

Featherback Fish (*Notopterus chitala*). Pla Krai.

From a specimen 48.25 cm. long taken in the Menam Chao Phya at Bangkok August 1, 1925.

From a drawing by Nai Chote Suvatti.



## CONTRIBUTIONS TO THE ICHTHYOLOGY OF SIAM.

By HUGH M. SMITH.

VII. THE FEATHERBACK FISH *Notopterus chitala* IN SIAM,  
WITH NOTES ON ITS EGG-LAYING AND YOUNG.

## THE FEATHERBACKS OF SIAM.

Of the four species of *Notopterus* now recognized, one occurs in Africa, one is found in Borneo and Sumatra, and two have a wide range in the East Indies, India, Indo-China, Malaya, and Siam. The Siamese forms are *Notopterus chitala* (Hamilton) and *Notopterus notopterus* (Pallas), the latter called *Notopterus kapiat* by Günther, Bleeker, and Day.<sup>1</sup> Both are among the commonest and best-known of the fresh-water fishes of Siam. While inhabiting rivers and canals, they occur in greatest abundance in lakes and swamps, which are their principal breeding places. The larger species, *N. chitala*, is essentially a fish of the large waters, in which it is always conspicuous from its habit of frequently coming to the surface, making a splash, and rolling over, exposing for a moment its broad, silvery side. Its maximum length, as reported from India, is 1.2 meters or more, while in Siam a length of 1 meter is rarely attained and the average size of adults does not exceed 70 to 75 cm. Weber and de Beaufort<sup>2</sup> give 875 mm. as the maximum length. The other species is said to reach a length of 60 cm. or more in India; Weber and de Beaufort,<sup>2</sup> following Bleeker, give a maximum length of 35 cm.; while Siamese records indicate that 40 cm. or more may be attained. A dozen adult fish taken at random from a large catch in a kabang at Hangkraben, Central Siam, December 11, 1924, were 24, 26, 28, 28, 28, 28, 29, 33, 33, 34, 35, and 38 cm. long.

<sup>1</sup> There is some evidence that a third species may inhabit Siam. In Bung Borapet, for instance, there has been observed a form which seems to differ considerably in general appearance from the other two local species, and is called *pla satu* by the fishermen, but no specimens are available for examination. If a third form actually occurs, it is likely to be *Notopterus borneensis* Bleeker, of Borneo and Sumatra.

<sup>2</sup> Fishes of Indo-Australian Archipelago, ii, 1913.



The Siamese names applied to *Notopterus chitala* are *pla krai* and *pla hang pan*, "krai" meaning to move slowly but smartly and "hang pan" meaning broad tail. *Chिताia* is the Bengali colloquial name for the fish. *Notopterus notopterus* is called *pla chalat* or *pla salat* in Siamese, the term meaning clever or cunning. *Kapirat* is a Malay name for both species. Featherback is a book-name having reference to the diminutive tuft-like dorsal fin.

The featherbacks subsist on insects, mollusks, shrimps, and fishes. The smaller species, *notopterus*, is reported to eat insects and the roots of aquatic plants. The small surface-swimming fishes appear to be the more common food of *pla krai*. In the Menam Chao Phya at Bang Sorn in Bangkok, on September 12, 1923, a scattered school of *pla krai* was feeding on the half-beak *Zenarchopterus ec-tuntio* (*pla katung heo*), which was then common and about 15 cm. long, and also on the shooting-fish *Toxotes jaculator* (*pla seuu*).

The featherbacks are of considerable commercial value in various parts of Siam, being caught in large quantities and sold fresh and smoked. The flesh is sweet but full of small bones. A favorite method of preservation is by smoking, especially for *pla chalat*. In the Bangkok markets, *pla krai* is beheaded and cut into steaks or slabs for the retail trade. A full-sized fish may sell for 2 ticals. For home use, in order to overcome the bones, the flesh is chopped fine, made into balls, and cooked with curry.

The business of transporting live *pla krai* from the fisheries to the markets is of some importance. On November 16, 1923, at the mouth of the Sikuk River, Central Siam, the writer examined a rice barge filled with water and containing 3,000 large *pla krai* destined for Bangkok. The fish had come from Bung Borapet, from a sub-swamp under lease.

*Pla krai* shows considerable color variation in different parts of its wide range. In Siam there is always a longitudinal series of large, round black spots above the anal fin; these spots number 6 to 10 on each side, are larger than the eye, and often have a well-defined white ring around them. In India, according to Day's very imperfect description (*Fishes of India*), the spots "are like black stars

in the caudal region, placed in a single or double row close to the anal fin and sometimes extending the whole length of its base," while his figure shows two minute round spots near the base of the caudal fin. In the Indo-Australian Archipelago, the fish usually lacks the black spots, and the figures of Bleeker (Atlas Ichthyologique) and of Weber and de Beaufort are immaculate; these authors remark, however, that rarely there is a series of 4 or 5 black spots in the caudal region.

#### EGGS AND EGG-LAYING IN *NOTOPTERUS CHITALA*.

Few observations appear to have been made anywhere in regard to the spawning, incubation, and young of any species of *Notopterus*, and little or nothing has been recorded thereon. Boulenger (Cambridge Natural History, Fishes, 1910) says: "Nothing is known of their breeding habits and development." In Dean's monumental Bibliography of Fishes (1916-1923) there are no references to this subject.

The principal purpose of the present paper is to put on record some observations on the spawning, eggs, and young of *Notopterus chitala* that have been made in Siam during the past ten years, to refer to experiments in artificial hatching, and to describe young stages of the fish from specimens in the collection of the Department of Fisheries. The chief observations were made in 1931, 1932, and 1933 at Bung Borapet by Luang Anantamasya Pithaks and Nai Boon Chuay Indrambarya, of the department staff, to whom much credit is due for their pioneer work. It will be apparent that there are various obscure points in the life of this fish, and it is hoped that the observations will be continued.

It has long been well known to fishermen in Siam, and was noted by the present writer as early as 1923, that *Notopterus chitala* attaches its eggs to piling, posts, stakes, roots, stumps, and branches of trees that have fallen in the water. The eggs are covered with an adhesive substance which quickly sets when it comes in contact with water.<sup>1</sup>

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<sup>1</sup> While it is reasonable to assume that the breeding habits of *pla chalat* are similar to those of *pla kraai*, there is a lack of observations. The only available information is a statement by the late Dr. Yai S. Sanitwongse that *pla chalat* attaches its eggs to the roots of aquatic plants.



No observations have been made as to the behavior of the fishes at the time of spawning and as to the manner in which the eggs are attached. Deposition appears to take place mostly or wholly at night, and the eggs are placed in a single layer, close together, and rather uniformly distributed over the surface of the stake or stump. On a four-sided post the eggs may be attached on each side, and on a cylindrical bamboo stake the eggs may be found completely encircling the wood.

In water 1.5 to 2 m. deep, the mass of eggs as laid may reach to within 50 to 70 cm. of the surface of the water and to within the same distance of the bottom, and the vertical extension of the egg mass may be from 60 cm. to 1 m.

In Bung Borapet, the period during which eggs are laid extends from February or even late January, into August, when flood water begins to reach the swamp. This protracted time is doubtless correlated (1) with the more or less uniform physical conditions which prevail in the bung during those months and (2) with the fact, elsewhere referred to, that a given female *pla krai*, in order to void all her eggs, requires several separate spawnings at intervals of perhaps a month or more.

While the fish lays its eggs in all parts of the bung, a favorite locality is Klong Borapet, the main outlet, between its head and the barrage, a distance of 5 kilometers. The klong seems to be preferred to the bung as a spawning ground. The advantages of the klong are that there are fewer enemies of eggs and young, the water is more turbid and hence provides more concealment, the water is somewhat warmer and hence development is more rapid, and there is an abundance of submerged stumps for the attachment of the eggs.

It is a belief among the fishermen in Bung Borapet that a fall of rain induces the deposition of eggs. Nai Boon Chuay systematically examined posts in connection with rainfall but reached the conclusion that the available evidence did not sustain the belief; and an examination of a temperature-rainfall record fails to show any obvious relation between rainfall and egg-laying.

An interesting observation, first recorded by Nai Boon Chuay,

is that, before the eggs are laid, the parent fish clear a circular space at or around the base of the stake or stump that has been chosen for the attachment of the eggs. The area is a shallow depression 50 to 60 cm. in diameter, and its purpose is to serve as a resting place or kind of nest for the fish during the early days of infancy. It has not been possible to determine definitely which parent prepares the nursery basin, but Nai Boon Chuay is inclined to believe that it is the male which is mainly, perhaps wholly, responsible.

The egg of *pla kra*i after fertilization and attachment is 4 mm. in diameter and spherical in shape except where it is flattened by contact with the wood. The color is pale yellow. A strong, fishy odor emanates from the eggs both before and after extrusion, and this persists after the eggs are attached to a post or stake. The odor doubtless has a useful purpose, but would seem to be detrimental to the welfare of the species in that it may attract fishes and other creatures which destroy the eggs. After attachment, the eggs are somewhat slimy during the whole hatching period. This condition would appear to be a disadvantage in that it favors the deposition of sediment which may interfere with development or completely smother the eggs.

The number of eggs deposited at one time, on a single post or stump, may reach several thousands. An egg-covered four-sided stake which was taken up for observation July 17, 1932, was found to have 1,733 eggs on two sides, with approximately the same number estimated to be on the other two sides, a total of more than 3,400. It is not known whether this was the first, second, or third laying of a given fish and whether the different layings are of similar size. It is apparent that *Notopterus chitala* is a fairly prolific fish, and it is likely that the egg-output of a single female in one season exceeds 5,000 and may even reach 10,000 or more.

During May, June, and July, 1932, there was maintained along the banks of Klong Borapet, near the regulator which controls the level of water in the bung, a series of experimental stakes one to two meters apart and driven into the bottom in water 1.5 to 2.0 m. deep. The stakes, which were of well-cured bamboo poles, or



square posts 6 to 10 cm. in diameter, and about 3 m. long, numbered 53 and were intended to serve as egg-laying places for *pla krai*. The stakes were examined daily or every other day, either by pulling them up so that their sides could be inspected or by having men dive and determine the presence or absence of egg by gently passing their fingers over the surface. The fish responded quite well to the facility thus afforded them, as shown by the following record, from which it will be seen that 36 stakes were utilized on 18 days, the largest number observed on any single day being 5 on July 2:

*Experimental stakes to which batches of eggs of pla krai were found attached on dates indicated, Klong Borapet, 1932.*

<i>Date.</i>		<i>Number of stakes.</i>	<i>Date.</i>		<i>Number of stakes.</i>
May	3	1	June	15	2
	4	1		20	2
	6	1		21	1
	18	2		30	1
	21	1	July	2	5
	26	2		6	1
	30	2		12	2
June	1	4		15	2
	8	4		30	2

In 1932 Nai Boon Chuay tried the experiment of placing around the eggs, on a stake in Klong Borapet, a metal frame covered by a thin white muslin cloth in such a way as to prevent predatory fishes from reaching the eggs. The experiment failed because this kind of protection to the eggs does not prevent the deposition of sediment in the dead water within the enclosure.

In a further experiment in 1932, a stake with attached eggs was placed in a protecting enclosure made of brass-wire mesh. This experiment was in the open water of the bung, near the floating headquarters of the Department of Fisheries, the water there being much clearer than in the klong. The eggs were cleaned daily by an attendant using a feather and acquired a very slight deposit of sediment; all hatched in about 9 days.

There is evidence, supported by anatomical data, indicating that the mature female *pla krai* lays each season three separate



batches of eggs at widely-separated periods, and that three male fish are needed to fertilize and care for the eggs of one female. This species may therefore be said to practice a form of polyandry.

The existence in a single fish of eggs of several different stages of development has been shown by repeated dissections. Thus, a fish 77.5 cm. long, weighing about 8.5 kilograms, was caught with a baitless hook at an egg-laying stake in Klong Borapet at 8 o'clock a. m. on May 28, 1932. It was a female which had evidently not completed the deposition of eggs on the stake, on which eggs had been detected at 6 a. m. on the same day. In the hands of Nai Boon Chuay the fish yielded about 200 fully ripe eggs on being "stripped" by gentle compression of the abdomen. When subsequently dissected the fish was found to contain ovarian eggs of two different sizes which the observer thought would have come to maturity in about one and two months, respectively.

On a number of occasions during 1933 Luang Anantamasya Pithaks, while stationed in Bung Borapet, confirmed the previous observations on this point. In June fish that were known to have recently laid one batch of eggs were shown to contain eggs of two non-intergrading sizes the larger of which were smaller than those found in ripe fish and were estimated to be several weeks short of maturity. On July 27, a dissected fish showed eggs of three different sizes: the largest fully ripe and running freely from the fish when the abdomen was compressed; the second grade a little less than 3 mm. in average diameter, adherent to the ovarian connective tissue and not extruded on compression of the abdomen; the smallest about 1 mm. in diameter and likewise not extrusile.

An interesting fact, confirmed by numerous observations, is that in *pla krai* only a single ovary develops during one season. Whether there are two ovaries which alternate in activity from year to year, or whether only one ovary ever functions, remains to be determined. The mature ovary occupies the left side of the comparatively small abdominal cavity, the digestive and other viscera being pushed to the right side. The ovarian mass is roundish, laterally compressed, and in a fish 75 cm. long is about 10 to 12 cm. in longitudinal

diameter. When the investing membrane is removed, the organ is seen to be multilobed and the lobes in turn lobulated. A short oviduct discharges into a cloaca.

#### CARE OF EGGS, INCUBATION PERIOD, AND NEWLY-HATCHED YOUNG.

It appears to be well established that the care of the eggs devolves only on the male fish. A given female, having deposited one hatch of eggs, is presumably occupied in finding a second mate, selecting a spawning place, and preparing for the next ripening of her eggs. At any rate, female fish are not found at the egg posts under circumstances that would suggest any maternal solicitude.

Throughout the time the eggs are hatching, the male fish is in assiduous attendance and performs a very important service. Human intruders have found that the parent will attack fiercely at that period. Prince Vipulya, in his "Notes on Red Fishing in Bangkok" (Journal of Natural History Society of Siam, vol. vi, 1923), states of *pla krai*: "It is very savage during the egg-laying season." Natural enemies of the eggs are driven off. These are for the most part small fishes, especially catfishes of the genus *Mystus*, called *pla kayeng* by the local fishermen, and minnows of the genus *Rasbora*, called *pla siew*. Perhaps the most important act of the male is to keep the eggs aerated and to prevent the accumulation of sediment, by fanning movements of its large tail. In the absence of current, the eggs may become covered with sediment which prevents normal development and induces the growth of fungus. With the guardian removed, the eggs are preyed on by small fishes and those that escape are coated with sediment and asphyxiated.

The local people take advantage of the devotion of the male *pla krai* to the care of the eggs by fishing around a stake or stump that has been found to bear eggs. Using unbaited hooks by jigging or a hook baited with shrimp, insect, or small fish, they sooner or later catch the guardian and thoughtlessly sacrifice the incipient brood.

Nai Boon Chuay experimented with the moving of the post after the eggs had been attached, in order to determine how far the parent fish would follow the eggs. Apparently the parent fish's



solicitude or recognition extends only a short distance. If an egg-bearing post is pulled up and again set within 50 cm. of its original site, the parent will continue to give attention, but if the post is moved a greater distance the eggs are abandoned and lost.

According to Nai Boon Chuay's observation in 1932, *pla kraï* eggs attached to stakes in Klong Borapet hatched in 5 to 6 days, at an average temperature of 33° C.

As soon as hatched, the young fish drop to the bottom and collect in the muddy depression at the bottom of the stake. In that situation the young are not easily observable, but the workmen sometimes dived and felt the young in the depression, and sometimes brought up young in their hands. The fish remain in the "nest" until the yolk-sac is absorbed and then begin to swim near or at the surface and to search for food.

#### EXPERIMENTAL HATCHING AND REARING OF PLA KRAI.

In 1931 Luang Anantamasya Pithaks, while stationed in Bung Borapet, made some pioneer experiments in artificially taking and fertilizing the eggs of *Notopterus chitala* and in artificially hatching eggs that had been found attached to posts.

On May 25 a pair of ripe fish was obtained, and the eggs and milt were stripped from them into a porcelain dish. As hatching troughs were not yet available, the eggs were placed in a basket and put in the klong. Subsequent examination showed them to be fertilized. On May 27 the eggs were found to be thickly covered with sediment, and hatching was not possible. An experimental hatchery for *pla kraï* was then arranged. Two tanks each holding 400 gallons were set up near the barrage in Klong Borapet, and these were filled, and kept filled, with klong water which was discharged into a supply trough at the rate of a gallon a minute from each tank. The water from the supply trough flowed into 3 hatching troughs each 2.5 m. long, 20 cm. wide, and 20 cm. deep, with an outlet and screen at the lower end. The water from the hatching troughs passed into an overflow trough from one end of which a pipe carried the water into a dirt pond 1.5 by 2.25 m. This little pond, with a screened outlet, drained into the klong. On June 2, two batches of eggs

as attached to stakes were placed in the hatching troughs. These eggs, believed to have been laid two days before, would have been lost because the guarding males had been caught by the local people, and one lot had already been partly destroyed by *pla kayeng* and *pla siew*. Hatching was successful, after 8 days, although about 20 per cent of the eggs were killed by fungus and sediment. The number of young actually hatched was 1,614; these were transferred to the small pond where they fed and kept under observation for some weeks, and liberated early in August.

Another lot of eggs, taken one by one from the roots of a tree to which they were attached, were placed in hatching troughs and successfully incubated. About 2,000 young were thus obtained, after an egg mortality of 20 per cent.

In 1932 Nai Boon Chuay repeated some of the hatching experiments of Luang Anantamasya Pitlaks of the previous year. Two lots of eggs laid on May 4 were transferred to hatching troughs on May 7 and hatched May 16, and the yolk-sac was absorbed by May 20 or May 21. When the young first began to eat, they were supplied with minute crustaceans and other plankton organisms caught in the klong by means of tow-nets made of silk bolting-cloth and of fine muslin, and on this food they thrived and grew rapidly.

#### SIZE, COLORATION, AND GROWTH OF YOUNG.

A normal batch of *pla krai*, hatched on May 25, 1931, had the following features: Length of fish immediately after emerging from the egg, 12 mm.; length of head and yolk-sac, 5 mm.; yolk-sac, 3 to 3.5 mm. long, 2.5 wide; body transparent, unpigmented; yolk-sac pale yellow; eyes black, showing distinctly through the sides of the opened mouth; a broad, median, lengthwise, continuous fin-like fold, broadest posteriorly, extending from the head completely around the tail to the yolk-sac.

A lot of fish hatched on May 16, 1932, from eggs laid on May 4 were killed on May 20 when the absorption of the yolk-sac was complete. Seven of these fish had the following over-all lengths: 1.3, 1.5, 1.5, 1.5, 1.6, 1.7, and 1.8 cm. One of the same batch with the yolk-sac not fully absorbed was 1.2 cm. long.



A lot of fish hatched May 16, 1932, from another batch of eggs laid on May 4, with yolk-sac absorbed by May 21, were kept in an artificial pond until June 13 and then preserved. The length of most of them when killed was 3.4 to 3.5 cm.; but some of them had attained a length of 5.1 cm.

The characteristic shape of the adult fish, with its strongly developed concavity at the nape, is not observable in the very young. At the time of absorption of the yolk-sac the dorsal profile is slightly convex, and even in fish up to 5 or 5.5 cm. long and 30 to 40 days old the upper profile of the head is slightly convex or nearly straight. At about the length of 7 cm., however, the concavity begins to appear and increases with advancing age.

The young *pla krai*, up to a length of 2.0 cm. or a little more, show no evidence of the strongly marked color pattern which is soon to appear. Fish 4 to 5 days old, of the lot already referred to as having been hatched on May 16, 1932, and killed on May 20, had the back dark gray; the head and abdomen profusely and minutely spotted with blackish or dark gray on a silvery-white background, similar spots being on the body along the base of the anal fin; the fins hyaline, with some dark powdering on the caudal.

The coloration of fish 29 days old and 3.4 to 3.5 cm. long, examined on June 13, 1932, was as follows: General color light gray; 10 or 11 dark gray cross bands, slightly narrower than the interspaces, involving the side both above and below the lateral line but not reaching the median line of the back; in some specimens each of the 2 anterior bands showed an incipient vertical division into two bands by the partial disappearance of the central pigment.

A fish of the same lot as the foregoing, 29 days old but 5.1 cm. long, had the general color bright silvery gray, with 12 or 13 very distinct dark gray or blackish crossbands about the width of the interspaces anteriorly but narrower posteriorly; these crossbands not reaching the median line of the back anterior to the dorsal fin, but meeting under and posterior to that fin; and the crossbands not reaching the median ventral line, and their lower end showing no indication of differentiation into a spot; side of head posterior to eye

with numerous sharply defined small black spots; similar spots less sharply defined occurring thickly on abdomen and along body at base of anal fin.

By the time the *pla krai* reach a length of about 6.75 to 7 cm., a new pattern of coloration is assumed, and there have appeared the forerunners of the large black lateral spots which are the only markings in the adult fish. On July 25, 1932, 50 fish with an average length of 4.5 cm., were taken in the Nan River near Pak-nampo. On August 25, when only 7 of the fish had escaped various vicissitudes and accidents, these were preserved, and showed the following lengths: 6.8, 6.8, 7.1, 7.1, 7.1, 7.3, and 7.7 cm. Their color (in formal) was as follows: Ground tone of body silvery gray; back with 15 dark gray cross-bands, meeting at the median line of the back, the first band on the nape, the others extending obliquely downward and forward, crossing the lateral line and running to the abdomen or to the base of the anal fin; the bands above about twice the width of the interspaces, becoming narrower below; each of the 8 posterior bands ending below in dark brown rounded or elliptical spot (the largest about the size of the eye), the anterior spot being posterior to the dorsal fin; head and lower part of the anterior third of the body profusely covered with small roundish dark brown spots largest and most distinct on the cheek.<sup>1</sup>

#### SUMMARY.

Summarizing the foregoing observations on the spawning, eggs, and young of *Notopterus chitala* in Bung Borapet, it appears that:

- (i) The egg-laying period extends from January to August.
- (ii) The eggs as laid are attached in a single layer to piling, posts, stakes, or stumps.

<sup>1</sup> The crossbands in *pla krai* are very different from those in *pla chalat*. In the latter fish the bands number 28 to 30, 3 or 4 extending on the head; they gradually grow less distinct and usually disappear when the fish reaches a length of about 15 cm., but occasionally persist faintly, on the anterior part of the body, in adult fish. A figure of a young *Notopterus notopterus* is introduced for comparison.



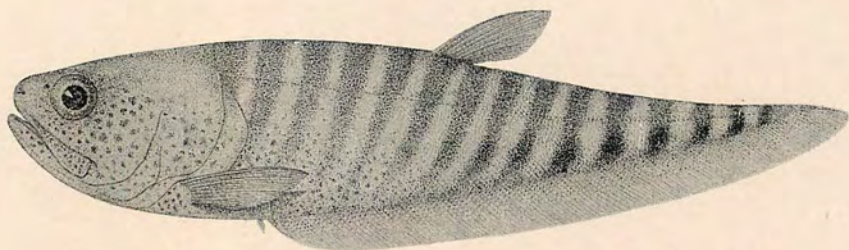


Fig. 1. Featherback Fish (*Notopterus chitala*). Pla Krai.

From a specimen 6.7 cm. long taken in the Menam Nan near Paknampo,  
Central Siam, July 25, 1932.

From a drawing by Luang Masya Chitrakarn.

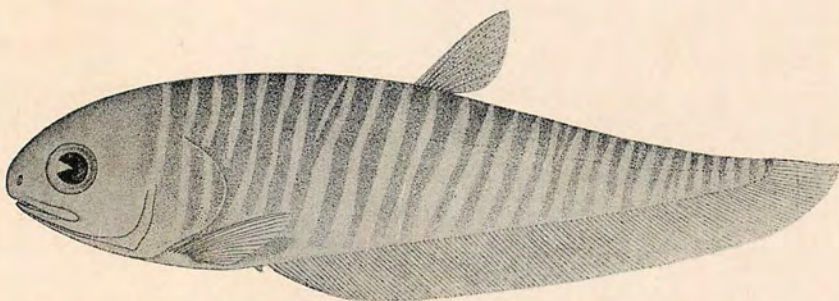


Fig. 2. Featherback Fish (*Notopterus notopterus*). Pla Chalat.

From a specimen 4.0 cm. long taken in the Menam Chao Phya at  
Bangkok August 4, 1925.

From a drawing by Nai Chote Suvatti.





- (iii) Each fully mature female lays three separate batches of eggs in the course of a season, and a separate male fish is required for the fertilization of each lot of eggs.
- (iv) Only a single ovary develops during a given season, and it occupies the left side of the small abdominal cavity, discharging into a cloaca by a short duct.
- (v) The eggs are comparatively numerous, several thousand may be deposited at one laying and ten thousand or more in the course of a season.
- (vi) The care of the eggs devolves on the male parent, which is active in keeping the nearby water agitated with his tail so that sediment may not settle on the eggs.
- (vii) The male parent assiduously guards the eggs, savagely attacks human and other intruders, and repels small fishes which are prone to devour the eggs.
- (viii) In the absence of the care and protection of the male, the eggs undergo heavy mortality from being covered by sediment and from being consumed by fishes.
- (ix) The eggs, either attached to stakes or removed therefrom, are susceptible of incubation in troughs of running water, and artificial hatching may profitably be resorted to in order to save eggs that have been deprived of the care of the male fish.
- (x) The period of incubation in klong water is 5 to 6 days in an average water temperature of 33°C., while in hatching troughs the incubation took about 12 days.
- (xi) Immediately after hatching, the young drop to the bottom and occupy a small shallow depression prepared by the parent fish before the eggs are laid.
- (xii) The young remain in the "nest" until the absorption of the yolk-sac, which occurred in 4 to 5 days in a hatching trough, while in klong water the period is shorter.

- (xiii) Newly-hatched fish are unmarked, but by the time a length of 3 to 3.5 cm. is reached the body shows numerous dark crossbands. At a length of 6 to 7 cm. a dark brown spot develops in the lower part of each of the posterior crossbands. With further growth, the crossbands gradually disappear but the dark spots become more intense and persist.
- (xiv) Adult *pla krai* in Siam always have along the base of the anal fin 6 to 10 round black spots, about the size of the eye, usually surrounded by a white ring.



## VIII. PLA SALID IN THE MALAY PENINSULA.

The well-known Siamese fish *Trichogaster pectoralis*, or *pla salid*, was described by Dr. C. Tate Regan in 1909 from specimens from Bangkok and Singapore in the British Museum. It has been an open question whether this species is native to any part of the Malay Peninsula. As the fish bears transportation readily and has a high reputation as a pond fish, its introduction into Malaya from Siam would have been easy and to be expected, but no record of such introduction has been met with by me.

In extensive collecting by the Siamese Department of Fisheries, this species has not been obtained in the Malay Peninsula. It is not mentioned by C. N. Maxwell in his "Malayan Fishes" (Singapore, 1921), and is not listed in Weber and de Beaufort's "Fishes of the Indo-Australian Archipelago" (Leiden, vol. iv. 1922) which includes Singapore.

In various reports of the Department of Fisheries of the Straits Settlements and Federated Malay States, there are references to a fish called *sepat siam*, *sepat* being a Malay name for members of genus *Trichogaster* (or *Trichopodus*). The designation *sepat siam* naturally suggested a Siamese origin, and in 1929 I wrote to the officer-in-charge of the Department of Fisheries as to the scientific identification of the fish so called. In a letter dated September 5, 1929, that official stated that "the *sepat benua* or *sepat siam* is undoubtedly *Trichopodus trichopterus* (Pallas)." That species in Siam is called *pla kadi mor* and is very distinct from *pla salid*.<sup>1</sup>

There the matter rested until 1933 when it was reopened by a request on the Department of Fisheries in Singapore for an example of the fish called *sepat siam*. This request was courteously complied with in April when there was forwarded a preserved "specimen of *sepat siam* which is found in large quantities in the rice fields in this country." The fish proved to be a *Trichogaster*

<sup>1</sup> A similar error is made by Chevey (Poissons des campagnes des "du Lanessan", Iconographie Ichtyologique de l'Indochine, 1932), in which monumental work, under *Trichopodus trichopterus*, the Siamese colloquial names are given as *pla salit* and *pla kadi*, and a full-page colored plate called *Trichopodus trichopterus* is that of *Trichogaster pectoralis*.

*pectoralis*. Further inquiry elicited from the Department of Fisheries the statement dated June 27, 1933, received through the Director of the Raffles Museum and Library, Singapore, that "the fish *sepat siam* was introduced into Singapore about 35 years ago and into the Krian District in Perak about 20 years ago," and had "been distributed in the padi fields in Malaya and stood journeys by rail for 300 miles in half a kerosene tin of water fairly well."

The report of the Department of Fisheries of the Straits Settlements and Federated Malay States for 1932 contains further information regarding the economic importance of this fish in Malaya. The fish, however, is there erroneously identified as "*Tricopodus leeri*." *Trichogaster (Trichopodus) leeri* is a fish of an entirely different aspect and food value, known among the Siamese as *pla kadi nang*. The report says:

The demand for "*sepat siam*" has not increased and only a few tins were required during the year. This is rather a good sign and indicates that the original stocking has been successful. The stocks will continue to increase as the cultivation of wet padi increases. Generally the fish is welcome, and there is no doubt as to its great economic value. Still there are many who object to its introduction on the ground that it drives away all the "*aruan*" (*Ophiocephalus*) and claim that it eats the spawn of "*aruan*". It is difficult to believe that this is altogether true. There are no figures available as to what is the total annual production of "*sepat siam*" in Kedah and Krian, but it is enormous. . . . . The fish is very oily and is of immense value as a locally produced food.

Figures are given for ten ponds each 29 to 32 feet long, 18 to 21 feet wide, and 6 feet deep showing an actual yield of 300 to 2,800 katties of *pla salid* per pond, a total of 9,080 katties (1 katty equal to 0.6 kilogram).