FAO Fisheries Synopsis No. 37
(Distribution restricted)

FRm/S37
SAST - Malayan anchovy - 1,21(05),050,03

SYNOPSIS OF BIOLOGICAL DATA

ON THE MALAYAN ANCHOVY

Stolephorus pseudoheterolobus Hardenberg 1933

Prepared by

THAM AH KOW

Director

Fisheries Biology Unit
University of Singapore

for

The Honolulu Symposium

on

The CSK Results

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, April 1968

PREPARATION OF THIS SYNOPSIS

This synopsis was prepared for presentation at the Symposium on the CSK Results to be held in Honolulu, 29 April - 2 May, 1968.

Distribution

Author
FAO Department of Fisheries
FAO Regional Fisheries Officers
Regional Fisheries Councils and Commissions
Participants of the Honolulu Symposium on the CSK Results

"Current Bibliography" entry

Tham, Ah Kow (1968) 13-6M153
FAO Fish.Synops., (37):pag.var.
Synopsis of biological data on the Malayan anchovy Stolephorus pseudoheterolobus Hardenberg 1933

Taxonomy. Distribution. Life history. Population structure. Exploitation. Management.
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C O N T E N T S

* As no information was available to the author these items have been omitted from the text.

1 IDENTITY

1.1 Nomenclature

1.11 Valid names

Stolephorus pseudoheterolobus Hardenberg 1933

This species was first described by Hardenberg (1933).

1.2 Taxonomy

1.21 Affinities

- Suprageneric

Phylum Vertebrata
Subphylum Craniata
Series Pisces
Class Teleostomi
Subclass Actinopterygii
Order Clupeiformes
Family Engraulidae

- Generic

Genus Stolephorus Lacépède 1803

Elongate; scales thin, very deciduous, not more than 7 prominent spined scutes between pectorals and ventrals. Snout prominent. Maxillary may be produced as far as gill opening. Dorsal, generally without small predorsal spine, situated totally or partly before anal, which is short (16-23 rays) and goes 4.5-7.5 times in length. Upper pectoral ray not produced. Teeth on jaws, vomer, palatines, pterygoids and tongue. Eleven to 13 branchiostegal rays. Caudal peduncle at least twice as long as high at its end. A silvery band along the sides. Gregarious planktonic marine fishes of small size, translucent when alive.

- Specific

Stolephorus pseudoheterolobus Hardenberg 1933 (Fig. 1)

D.14-15; A. 16-18; P. 13-14; V. 7; L.l. 38; L.tr.9. Head 3.8-4.2, height 5.6-6.2 in length. Eye 3.5-4.0 in head. Snout somewhat shorter than eye. Maxillary reaches to somewhat behind mandibulary joint, dilated posteriorly, pointed. Distance tip of snout-back end of maxillary 4.4-4.7 in length. Origin of dorsal in the midst (or somewhat behind it) between tip of snout and first rays of caudal. Ventrals inserted before dorsal, in the middle between origin of anal and root of pectorals. Distance origin of anal-root of caudal equal to the distance origin of anal-root of pectorals or gill opening. Anal 5.8-6.2 in length, about as long as lower jaw, its origin behind dorsal. Ventrals two-thirds of pectorals, which are about as long as post-orbital part of head. Gill rakers 23-25, 4-6 abdominal scutes, the last one remote from ventrals. A silvery band on both sides and a black spot on occiput. There are 3 or 4 enlarged and curved serrations on ventral edge of maxillary which distinguish it from other species.

1.22 Taxonomic status

Key to the species of Stolephorus

1. Maxillary extending to gill opening...2
   Maxillary extending to mandibulary point.....5
2. A double pigment line on back.....3
   No pigment lines on back...S. insularis
3. Pigment lines from head to caudal (two broad ones from head to dorsal and two narrow ones from dorsal to caudal) .....S. tri
   Pigment lines different.....4
4. Two broad pigment lines from head to dorsal.....S. commersoni
   Two narrow pigment lines from dorsal to caudal.....S. baganensis
5. End of maxillary pointed.....6
   End of maxillary rounded, truncated...8
6. Origin of anal below about middle of dorsal.....S. indicus
   Origin of anal below or behind last 3 rays of dorsal.....7
7. Height 6.0-6.2 in length; 3-4 curved enlarged serrations on ventral edge of maxillary.....S. pseudoheterolobus
   Height 5.1-5.6 in length; no curved enlarged serrations on ventral edge of maxillary.....S. heterolobus
8. Abdominal spines present..S. zollingeri
   No abdominal spines.....S. celebicus

1.23 Subspecies

Delsman (1931) in his studies on the fish eggs and larvae from the Java Sea found two types of eggs which he thought could be ascribed to this species. Both were oval shaped and without knobs or oil globules, but one was slightly longer than the other. The larvae hatched out from the shorter eggs had 27-28 prae-anal myotomes whilst those from the longer eggs had 28-30. The two types of larvae had a very characteristic feature in common which distinguished them from the larvae of all the other elongated Stolephorus eggs. The terminal portion of the gut does not extend to the border of the lower unpaired fin fold as in the case of nearly all other fish larvae. The vent is situated either on the left or on the right side of the fin fold, close beneath the inferior border of the myotomes. He had the impression that the longer variety could be the more oceanic of the two.

1.24 Standard common names, vernacular names

English name:	Malayan anchovy
Chinese name (Hokkien):	Kang Hu
Chinese name (Cantonese):	Kong Yue
Chinese name (Teochew):	Oh Jiau
Malay name:	Ikan Bilis
Indonesian name:	Ikan Tri

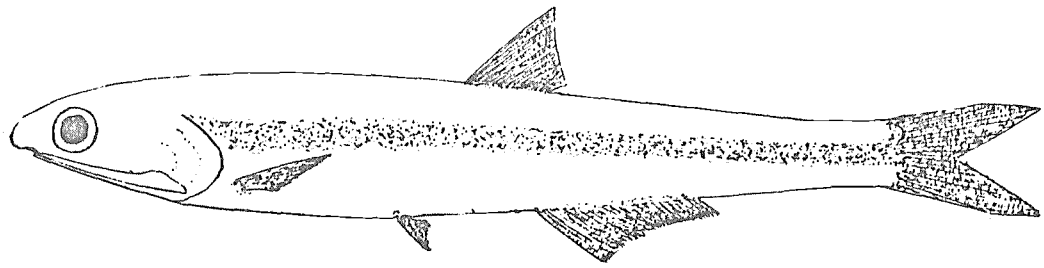

Figure 1a. Stolephorus pseudoheterolobus Hardenberg.

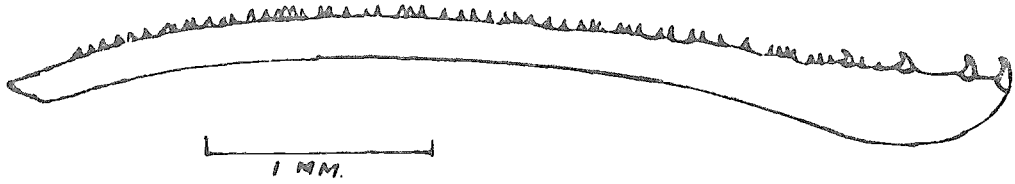

Figure 1b. Maxillary bone of S. pseudoheterolobus with characteristic enlarged curved serrations.

2 DISTRIBUTION

2.1 Total area

According to Hardenberg (1934), S. pseudoheterolobus is found in the Rhio-Lingga Archipelago, Java and Celebes. Tham (1965) has found it in Singapore, south and east coast of Johore (Malaysia).

2.2 Differential distribution

2.21 Spawn, larvae and juveniles

Spawn: Delsman (1931) found the planktonic eggs of this species in the whole of the Java Sea throughout the year. Tham (1965) has also found the eggs of this species in Singapore Straits occasionally but in very small numbers. The large specimens of this species caught in Singapore Straits are found by him to be mature. They probably do not spawn in Singapore Straits because the salinity is not suffioiently high, since according to Hardenberg (1934) this species is found in the Java Sea further out to sea. The presence of this fish in Singapore Straits may be due to the fact that they are carried in by the monsoon currents or they have moved in to feed on the plankton, since Tham (1953) found a definite correlation between the quantity of the catch of this species and the quantity of plankton in Singapore Straits.

Larvae: The larvae are found in the same areas as the eggs.

Juveniles: The juveniles may be caught in large quantities along the south and south-east coast of Malaysia, Singapore Straits and the Rhio-Lingga Archipelago.

2.22 Adults

The adults are caught in large quantities along the east coast of West Malaysia, Johore Straits, Singapore Straits, the Rhio-Lingga Archipelago, Banka and Java Sea. They are always found in a maturing or mature condition. In Singapore Straits Tham (1953) found a definite seasonal variation. They are caught in maximum quantities during February-March-April-May and August-September-October.

2.3 Determinants of distribution

From the temperature and salinity data collected by Tham (1953) during 1948 and 1949, temperature and salinity, within the limits observed, did not appear to have any effect on the availability of S. pseudoheterolobus. However, with exceptionally heavy and continued rainfall the shoals appear to move away from the coast, so that it would appear that the increased turbidity and lower salinity are adverse environmental factors. The range of temperature observed in Singapore Straits is from 27.0°C to 30.5°C. The limits of temperature tolerance may thus be assumed to be not far below 27°C and not much above 31°C. In the absence of heavy continued rainfall, Tham (1955) observed that high windforce under certain circumstances favoured the aggregation of S. pseudoheterolobus in Singapore Straits. There is no doubt that this species as well as the other species of Stolephorus found in Singapore Straits are attracted by light, since fixed traps which do not use light to attract fish do not catch Stolephorus in large quantities. Their food, which consists almost entirely of planktonic organisms, may be a factor which restricts their abundance to coastal waters, since in the seas around Malaysia and Singapore the plankton is most abundant along the coastal area and is sparse in the open sea.

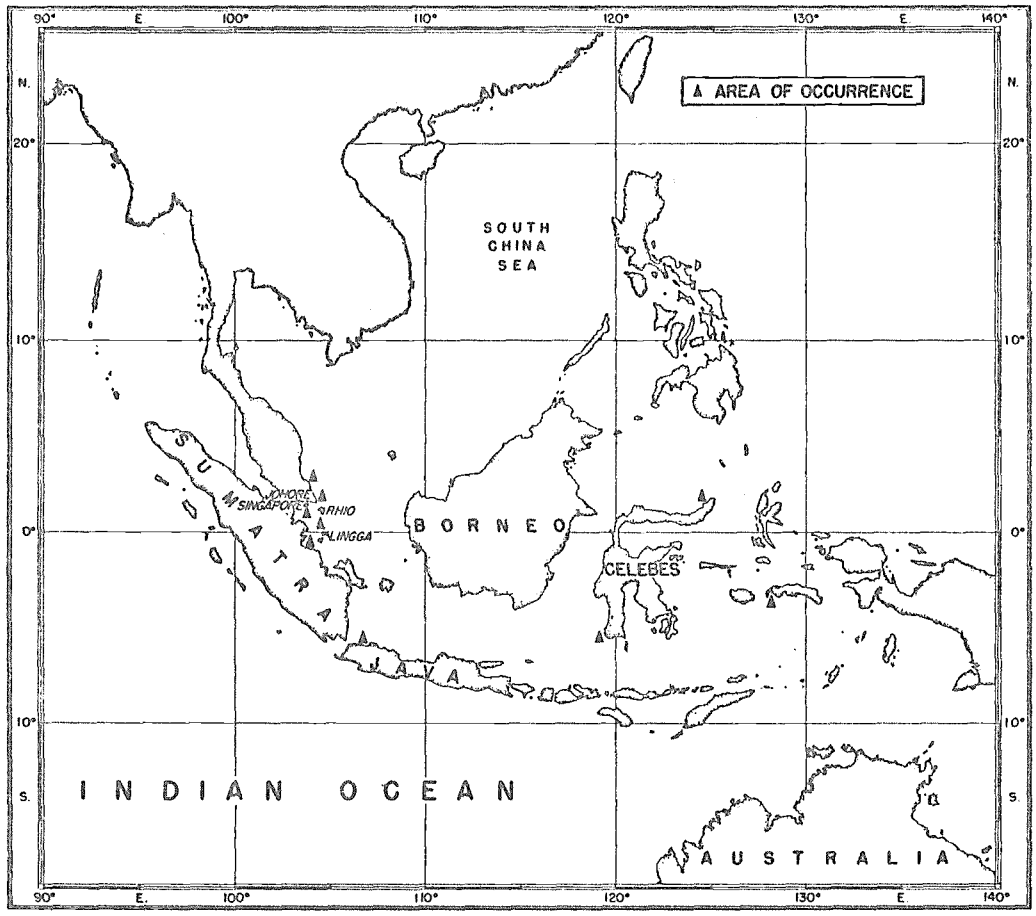

Figure 2. Distribution of S. pseudoheterolobus.

3 BIONOMICS AND LIFE HISTORY

3.1 Reproduction

3.11 Sexuality

Stolephorus pseudoheterolobus is heterosexual. There are no known observable external characters for distinguishing males from females. There are no reports of any observed cases of hermaphroditism or state of inter-sexuality in this species.

3.12 Maturity

According to Tham (1965) S. pseudo-heterolobus matures at about 50 mm standard length. This observation is based on maturity studies of over 10,000 specimens.

3.13 Mating

Spawning is believed to be carried out in schools since both mature males and females are caught by the millions in Singapore Straits during certain seasons.

3.14 Fertilisation

Fertilisation is believed to be external and both the ova and sperms are shed freely into the water, as there are no intromittent organs in the males.

3.15 Gonads

According to Tham (1965) the gonads begin to be visible to the naked eye at a standard length of 35-40 mm. The ovaries are full with eggs visible to the naked eye at a standard length of 50 mm or above.

Fecundity: In a single specimen of a female of 62 mm standard length a total of 1,500 eggs were counted. This indicates that the number of eggs in a single mature female is of the order of 1,000 to 2,000.

3.16 Spawning

From Delsman's (1931) data on occurrence of eggs in the plankton and from Tham's (1966o) length-frequency studies of this species, it appears to spawn throughout the year at intervals of slightly over a month or about 2 months. It may be that some of these spawning periods are much more intensive than others. According to Delsman (1931) the spawning may take place fairly far out at sea. Tham (1953) found very few Stolephorus eggs in Singapore Straits in his study of the plankton.

3.17 Spawn

According to Delsman (1931) the eggs of S. pseudoheterolobus are oval in shape without a knob or oil globule. There are two sizes of eggs, (a) length 0.98-1.14 mm; breadth 0.51-0.55 mm (b) length 1.10-1.22 mm; breadth 0.53-0.57 mm. The ovum is transparent and non-adhesive.

3.2 Pre-adult phase

3.21 Embryonic phase

Delsman (1931) was of the opinion that the eggs of this species as well as other species of Stolephorus hatched out about 24 hours after fertilisation so that embryonic development is completed within this period.

3.22 Larval phase

Development in the larval phase (after Delsman 1931)

On hatching, length of 3.33 mm: yolk sac from head to three-quarters of length of fish; mouth not yet open; no paired fins; no branchial skeleton.

After 12 hours, length of 5.22 mm: yolk sac quarter of length of fish, partly absorbed.

After 36 hours, length of 5.45 mm: yolk sac absorbed; mouth and branchial skeleton forming; pigment spots formed along length of fish; caudal marked off in primordial fold.

No data are available for larvae after 36 hours.

3.23 Adolescent phase

Delsman (1931) observed that in specimens of species of Stolephorus of 25.5 mm total length all the fins including the ventrals had been formed. At 18 mm total length all the other fins had been formed, whilst the ventral fins were growing rapidly. He designated the Stolephorus specimens of 18 mm or more total length as 'young fish'. Tham (1965) observed that young specimens of S. pseudoheterolobus of 15 mm standard length in Singapore Straits could be distinguished from the young of other species in that their maxillary had the last 3 or 4 serrations enlarged and curved.

3.3 Adult phase

3.31 Longevity

Nothing is known of the longevity of this species. Hardenberg (1934) stated that the length of the largest specimen of this species is 100 mm total length or about 83 mm standard length. According to the growth equation given under 3.43 the age of a fish of this length could be about 1 year 3 months. But the

majority of the specimens of this species caught in Singapore Straits have never reached this length, the largest specimen being only about 80 mm standard length.

3.32 Hardiness

In Singapore Straits this species is found in salinities ranging from 26 °/oo to 32 °/oo and the water temperature ranges from 27°C to 30.5°C. According to Hardenberg (1934) they are never found in water of less than 17 °/oo salinity. Most of them die immediately after they are lifted out of the water. Among fish found in Singapore Straits this species is the least hardy.

3.33 Competitors

Tham (1950) found that this species feeds on the same planktonic organisms as a host of other species found in Singapore Straits. It can therefore be expected that it has many competitors in Singapore Straits.

3.34 Predators

This species forms the food of many species of predacious fish in Singapore Straits, the most important of which are Scomberomorus guttatus, Scomberomorus lineolatus, Scomberomorus commersoni, Chirocentrus dorab, Engraulis spp., Saurida gracilis, Sphyraena spp., carangids, Trichiurus spp., Gazza minuta, sciaenids, Therapon spp. (Tham, 1950).

3.4 Nutrition and growth

3.42 Food

In Singapore Straits this species has been observed to feed heavily on calanid copepods and also Leptochela sp. to a slightly lesser extent. Plankton diatoms also form a fairly large proportion of its diet. Those over 50 mm standard length have been observed to feed on polychaetes, pteropods, lamellibranch larvae, mysids, squilla larvae, Lucifer sp., other decapod larvae as well as gastropod larvae, ostracods, cypris larvae, harpacticids, amphipods, cumaceans and Acetes spp. In Singapore Straits their stomachs are never empty. From December to the following February they have been observed to feed very heavily. From April to July their stomachs are moderately full. Feeding appears to be slight from August to November (Tham, 1950).

3.43 Growth rate

Tham (1966b) studied the growth of several species of Stolephorus, including S. pseudoheterolobus, in Singapore Straits and suggested that the growth of S. pseudoheterolobus could be represented by the equation

$$l_t = 89 \left(1 - e^{-0.0057(t+16)} \right)$$

where l_t = standard length (mm) at time t

t = age of fish in days.

The catabolic growth coefficient K is 0.0057 for one day and the asymptotic standard length is 89 mm. According to this equation, at the standard length of first maturity (50 mm) the age of this species should be about 125 days or a little over 4 months. This gives an average growth rate of about 12 mm per month.

3.5 Behaviour

3.51 Migrations and local movements

Hardenberg (1934) observed this species migrating from Banka to the Lingga Archipelago and then further north to the Riau Archipelago from February to October, but he was not sure whether there was a reverse migration. Nothing is known about the migration of this species in Singapore Straits.

3.52 Schooling

It is not known whether or not this species exhibits schooling behaviour but this species has been observed to aggregate in huge shoals in Singapore Straits and east coast of West Malaysia.

3.53 Responses to stimuli

It is well known that this species can be induced to aggregate by means of light, since in Singapore Straits this forms the main basis of the kelong method of fishing which catches mainly Stolephorus spp. and, in particular S. pseudoheterolobus. Tham (1953) has also shown that, provided the physical and chemical environmental conditions are favourable, this species appears to aggregate in Singapore Straits to feed.

4 POPULATION

4.1 Structure

4.11 Sex ratio

Practically no work has been published on this aspect. In one sample of 100 mature fish, Tham (unpublished) found 62 males to 38 females.

4.12 Age composition and size composition

According to the study of length frequencies carried out by Tham (1966a), the structure of the population in Singapore Straits changes from month to month. Throughout the year one may find fish of any length between 35 mm standard length to 60 mm standard length. There may be one or more modes, with a maximum of 4 modes in any one sample. These modes shift from month to month. During the months of December to May the following year a large number of juveniles ranging from 20 mm to 35 mm in length are caught together with larger fish. From August to November fish of less than 35 mm standard length are seldom found in the catch. This species appears to enter the commercial catch at a standard length of about 15 mm.

The weight-length relationship for this species was determined by Tham (1966c) and may be expressed as

$$W = 0.003717\ L^{3.594}$$

where W = weight of the fish in grams

and L = standard length of fish in cm.

4.2 Abundance and density of population

4.22 Changes in abundance

From the catch data collected by Tham (1953), there is a definite change in the abundance of this species during the different months of the year in Singapore Straits. This species is much more abundant from February to May and from August to October. Hardenberg (1934) also noted that this species was abundant from October to February the following year around Banka, from February to August around Lingga Archipelago and from April to October around Rhio Archipelago.

4.6 The population in the community and the ecosystem

From the observations made by Tham (1953), S. pseudoheterolobus appears to be a key species in the fish population in Singapore Straits which is a feeding ground for this species. When plankton is abundant, this species is abundant also. When this species is abundant, Scomberomorus spp. which prey on it is also abundant. It is believed that they are brought into the proximity of Singapore Straits by the north-east monsoon current from the South China Sea from December to April the following year and by the south-west monsoon current from the Java Sea from June to October.

Salinity range:	17 °/oo to 32 °/oo
Temperature range:	27.0°C to 30.5°C
Trophic habitat:	coastal areas
Breeding habitat:	surface waters over deep areas

5 EXPLOITATION

5.1 Fishing equipment

5.11 Gears

In general, this species may be caught in inshore gears such as the fixed traps, beach seines and push nets. The most important of the fixed traps for catching this species in Singapore waters and the south and south-east coasts of West Malaysia is the kelong which uses a light to attract the fish into the trap. It may also be caught by fixed filter nets such as the ambai and jermal. Along the east coast of West Malaysia the lighted purse seines are also used for catching this species.

5.12 Boats

The fishing boats used include rowboats as well as powered boats.

5.2 Fishing areas

5.21 General geographic distribution

According to Hardenberg (1934) this species is found mainly in the Rhio-Lingga Archipelago. It is also found at Tjarita, Batam and Batavia in Java, at Muntok in Sumatra, in Macassar, Menado and Amboina in Celebes. It is very abundant in Singapore and along the south and south-east coasts of West Malaysia.

5.23 Depth ranges

This species is generally regarded as a surface fish, although the fact that it feeds heavily on Leptochela sp. indicates that it does venture down to somewhat below 5 fathoms along the coast of Singapore where this food organism is found.

5.24 Conditions of the grounds

Mud, sand or mud-sand mixture.

5.3 Fishing seasons

In Singapore Straits and Johore Straits fishing for this species is carried out throughout the year. Along the south-east coast of West Malaysia fishing for this species is carried out from March to November.

5.4 Fishing operations and results

No data on landings of S. pseudoheterolobus are available, the landings of mixed S. pseudoheterolobus, S. insularis, S. indica and S. heterolobus of three kelongs in Singapore Straits throughout the year for 1948 and 1949 are available. Roughly speaking, S. pseudoheterolobus makes up about 80% of the total Stolephorus catch. The catch of all species of Stolephorus in Singapore Straits during the two years (Tham 1953) are as follows:

Best month:	1178-1738	kg	per gear per month
	276-435	kg	per man per month
Worst month:	198-231	kg	per gear per month
	50-58	kg	per man per month

6 PROTECTION AND MANAGEMENT

6.1 Regulatory (legislative) measures

6.11 Limitation or reduotion of total oatoh

No regulatory measures of any kind are enforced in Malaysian waters. In Singapore waters no new kelongs have been licensed since 1954 as it was found that an inorease in the number of such gears in Singapore waters leads to a decrease in the catch per gear.

6.12 Proteotion of portions of population

There are no olosed areas or olosed seasons which are enforced by law in Singapore or Malaysian waters. There is also no limitation in size or efficienoy of gears or on mesh size of nets, because any gear whioh catches the adult of Stolephorus will also catch the young of other species of fish which are caught by the same gear.

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6.12 Protection of portions of population

There are no closed areas or closed seasons which are enforced by law in Singapore or Malaysian waters. There is also no limitation in size or efficiency of gears or on mesh size of nets, because any gear which catches the adult of Stolephorus will also catch the young of other species of fish which are caught by the same gear.

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