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# Sillaginid fishes of Palk Bay and Gulf of Mannar with an account on the maturation and spawning of Indian sand whiting, *Sillago sihama* (Forsskal)*

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ABSTRACT

In the Palk Bay and Gulf of Mannar 6 species of the family Sillaginidae occurred: *Sillago (Sillaginopodys) chondropus, Sillago (Sillago) sihama, Sillago (Sillago) indica, Sillago (Parasillago) vincenti, Sillago (Parasillago) argentifasciata* and *Sillago (Parasillago) soringa*. A key to the identification of these species is given and their morphometric and meristic characters tabulated. *S. sihama*, the most dominant sillaginid species in this region, was a prolonged breeder. The spawning season of this species extended from July to February, with peak spawning activity during July to November. Lengths at first maturity of females and males were 179 and 159 mm respectively. Fecundity varied from 6 956 to 48 373 and showed high correlation with length, body weight and ovary weight of the fish. Overall sex ratio indicated predominance of females. Length-related sex ratio showed significant dominance of males till 170 mm and that of females above this length.

Sillaginids or sand whitings are highly esteemed food fishes occurring in Indian waters from Hooghly river in the east coast to Goa in the west coast (Sujatha 1987). In 1980, it was established that 9 species of sand whitings occur in Indian waters (Dutt and Sujatha 1983). Proper identification of the fishes belonging to 6 species of Sillaginidae has not so far been done in the Palk Bay and Gulf of Mannar. These 6 species were collected and their identification key given in this study.

Among the Indian sillaginids, *Sillago sihama* is commercially most important. It forms about 60% of all sillaginids landing in Palk Bay and Gulf of Mannar. Its high palatability, euryhalinity and good growth rate make it ideal for coastal aquaculture. This study gives a detailed description on its reproductive biology.

## MATERIALS AND METHODS

Samples of *S. sihama* were collected from Mandapam, Pamban, Rameswaram and Dhanushkodi in the Palk Bay, and Kundugal, Manoli island and Mundal in the Gulf of Mannar during April 1984 to March 1986. Fishes were sampled through trawl nets, shore seines and a stake net, locally known as 'Kalamkattivalai', operated in shallow waters. The data of 1984-85 and 1985-86 on the reproductive biology were pooled since their results were almost similar.

Both fresh and preserved (in 5% formalin) specimens were used in the systematic study. Meristic and vertebral counts and morphometric measurements were made as per Mckay (1985). Identification of different spe-

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cies on the basis of swimbladder structure was done as per Sujatha and Dutt (1985).

Maturity stages of male *S. sihama* were determined on the basis of size, colour and extent of the testes in the body cavity, while those of female by diameter measurements of ova from fresh ovaries. Ova from middle portion of the ovary were considered in all measurements. Diameter of atleast 500 ova was measured under the microscope with an ocular micrometer, each division giving a value of 16.7 µm.

Gonadosomatic index (GSI) was determined by the following equation

$$\frac{\text{Weight of the ovary (nearest to 1 mg)}}{\text{Body weight of fish (nearest to 0.1 g)}} \times 100$$

The ova for fecundity estimation were selected as per Macer (1974) for *Trachurus trachurus*. Ova measuring more than 0.23 mm were having considerable amount of yolk and those measuring more than 0.52 mm were fully ripe. Ova in the range of 0.23–0.52 mm were counted for fecundity.

Chi-square test (Snedecor and Cochran 1967) was done to test the significance of monthly sex ratio and length-related variations in sex ratio.

## RESULTS

### *Description of the species*

Different species of the family Sillaginidae collected from the study area, their main fishing seasons, length ranges in the fishery, etc. are mentioned in Table 1.

Key to the subgenera and species of genus *Sillago* collected during the study, is given below:

1

–Ventral fin spine very small and situated at the base of a thickened club-shaped outer ventral fin ray; swimbladder reduced; no median tubular duct-like process; no modified caudal vertebrae

.....*Sillaginopodys*

(only 1 species, *S. chondropus*: Fig. 1 A)

– Ventral fin spine normal; swimbladder not reduced; median tubular duct-like process present; modified caudal vertebrae present or absent

.....2

Table 1. Fishes of the family Sillaginidae from Palk Bay and Gulf of Mannar

| Species | Main fishing season | Length range in the fishery (mm) | Remarks |
|---|---|---|---|
| *Sillago* (*Sillaginopodys*) *chondropus* (Bleeker 1849) | Oct–Apr | 150–160 | Collected only from Mundal, where shore seines were operated |
| *Sillago* (*Sillago*) *sihama* (Forsskal 1775) | May–Dec | 140–250 | Most dominant, occured in all the landing centres visited and gears examined during the study |
| *Sillago* (*Sillago*) *indica* Mckay, Dutt and Sujatha 1985 | May–Dec | 130–200 | Collected only through trawl catches. Appeared to be a more offshore species. Second most dominant |
| *Sillago* (*Parasillago*) *vincenti* Mckay 1980 | Nov–Apr | 180–215 | Collected only through 'Kalamkattivalai' at Pamban and Manoli island |
| *Sillago* (*Parasillago*) *argentifasciata* Martin and Montalban 1935 | May–Dec | 130–160 | Predominant in trawl catches |
| *Sillago* (*Parasillago*) *soringa* Dutt and Sujatha 1983 | Apr–Dec | 115–135 | Occurred in trawl and shore seine catches. |

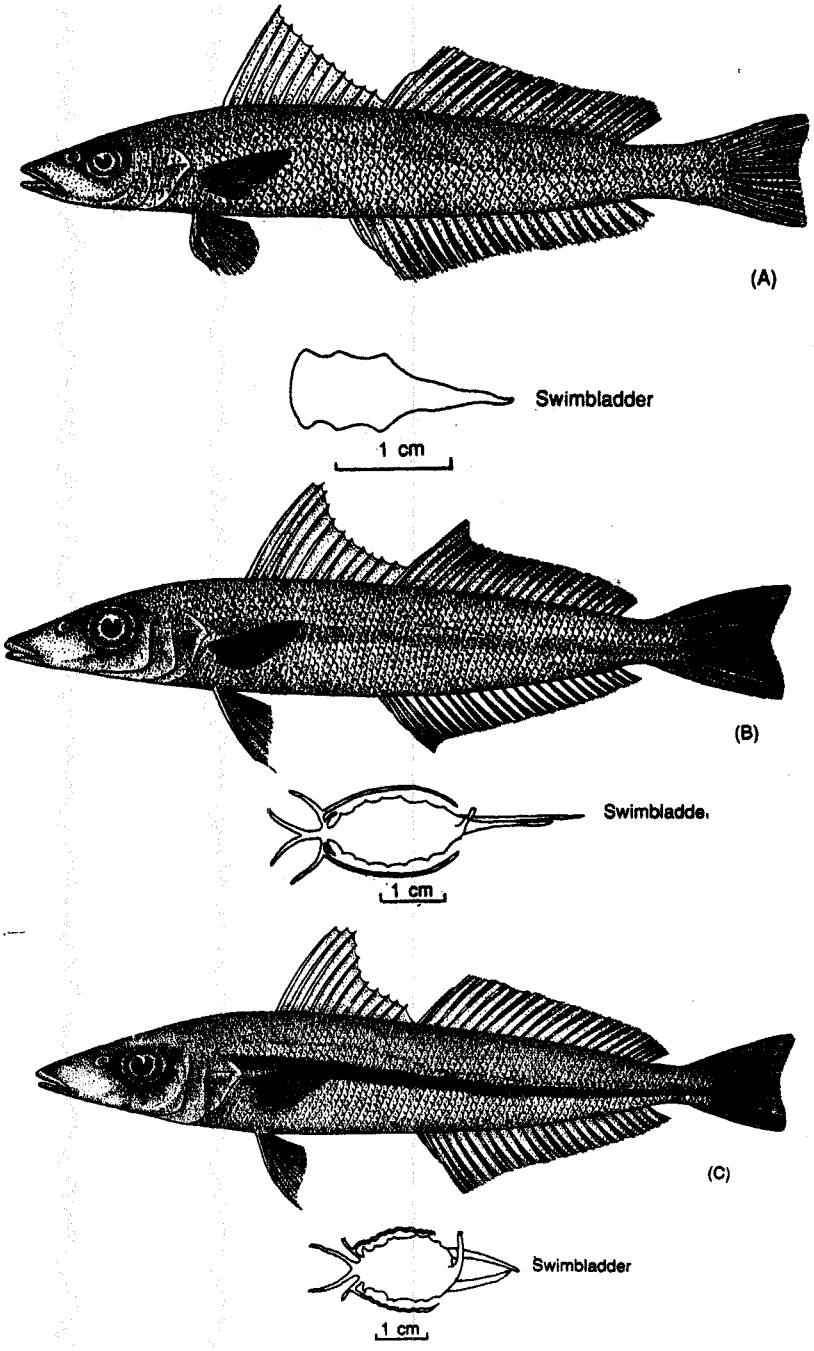


Fig. 1. A. *Sillago (Sillaginopodys) chondropus* (Bleeker 1849); B. *Sillago (Sillago) sihama* (Forsskal 1775); C. *Sillago (Sillago) indica* Mckay, Dutt and Sujatha 1985.

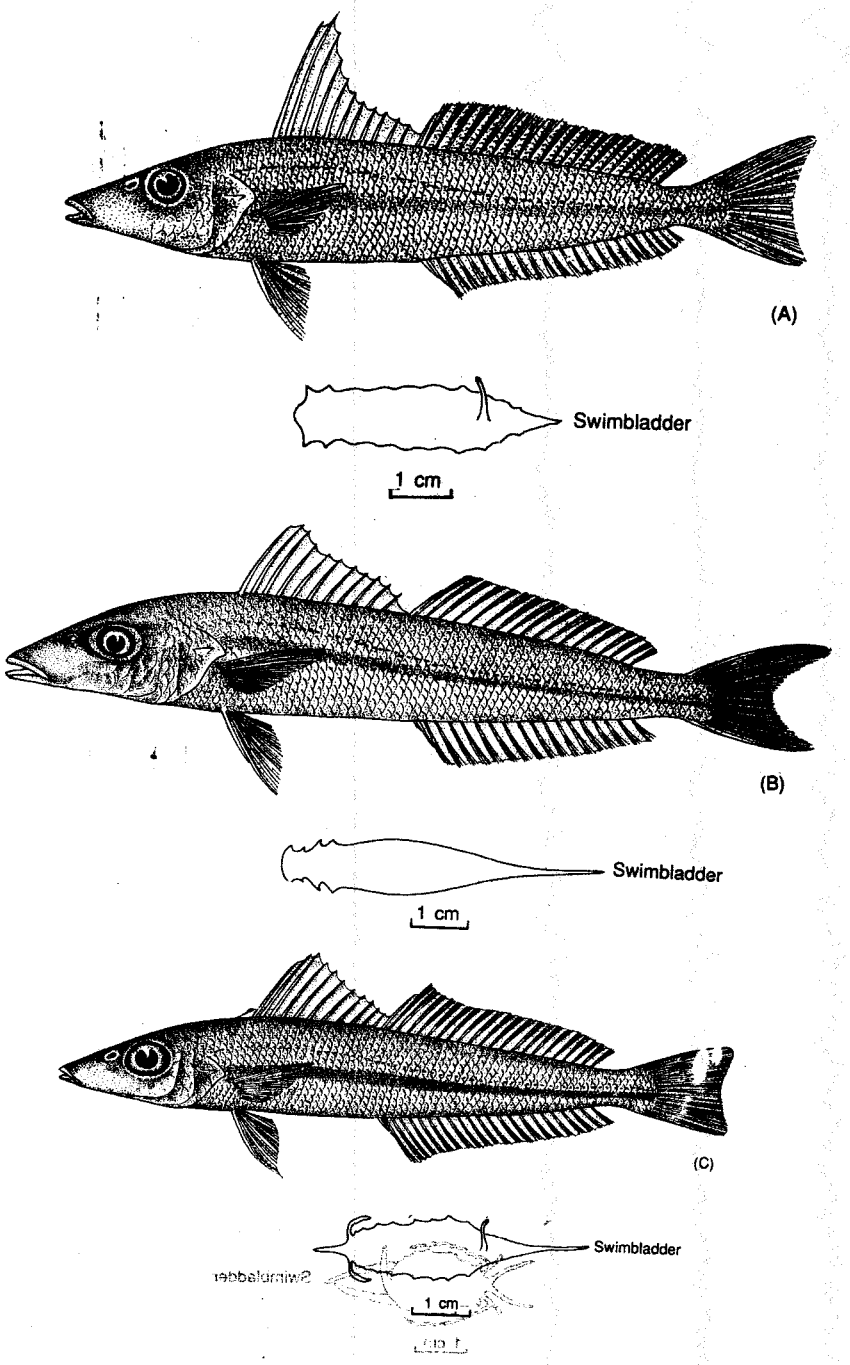


Fig. 2. A. *Sillago (Parasillago) vincenti* Mckay 1980; B. *Sillago (Parasillago) argentifasciata* Martin and Montalban 1935; C. *Sillago (Parasillago) soringa* Dutt and Sujatha 1983.

2

– Swimbladder divided posteriorly into 2 tapering extensions; modified caudal vertebrae present.
.....*Sillago*.....3

– Swimbladder with single posterior extension and tapering to a fine point, or round; modified caudal vertebrae present or absent
.....*Parasillago*.....4

3

– Two series of scales on the cheek; minute discrete black spots along the flanks below lateral line
..... *Sillago sihama* (Fig. 1 B)

– Three series of scales on the cheek; a dark band on each flank commencing behind the upper part of the opercle till about hypural flexure, sometimes broken into blotches
.....*Sillago indica* (Fig. 1 C).

4

– Second dorsal fin with at least 5 rows of dusky black or black-brown spots that may be quite separate or somewhat confluent
.....*Sillago vincenti* (Fig. 2 A)

– Second dorsal fin without any distinct rows of pigment spots
.....5

5

– A wide, brilliant, silvery longitudinal band on each side of the body; median tubular duct-like process of the swimbladder absent
.....*Sillago argentifasciata* (Fig. 2 B)

– Silver longitudinal band along the sides of the body absent; median tubular duct-like process of the swimbladder present
.....6

6

– Swimbladder with 3 anterior extensions, the middle one projecting forward and the anterolateral ones curved backward for a short distance along the sides.
.....*Sillago sihama* (Fig. 2 C).

Details of morphometric and meristic characters, of the different species of family

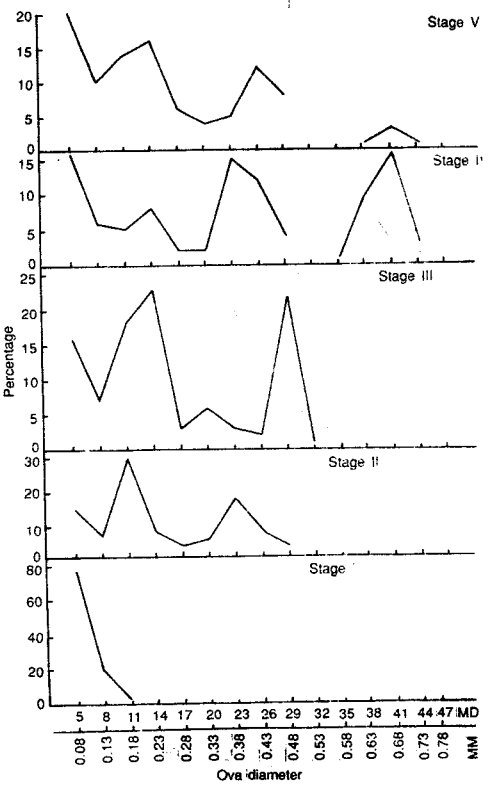


Fig. 3. Ova diameter frequency polygons of different maturity stages of *S. sihama*.

sillagin idae, which were collected during the present study, are given in Tables 2 and 3, respectively.

*Maturation and spawning of* Sillago sihama

*Gonads and classification of maturity stages:* Female and male reproductive systems of *S. sihama* were typically teleostean, with a pair of gonads (ovaries or testes), each with a duct (oviduct or vas deferens) both of which combining to form a common duct (ovarian duct or sperm duct). Though generally symmetrical, cases of asymmetry were not uncommon in the gonads. Maturity stages identified were 5 (Table 4).

*Development of ova to maturity:* Size-wise distribution of ova in the 5 maturity

Table 2. Morphometric characters of 6 species of sillagnid fishes collected from Palk Bay and Gulf of Mannar (Mean ± SD given in parentheses)

| Characters | *Sillago chondropus* n=4 | *S. sihama* n=16 | *S. indica* n=9 | *S. vincenti* n=5 | *S. argenti-fasciata* n=7 | *S. soringa* n=5 |
|---|---|---|---|---|---|---|
| Standard length (SL) | 150–165 | 110–170 | 125–193 | 204–217 | 144–163 | 115–135 |
| *As per cent of SL* | | | | | | |
| Greatest depth of body | 15.2–16.1 (15.7±0.4) | 16.4–20.0 (18.1±1.4) | 18.4–21.2 (19.9±1.1) | 16.7–19.8 (18.1±1.2) | 18.8–20.3 (19.6±0.5) | 17.4–19.2 (18.0±0.8) |
| Snout tip to ventral origin | 26.0–27.3 (26.5±0.5) | 27.4–32.3 (30.1±1.5) | 29.9–31.2 (30.5±0.4) | 26.5–30.0 (28.3±1.3) | 30.6–31.9 (31.3±0.4) | 30.0–31.3 (30.6±0.4) |
| Snout tip to first dorsal origin | 27.9–29.0 (28.6±0.5) | 32.8–34.9 (33.8±0.6) | 33.3–34.4 (33.7±0.4) | 30.8–35.0 (33.4±1.7) | 33.3–35.3 (34.4±0.8) | 31.2–35.0 (34.0±1.6) |
| Snout tip to second dorsal origin | 50.3–57.3 (50.8±0.4) | 53.7–57.3 (55.8±0.8) | 52.8–57.0 (54.8±1.6) | 53.6–54.8 (54.1±0.6) | 56.0–57.9 (57.0±0.7) | 56.1–58.3 (57.5±1.0) |
| Snout tip to anal origin | 47.5–50.0 (49.0±1.2) | 54.7–58.3 (50.6±1.0) | 53.9–56.8 (55.5±0.9) | 53.5–55.6 (54.4±0.8) | 56.0–58.7 (57.4±0.9) | 54.6–56.3 (55.3±0.7) |
| Least depth of caudal peduncle | 8.0–8.5 (8.3±0.2) | 7.1–8.3 (7.7±0.4) | 7.1–8.3 (7.6±0.5) | 6.2–6.9 (6.6±0.3) | 8.0–8.3 (8.1±0.1) | 6.4–7.0 (6.7±0.2) |
| Head length | 24.9–25.3 (25.1±0.2) | 25.0–29.4 (27.2±1.6) | 28.0–29.1 (28.7±0.4) | 21.1–29.0 (27.3±1.2) | 29.3–30.1 (29.8±0.3) | 24.8–28.8 (28.2±0.4) |
| *As per cent of head length* | | | | | | |
| Length of snout | 32.5–34.2 (33.6±0.8) | 36.8–42.9 (39.3±2.1) | 36.4–39.5 (38.3±1.0) | 40.0–46.2 (43.1±2.3) | 38.5–42.9 (40.1±1.8) | 37.5–39.5 (38.4±0.8) |
| Horizontal diameter of eye | 19.5–22.5 (20.9±1.3) | 21.9–25.6 (24.1±1.1) | 18.6–22.0 (20.2±1.4) | 16.4–22.4 (19.4±2.1) | 27.3–29.6 (28.3±0.9) | 24.3–29.4 (26.6±2.1) |
| Least width of inter-orbital | 15.0–17.1 (15.8±0.9) | 16.3–21.4 (18.8±1.5) | 18.2–20.9 (19.6±0.8) | 16.4–19.6 (18.0±1.3) | 18.0–18.8 (18.3±0.3) | 18.8–22.2 (20.9±1.3) |

stages of ovary is given in Fig. 3. In the immature ovary, majority of the ova were 0.02–0.13 mm and a few measured up to 0.22 mm. The immature stock of ova were found in all the subsequent stages of ovary. Stage II ovary showed withdrawal of a batch of ova with a mode at 0.18 mm. Another distinct mode was formed at 0.38 mm. The latter represented the maturing stock, in which vitellogenesis had commenced. In stage III ovary, the mature group of ova was well demarcated from the maturing and immature groups by a mode at 0.48 mm. At this stage, the maturing ova formed a mode at 0.23 mm. Stage IV ovary contained all the 4 stages of ova. Actually, the mature group of ova which formed a mode at 0.48 mm in stage III, developed further as ripe ova forming a mode at 0.68 mm in stage IV ovary. The maturing and mature groups of ova passed in succession to advanced maturity stages and fresh batches of maturing ova from the immature stock took their place. Ripe ova formed a distinct mode in the polygon of stage IV ovary. At any single spawning, only this group may be expected to be ovulated and spawned. Stage V ovary showed, in addition to immature, maturing and mature ova, few residual ova forming a mode at 0.68 mm indicating that spawning had occurred.

*Spawning period:* Percentage occurrence of different maturity stages of females and males is given in Fig. 4. It showed that *S. sihama* had a prolonged breeding season extending from July to February, with peak spawning activity during July to November.

*Gonadosomatic index (GSI):* It is an useful index of breeding activity in fish. Monthly variations in mean GSI values of both sexes are depicted in Fig. 5. Since the smallest specimen with mature gonads measured 139 mm, those above this length were considered for determining monthly GSI.

Though stages IV and V fish occurred among the catch from May to February, rela-

Table 3. Meristic characters of 6 species of sillaginid fishes collected from Palk Bay and Gulf of Mannar

| Characters | *Sillago chondropus* n=4 | *S. sihama* n=16 | *S. indica* n=9 | *S. vincenti* n=5 | *S. argenti-fasciata* n=7 | *S. soringa* n=5 |
|---|---|---|---|---|---|---|
| Dorsal fin | XI–XII, 1, 21 | XI, I, 21–22 | XI, I, 21–22 | XI, I, 21–22. | XI, I, 17–18 | XI, I, 21 |
| Anal fin | II, 23 | II, 23 | II, 21–23 | II, 22–24 | II, 16–17 | II, 22 |
| Lateral line scales | 70–71 | 69–70 | 70–76 | 71–73 | 62–68 | 64–68 |
| Transverse scale rows | 6/10–11 | 5–6/10–12 | 6/11–12 | 5–6/13–14 | 5/8–9 | 3–4/9–10 |
| Cheek scale rows | 3, ctenoid | 2, cycloid | 3, cycloid | 2, cycloid | 3, cycloid and ctenoid | 2, cycloid and ctenoid |
| Vertebrae | 35 (13 abdominal, 22 caudal) | 34 (14 abdominal, 3–4 modified, 16–17 caudal) | 34 (14 abdominal, 3–4 modified, 16–17 caudal) | 34 (14 abdominal, 4–6 modified, 14–16 caudal) | 33 (13 abdominal, 8–9 modified, 11–12 caudal) | 33 (13 abdominal, 5–6 modified, 14–15 caudal) |

Table 4. Maturity stages of *Sillago sihama*

| Maturity stage | Particulars of gonads | Intraovarian ova | Total length (mm) |
|---|---|---|---|
| Stage I, Immature | Ovaries thin, short and glassy in appearence and weigh 9–527 mg; testes thin, semitransparent, thread-like and extend upto less than half the body cavity length, weigh 4–114 mg | 100% immature ova | 185 (MF)<br>164 (MM) |
| Stage II, Maturing | Ovaries opaque and creamy yellow, weigh 0.18–3.64 g; tests moderately thick, flattened and white, extending in about 2/3 body cavity length, weigh 45–153 mg | 52% immature,<br>36% maturing and<br>12% mature ova | 136–226 (female)<br>132–185 (male) |
| Stage III, Mature | Ovaries reddish yellow and weigh 0.34–4.16 g; testes flat, well-developed and creamy white, extending in more than 2/3 of the body cavity length, weigh 144–490 mg | 41% immature,<br>34% maturing and<br>25% mature ova | 139–232 (female)<br>139–205 (male) |
| Stage IV Ripe/Oozing | Ovaries yellow to amber coloured filling the entire body cavity, weigh 0.49 –6.1 g; testes very thick, flat, turgid and creamy, extending in the entire body cavity length, weigh 0.52–1.45 g | 27% immature,<br>27% maturing,<br>16% mature and<br>30% ripe ova | 147–245 (female)<br>163–209 (male) |
| Stage V, Partially spent | Ovaries rather flaccid, reddish yellow and weight 0.45–0.7 g; testes shrunken, extending in 2/3 body cavity length, weigh 200–300 mg | 44% immature,<br>31% maturing,<br>20% mature and<br>5% residual ova | 180–217 (female)<br>175–195 (male) |

MF, maximum female; MM, maximum male.

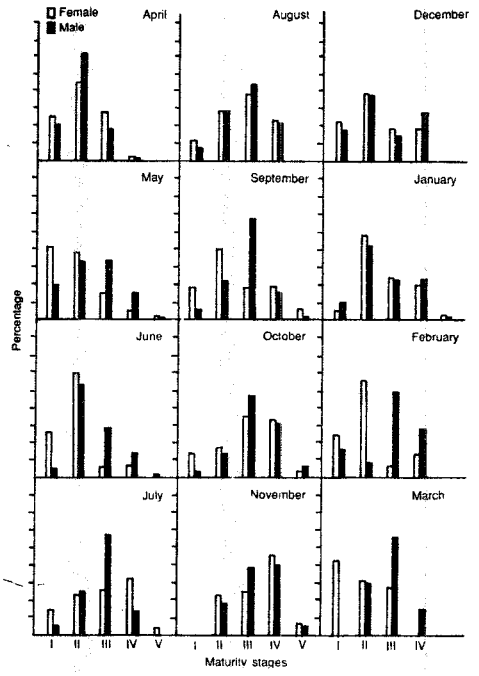


Fig. 4. Percentage occurrence of female and male *S. sihama* during April 1984–March 1986 (pooled data).

tively more of them were present during July to November (Fig. 4), which coincided with high values of GSI. The maximum occurrence of advanced maturity stages as well as the maximum GSI vlaue were in November. Although the high standard deviations of monthly mean GSI values may create doubt whether their cycle actually reflected the gonadal activity, the coincidence of occurrence of stages IV and V with high GSI values can validitate that the peak spawning took place during July to November.

*Length at first maturity:* To determine minimum length at first maturity, 802 females and 666 males collected during July to February were examined. Fish were grouped sexwise into 10 mm length groups and the percentage of fish in various maturity stages in different length groups was calculated. For calculating length at first maturity, fish belonging to stages III, IV and V were considered as mature fish.

All females upto 129 mm were immature whereas 50% were mature in 170–179 mm length group (Fig. 6). All females above 220 mm were mature. Over 40% males were mature in 150–159 mm group and about 60% in the next groups. All males above 190 mm were mature. The data inferred that females and males attained first sexual maturity at 179 and 159 mm, respectively.

*Fecundity:* It varied from 6 956 to 48 373 in individuals of 150 to 210 mm length (Table 5). The mean fecundity of 17 specimens was 25 979.

Length-fecundity plots showed a curvilinear relationship, while plots of body weight and ovary weight versus fecundity appeared linearly related. The following logarithmic equations were obtained:

$$\text{Log } F = -8.1812 + 5.5458 \log L;\ r = 0.91$$
$$\text{Log } F = 1.4169 + 1.7418 \log W;\ r = 0.89$$
$$\text{Log } F = 0.8107 + 1.1793 \log w;\ r = 0.95$$

Where F, fecundity; L, total length; W,

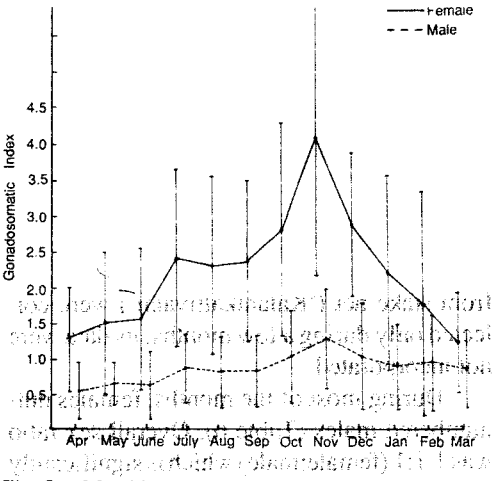


Fig. 5. Monthly mean gonadosomatic index values of *S. sihama* during April 1984–March 1986 (pooled data; vertical bars indicate standard deviations).

Table 5. Fecundity of *Sillago sihama*

| Total length L (mm) | Body weight W (g) | Ovary weight w (mg) | Observed fecundity | Estimated fecundity | | |
|---|---|---|---|---|---|---|
| | | | | $F=aL^b$ | $F=aW^b$ | $F=aw^b$ |
| 150 | 28.2 | 492 | 6 956 | 7 709 | 8 768 | 9 670 |
| 151 | 23.8 | 143 | 7 931 | 8 000 | 6 527 | 6 319 |
| 160 | 35.0 | 500 | 9 000 | 11 020 | 12 770 | 9 884 |
| 164 | 37.0 | 530 | 11 000 | 12 620 | 14 070 | 10 550 |
| 166 | 38.5 | 520 | 10 075 | 13 520 | 15 090 | 10 320 |
| 170 | 40.0 | 850 | 15 000 | 15 430 | 16 120 | 18 420 |
| 174 | 43.5 | 1 265 | 27 279 | 17 550 | 18 650 | 29 440 |
| 175 | 40.6 | 1 201 | 30 000 | 18 110 | 16 540 | 27 700 |
| 184 | 51.8 | 1 471 | 41 296 | 23 930 | 25 280 | 35 180 |
| 186 | 49.0 | 922 | 22 556 | 25 410 | 22 960 | 20 280 |
| 191 | 50.0 | 970 | 18 201 | 29 430 | 23 780 | 21 530 |
| 198 | 59.0 | 1 321 | 45 565 | 35 960 | 31 740 | 30 950 |
| 202 | 61.0 | 1 400 | 35 245 | 40 190 | 33 610 | 33 180 |
| 204 | 74.0 | 1 600 | 48 373 | 42 400 | 47 070 | 38 880 |
| 206 | 73.5 | 1 700 | 47 000 | 44 790 | 47 630 | 41 720 |
| 208 | 75.5 | 1 800 | 45 725 | 47 260 | 48 730 | 44 640 |
| 210 | 79.1 | 2 270 | 34 360 | 49 800 | 52 860 | 58 660 |

a, b are constants.

body weight and w, ovary weight.

Correlation coefficient (r) was significant ($P < 0.01$) for all the 3 relationship. Scattered dots and fitted lines are shown in Fig. 7.

*Sex ratio*: Sex composition of samples collected from trawlers and shore seines did not show noticeable difference, therefore, in all the subsequent samplings the data collected from both the gears were pooled. Samples from stake net ('Kalamkattivalai') were collected only during a few months, its data were not incorporated.

During most of the months, females outnumbered males (Table 6). Overall sex ratio was 1.1:1 (female:male) which is significantly different from 1:1 ($X^2$, 4.86; $P < 0.05$).

Sex ratio at every 10 mm length group of total length observed during the 2 year period, showed male dominance till 170 mm (Table 7). A reverse trend was noticed above this size.

Table 6. Month-wise sex ratio of *Sillago sihama*

| Month | No. of fish examined | Proportion of females | Chi-square |
|---|---|---|---|
| April | 258 | 1.19 | 1.88 |
| May | 236 | 0.84 | 1.69 |
| June | 182 | 1.39 | 4.95* |
| July | 178 | 1.12 | 0.56 |
| Aug | 144 | 1.83 | 0.69 |
| Sept | 192 | 1.13 | 0.75 |
| Oct | 186 | 1.27 | 2.60 |
| Nov | 200 | 1.35 | 4.50* |
| Dec | 198 | 0.94 | 0.18 |
| Jan | 164 | 1.19 | 1.20 |
| Feb | 206 | 0.91 | 0.49 |
| March | 280 | 0.81 | 3.21 |

* $P < 0.05$.

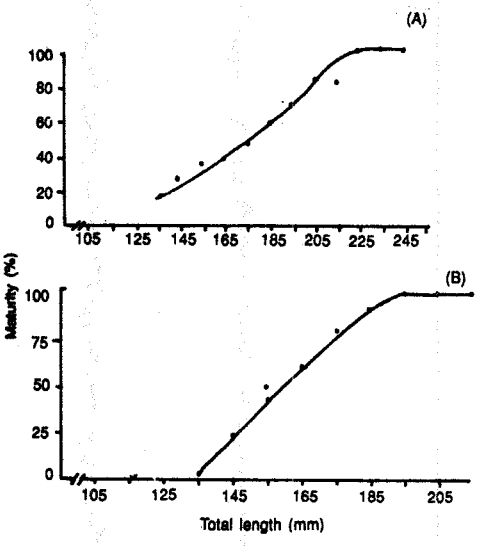


Fig. 6. Mean percentage of mature female (A) and male (B) *S. sihama* during July 1984–February 1985 and July 1985–February 1986, in different length groups.

Table 7. Sex ratio of *Sillago sihama* in various size groups

| Month | No. of fish examined | Proportion of females | Chi-square |
|---|---|---|---|
| 100-109 | 16 | 0.60 | 01.00 |
| 110-119 | 49 | 1.04 | 00.00 |
| 120-129 | 86 | 0.41 | 15.07** |
| 130-139 | 167 | 0.89 | 00.86 |
| 140-149 | 232 | 0.88 | 00.84 |
| 150-159 | 330 | 0.73 | 08.19** |
| 160-169 | 462 | 0.93 | 00.70 |
| 170-179 | 383 | 1.62 | 21.09** |
| 180-189 | 316 | 1.72 | 22.33** |
| 190-199 | 200 | 3.76 | 67.28** |
| 200-209 | 107 | 16.80 | 81.81** |
| 210-219 | 31 | – | 31.00** |
| 220-229 | 19 | – | 19.00** |
| 230-239 | 14 | – | 14.00** |
| 240-249 | 12 | – | 12.00** |

** $P < 0.01$.

## DISCUSSION

This study has helped to clear the confusion regarding identification of the sand whitings in the Palk Bay and Gulf of Mannar.

Fully spent specimen of *S. sihama* was not

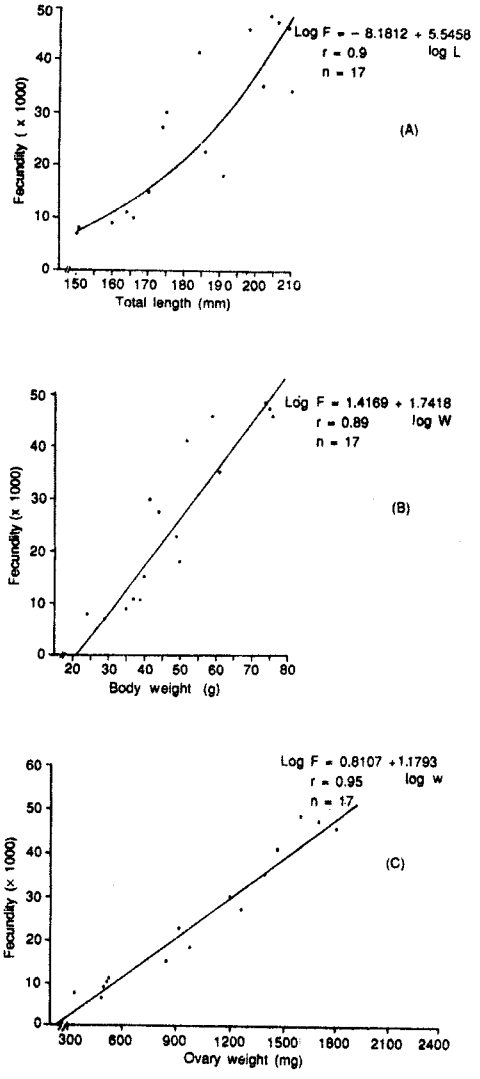


Fig. 7. Relationship of fecundity of *S. sihama* with total length (A), body weight (B) and ovary weight (C). r, correlation coefficient; n, number of specimens.

available in the samples. Therefore, a 5-stage maturity scale appeared best suited. The results were in conformity with those of James *et al.* (1976) who indicated a prolonged breeding season in *S. sihama* from Netravathy and Gangolli estuaries.

An approximate estimate of the number of batches of ova spawned during the spawning season can be obtained from the ratio of egg number in the most advanced mode and all other yolked ova (Morse 1980). Here the ratio of the ripe ova and all other yolked ova > 0.23 mm (yolked) averaged 30%, which indicated that approximately 3 batches of eggs would be spawned by a female during the spawning period. However, this theoretical estimate still needs confirmation. Kumai and Nakamura (1977) noted that a single female *S. sihama* of 201 mm (fork length) spawned 65 times in 108-day captivity, spawning every day or every other day. It suggested that the most advanced mode of ova were released in several batches, thus making it difficult to estimate the batch size accurately.

Rare presence of stages IV and V in shore seine catches and stage III in samples drawn through 'Kalamkattivalai', both gears being operated in close inshore waters, showed that in Palk Bay and Gulf of Mannar, *S. sihama* breeds in the open sea. Palekar and Bal (1961) have reported that marine specimens of *S. sihama* obtained from inshore catches were generally immature. Chaudhuri (1923 b) observed that *S. sihama* breeds either in the sea or in the mouth of Chilka lake, where the species lives permanently.

Radhakrishnan (1957) determined the age of *S. sihama* by otolith study and reported that fishes measuring 160–200 mm were 2 years old. Hence, it was assumed that both sexes attained first maturity in the second year. James *et al.* (1976), working on *S. sihama* from Netravathy and Gangolli estuaries, found that males and females mature at 151 and 191 mm respectively. At Kali estuary, female *S. sihama* was reported to attain maturity at 235 mm (Palekar and Bal 1961).

Fecundity estimates of *S. sihama* by different workers show variations. Radhakrishnan (1957) stated that a fully mature ovary of the fish contained 14 000 eggs, but size of the eggs or other criteria for fecundity estimation was not indicated. Fecundity of this species varied from 16 682 to 1 66 130 in Kali estuary (Palekar and Bal 1961) and from 11 304 to 1 00 593 in Netravathy and Gangolli estuaries (James *et al.* 1976). The present estimate ('maximum potential fecundity') was lower than these 2 estimates. Kumai and Nakamura (1977) reported that a female specimen of *S. sihama* measuring 201 mm (flork length) had spawned a total of 18 00 750 eggs in 108-day captivity.

Preponderance of females in the commercial catches was not in agreement with the earlier results reported from Mandapam (Radhakrishnan 1957). Size-related sex ratio variations could be due to differential growth rate between the sexes and longevity (Morse 1981). Adjusting sex ratios to 1:1 at 150–159 mm length group, and assuming that females have a greater growth rate and longevity, the total female to male ratio would become 1.8:1, with a significant dominance of females. It appeared that both, length at first maturity, and differential sex ratios, combined to produce equal numbers of each sex in the spawning stock.

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