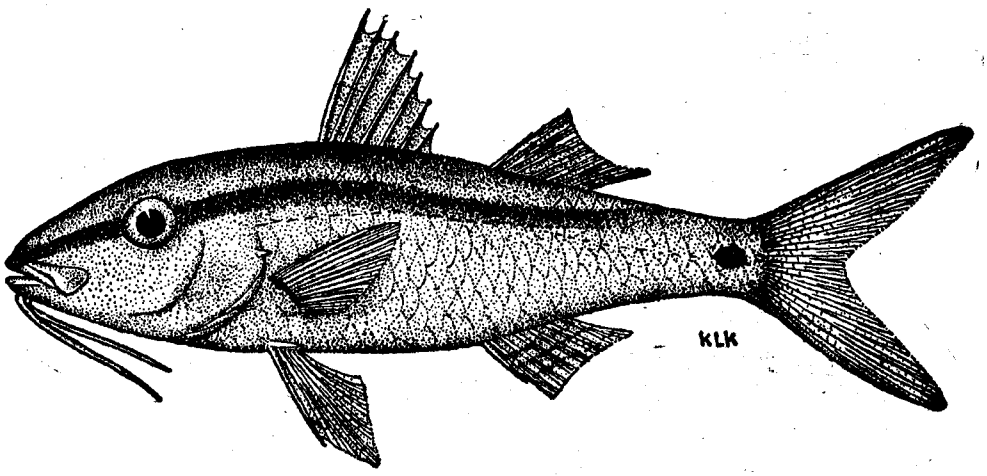

Fig. 30. *Parupeneus barberinus* (Lacépède).

Mullus barberinus Lacépède, 1802 : 406.
Upeneus barberinus Day, 1878 : 124.
Parupeneus barberinus Weber and de Beaufort, 1931 : 392. Munro, 1955 : 165. Jones and Kumaran, 1959 : 47.

Distribution : From Red Sea and East Africa to Hawaii, Samoa, Society and Tuamotu islands.

Utility : Small specimens occasionally seen in bait net collections.
Local name : Thilakanthi.

30. **Parupeneus bifasciatus** (Lacépède)

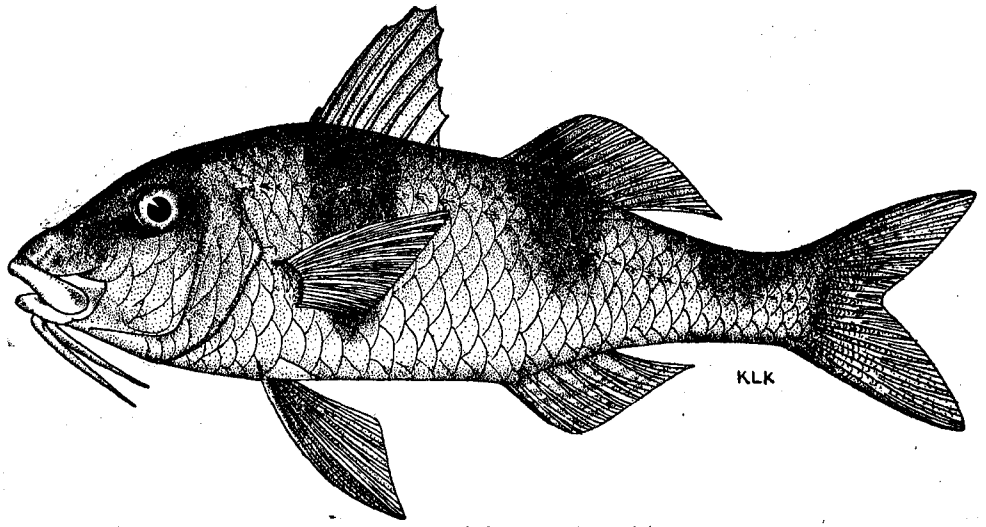

Fig. 31. *Parupeneus bifasciatus* (Lacépède).

Mullus bifasciatus Lacépède, 1802 : 404.
Parupeneus bifasciatus Weber and de Beaufort, 1931 : 386. Munro, 1955 : 164.

Distribution : Tropical Indo-Pacific from Madagascar and Reunion Islands to Carolines, Hawaii, Samoa and Society Islands.

Utility : Occasionally encountered in bait fish collections.
Local name : Thilakanthi.

31. **Parupeneus macronema** (Lacépède)

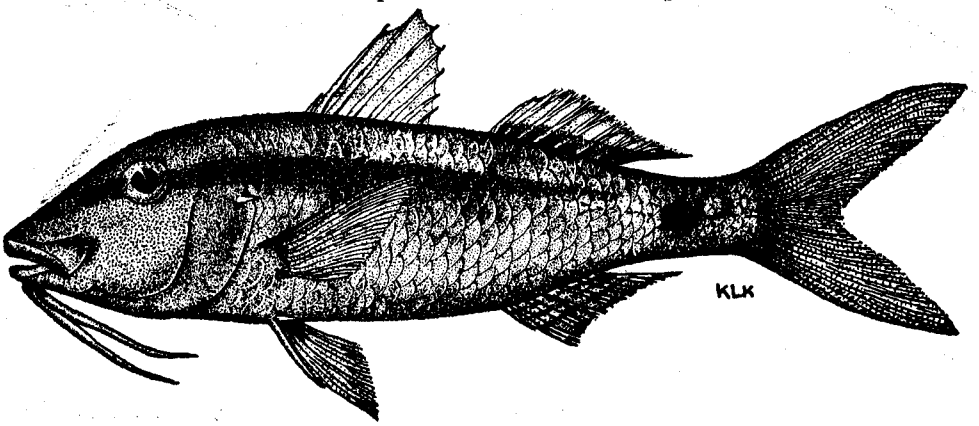

Fig. 32. *Parupeneus macronema* (Lacépède).

Mullus macronema Lacépède, 1802 : 383 and 404.
Upeneus macronemus Day, 1878 : 123.
Parupeneus macronema Weber and de Beaufort, 1931 : 388.
Pseudupeneus macronema Smith, 1949 : 229.
Parupeneus macronemus Munro, 1955 : 164. Jones and Kumaran, 1959 : 47.

Distribution : Tropical Indo-Pacific from Red Sea and east coast of Africa to Hawaii and Tahiti.

Utility : Juveniles esteemed as tuna bait fish. But it is not found in shoals and does not occur in the bait fish catches in large numbers.
Local name : Thilakanthi.

Family Cichlidae

32. **Tilapia mossambica** (Peters)

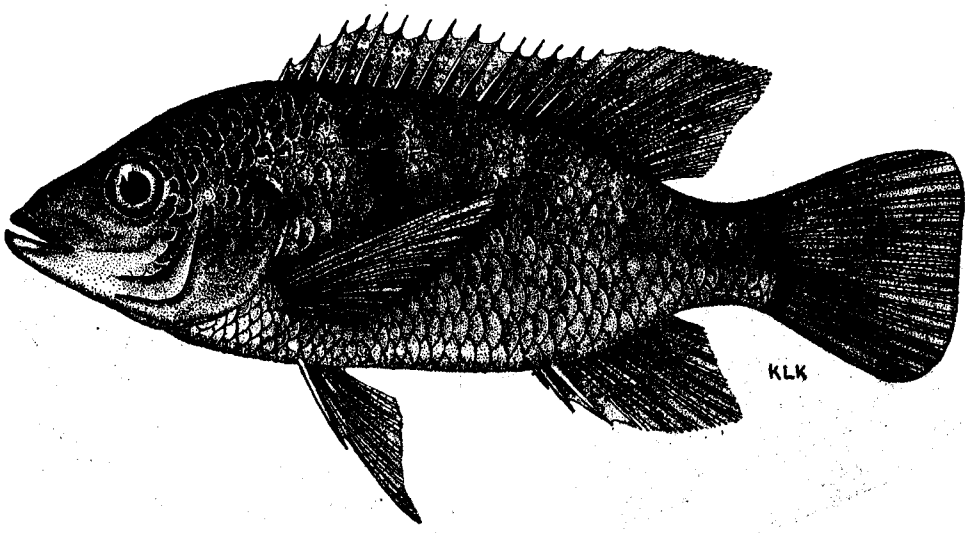

Fig. 33. *Tilapia mossambica* (Peters).

Chromis mossambicus Peters, 1852 : 681.
Tilapia mossambica Munro, 1955 : 176. Jones, 1962 (MS).

Distribution : Originally from East Africa. Now introduced in various countries in the tropical Indo-Pacific.

Utility : Recently introduced into the ponds of the Island. Its importance as live bait for tuna fishing in Minicoy when bait fishes become scarce is under observation.
Local name : Mandapa.

Family Pomacentridae

Key to the Species of Pomacentridae

1. Teeth conical or villiform ; 12 dorsal spines.....2
   Teeth compressed and incisiform.....5

2. Preopercle smooth.....3
   Preopercle serrated.....4

3. Second dorsal spine longest ; blue line from snout to eye.....*Chromis caeruleus*
   Middle dorsal spines longer than second ; caudal lobes dark brown and filamentous ; first ventral fin ray long.....*Chromis ternatensis*
   Posterior part of body white.....*Chromis dimidiatus*

4. 25-28 scales laterally ; 3 transverse dark cross bands ; ventrals black ; anal rays 12-13.....*Dascyllus aruanus*
   About 36 scales in lateral series ; anal with 15-17 rays.....*Lepidozygus tapeinosoma*

5. Preopercle serrated posteriorly ; a notch between preorbital and suborbital; an ocallus on dorsal fin and a blue edged black spot at the base of last dorsal rays.....*Pomacentrus tripunctatus*
   Hind border of preopercle smooth ; blue spots on each scale ; broad blue longitudinal streak above lateral line ; ocellus on the base of last dorsal rays extending upto the lateral line.....*Abudefduf biocellatus*

33. **Abudefduf biocellatus** (Quoy and Gaimard)

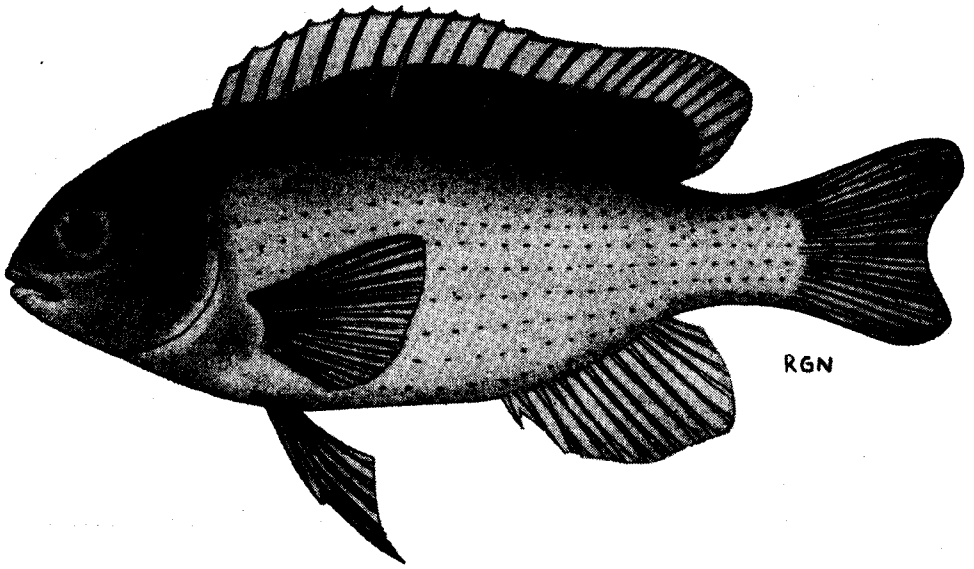

Fig. 34. *Abudefduf biocellatus* (Quoy and Gaimard).

Glyphisodon biocellatus Quoy and Gaimard, 1824 ; 389.
Glyphidodon antjerius Day, 1878 : 387.
Abudefduf biocellatus De Beaufort, 1940 : 436. Smith, 1949 : 284. Munro, 1955 : 183. Jones and Kumaran, 1959 : 47.

Distribution : Tropical Indo-Pacific from the coast of Africa to the Marshall and Tuamoto Islands.

Utility : Common near the reefs and occurs frequently in the bait fish catches.
Local name : Nu mas.

34. **Chromis caeruleus** (Cuvier and Valenciennes)

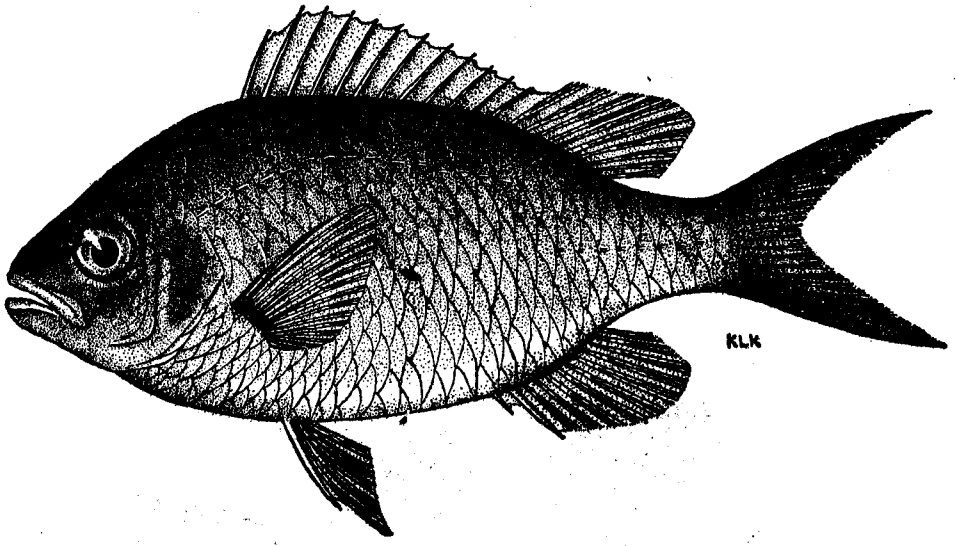

Fig. 35. *Chromis caeruleus* (Cuvier and Valenciennes).

Heliases caeruleus Cuvier and Valenciennes, 1830 : 497.
Heliastes lepidurus Day, 1878 : 389.
Chromis caeruleus De Beaufort, 1940 : 451. Munro, 1955 : 180. Jones and Kumaran, 1959 : 47.

Distribution : Widely distributed in the Indo-Pacific from Red Sea, Madagascar and Zanzibar to Solomon, Gilbert and Tuamoto Islands and Queensland.

Utility : This forms second in importance among the pomacentrids. It is used mainly at the beginning of the tuna fishing season and occurs in fairly large numbers in the bait fish catches.
Local name : Nilamahi.

35. **Chromis dimidiatus** (Klunzinger)

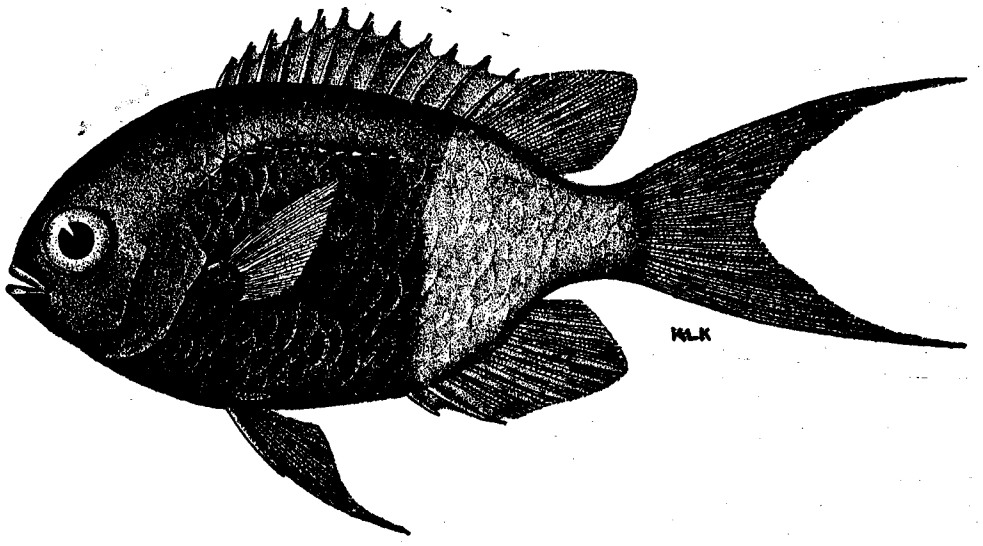

Fig. 36. *Chromis dimidiatus* (Klunzinger).

Heliastes dimidiatus Klunzinger, 1871 : 529.
Chromis dimidiatus De Beaufort, 1940 : 460. Smith 1949 : 507. Jones and Kumaran, 1959 : 47.

Distribution : From the Red Sea and Coast of Natal in the Indian Ocean to Hawaiian and Society Islands in the Pacific.

Utility : Comparatively rare in bait nets.
Local name : Burang.

36. **Chromis ternatensis** (Bleeker)

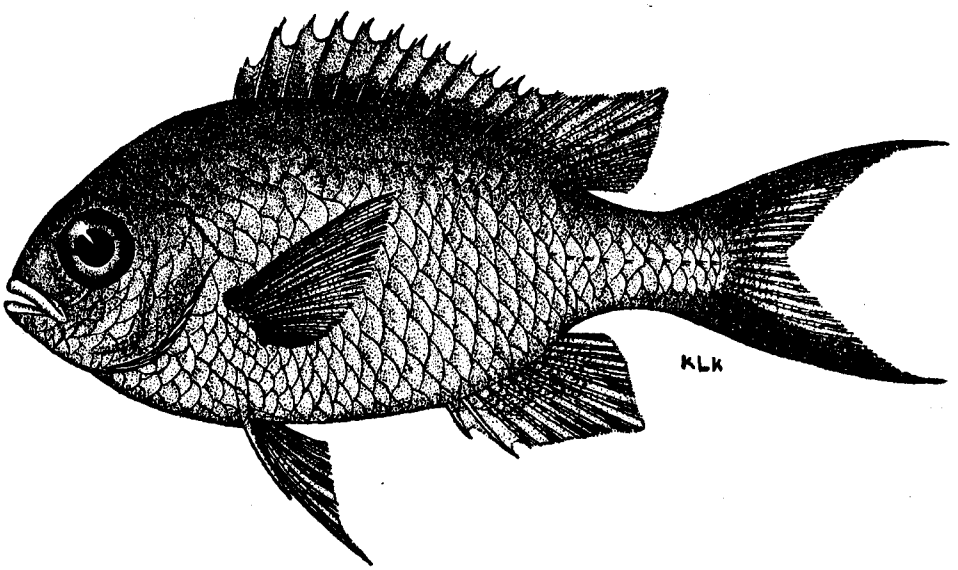

Fig. 37. *Chromis ternatensis* (Bleeker).

Heliases ternatensis Bleeker, 1856 : 377.
Chromis ternatensis De Beaufort, 1940 : 458. Jones and Kumaran, 1959 : 47.

Distribution : Laccadives, Philippines, New Hebrides and Samoan Islands.

Utility : Occurs commonly in the bait fish catches.
Local name : Nilamahi.

37. **Dascyllus aruanus** (Linnaeus)

Chaetodon aruanus Linnaeus, 1758 : 275.
Tetradrachmum aruanum Day, 1878 : 381.
Dascyllus aruanus De Beaufort, 1940 : 467. Smith, 1949 : 280. Munro, 1955 : 180. Jones and Kumaran, 1959 : 47.

Distribution : Tropical Indo-Pacific from the coast of Africa to Queensland, New Zealand, Society, Tuamotu, Marshall and Marquesas Islands.

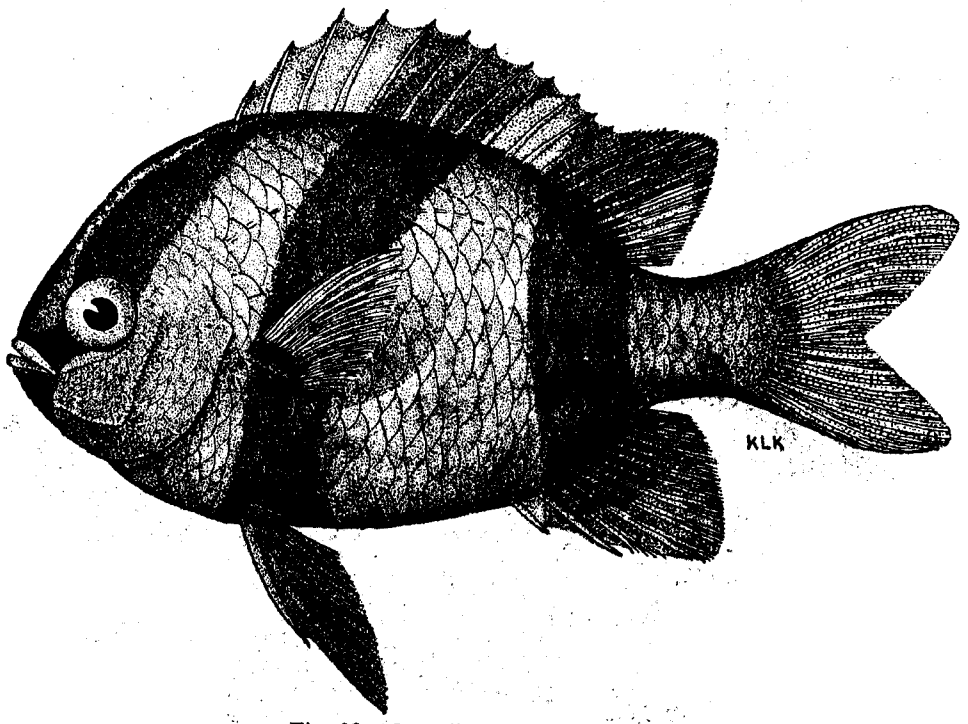

Fig. 38. *Dascyllus aruanus* (Linnaeus).

Utility : Frequently seen in the bait fish catches.
Local name : Burang.

38. **Lepidozygus tapeinosoma** (Bleeker)

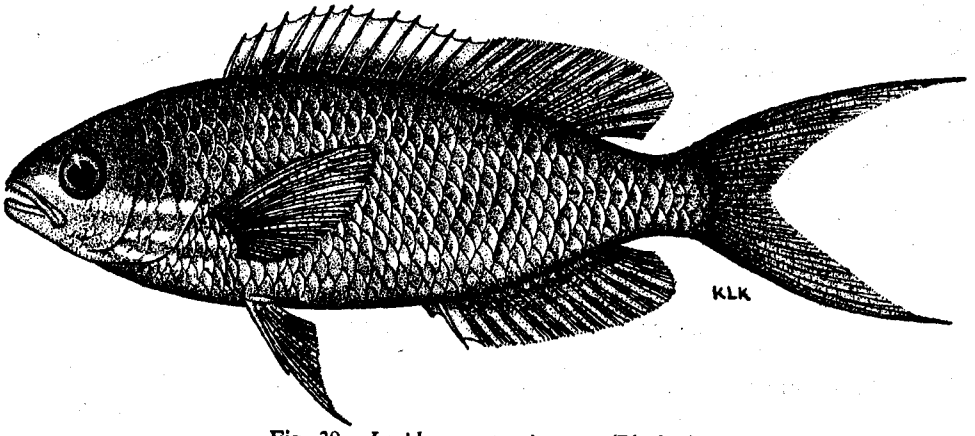

Fig. 39. *Lepidozygus tapeinosoma* (Bleeker).

Pomacentrus tapeinosoma Bleeker, 1855 : 376.
Lepidozygus tapeinosoma De Beaufort, 1940 : 471.
Daya jerdoni Jones and Kumaran, 1959 : 47. (nec Day, 1873)

Distribution : Minicoy, East Indies and Philippines.

Utility : This is the most important tuna-bait used in Minicoy Island. It occurs in large shoals though there may be abrupt set-backs in their occurrence during certain months. It is most suitable as bait fish owing to the very high rate of survival in the bait well. A very active and hardy fish and is very effective in chumming tunas.

Local name : Bureki.

39. **Pomacentrus tripunctatus** Cuvier and Valenciennes

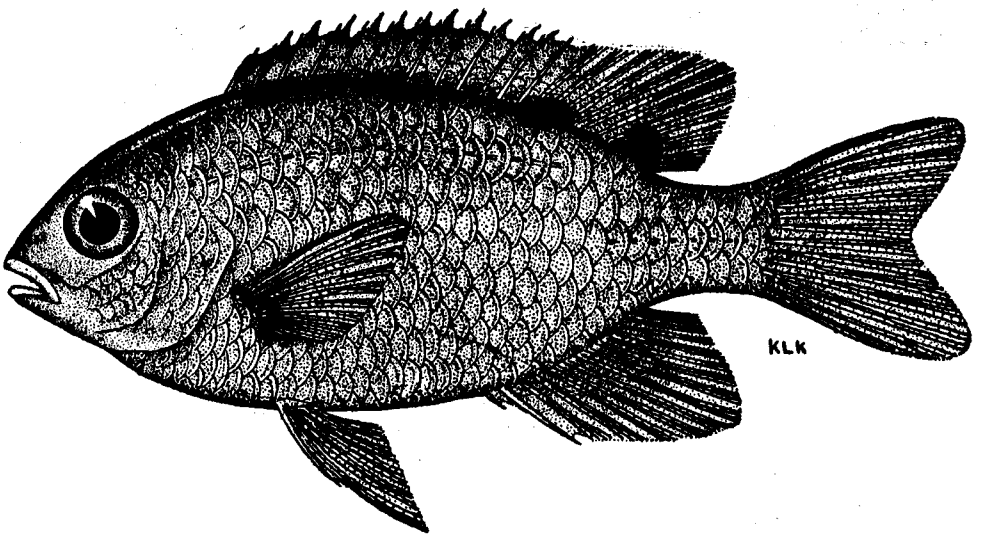

Fig. 40. *Pomacentrus tripunctatus* (Cuvier and Valenciennes).

Pomacentrus tripunctatus Cuvier and Valenciennes, 1830 : 421.
Pomacentrus bankanensis Day, 1878 : 383.
Pomacentrus tripunctatus De Beaufort, 1940 : 388. Smith, 1949 : 281. Munro, 1955 : 181. Jones and Kumaran, 1959 : 47.

Distribution : Widespread in the Indo-Pacific from the east coast of Africa to Australia, Japan, Solomon Islands, New Hebrides and Fiji.

Utility : This species occurs in the bait fish catches during certain months only.

Family Labridae

Key to the Species of Labridae

1. Lateral line interrupted ; bases of dorsal and anal covered with scales. .... *Cheilinus trilobatus.*
   Lateral line continuous with sharp bent below soft dorsal. 2
2. Dorsal with 8 spines ; 5-6 vertical dark bands on body ; black blotch between anterior anal rays. ..... *Thalassoma hardwicki.*
   Dorsal with 9 spines ; no vertical dark bands on body. 3

3. Cheeks scaly ; 2 canines in the jaws ; scales 46-53 in lateral line ; broad dark band from snout to caudal fin. .....*Fissilabrus dimidiatus.*

   Cheeks naked ; canine teeth only at corner of mouth ; scales in lateral line 26-30. 4

4. Three bands on sides, the first from snout through eye to base of caudal, second from snout to upper part of pectoral, third from corner of mouth to caudal base. .....*Stethojulis renardii.*

   One band from snout to 5th scale of lateral line, second from upper lip to caudal base, third from corner of mouth to hind border of opercle curved along the base of pectoral and continued to caudal. .....*Stethojulis albovittata.*

   Axil of pectoral with traingular spot ; 2 or 3 white edged ocelli in a line on caudal peduncle.....*Stethojulis axillaris.*

40. **Cheilinus trilobatus** Lacépède

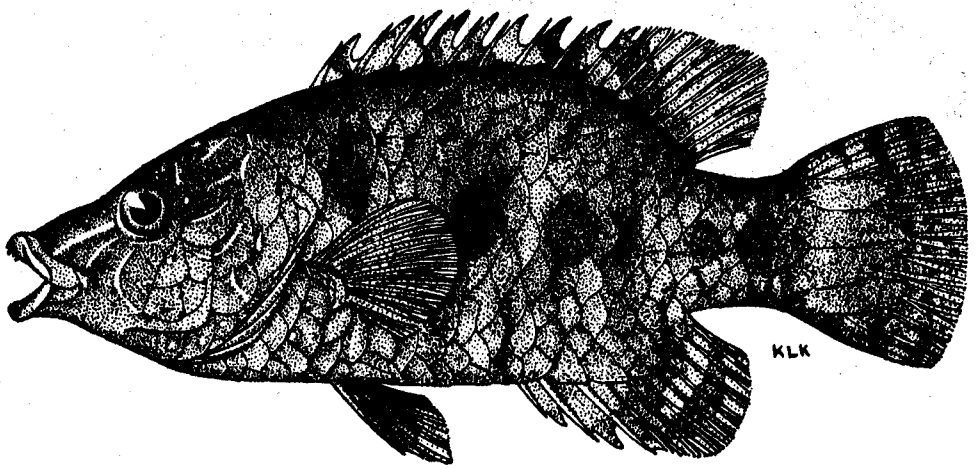

Fig. 41. *Cheilinus trilobatus* (Lacépède).

Cheilinus trilobatus Lacépède, 1802 : 274, 284. Day, 1878 : 394. De Beaufort, 1940 : 79. Smith, 1949 : 294. Munro, 1955 : 187. Jones and Kumaran, 1959 : 47.

Distribution : From the coast of Africa to the Central Pacific Islands as far as Fiji, Hawaii and Society Islands.

Utility : Common in the lagoon and juveniles are frequently caught in bait nets.
Local name : Thoka.

41. **Fissilabrus dimidiatus** (Cuvier and Valenciennes)

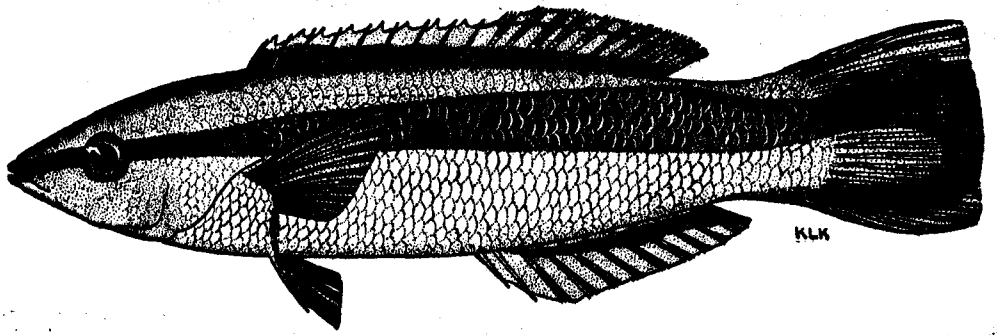

Fig. 42. *Fissilabrus dimidiatus* (Cuvier and Valenciennes).

Cossyphus dimidiatus Cuvier and Valenciennes, 1839 : 136 and 139.
Labroides dimidiatus Day, 1878 : 393. De Beaufort, 1940 : 148.
Fissilabrus dimidiatus Smith, 1949 : 291. Jones and Kumaran, 1959 : 47.

Distribution : East African Coast and Red Sea to Queensland, Hawaii, Tahiti and Society Islands.

Utility : Occasionally found in the bait fish catches.
Local name : Haremkali.

42. **Stethojulis albovittata** (Bonnaterre)

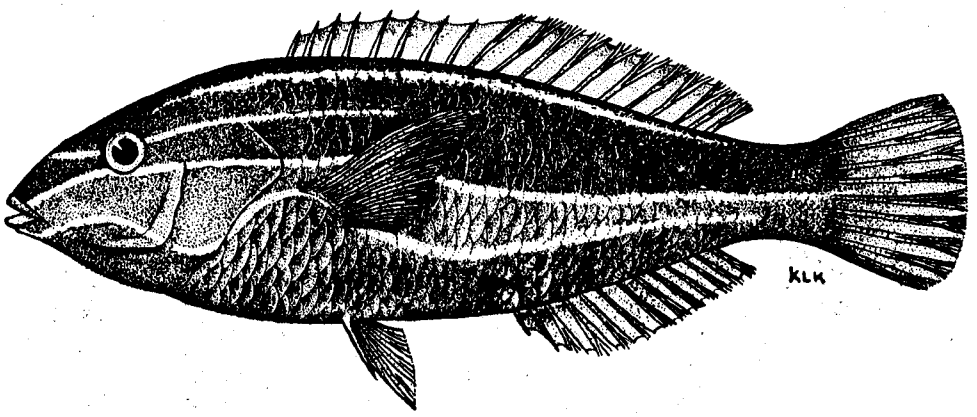

Fig. 43. *Stethojulis albovittata* (Bonnaterre).

Labrus albovittatus Bonnaterre, 1788 : 108.
Stethojulis albovittata De Beaufort, 1940 : 159. Smith, 1949 : 291. Jones and Kumaran, 1959 : 48.

Distribution : Coast of South Africa and Red Sea to Queensland, Philippines, Samoa, Fiji and Cook Islands.

Utility : Small specimens occur in the bait fish catches frequently.
Local name : Hikka.

43. **Stethojulis axillaris** (Quoy and Gaimard)

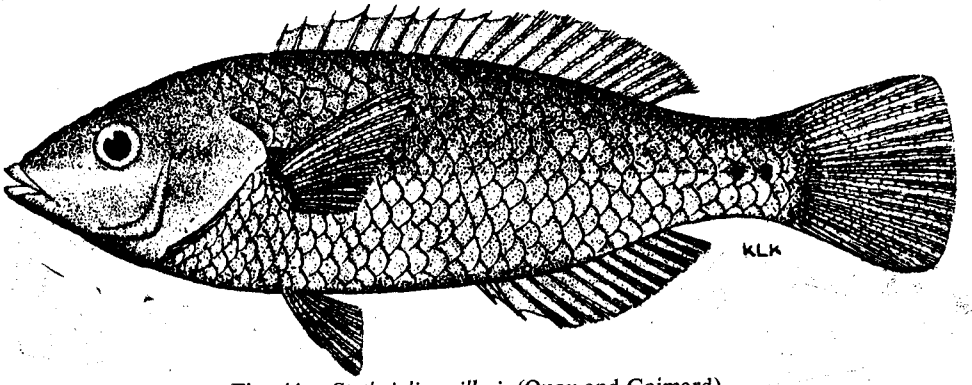

Fig. 44. *Stethojulis axillaris* (Quoy and Gaimard)

Julis axillaris Quoy and Gaimard, 1824 : 272.
Stethojulis axillaris De Beaufort, 1940 : 167. Smith, 1949 : 291. Munro, 1955 : 191. Jones and Kumaran, 1959 : 48.

Distribution : Indo-Pacific from Red Sea and east coast of South Africa to Samoa, Fiji, Marshall, Masquesas, Tuamotu Islands and Queensland.

Utility : Though abundant near reefs, found only occasionally in bait fish catches.

Local name : Hikka.

44. **Stethojulis trilineata** (Bloch and Schneider)

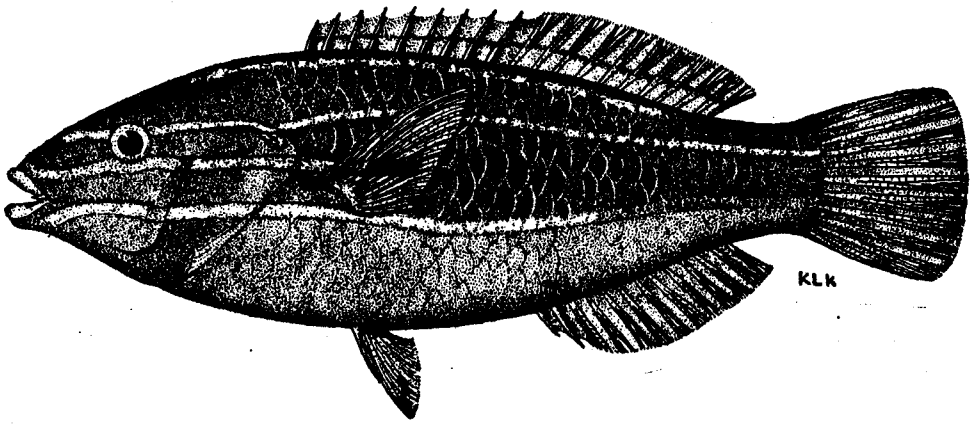

Fig. 45. *Stethojulis trilineata* (Bloch and Schneider).

Labrus triliniatus Bloch and Schneider, 1801 : 253.

Stethojulis trilineata De Beaufort, 1940 : 156.

Distribution : Tropical Indo-Pacific from Red Sea and Madagascar to East Indies Philippines and Bismarck Archipelago.

Utility : Occasionally found together with other labrids.

Local name : Hikka.

45. **Thalassoma hardwicki** (Bennett)

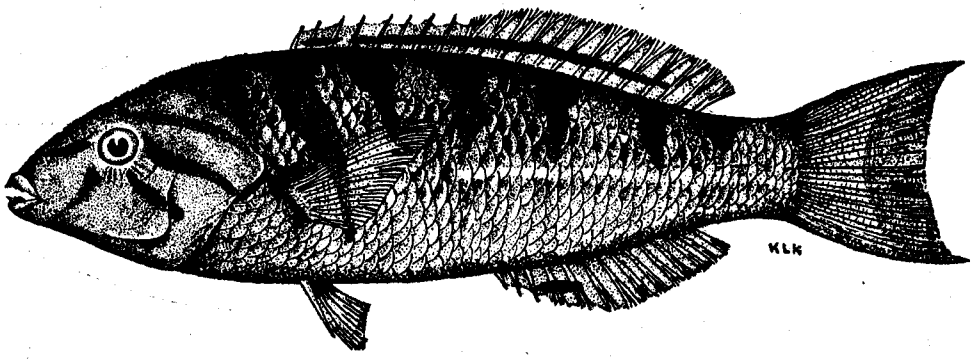

Fig. 46. *Thalassoma hardwicki* (Bennett).

Sparus hardwicki Bennett, 1830 : 12.

Julis dorsalis Day, 1878 : 403.

Thalassoma hardwicki De Beaufort, 1940 : 122. Smith, 1949 : 287. Munro, 1955 : 189. Jones and Kumaran, 1959 : 48.

Distribution : Tropical Indo-Pacific from the coast of South Africa to Queensland, Samoa, Tahiti, Fiji, Caroline and Society Islands.

Utility : Common in the lagoon. Small ones occur frequently in the catches.

Local name : Gali hikka.

TABLE I

Distribution of bait fishes in the Laccadive Archipelago (+ indicates availability)

Bait fishes	Minicoy	Agathi	Ameni	Androth	Bangaram	Bitra	Chetlat	Kadamat	Kalpeni	Kavarathi	Kiltan	Suheli-par
FAMILY ALBULIDAE												
1. *Albula vulpes* (Linnaeus)	+	—	+	+	+	+	—	—	+	+	—	+
FAMILY DUSSUMIERIIDAE												
2. *Spratelloides delicatulus* (Bennett)	+	+	—	—	—	+	+	—	—	+	+	+
3. *Sparatelloides japonicus* (Houttuyn)	+	+	+	—	—	+	+	+	—	+	+	—
FAMILY CLUPEIDAE												
4. *Sardinella melanura* (Cuvier)	+	+	+	—	—	—	—	—	—	—	—	—
FAMILY CYPRINODONTIDAE												
5. *Panchax panchax* (Hamilton Buchanan)	+	+	—	+	—	—	—	—	+	+	—	—
FAMILY SPHYRAENIDAE												
6. *Sphyrana obtusata* (Cuvier and Valenciennes)	+	+	+	—	—	—	—	—	—	+	—	—
FAMILY MUGILIDAE												
7. *Crenimugil crenilabis* (Forskål)	+	—	—	—	—	—	—	+	—	+	—	—
8. *Valamugil seheli* (Forskål)	+	+	—	+	—	—	—	—	—	+	—	—
FAMILY ATHERINIDAE												
9. *Allanetta forskåli* (Rüppell)	+	+	+	—	—	+	—	+	+	+	—	+
10. *Pranesus duodecimalis* (Cuvier and Valenciennes)	+	+	—	—	+	—	—	—	—	+	—	+
FAMILY POLYNEMIDAE												
11. *Polynemus sexfilis* (Cuvier and Valenciennes)	+	—	+	—	—	—	—	+	—	+	—	—

FAMILY KUHLIIDAE												
12. *Kuhlia taeniurus* (Cuvier and Valenciennes)	+	+	+	+	+	—	—	+	+	+	—	+
FAMILY ANTHIIDAE												
13. *Anthias cichlops* (Bleeker)	+	—	—	—	—	—	—	—	—	—	—	—
FAMILY APOGONIDAE												
14. *Archamia buruënsis* (Bleeker)	+	—	—	—	—	—	—	—	—	—	—	+
15. *Archamia lineolatus* (Cuvier and Valenciennes)	+	+	+	—	—	—	—	—	—	+	—	+
16. *Apogon frenatus* Valenciennes	+	—	—	—	—	—	+	—	—	+	—	—
17. *Apogon endekataenia* (Bleeker)	+	+	—	—	—	—	—	—	—	+	—	—
18. *Apogon bandanensis* (Bleeker)	+	—	+	—	—	—	—	+	—	—	—	—
19. *Apogon sangiensis* (Bleeker)	+	+	—	—	—	—	—	+	—	+	—	—
20. *Apogon quadrifasciatus* Cuvier and Valenciennes	+	—	—	—	—	—	—	—	—	+	—	—
FAMILY CARANGIDAE												
21. *Trachinotus bailloni* (Lacépède)	+	+	+	+	+	+	+	+	—	—	+	+
FAMILY LUTIANIDAE												
22. *Lutianus kasmira* (Forskål)	+	—	+	—	—	+	+	—	+	+	+	+
FAMILY EMMELICHTHYIDAE												
23. *Dipterygonotus leucogrammicus* Bleeker	+	—	—	—	—	—	—	—	—	—	—	—
FAMILY CAESIODIDAE												
24. *Caesio coerulaureus* Lacépède	+	+	+	+	—	+	—	—	—	+	—	+
25. *Caesio chrysozona* Cuvier and Valenciennes	+	—	+	+	—	—	—	+	—	+	—	+

TABLE I (*Continued*)

Bait fishes	Minicoy	Agathi	Ameni	Androth	Bangaram	Bitra	Chetlat	Kadamat	Kalpeni	Kavarathy	Kiltan	Suheli-par
26. *Caesio erythrogaster* Cuvier and Valenciennes	+	−	−	−	−	−	−	−	−	−	−	−
27. *Caesio tile* Cuvier and Valenciennes	+	−	−	+	−	−	−	−	−	−	−	−
FAMILY MULLIDAE												
28. *Mulloidichthys auriflamma* (Forskål)	+	+	+	−	−	−	+	−	+	+	−	−
29. *Parupeneus barberinus* (Lacépède)	+	+	−	−	+	−	−	−	+	+	−	−
30. *Parupeneus bifasciatus* (Lacépède)	+	+	+	−	−	−	−	−	−	+	−	+
31. *Parupeneus macronema* (Lacépède)	+	+	+	+	−	−	−	+	−	+	−	+
FAMILY CICHLIDAE												
32. *Tilapia mossambica* (Peters)	+	+	−	+	−	−	−	−	−	−	−	−
FAMILY POMACENTRIDAE												
33. *Abudefduf biocellatus* (Quoy and Gaimard)	+	−	−	+	−	−	−	+	−	−	−	−
34. *Chromis caeruleus* (Cuvier and Valenciennes)	+	+	+	−	−	−	+	+	+	+	−	+
35. *Chromis dimidiatus* (Klunzinger)	+	+	+	+	−	−	−	−	−	−	−	−
36. *Chromis ternatensis* (Bleeker)	+	−	+	−	−	−	−	−	+	−	−	+
37. *Dascyllus aruanus* (Linnaeus)	+	+	+	+	−	−	−	+	−	+	+	+
38. *Lepidozygus tepeinosoma* (Bleeker)	+	−	−	−	−	−	−	−	−	−	−	−

39. *Pomacentrus tripunctatus* (Cuvier and Valenciennes)	+	+	+	−	−	−	+	−	+	−	−	−
FAMILY LABRIDAE												
40. *Cheilinus trilobatus* Lacépède	+	+	+	+	−	−	−	+	+	+	+	+
41. *Fissilabrus dimidiatus* (Cuvier and Valenciennes)	+	+	+	−	−	−	−	+	−	+	−	−
42. *Stethojulis albovittata* (Bonnaterre)	+	+	+	−	−	−	−	+	−	+	−	−
43. *Stethojulis axillaris* (Quoy and Gaimard)	+	+	+	+	−	−	+	−	−	−	−	−
44. *Stethojulis trilineata* (Bloch and Schneider)	+	+	+	−	−	−	−	+	−	−	+	−
45. *Thalassoma hardwicki* (Bennett)	+	−	+	−	−	−	+	+	+	+	+	+

8

GENERAL REMARKS

The distribution of the live-bait fishes found in Minicoy around other islands of the Laccadive Archipelago is given in table 1. In this connection it may be stated that collections from Minicoy have been fairly exhaustive, whereas only occasional visits were possible to the other islands. Some islands were visited only once or twice and that too for a few days, whereas some of the more accessible ones were visited several times. In none of these islands bait net of the type used in Minicoy is in existence and as such improvised methods which were comparatively much less efficient had to be followed for making these collections. The results are therefore not at all comparable and the non-availability of any particular species in one or other island need not necessarily mean its total non-occurrence there.

Of the various islands Ameni and Kadamat which are only a few miles apart were visited more often than the rest and taking these two as a single unit it will be seen that there are 30 species of bait fishes. On the other hand Kavarathi which was visited thrice and the uninhabited island of Suheli-par from where collections were made only once have yielded 29 and 18 species respectively. This obviously indicates that regular collections would reveal the presence of many more species in this area. Both these islands have very large lagoons and *Spratelloides*, atherinids, caesiodids and pomacentrids were dominant there at the time of collections. Other islands which might have potential bait fish resources are Agathi and Bitra which have large lagoons. It was close to Bitra that enormous shoals of *Spratelloides delicatulus* were first encountered (Jones, 1960). From the preliminary studies made it would appear that Agathi, Kavarathi, Suheli-par and Bitra are likely to have bait fish resources to support pole-and-line fishing for tunas on a successful scale in the Laccadive Sea.

A striking feature perhaps is the total absence of *Lepidozygus tapeinosoma*, the most important bait fish of Minicoy in the collections from the other islands. *Caesio erythrogaster* and *Dipterygonotus leucogrammicus* which are also comparatively abundant in Minicoy have not so far been collected from other islands.

The study of the bait fishes in the Laccadive Sea is only in a preliminary stage and it is presumed that this account will be useful as a basis for further investigations on the subject.

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REFERENCES

ALCOCK, A. 1902. *A naturalist in Indian Seas.* London.

BENNETT, J. W. 1830. *A selection of rare and curious fishes found upon the coast of Ceylon.* London.

BENNETT, E. T. 1831. Observations on a collection of fishes from the Mauritius, with characters of new genera and species. *Proc. Zool. Soc. London*, 165-69.

BEAUFORT, L. F. de. 1940. *The fishes of the Indo-Australian Archipelago.* Leiden, **8**.

BLEEKER, P. 1849. A contribution to the knowledge of the ichthyological fauna of Celebes. *J. Ind. Arch.*, **3**: 65-74.

——— 1852. Bijdrage tot de kennis der ichthyologische fauna van het eiland Banka. *Ibid.*, **3**: 443-60.

——— 1853. Diagnostische beschrijvingen van nieuwe of weinig bekende vischsoorten van Sumatra. *Ibid.*, **4**: 243-302.

BLEEKER, P. 1854. Derde bijdrage tot de kennis der ichthyologische fauna van de Banda-eilanden, *Ibid.*, **6** : 89-114.

——— 1856a. Zevende bijdrage tot de kennis der ichthyologische fauna van Ternate. *Ibid.*, **10**: 357-86.

——— 1856b. Bijdrage tot de kennis der ichthyologische fauna van het eiland Boero. *Ibid.*, **11**: 384-414.

——— 1857. Bijdrage tot de kennis der ichthyologische fauna van de Sangi-eilander. *Ibid.*, **13**: 369-80.

BLOCH, M. E. AND J. G. SCHNEIDER 1801. *Syst. Ichth.*, 253.

BONNATERRE, J. P. 1788. *Tabl. encycl. Ichthyol.* Paris, 108.

BRITISH ADMIRALTY 1950. *West Coast of India Pilot*. London.

BROCK, VERNON E., AND MICHIO TAKATA 1955. Contributions to the problems of bait fish capture and mortality together with experiments in the use of Tilapia as live-bait. *Final Report. IRAC Grant No.* 49 : 1-39.

CUVIER, G. 1829. *Regne animal*, ed. 2, **2**, Paris, 318.

—— AND A. VALENCIENNES 1828. *Histoire naturelle des poissons*, Paris, 2.

——— 1829. *Ibid.*, **3**.

——— 1830. *Ibid.*, **5 & 6**.

——— 1831. *Ibid.*, **7**.

——— 1835. *Ibid.*, **10**.

——— 1839. *Ibid.*, **13**.

DAY, F. 1878. *The fishes of India*, **1 & 2**, London.

ELLIS, R. H. 1924. *A short account of the Laccadive Islands and Minicoy*. Govt. Press, Madras.

FORSKÅL, P. 1775. *Descript. animal*, **30** : 46, 73.

GARDINER, S. 1903 & 1906. *The Fauna and geography of the Maldive and Laccadive Archipelagos*. Cambridge University Press.

HAMILTON-BUCHANAN 1822. *An account of the fishes found in the river ganges and its branches*. Edinburgh & London.

HOUTTUYN, M. 1782. *Verh. Holl. Maatsch. Haarlem*, **20**: 340.

JONES, S. 1958. The tuna live-bait fishery of Minicoy. *Indian J. Fish.*, **5** (2) : 300-307.

——— 1960a. *Spratelloides delicatulus* (Bennett) as a potential live-bait for tuna in the Laccadives. *J. Mar. biol. Ass. India*, **2** (1) : 103-104.

——— 1960b. Further notes on *Spratelloides delicatulus* (Bennett) as a tuna live-bait with a record of *S. japonicus* (Houttuyn) from the Laccadive Sea. *Ibid.*, **2** (2) : 267-68.

——— 1962. On the Introduction of tilapia, *Tilapia mossambica* (Peters) as a tuna live-bait in the island of Minicoy in the Indian Ocean. *Symposium on Scombroid fishes*. Marine Biological Association of India, Mandapam Camp. (MS).

——— AND M. KUMARAN 1959. The fishing industry of Minicoy Island with special reference to the tuna fishery. *Indian J. Fish.*, **6** (1) : 30-57.

JUNE, F. C. AND J. W. REINJES 1953. Common tuna bait fishes of the Central Pacific. *U.S. Fish Wildl. Serv. Res. Rep.*, **34** : 1-54.

KING, JOSEPH E. AND PETER T. WILSON 1957. Studies on tilapia as skipjack bait. *U.S. Fish Wildl. Serv. Spec. Sci. Rep.*, **225** : 1-8.

KLUNZINGER, C. B. 1871. Synopsis der Fische des Rothen Meeres. *Verh. zool. bot. ges. Wien*, **21**: 529.

LACÈPÉDE, B. G. E. 1802. Histoire naturelle des poissons, Paris, **3** : 85, 93, 383, 404 40

——— 1802. *Ibid.*, **6**, 274, 284.

LINNAEUS, C. 1758. *Systema Naturae*, ed. 10 : 275, 313.

MUNRO, I. S. R. 1955. *The Marine and Fresh Water Fishes of Ceylon.* Department of External Affairs, Canberra.

PETERS, W. C. H. 1852. Diagnosen von neuen Flussfischen aus Mossambique. *Monatsb. Akad. Wiss.* Berlin, 681.

QUOY, J. R. C. AND P. GAIMARD 1824. *Voy. Uranie et Physic., Zool., Paris*, 272, 389.

RÜPPELL, E. 1835. *Neue Wirbelt., Fische Rothen Meeres*, 132.

SMITH, J. L. B. 1949. *The Sea Fishes of Southern Africa.* Cape Town.

THOMAS, P. T. 1962. A study on the fluctuations in the occurrence of the major tuna live-bait fishes of Minicoy. *Symposium on scombroid fishes.* Marine Biological Association of India, Mandapam Camp. (MS).

VALENCIENNES, A. 1832. *Nouv. Ann. Mus. Hist. Nat.*, 57.

WEBER, M. AND L. F. de BEAUFORT 1913. *The fishes of the Indo-Australian Archipelago.* Leiden, **2.**

——— 1922. *Ibid.*, **4.**

——— 1929. *Ibid.*, **5.**

——— 1931. *Ibid.*, **6.**

——— 1936. *Ibid.*, **7.**

A STUDY ON THE FLUCTUATIONS IN THE OCCURRENCE OF THE MAJOR TUNA LIVE-BAIT FISHES OF MINICOY*

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INTRODUCTION

MINICOY, the southernmost island of the Laccadive Archipelago, is the most important tuna fishing centre in the Indian Union. The fishing industry of the island with special reference to the tuna fishery has been comprehensively described by Jones and Kumaran (1959). The entire fishery is a pole and line one for the oceanic skipjack *Katsuwonus pelamis* (Linnaeus) mainly and the yellowfin tuna *Neothunnus macropterus* (Temminck & Schlegel), using live-bait fishes. The tuna live-bait fishery of Minicoy has been dealt with in detail by Jones (1958). Appreciable fluctuations have been noticed in the catches in the island from year to year. Even though large shoals may be available for capture in the vicinity of the island, the availability of the right kind of bait fishes in sufficient quantities throughout the fishing season, may be a factor influencing the catches of a particular year. About forty species of fishes are used by the fishermen of Minicoy as tuna live-bait. Of these only ten species show regularity in their occurrence, the rest being specimens entering the nets during fishing. The present study reports on the relative abundance of the major species of live-bait fishes of Minicoy.

The major species of tuna live-bait fishes of Minicoy are *Lepidozygus tapeinosoma* Günther, *Archamia lineolatus* (Cuvier), *Caesio caerulaureus* Lacépède, *C. tile* Valenciennes, *C. chrysozona* Cuvier, *Dipterygonotus leucogrammicus* (Bleeker), *Apogon sangiensis* Bleeker, *Chromis caeruleus* (Cuvier). *Spratelloides delicatulus* (Bennett) and *S. japonicus* (Houttuyn).

MATERIAL AND METHODS

The material for this study consists of samples obtained from the bait fish catches of Minicoy, during the period December 1960-April 1961. The bait fish sample was collected when the fishermen transferred them from the net into the bait wells. This is better than collecting them from the bait well as some species show the tendency to remain at the surface of the bait wells while others confine themselves to the bottom. The catches of one day consisted of more than one species on most days. Four persons have been going on rotation basis in different boats so that the samples would be more representative. The bait collection ground was more or less the same for all the boats engaged in tuna fishing. The sample was immediately preserved in 5% formalin and brought to the laboratory at the end of the fishing trip.

Twenty-six boats were engaged in tuna fishing in Minicoy during the season. Of these three or four boats did not go on each day, owing to various reasons. Thus the number of boats engaged in fishing on each day remained more or less constant. The number of bait wells in a boat may be three or four according to the size of the boat. But the average quantity of bait fish taken on a boat was two bait wells full. They returned without fishing if they could not obtain sufficient quantity of the bait, as it was not profitable. The fishermen of Minicoy do not keep any account

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of the bait caught by them or used on each fishing day. This study has been made on the assumption that the total number of boats engaged in fishing on each day and the total quantity of the bait fish taken by each boat remained more or less constant.

More than five samples per month have been analysed and the species in each sample sorted out. The number and the total weight of each species in a sample were determined. A sensitive pan balance was used in the determination of the weight. The total weight of each species in all the samples examined during a month was converted into percentages of the total quantity of bait fish examined for the month. So also with the number. The percentage composition of the samples of the different months thus became comparable. The percentages of the three major species according to the months of their occurrence are shown in Fig. 2.

The length frequency distribution of three major species, namely, *Lepidozygus tapeinosoma*, *Archamia lineolatus*, and *Caesio caerulaureus* has been studied. The standard length of fifty specimens of each species from each sample was measured to the nearest millimeter. When fifty specimens were not available in a sample, all available specimens were measured. The frequency of each millimeter group during a month was converted into percentages of the total number of fish examined during the month.

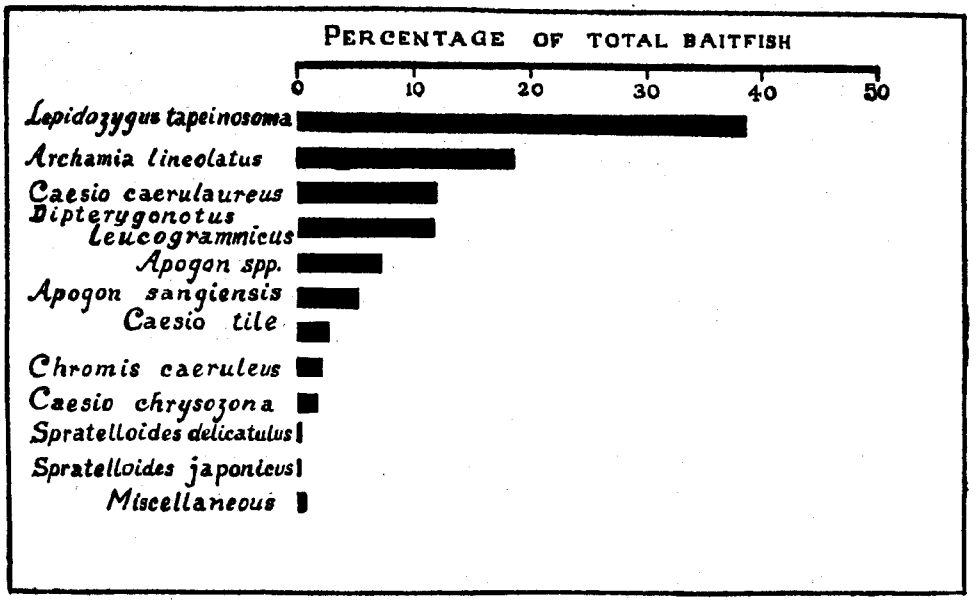

Fig. 1. The relative abundance of the bait fishes of Minicoy, during the season 1960-61 according to weight.

The Occurrence of the Bait Fishes

The pattern of occurrence of the major tuna live-bait fishes of Minicoy during the season 1960-61, is given in Fig. 1 and Table 1. *Archamia lineolatus*, *Spratelloides delicatulus* and *S. japonicus* were the bait fishes used from the beginning of the season to the third week of December. On December 18th, *L. tapeinosoma* appeared for the first time in the season. Considering the bait fish catches for the month of December as a whole, *L. tapeinosoma* formed the majority by weight, followed by *Dipterygonotus leucogrammicus* and *A. lineolatus*. But according to number (Tab. 2), *Apogon* spp. came first, followed by *A. lineolatus* and *D. leucogrammicus*. Compared with *L. tapeinosoma*, the other species were smaller in size.

During January, *L. tapeinosoma* was the only dominant species forming above 80% of the bait catches both by weight and by number, the rest being contributed by *Caesio tile* and other species of *Caesio* (Fig. 2). *A. lineolatus* was absent in the catches during January. In February, *L. tapeinosoma* contributed 38% of the catches while *D. leucogrammicus* formed 31.8% by weight, the rest being formed by *C. caerulaureus*, *A. lineolatus* and *Chromis caeruleus*. According to numbers *L. tapeinosoma* came first followed by *A. lineolatus* and *D. leucogrammicus*. During March *A. lineolatus* predominated in the catches both by weight and by numbers, followed by *Caesio caerulaureus*. *L. tapeinosoma* almost disappeared during the month and appeared again only after the middle of April. Considering the bait catches during the month of April, *L. tapeinosoma* again formed the dominant species by weight, followed by *A. lineolatus* and *Apogon* spp. But according to numbers, *A. lineolatus* came first and *Apogon* spp. came second.

TABLE 1

The percentage composition by weight of tuna live-bait catches in Minicoy, during the season 1960-61

Species	Dec.	Jan.	Feb.	March	April	Average for Season
Archamia lineolatus	18.69	—	7.52	37.49	17.74	16.288
Caesio caerulaureus	4.54	4.51	15.64	29.03	6.78	12.100
Lepidozygus tapeinosoma	30.90	84.09	38.02	00.40	41.46	38.974
Caesio chrysozona..	2.23	00.07	00.58	06.15	00.85	01.976
Apogon sangiensis	—	—	02.06	15.94	8.12	5.224
Apogon spp.	16.99	—	00.89	4.22	14.97	7.414
Caesio tile	00.63	7.69	00.84	—	4.85	2.802
Dipterygonotus leucogrammicus ..	22.33	1.83	31.78	1.73	0.88	11.710
Chromis caeruleus	—	1.04	2.67	4.51	2.66	2.176
Spratelloides delicatulus	2.25	—	—	—	—	0.450
S. japonicus	0.56	—	—	—	—	0.112
Miscellaneous	0.88	0.77	—	0.53	1.69	0.774

Lepidozygus tapeinosoma Günther (Mahl name—Burechi)

L. tapeinosoma is a small Pomacentrid fish growing to a maximum size of 80 mm. It is most suited among the small fishes available in Minicoy, to be used as tuna live-bait. The bait fish have to be supplied to the tuna in the living condition and large numbers of them are required at a time. *L. tapeinosoma* occurs in shoals and so can be caught in large numbers at a time. The bait fish should remain alive and healthy even when kept in the bait wells of the tuna boat for a long time. Among all the species of bait fish used in Minicoy, this species has the maximum rate of survival in the bait wells. It is able to remain alive even if the water in the bait well is not changed very often. It is a very active fish. It has also the peculiar habit of moving towards the tuna boat when thrown in the water, to take shelter in the shadow of the boat. Thus it helps in chumming the tuna towards the boat.

The peak of occurrence of the species in January coincided with the maximum catches of tuna. During the season 1960-61 the tuna catches were exceptionally good. The unusual abun-

dance of *L. tapeinosoma* during the season was also a factor which contributed towards the betterment of the catches of tuna, according to the fishermen of Minicoy.

Length frequency distribution :

The length frequency distribution of *L. tapeinosoma* during the season is shown in Fig. 3. The majority of the fish belonged to the length-group 30-40 mm. when they appeared in December.

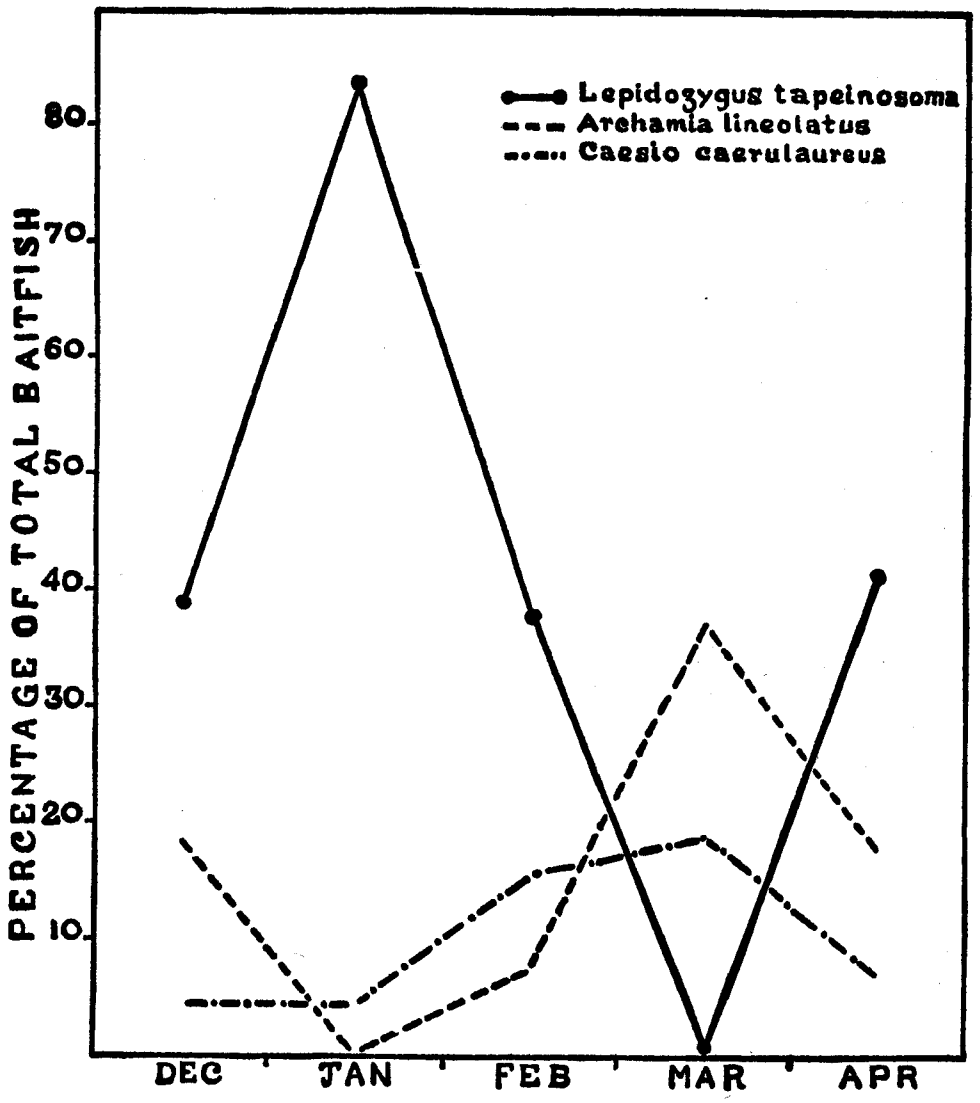

Fig. 2. Fluctuations in the occurrence of *Lepidozygus tapeinosoma* *Archamia lineolatus* and *Caesio caerulaureus* in the tuna tuna live-bait catches in Minicoy, during the season 1960-61.

In January, the length-group 40-55 mm. predominated. The graphs for the months of February and April show that fish of smaller size again enter the fishery.

Maturity :

All the specimens used in the length frequency study were examined for their stage of maturity also. It was found that the majority of the specimens were immature, with the gonads either absent or just developing.

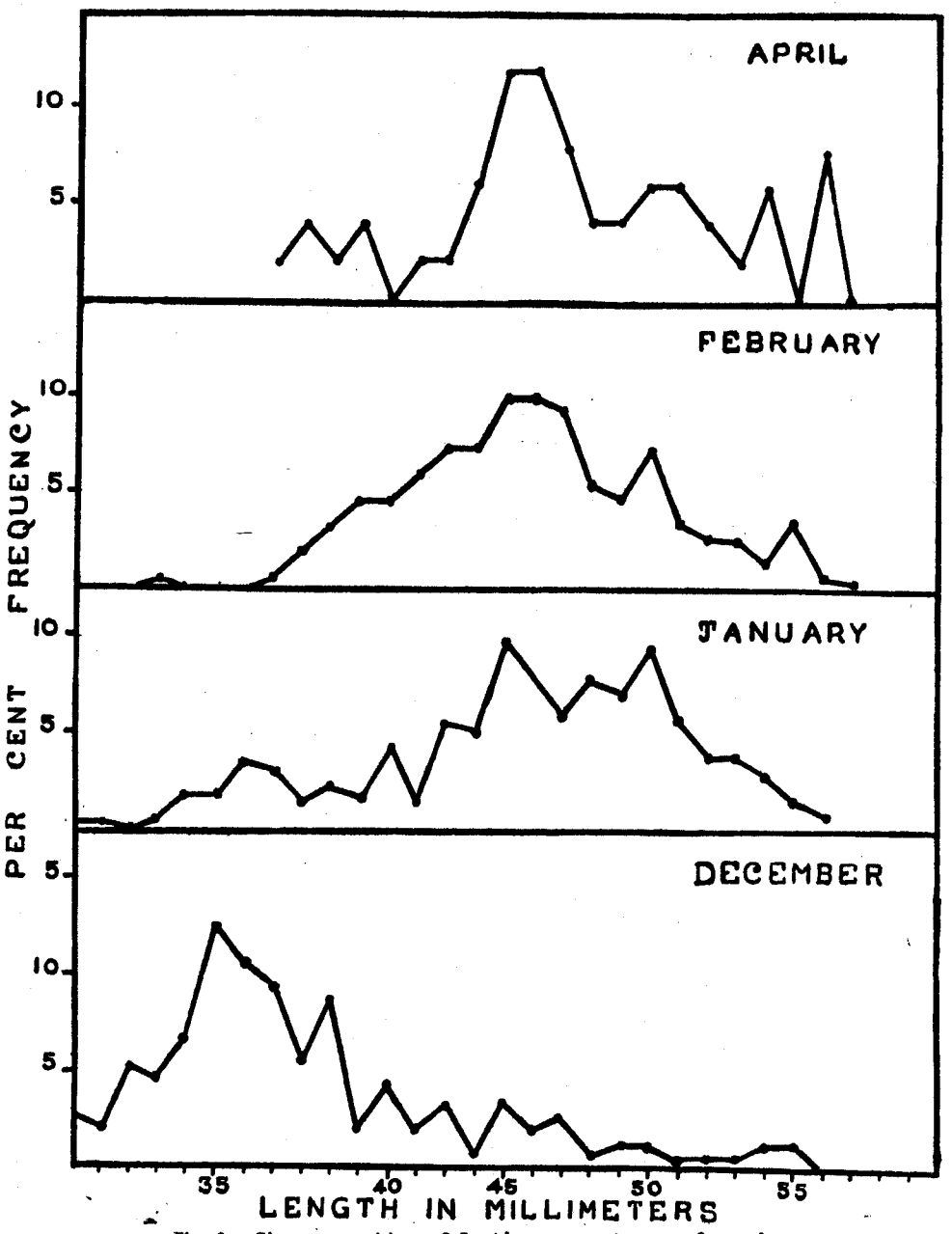

Fig. 3. Size composition of *Lepidozygus tapeinosoma* from the bait fish catches in Minicoy during the period December 1960-April 1961.

Archamia lineolatus (Cuvier) (Mahl name—Bodhi)

A. lineolatus is a small Apogonid fish occurring on corals in very large numbers. Though the species exceed all other bait fishes in number, it comes only second to *L. tapeinosoma* by weight, owing to the small size. The species was present in the bait catches from the beginning of the season, but became rare towards the end of December. The peak of occurrence of the species was in March.

TABLE 2

Showing the percentage composition by number of the tuna bait fish catches of Minicoy, during the season 1960-61

Species	Dec.	Jan.	Feb.	March	April	Average for season
Archamia lineolatus	27.83	—	27.57	54.48	34.17	28.81
Caesio caerulaureus	6.95	11.29	13.99	13.60	11.15	11.39
L. tapeinosoma	10.71	80.82	32.24	00.33	09.21	26.66
Caesio chrysozona	01.15	00.27	02.06	03.92	01.08	01.69
Apogon sangiensis	—	—	04.12	15.86	07.72	05.54
Apogon spp.	34.22	—	02.61	03.92	30.79	14.31
Caesio tile	00.12	02.93	00.27	—	02.61	01.19
Dipterygonotus leucogrammicus ..	12.53	02.58	16.32	00.80	01.48	06.74
Chromis caeruleus	—	00.27	00.82	06.43	01.28	01.76
Spratelloides delicatulus	04.20	—	—	—	—	00.84
Spratelloides japonicus	00.16	—	—	—	—	00.03
Miscellaneous	02.13	00.84	—	00.66	00.51	01.02

Length frequency distribution :

The length frequency distribution of the species is shown in Fig. 4. The majority of the fishes belonged to the length-group 20-30 mm. in December, with the mode at 24 mm. The length-group 28-33 mm. predominated in February. During March and April fish ranging in size from 30-mm. to 40 mm. formed the majority.

Maturity :

The specimens measured for their length were examined for their stage of maturity also. As in *L. tapeinosoma*, the majority of the specimens were immature.

Caesio caerulaureus Lacépède (Mahl name—Mugurang)

Caesiodids are important among the bait fishes of Minicoy owing to their comparatively larger size. Though a large number of species of *Caesio* are represented in the bait fish catches in Minicoy, *C. caerulaureus* is the prominent one. It is third in importance among the bait fishes of Minicoy, according to weight.

Length frequency distribution :

The length frequency of the species during the season is shown in Fig. 5. Fish of the length-group 17-40 mm. predominated in the catches during December, with the mode at 27 mm. During

January, the majority of the fish belonged to the length-group 32-37 mm., while in February, fish of the length-group 42-67 mm. formed the majority with the mode at 52 mm. In march there was the entry of smaller fish into the fishery. During April, fish ranging in size from 22 mm. to 32 mm. predominated in the catches. It indicates that there was the influx of smaller fish into the fishery during the month also, and that the spawning of the species is more than once in a year.

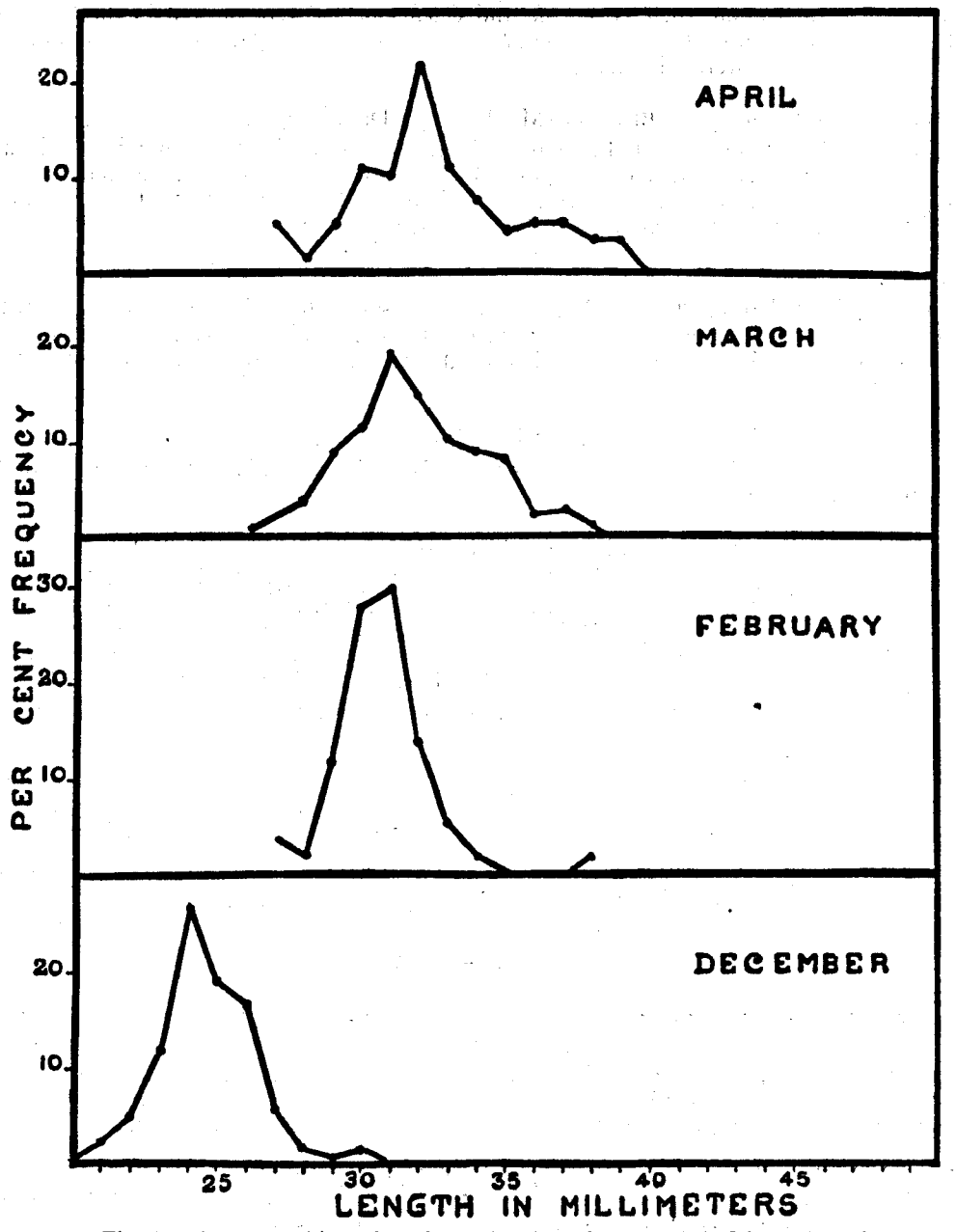

Fig. 4. Size composition of *Archamia lineolatus* from the bait fish catches of Minicoy during the period December 1960—April 1961.

Maturity :

C. caerulaureus is reported to grow to a maximum size of 280 mm. But fish of size above 75 mm. have not been observed among the bait fish catches of Minicoy during the season. All specimens were immature.

Other caesiodids :

Other species of *Caesio*, such as, *C. tile* and *C. chrysozona* were present in the bait catches in small numbers throughout the season. They also belonged more or less to the same size groups as of *C. caerulaureus* and were all immature.

Dipterygonotus leucogrammicus (Bleeker) (Mahl name—Dandimugurang)

This fish belonging to the family Emmelichthyidae formed 11.7% of the total bait fish catches during the season, by weight and 6.7% according to numbers. The species was more abundant during December and March when it formed 31.7% and 22.3% respectively, of the bait catches. During the other months it was comparatively rare. All were juveniles.

Apogonids :

Apogonids formed about 20% by number of the total bait fish catches of the season. *A. sangiensis* Bleeker was the dominant species. *A. hyalosoma* Day and *A. frenatus* Valenciennes were also found in small numbers. All of them belonged more or less to the same size group as *Archamia lineolatus.*

Chromis caeruleus (Cuvier) (Mahl name—Nilamahi)

It is a small fish inhabiting corals. The species formed only 2.1% by weight of the total bait catches during the season.

Spratelloides delicatulus (Bennett) and *S. japonicus* (Houttuyn) (Mahl name—Rahi)

These two species were used as bait fish at the beginning of the season. Both are small fishes belonging to the family Dussumieriidae, entering the lagoon just before the monsoon and remaining till the end of the monsoon (Jones 1960a and 1960b). During the season they were available in fairly large quantities till the first week of December, after which they were absent from the catches, during the tuna fishing season. Samples have been obtained by experimental fishing in the lagoon during the night with the aid of light in the month of April.

Miscellaneous fishes :

The fishermen of Minicoy show no selection in the collection of bait fishes. Any fish that enters the net is used, provided it keeps alive in the bait well or storage basket. *Polynemus sexfilis*, juveniles of *Sphyraena obtusata*, *Allanetta forskåli*, *Trachinotus* spp., *Lutjanus* spp., *Pomacentrus* spp. and *Caranx* spp., also enter the nets and are used along with the other species of bait fishes. Altogether about thirty species of fishes come under this category.

General Remarks

A study of the relative abundance of the tuna bait fishes of Minicoy indicates that *L. tapeinosoma* is the most important species. *Archamia lineolatus* comes next in importance followed by *Caesio caerulaureus*. Though species of *Caesio*, especially *C.tile* have been reported by the fishermen of Minicoy as the bait most effective in chumming the oceanic skipjack and the yellowfin tuna, the present study shows that the occurrence of the species is not regular.

The examination of the pattern of occurrence of the bait fishes shows that most of the species appear in the bait collection grounds all on a sudden, remain for some time and disappear also abruptly. The factors influencing their movements are not known at present. Studies on their food and feeding habits and reproduction may throw some light on this aspect.

A report on the skipjack bait investigation of Saipan waters (Ikebe and Matsumoto 1938) shows that the main bait fishes used are the same as used in Minicoy. *Stolephorus delicatulus*

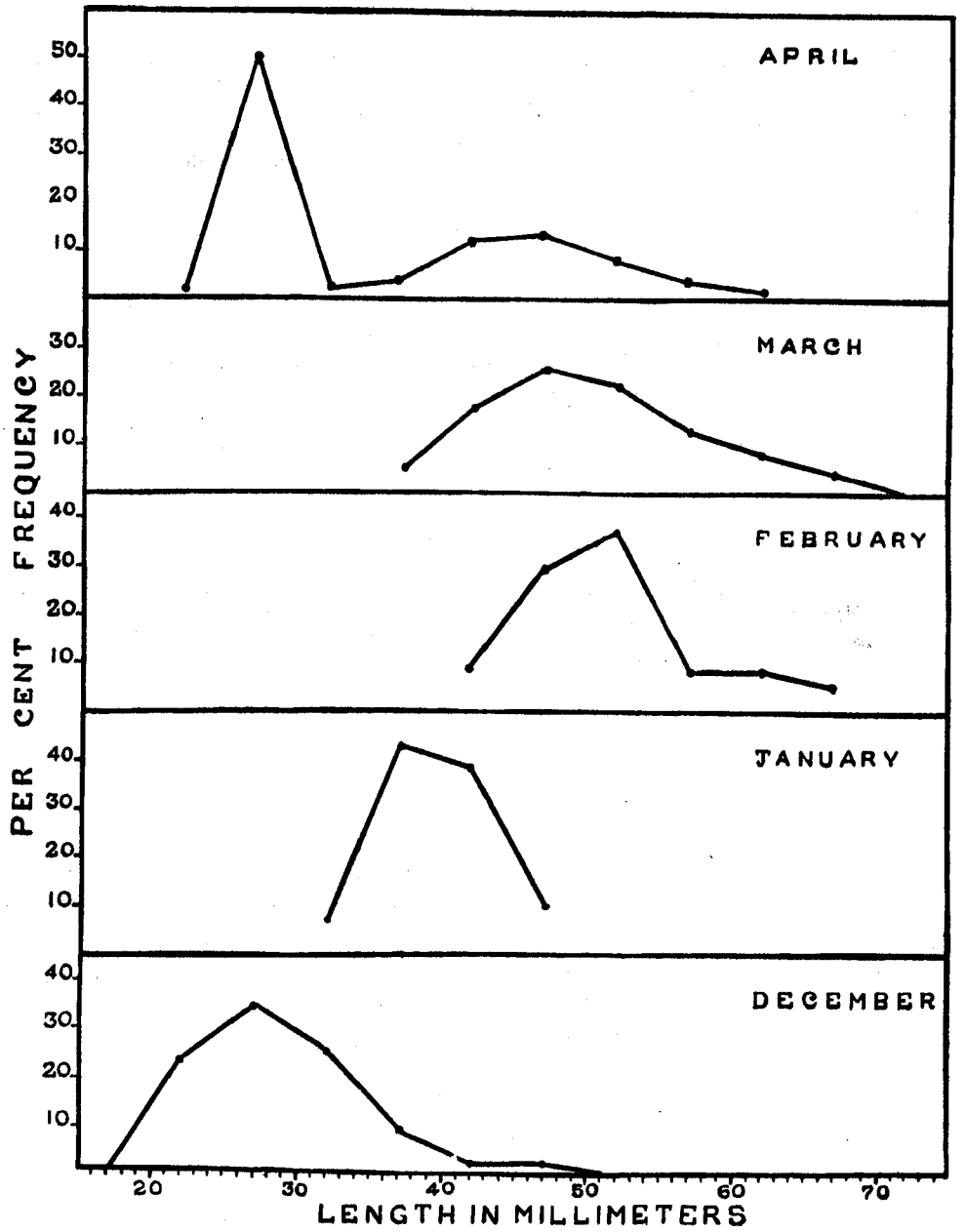

Fig. 5. Size composition of *Caesio caerulaureus* from the bait fish catches of Minicoy during the period December 1960-April 1961.

(Bennett) is reported as the most important bait fish of Saipan. *Caesio chrysozona* and *Abudefduf sexfasciatus* are also used there. *Caesio chrysozona* appears in Saipan waters in very large shoals occasionally when they are impounded in hastily constructed enclosures.

A study of the natural food of *Katsuwonus pelamis* and *Neothunnus macropterus* from the catches in Minicoy, shows that all the species used as bait fishes are fed upon by them occasionally. These may be the specimens straying out of the lagoon.

The fishermen of Minicoy use traditional gear for the procurement of the bait fishes. Fishing with the aid of high power lights, as is practised successfully in many parts of the world, may bring in better results. According to the Japanese, juvenile fishes give better results when used as live-bait in the skipjack fishery. It is seen from the present study that the majority of the bait fishes used in Minicoy during the season were juveniles, which factor could have been of advantage to the fishery.

Summary

A study on the relative abundance of the major tuna live-bait fishes of Minicoy has been made by the analysis of samples obtained from the bait fish catches during the tuna fishing season 1960-61. Eleven species of bait fishes were found to be regular in occurrence, though about forty species of fishes occur in the bait fish catches. The size composition of three major species during the season, has been studied. It was also found that most of the fishes used were juveniles, which could have been advantageous to the tuna fishery as juvenile fishes are reported to give better results when used as tuna live-bait.

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References

Ikebe, K. and T. Matsumoto 1938. Report of a skipjack bait investigation in Saipan waters. *Nanyo Suisan Joho*, 6 : 2-12. (Translation : *U.S. Fish Wildl. Serv., Spec. Sci. Rep., Fish* : 44).

Jones, S. 1958. The Tuna Live-bait Fishery of Minicoy Island. *Indian J. Fish.*, **5** (2) : 300-307.

——— 1960a. *Spratelloides delicatulus* (Bennett) as a potential live-bait for tuna in the Laccadives. *J. Mar. biol. Ass. India*, **2** (1) : 103-104.

——— 1960b. Further notes on *Spratelloides delicatulus* (Bennett) as a tuna live-bait fish with a record of *S. japonicus* (Houttuyn) from the Laccadive Sea. *J. Mar. biol. Ass. India*, **2** (2) : 267-268.

——— 1962. A preliminary survey of the tuna bait fishes of Minicoy and their distribution in the Laccadive Archipelago. (MS for the symposium)

—— and M. Kumaran 1959. The Fishing Industry of Minicoy Island with Special Reference to the Tuna Fishery. *Indian J. Fish.*, **6** (1) : 30-57.