FISH EGGS AND LARVAE FROM THE JAVA SEA [1])

by

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12. The genus ENGRAULIS.

As has been shown first by WENCKEBACH [2]) for the European and afterwards by NISHIKAWA [3]) for the Japanese anchovy, the eggs of both these species of *Engraulis* (*encrasicholus* resp. *japonicus*) have an elongated shape. The egg of the former has a length of 1,3—1,9 mm and a breadth of 0,7—1,2 mm. For the egg of the Japanese species these values are 1,2—1,6 and 0,55—0,7 mm. They contain no oil-globule.

In looking for the eggs of the Indian species of *Engraulis* one would naturally expect, therefore, to find similar elongated eggs. This, however, proved not to be the case.

Eggs of an elongated shape, it is true, occur in quite a number of varieties in Indian waters. They will be dealt with in a subsequent article of this series [4]). We have, however, been able to ascertain that probably all of them belong to species of the related genus *Stolephorus*.

WEBER and DE BEAUFORT in their "Fishes of the Indo-Australian Archipelago", Vol. II, enumerate 10 species of *Engraulis* for the Indian waters. I have thus far seen seven of them in the seas round Java. According to the number of vertebrae they may be divided into two groups, viz. one with 44-45 and one with 41 vertebrae. The European anchovy has 45-47 vertebrae [5]), the Japanese one evidently a similar number, both species belonging to the first group. We find the

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[1]) cf. Treubia, Vol. II, p. 97, Vol. III, p. 38, Vol. V, p. 408, Vol. VI, p. 297, Vol. VIII, p. 199 and p. 389, Vol. IX, p. 338.

[2]) K. F. WENCKEBACH, 1887, Verslag omtrent op de ansjovis betrekking hebbende onderzoekingen. Verslag Staat Nederl. Zeevisscherijen over 1886.

[3]) T. NISHIKAWA, 1901, On the development of *Engraulis japonicus*, Journal of the Fisheries Bureau (Tokyo), Vol. X, Nr. I.

[4]) The said article, which was written before the present one, cannot yet be published as a previous critical review of the Indian *Stolephorus*-species has proved necessary. My assistant Dr. HARDENBERG is now engaged in this investigation.

[5]) The following average values have been found: Zuydersea 46,5, Bay of Gascogne 47,2, Mediterranean 45,5—45,6, Black Sea 44,9.

following average and somewhat rounded off values for the Indian species [1]):

Engraulis	*mystax*	21 + 24 = 45
„	*Grayi*	20 + 25 = 45
„	*setirostris*	19 + 26 = 45
„	*valenciennesi*	18 + 26 = 44
„	*baelama*	19 + 22 = 41
„	*kammalensis*	18 + 23 = 41
„	*dussumieri*	17 + 24 = 41

Within each of these two groups, arranged in the above way, we see the anus shift gradually forwards, as shown by the relation of the numbers of trunk- and tail vertebrae. The group with the lower number of vertebrae has been separated from the genus *Engraulis* by JORDAN and EVERMANN under the name of *Anchovia*. According to these authors the latter genus, with about 41 vertebrae, comprises the tropical species, the former, with about 45 vertebrae, the species of the temperate zone. Their genus *Anchovia*, however, comprises in the first place the *Stolephorus*-species. In the Indian species of this genus also I found the average numbers of vertebrae to vary from 37.8 to 42.8.

It seems to me not advisable, thus to unite the genus *Stolephorus* with the *Engraulis*-species with a lower number of vertebrae. Evidently the latter are intermediate between *Engraulis* with 45 vertebrae and *Stolephorus*, but by their whole appearance — e. g. the silvery hue not being limited to a lateral band as with *Stolephorus*, — they stand nearer to the former than to the latter, which form a fairly well-defined natural group. Thus, e. g., the genus *Stolephorus* differs from *Engraulis* not only by the lateral silvery band and the more elongated shape but also by the relation of the number of trunk vertebrae to that of the tail vertebrae. In *Stolephorus* both numbers are alike or nearly alike, as a rule the number of trunk vertebrae slighty surpassing that of the tail vertebrae (cf. the article on *Stolephorus*, which will follow). In *Engraulis*, on the contrary, the number of tail vertebrae is always

[1]) I owe to Dr. HARDENBERG the following, more precise, numbers. He found in

Engraulis mystax	6 × (21 + 24 = 45)
	2 × (20 + 24 = 44)
	1 × (20 + 25 = 45)
Engraulis Grayi	8 × (20 + 25 = 45)
	1 × (20 + 24 = 44)
	1 × (19 + 25 = 44)
Engraulis setirostris	2 × (19 + 26 = 45)
Engraulis valenciennesi	2 × (19 + 26 = 45)
	13 × (18 + 26 = 44)
	2 × (19 + 25 = 44)
	2 × (18 + 25 = 43)
Engraulis baelama	3 × (19 + 22 = 41)
Engraulis kammalensis	12 × (18 + 23 = 41)
	1 × (18 + 22 = 40)
Engraulis dussumieri	6 × (17 + 24 = 41)
	1 × (18 + 23 = 41)
	1 × (17 + 23 = 40)

considerably higher than that of the trunk vertebrae (cf. above). As we shall see, the shape of the eggs also points to a subdivision of the tropical Engraulidae into a group *Engraulis* and a group *Stolephorus*, as has been made by WEBER and DE BEAUFORT in their work on the Indo-Australian fishes. The subdivision into the genera *Engraulis* and *Stolephorus*, then, seems to me preferable to a division into the genera *Engraulis* and *Anchovia*.

If we examine the ovaria of *Stolephorus*-species, we see that the elongated shape of the eggs becomes evident at a fairly early stage already. The same holds for the ovaria of the European *Engraulis encrasicholus*. If, however, we examine the ovaria of Indian *Engraulis*-species, we find that the eggs are not elongated but round, even in fully ripe ovaria. I have had an opportunity to examine in this way the ovaria of *Stolephorus Grayi, mystax, setirostris, valenciennesi, kammalensis* and *dussumieri*, and in all these species I found the eggs to be round.

At the fish-market of Batavia the only common species belong to the group with the higher number of vertebrae. They are *Engraulis Grayi, mystax* and *valenciennesi*, all known as "bulu ajam" (= hen's feather) among the fisherfolk, who do not distinguish these three closely related species from each other.

Now, in the Bay of Batavia, and elsewhere along the coast of Java and Sumatra, eggs are very common which, at first, I was inclined to attribute to some *Clupea*-species; the more so, as they show a certain likeness to the egg of the European sprat (*Clupea sprattus*). Afterwards, however, the study of the larvae hatching from them showed that they belong to Engraulids. The eggs have a globular shape, but slightly irregular and not so perfectly globular as is the rule with other pelagic fish-eggs. Upon closer examination one axis often proves to be slightly longer than the other but the difference is so trifling, that it can hardly be observed and one gets the impression of a slightly irregular globular egg only.

The yolk shows the segmented structure so characteristic of the eggs of eel- and herring-like fishes as mentioned in several of the foregoing articles. The egg-membrane is nearly filled up by the egg, especially in early developmental stages. No oil-globule is present. Owing to this and the smaller size it may be easily distinguished from the egg of *Dussumieria*, which has been described in Nr. 4 of this series. The diameter varies from 0.8 to 1.1 mm.

These are very common eggs, which are caught e. g. in great number in the Bay of Batavia, round and between the islands.

Spawning occurs in the evening, after sunset, as was shown by a few hauls made especially for this purpose at 10 and 11 p.m. in the Bay of Batavia. Both catches contained numerous eggs all showing a small germinal disc. It was evident that spawning had taken place one or a few hours before, after sunset. We have seen in the foregoing nrs. of this series that there are many species of marine fishes that all spawn at this time of the day (cf. e. g. Treubia VIII, p. 202 and 396).

The development of the eggs and larvae proceeds as follows.

As is the rule with pelagic fish eggs of this size we find early in the morning a young embryo, which develops in the course of the day and hatches in the afternoon or in the evening. In this case hatching occurred about 6 p.m. From this it is evident that the whole development takes less than 24 hours.

The newly hatched larva looks quite like those of other Clupeid larvae formerly described by me (*Dussumieria, Chirocentrus, Clupea* spp, *Dorosoma, Stolephorus* spp. [1]). It also shows the characteristic crossed arrangement of the muscle fibres in the myotomes.

In front of the anus 30 myotomes could be counted. This is more than in the *Stolephorus*-larvae where this number is reached only by the larvae from one kind of egg (cf. the subsequent article of this series). In *Stolephorus*-larvae the number of praeanal myotomes varies from 24 to 30, in *Clupea*-larvae from 37 to 40. In the adult *Stolephorus* these numbers vary from 18.8 to 23.2, in the adult *Clupea* from 27 to 32, the difference being caused by the forward shifting of the anus. From this it is evident at once that my first supposition, viz. that this egg, owing to its resemblance to the European sprat egg, might belong to some *Clupea* species, was wrong.

Evidently it belonged to some Engraulid. And as the examination of the ovaries of several *Engraulis*-species had shown that the eggs here are round and those of *Stolephorus* elongated, it could no longer be doubted that our eggs belonged to some species of *Engraulis*, most probably to one of the two most common species in the Bay of Batavia, viz. *Engraulis Grayi* or *mystax*.

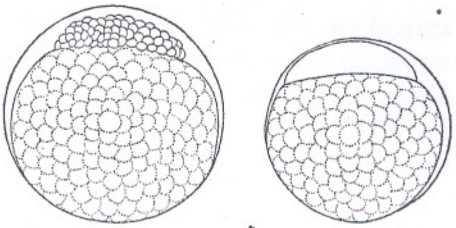
I now examined the ovarial eggs of ripe specimens of different *Engraulis* species and found that *Engraulis Grayi*, the largest species, had also the biggest eggs, with a diameter of 0.6 mm. Smaller are the ripe ovarial eggs of *Engraulis mystax*, with a diameter of 0.5 mm., those of *Engraulis Valencienesi* and *setirostris* having about the same size, whereas the eggs of *Engraulis kammalensis* and *dussumieri* appeared to be smaller still, the diameter being about 0.4 mm.

Now closer examination showed that two varieties also may be distinguished among the pelagic eggs dealt with in this article, viz. a somewhat larger one, with a diameter of 1.—1,1 mm, and a smaller one, with a diameter of 0,8—0,9 mm. This was especially evident in a few catches made late in the evening of September 7th, 1928. viz. at 10 and at 10.30 p.m., slightly north of the harbour entrance of Batavia (106°48$^1/_2$" E 6° 4' S, depth 12—14 metres). These catches contained both varieties of eggs. The smaller ones in the first haul showed an unsegmented germinal disc, the larger ones a multicellular germinal disc. The conclusion is obvious that the former were the eggs of *Engraulis mystax* (or *Valenciennesi*), the latter those of *Engraulis Grayi*. Evidently a mixed shoal was present at this place but *Engraulis Grayi* had spawned somewhat earlier in the evening than *Engraulis mystax*. A similar

[1]) The latter to be described in a subsequent article.

case has been mentioned by me for a mixed shoal of *Clupea fimbriata* and *leiogaster* in Treubia Vol. VIII, p. 230, and has been observed by me also in mixed shoals of the *Stolephorus*-species.

We see that the ovarial eggs after or during spawning swell up to somewhat less than double the diameter. For comparison I mention here *Dussumieria hasseltii*. I found for the diameter of ripe ovarial eggs 0.85 mm., for the diameter of the planktonic eggs about 1,5 mm. A similar relation consequently.



The two varieties of *Engraulis* eggs in the catch of September 7th, 1928, 10 p.m. × 26.

I suppose that the eggs of the different species of *Engraulis* differ from each other by their diameter only, as I have never found other eggs, differing in other respects, even in places where other species were abundant. Thus *Stolephorus kammalensis* is common near Bagan Si Api Api in the mouth of the Rokan river (East coast of Sumatra) and *Engraulis baelama* and *dussumieri* are common near Laboean (Sunda Strait). I did not find here, however, any other type of egg than the one described in this article.

However this may be, we may safely conclude now, that the larger and most common egg belongs to *Engraulis Grayi*, together with *Engraulis mystax* the most common form along the whole north coast of Java. It is this egg whose development is shown in figs. 2-7.

These figures show the development of the larva up to the moment when the yolk has been completely resorbed and the eyes have become black. In the usual way we see the pectoral fin and, slightly later, the brownish black pigment spots appear. The mouth, originally a longitudinal slit below the eyes, is directed forward by the growing-out of the under lip. All this, however, does not offer any marked difference with what we have seen in the larvae of other clupeoid fishes. The figures agree fully with those in former articles on the development of herring-like fishes.

Further advanced larvae of Engraulid fishes are often found in the surface-catches but from the foregoing it will be evident that it won't be practically possible to distinguish *Engraulis*- from *Stolephorus*-larvae by the number of vertebrae, the differences being too insignificant. In the next article, on the eggs and larvae of the genus *Stolephorus*, I hope to give a few figures of such pelagic larvae.

The chart on p. 280 gives us an idea of the distribution of these eggs on May 2nd and 3rd, 1922, when a series of horizontal surface-hauls of 6 minutes each was made. These stations are shown by the chart, each provided with two numbers. The left one indicates the total number of eggs in the catch, the right one the number of *Engraulis* eggs. We find the former

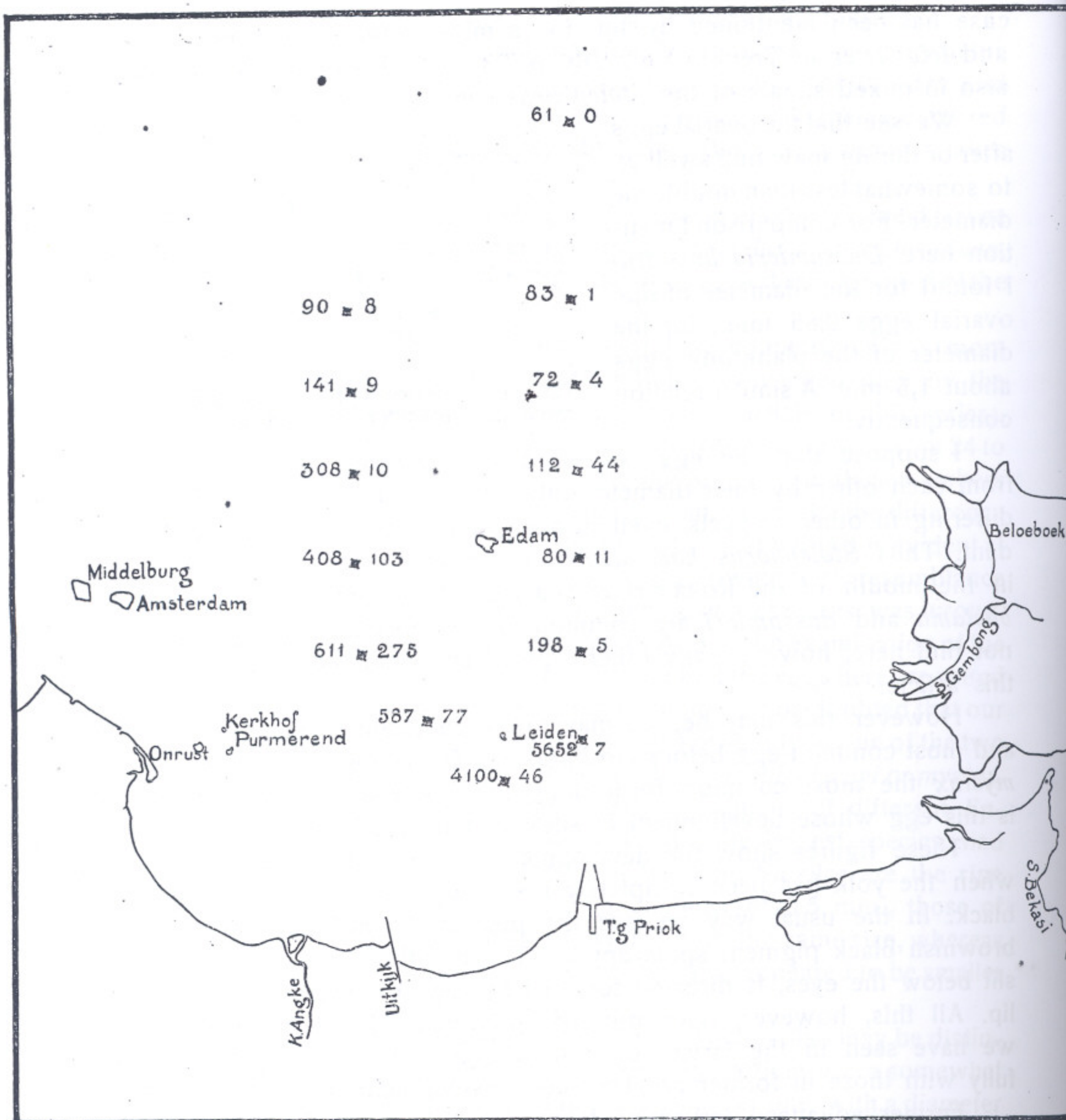


Chart showing the distribution of the *Engraulis* and other fish eggs in the Bay of Batavia on May 2nd and 3rd, 1922. The figure at the left of each station indicates the total number of pelagic fish eggs in a horizontal haul of 6 minutes, those at the right the number of *Engraulis* eggs.

numbers highest in the stations near the coast. The numbers at the right, however, reach a maximum at some distance from the coast, round and between the islands, to diminish again and, finally, to disappear when we go further northward in the direction of the open sea.

The salinities in the left series, which was made on May 2nd and begins with the station south of the island of Leiden, rose gradually in the direction south-north from 32,5 to 32,9‰, those in the right series, which was made on May 3rd, rose in the same direction from 31,3‰ up to 33,1‰. With the left maximum for *Engraulis*-eggs the salinity was 32,4‰, with the right one 33,1‰ (depths 11 and 16 fathoms resp.).

A similar series of hauls made September 7th, 1928, showed in the same way maxima between the islands of Onrust and Leiden. Observations made at other places on the north coast of Java also show that the *Engraulis* eggs form a kind of belt along the coast, occurring to quite near the coast, but disappearing at a certain distance from it.

13. Chanos chanos (FORSK).

In a former nr. of this series (Treubia VIII, p. 400) I have dealt with the propagation of the b a n d e n g (Mal.), or m i l k-f i s h as it is called by American authors (*Chanos chanos* FORSK.). This fish occurs along the tropical coasts of the Indian Ocean and of the western part of the Pacific, according to WEBER and DE BEAUFORT eastward as far as the Paumotu islands, north as far as southern Japan, southward as far as New South Wales, westward as far as the Red Sea and the East coast of Africa and Madagascar. It is of great economic importance, being grown in ponds communicating with the sea, and is much esteemed as food, especially by the Chinese. No wonder, then, that I was very anxious to find out the eggs and the early development of this fish. In the above-mentioned article I gave a survey of what was known about the propagation of the b a n d e n g up to that time. Our knowledge of the eggs and the earlier stages of development proved to be very scanty. I am now able to give a more complete description and will combine this with a recapitulation of the main statements given in article nr. 10 of the present series.

In the marine fish-ponds or e m p a n g s the b a n d e n g does not propagate. It is not allowed to reach the full-grown size and sexual maturity, as long before that time it is caught away to be offered for sale at the fish-market.

Big b a n d e n g l a u t (= sea-bandeng) are caught now and then in the s e r o's (native fish-traps) along the coast. They may attain a length of more than 1 meter. One of 1.12 meter and weighing 11.9 kg is mentioned in SUNIER's article on the marine fish-ponds [1]). The roe of this animal weighed 1304 grammes. The number of eggs making up a weight

[1]) Treubia II p. 159.

of 1 gramme was counted by me and proved to be 4370. The whole roe therefore contained about 5.700.000 eggs [1]). This is among the highest numbers found in fishes; we may safely draw the conclusion from it that the bandeng is a fish with pelagic eggs, as in fishes with demersal eggs or with some form of parental care not nearly such numbers are found.

The diameter of the ripe ovarial eggs proved to be about 0.7 mm. I have found that in general the diameter of pelagic eggs is nearly, but quite, twice the diameter of the ripe ovarial eggs (cf. p. 279). Thus we may expect to find that the eggs of the bandeng will have a diameter of about 1,2 mm. Such eggs are too small to be demersal, they must be pelagical. This conclusion has been confirmed by my recent investigations. In 1926 I described my vain attempts to find the eggs along the Krawang coast (east of Batavia), where the young fry appears at certain periods of the year in considerable number. Numerous hauls with the egg-net were made, quite near the coast as well as at a more or less considerable distance from it, but all attempts were in vain. No. bandeng eggs were found.

On the other hand, during my numerous cruises over the Java-Sea I had once, and once only, found an egg which I believed to belong to the bandeng. This was north of Surabaya, in the year 1921, and as my whole material consisted of one egg only, I could not show the development by a complete series of figures illustrating the succeeding stages.

Quite recently only I have found more of these eggs so that I can now give a more complete description of their development.

First we will consider the places where the eggs were caught. They are:

1° 1 egg, north of Surabaya, 6°47' S 112°50' E (depth 35 metres [2])), date September 24th, 1921. Salinity not determined.

2° 2 eggs, in the Bay of Batavia, halfway between Tandjong Priok and the Cape of Krawang, 5°59' S, 106°55$^1/_2$' E (depth 20 metres) date, September 25th, 1928. Salinity 32$^0/_{00}$.

3° 12 eggs, north-east of the mouth of the Tjimanoek, 6°2' S 188°30' E (depth 41 metres), date September 27th, 1928. Salinity 32.8$^0/_{00}$.

So not before seven years after my first find did I discover more bandeng eggs. Although their number is not yet very great, they allow us to draw certain conclusions regarding the spawning-places of the bandeng. All the eggs have been found in fairly shallow water (depth 20-40 metres), not far from the coast. The salinity in the two cases in which it has been determined was not high, being under 33$^0/_{00}$. From this it seems fairly evident that the bandeng does not migrate so far as e.g. the fresh water eels (*Anguilla*). The numbers of eggs found would have been higher if I had made longer hauls, the two last-mentioned being horizontal surface-hauls of 6 minutes each only.

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[1]) cf. also: *Herre* and *Mendoza*, Bangos Culture in the Philippine Islands, in Philipp. Journal of Science, Vol. 38, 1929.

[2]) All the eggs mentioned here were caught in horizontal surface hauls.

The description of the egg given in my article "On a few larvae of empang fishes" (Treubia VIII, p. 400) applies perfectly to the eggs found in 1928. The diameter is 1.2 mm. which tallies very well with our conclusions drawn from the study of the ripe ovarial eggs (cf. above). The yolk is segmented, but the segmentation is considerably finer than in the eggs of Clupeids. It is so fine, indeed, that I fear I may have overlooked it sometimes in identifying the eggs of the catches and that this might be one of the reasons why I have not found more b a n d e n g eggs during the years 1921—1928. Another particularity of this egg is that the yolk is not quite colourless, as in clupeid eggs, but slightly yellowish. From the *Engraulis*-egg, described in the foregoing nr. of this series, it may be distinguished by the larger diameter, the finer segmentation and the yellowish tinge of the yolk.

Hatching occurs in the evening. The eggs of September 25th, 1928, both hatched at 9 p.m. The eggs of September 27th, 1928, had not yet hatched at 10 p.m. but seem to have hatched slightly later as the larvae examined the next morning at 6 a.m. proved to be in a further advanced stage than the newly hatched larvae of Sept. 25th, the yolk having been resorbed for a considerable part (cf. figs. 2 and 3 of plate III).

The larvae are of the common clupeid type, of elongated shape with the anus situated far backward and a short tail. In two respects they differ from the larvae of clupeids. In the first place the newly hatched larvae show a great number of fine branching black pigment cells, especially on the unpaired finfold, dorsally as wel as ventrally, with the exception of the hindmost part of the tail. But also on the yolk-sac and on the embryo itself they are present, though in smaller number. In newly hatched larvae of clupeids we do not find any pigment cells, these appear only after one or more days. We do find them in the newly hatched *Dussumieria*, though in smaller number than in the newly hatched b a n d e n g (cf. Treubia VI p. 299, figs. 2 and 3). Only black pigment cells are observed in all these early malacopterygoid larvae, no brown, yellow, red, or other colours.

A second difference with clupeid larvae is found in the arrangement of the muscle fibres in the myotomes. In clupeid larvae they show a crossed arrangement, as described by me in Treubia III p. 40. In the b a n d e n g larvae the muscle fibres are all p a r a l l e l to the longitudinal axis of the body, although diverging slightly in the dorsal half of the myotome to the dorsal side, and in the ventral half to the ventral side. A similar parallel arrangement of the muscle fibres is found in the ribbon-shaped larvae of the eels and of *Albula*, *Elops* and *Megalops*. No such stage is passed through by the b a n d e n g. On the other hand the muscle fibres in the myotomes of the *Dussumieria* larva show the crossed arrangement which is characteristic of the clupeid larvae (cf. Treubia VI, p. 229).

The yolk tapers gradually into the gut, as is the case with the newly hatched larvae of *Dussumieria*, *Chirocentrus*, *Engraulis*, *Stolephorus*, *Pellona*, (both not yet published), but not with *Clupea* and *Dorosoma* where the hind part of the yolk is rounded off and does not pass gradually into the gut (cf. Treubia VIII, p. 218 and 389).

In the newly hatched larva (fig 2) the head does not project in front of the yolk. The next morning (fig. 3) the yolk has been resorbed so far that the head now projects beyond it, and one day later a small portion only of the yolk has remained and the under-jaw is growing out. Curious is the early appearance of the first gill-opening long before the remaining gill-slits open. I could see it in the stage of fig. 2 already and in those of figs. 3 and 4 it was quite obvious. In the *Dussumieria*-larva also I observed the early appearance of the first gill-opening. There, however, the gill-openings are covered only by the gill-cover.

The rudiment of the pectoral fin has made its appearance in the stage of fig. 4, in that of fig. 5 it has further developed.

On the third morning after hatching the yolk has been resorbed and the eyes have become black. The distribution of the chromatophores is changing, they are concentrating along the dorsal and the ventral edge of the myotomes. Not more than about a dozen of them are still found on the unpaired fin-fold. A slightly younger stage is shown in Treubia VIII p. 404 where the concentration has advanced about half way.

The next day (fig. 5) this concentration has been achieved, no chromatophores being found any longer on the fin-fold. The chromatophores on the anterior part of the tail show a stronger tendency to branch than those on the trunk.

The number of myotomes in front of the anus in these early larvae was 33-34. Behind the anus some 8-10 more could be counted. The length of the larva shown in fig. 5 is about 5 mm.

The larva shown in fig. 6 (plate IV) is one of the youngest found in plankton catches. Two of them were found in a catch of September 27th, 1928, at5°51 S 108°37' E (depth 48 meters [1]), salinity 33 ‰. The agreement with the larvae hatched from eggs (fig. 5) is quite evident: 33 myotomes in front of the anus, clupeid type but no crossed arrangement of the muscle fibres, black pigment spots along the upper and the lower border of the myotomes. The length has increased from 5 mm to 6 mm, the tail is developing and the rudiment of the dorsal and the anal fin is appearing.

The larvae of figs. 7-10 have been reproduced in my article on the larvae of empang fishes. For the sake of completeness these figures are given here again.

Although the larva of fig. 7 has nearly twice the size of the larva of fig. 6 the agreement between both is quite evident. The number of myotomes in front of the anus is 33, just as in the earlier larvae. The muscle fibres in the myotomes do not show a crossed arrangement, as in clupeid

[1]) This indicates only the depth at the place where the larva was caught. All the larvae were caught in horizontal surface hauls.

larvae, but run parallel to the longitudinal axis. Again we find two rows of black pigment spots, one along the upper edge of the myotomes and one ventral. The latter, however, does not exclusively line the ventral edge of the myotomes but is partly situated along the under side of the gut, especially in the hinder part. The tail has developed, the dorsal and the anal fin are just appearing.

This larva was caught in the Bay of Batavia near the isle of Amsterdam, 106°44' E, 5°58' S, January 13th, 1923 (salinity of the water 32.7 ‰, depth 24 meters).

Larvae of 11, 12 and fully 13 mm resp. are shown in figs. 8, 9 and 10. The two former were taken in horizontal hauls with the egg-net, the latter shows the stage in which the b a n d e n g fry approaches the coast and is gathered there as b i b i t b a n d e n g or n e n e r for the sea-water ponds in which the b a n d e n g is reared.

In these successive stages we see the number of myotomes in front of the anus gradually decrease from 33 to 31-32. In the larva of 13 mm. $32 + 11 - 12$ myotomes could be counted. In the adult b a n d e n g the number of vertebrae is $30 + 13$. Just as is the rule with clupeids and with *Dussumieria* we consequently see a forward shifting of the anus during larval development.

A gradual change in the pigmentation may likewise be observed. We see a gradual displacement of the chromatophores from the dorsal edge of the myotomes to the lateral line where in fig. 10 they are arranged in a regular row.

I succeeded in rearing a number of these larvae brought to Batavia on October 4th, 1924, by feeding them with the yolk of hard-boiled eggs. They reached a length of $19^1/_2$ mm on November 11th, when they died. In a stage of 14 mm the first rudiments of the ventral fins made their appearance, under the 20th myotome. In a stage of 16—17 mm these fins had developed further and the fin rays had appeared. In this stage I counted 30 myotomes in front of the anus.

The height of the larva increased gradually and consequently the shape of the young fish approached that of the adult form. At the same time a fine black dotting spreads all over the surface of the body of the fish, being densest dorsally.

Many sea-fishes in the tropics appear to spawn the whole year round, without any marked seasonal periodicity. The b a n d e n g is one of the cases in which seasonal periodicity may be observed. The b a n d e n g fry appears on the coast in two periods, viz. first in the months of April and May and again in the months of September, October, November, the catch during the latter period being of the greatest importance. It seems, therefore, no mere chance that the three catches of b a n d e n g eggs made thus far were all in the same month, September.

The way in which the b a n d e n g fry is collected has been described before (cf. Treubia VIII p. 400).

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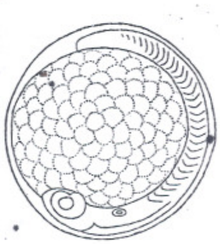

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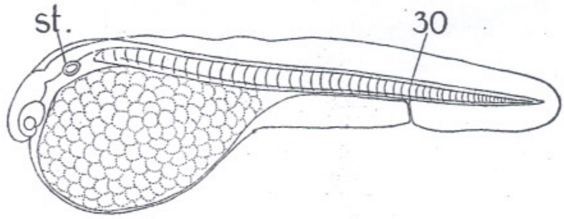

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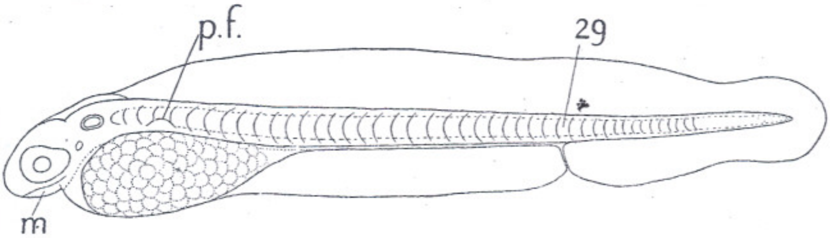

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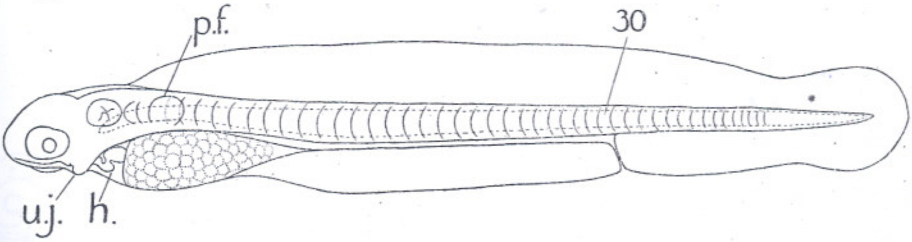

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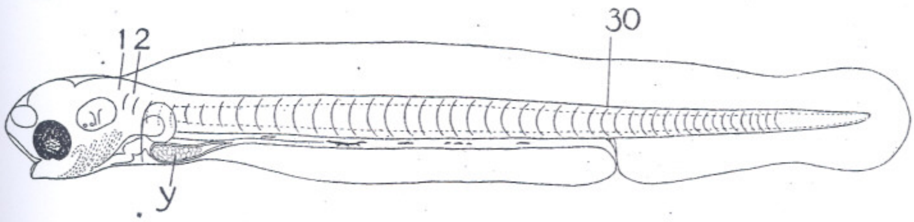

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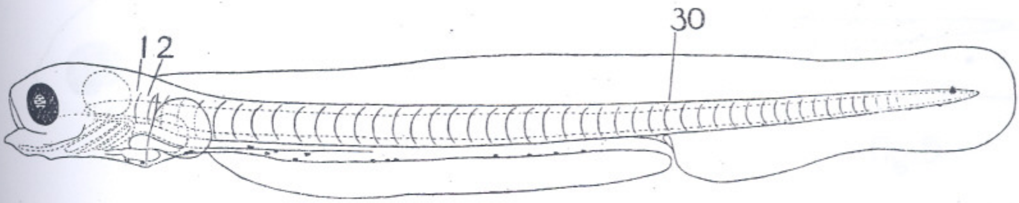


Fig. 1. Egg of *Engraulis Grayi*, about 10 a.m., × 26.
Fig. 2. Newly hatched larve, × 26. *st.* statocyst.
Fig. 3. Larva of the next morning, 6.30 a.m., × 26. *pf.* rudiment of pectoral fin, *m.* mouth.
Fig. 4. Larva of 24 hours, × 26. *h*, heart, *u.j.* lower jaw.
Fig. 5. Larva of 36 hours, with black eyes and pigmentation, × 26. *y* rest of the yolk.
Fig. 6. Larva of $3^1/_2$ days, × 26. In the eye the *tapetum lucidum* has appeared.

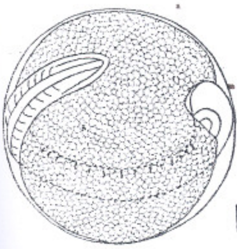


Fig. 1

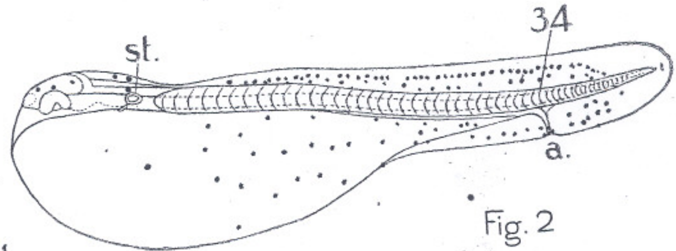


Fig. 2

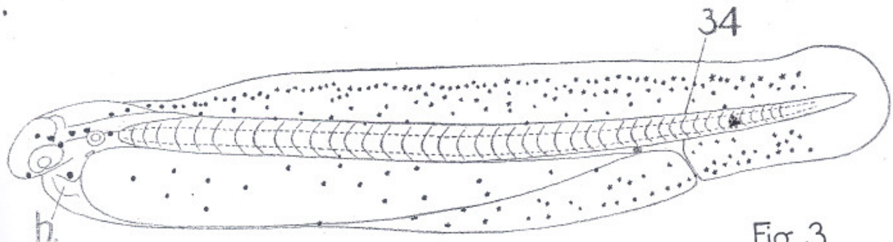


Fig. 3

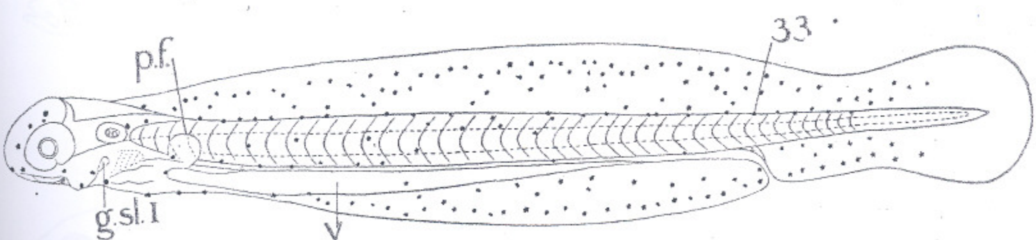


Fig. 4

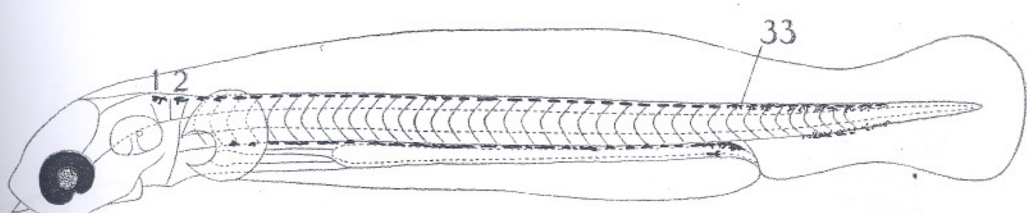
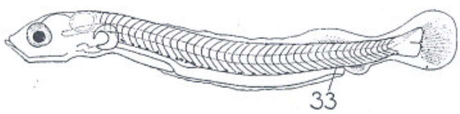
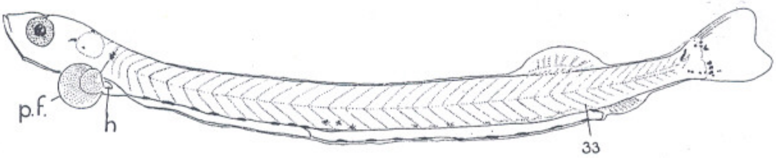
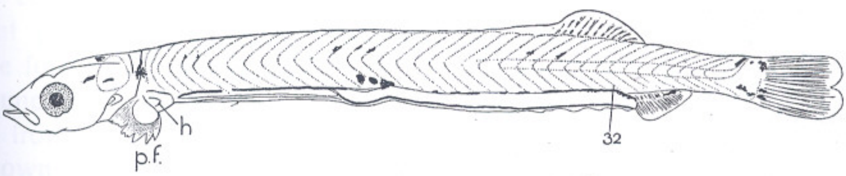


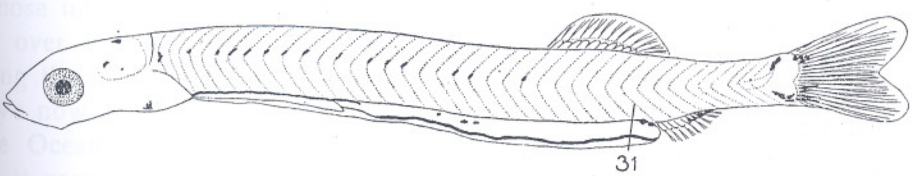
Fig. 5

Fig. 1. Egg of the bandeng, drawn 3.30 p.m., ×26
Fig. 2. Newly hatched larva, at 9 p.m. ×26
a. anus, *st.* statocyst.
Fig. 3. Larva of the next morning, ×26
h. heart.
Fig. 4. Larva of the second morning, ×26
g. sl. I. first gill slit, *p.f.* pectoral fin, *y.* yolk.
Fig. 5. Larva of the fourth morning, ×26





8. 

9. 

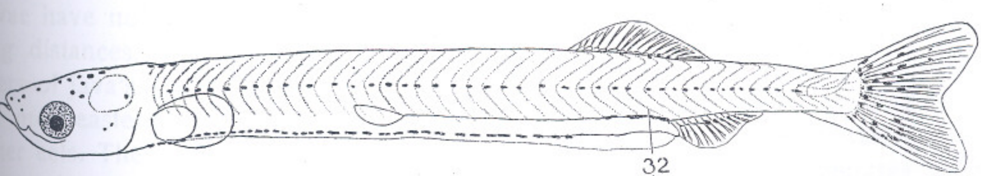
10. 

Fig. 6 Pelagic larva of 6 mm, ×10
,, 7 ,, ,, 10 ,, , ×10
,, 8 ,, ,, 11 ,, , ×10
,, 9 ,, ,, 12 ,, , ×10
,, 10 Larva of fully 13 mm, showing the stage in which the b a n d e n g is caught along the coast, × 10.