

SEED IDENTIFICATION OF FOUR SPECIES OF MULLET OFF RATNAGIRI, WEST COAST OF INDIA

S. K. BARVE AND D. R. JALIHAL

*Marine Biological Research Station and College of Fisheries
(Konkan Krishi Vidyapeeth), Ratnagiri-415 612, Maharashtra State, India*

ABSTRACT

For selective stocking, particularly when depending on seed from the wild as in mullet culture, proper identity of fry/seed is very essential. In India, information on this aspect is rather meagre — on only seven species and restricted mainly to their colouration, body profile and morphometric measurements — characters which change with growth and thereby resulting even in erroneous descriptions. In the present work, therefore, seed of four species available locally off Ratnagiri viz. *Liza parsia*, *L. tade*, *Valamugil seheli* and *Ellochelon vaigiensis* have been described in detail with special emphasis, on characters that do not alter with age such as lateral line scale count, position of anal fin, number of anal fin elements, shape and nature of maxilla, number and arrangement of pyloric caeca, etc. Adults have been thoroughly examined in order to correctly assign the fry to their respective species. A field key for easy separation of seed of above species, especially in live condition, has been incorporated.

INTRODUCTION

REALIZING the importance of coastal aquaculture, many brackishwater fish farms are being established along both coasts of India. Mullet (Pisces : Mugilidae) along with milkfish are considered to be quite suitable for brackishwater culture. However, since mullets do not breed in captivity and their artificial breeding technique is still in its infancy (Jhingran, 1982) continuous seed supply of desired species is one of the major constraints in their farming, necessitating complete dependence on seed from the wild for stocking. Here again, except for the works of Chidambaram and Kuriyan (1952), Sarojini (1958), Rangaswamy (1978, 1985) and Rajyalakshmi (1980), information available on seed characters which is so essential for selective stocking is far from adequate. Thus, there is a need for authentic field characters for easily identifying the seed of locally available species of mullets. The present study was, therefore, undertaken with this objective especially in the

wake of establishment of first brackishwater fish farms by the Government of Maharashtra State and Konkan Krishi Vidyapeeth in Ratnagiri.

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MATERIAL AND METHODS

The material was collected regularly either during low tides using a small hand net or at high tides using a cast net, in the mangrove area of Kalbadevi Estuary near Bhatimirya. Occasional collections were also made at the mouth of Kajali Estuary near Fisheries College, Ratnagiri.

After detailed observations in live condition, the fry were anaesthetised using a strong solution of Ethyl m-Aminobenzoate Methanesulphonic acid salt (MS 222) since it reduces frenzied swimming movements and the resultant scale loss. Specimens were then washed and preserved in 5% Formaldehyde solution. Gill raker count was made of first gill arch on the left side of the specimen, following Zismann (1981). For studying dentition, jaws and tongue were treated in a solution of Potassium hydroxide which dissolves the tissue and clearly exposes the teeth.

Regular fortnightly collections were made for a period of one year i.e. from April 1985 to March 1986, to find out the seed abundance of different species. The specimens ranged in size from 15 to 60 mm (size used for stocking) and they have been referred as fry, following Zismann (1981). Young ones smaller than 15 mm and variously referred to as larvae and postlarvae are generally found off shore in the sea and are usually captured by plankton or neuston nets (Ben-Yami and Grofit, 1981). In these individuals (i.e. below 15 mm) important identification features/characters of scales and fins are not yet fully developed and it is difficult to separate such young ones based on pigmentation alone (Sarojini, 1957). Moreover, they are not used for stocking and, therefore, have not been considered in the present study.

OBSERVATIONS AND REMARKS

The precise knowledge regarding the time of arrival of fry in estuaries is possibly the best practical criterion for seed identification (Bograd, 1961). During the present investigation, seed of *Liza parsia* (Hamilton-Buchanan) was found to be available in plenty throughout the year, constituting about 95% of total seed collection. *Valamugil seheli* (Forsskal) forming 2.5% and *Ellochelon vaigiensis*, (Quoy and Gaimard) forming 2.3% of total

seed, could be collected in April-June and February-July respectively. The seed of *Liza tade* (Forsskal) constituted barely 0.2% of the total catch indicating the rare occurrence of this species in Ratnagiri waters.

The field observations, especially those which can help in sorting the species in live condition for stocking purpose, supplemented by laboratory observations are given below:

FIELD OBSERVATIONS

A. *Swimming behaviour*

The fry of different species exhibit varying swimming patterns as under:

Liza parsia: Fast moving schools, mostly led by larger specimens and swimming smoothly without any jerky movements. With slightest vibration or disturbance, the schools get scattered, individuals darting away at greater speed.

Valamugil seheli: Schools slow moving compared to *L. parsia* and the individuals swim with characteristic jerky movements which are pronounced near caudal region.

Ellochelon vaigiensis: Almost same as in *V. seheli*.

With reference to *Liza tade*, observations on swimming could not be made due to lack of sufficient material.

B. *Live colouration and stellate melanin pigmentation*

Identification and subsequent segregation of fry based on live colouration is very important since it helps in stocking the ponds causing least damage to the seed. Similarly, the distribution and arrangement of stellate melanin pigments also appear to be specific as seen in Table 1. The pigmentation remains prominent even after prolonged preservation unlike the live colouration.

TABLE 1. Live colouration and stellate melanin pigment distribution in the fry of four mullet species off Ratnagiri

Characters	<i>Liza parsia</i>	<i>Liza tade</i>	<i>Valamugil seheli</i>	<i>Ellochelon vaigiensis</i>
Live colouration				
General	Upper quarter to half dark green and remaining silvery white. Four or five indistinct longitudinal lines running along body. A slightly yellowish patch on upper half of operculum.	Upper quarter black and remaining silvery white. Five to seven fairly distinct longitudinal lines running along the body.	Upper quarter greenish yellow and remaining silvery white. An yellow patch on upper part of operculum.	Upper quarter to half dark greyish and remaining silvery white. Dorsally grey colour is interrupted by 3 off white/yellow transverse bars arranged as under: (a) just before I dorsal fin, (b) in between I and II dorsal fins and (c) between II dorsal and caudal base.
Fins				
I Dorsal	White with slightly dark border.	Fairly dark.	Almost white except for a few dark spots on first 3 spines.	Almost completely pitch black.
II Dorsal	White with slightly dark border.	Darker than I dorsal.	White except for a few dark spots on anterior 1/4th part.	Upper half black (slightly lighter than I).
Pectoral	White.	Slightly dark with a black spot at the base.	White, with a few dark dots which are more towards base.	Upper half to 1/3rd portion pitch black.
Pelvic	White.	White.	White.	Orange-yellow.
Anal	White.	Dark in distal half.	White.	Distal half orange with dark border.
Caudal	Dark pigments distributed sparsely all over.	Dark pigments distributed more towards proximal half.	Almost white.	Proximal half orange and distal half yellowish.
Distribution of Stellate pigmentation				
Body	Almost absent.	In a single row all along lateral line.	Along and below lateral line and a few below orbit.	A few on operculum and outer base of pectoral.
Chin region	In 3 densely distributed patches.	A few in a single midventral patch.	A few on a median patch.	In 3 densely distributed patches.

Another interesting observation is that, even after prolonged preservation, the fry of *V. seheli* can be easily distinguished by the presence of a dark, triangular patch on belly in the region of intestinal coil (probably due to the mud and decayed organic matter engulfed by them).

C. Contour of body

It has been observed that this feature tends to alter with death and subsequent preservation (Pillay, 1962 a). However, the contour/profile as well as stoutness of head and body through juveniles to adult appear to be species specific and aid as good supplementary characters in field identification of live seed.

Liza parsia: Body rather stout. Both margins convex with gradual curvature, dorsal being more convex than ventral profile. Head rather broad and flat.

Liza tade: Body slender and elongated. Ventral margin almost straight while dorsal margin gradually sloping behind head region. Head broad and flat.

Valamugil seheli: Body slender. Upper margin almost straight behind head while lower margin convex. Head narrow and smoothly curved.

Ellochelon vaigiensis: Body rather stout. Ventrally almost straight, but dorsal aspect rather triangular with maximum height being at the origin of first dorsal fin. Head flat and broadest amongst all 4 species.

D. Fin characters

The position of anal fin in relation to second dorsal fin and total number of anal fin elements are useful in separating some species. Usually fry smaller than 30 mm have 9 or 10 soft rays, but with growth the first ray gets transformed into third spine (Sarojini, 1957 ; Zismann, 1981). The nature of this fin along with features of other fins are given in Table 2.

TABLE 2. Fin characters in the fry of four mullet species off Ratnagiri

Characters	<i>Liza parsia</i>	<i>Liza tade</i>	<i>Valamugil seheli</i>	<i>Ellochelon vaigiensis</i>
Origin of anal fin	Distinctly in front of second dorsal fin.	Distinctly in front of second dorsal fin.	Opposite the origin of second dorsal fin.	Distinctly in front of second dorsal fin.
Origin of first dorsal fin	Distinctly nearer to caudal base than to tip of snout.	Distinctly nearer to caudal base than to tip of snout.	Almost in the middle of caudal base and tip of snout.	Nearer to caudal base than to tip of snout.
Pectoral axillary scale	Absent.	Absent.	Present (Well developed).	Absent.
Extension of pectoral fin	Falls slightly short of base of first dorsal fin.	Falls considerably short of base of first dorsal fin.	Just reaches base of first dorsal fin.	Just reaches or falls slightly short of base of first dorsal fin.
Anal fin elements	II, 10 (upto 35 mm) or III, 9 (above 35 mm) i.e. 12.	II, 10 i.e. 12.	II, 10 (upto 30 mm) or III, 9 (above 30 mm) i.e. 12.	II, 9 (upto 40 mm) or III, 8 (above 40 mm) i.e. 11.
Nature of caudal fin	Deeply forked.	Forked.	Deeply forked.	Only slightly emarginate/truncated.

NOTE : Roman and Arabic numerals indicate number of spines and rays respectively.

E. Chin and maxilla

The shape of chin and maxilla help considerably in segregating the seed, details of which are given in Table 3.

LABORATORY OBSERVATIONS

Identifications based on field characters have been further confirmed by detailed laboratory studies on morphometric measurements, lateral line scale count, gill raker count, nature of labial + lingual + oral roof dentition, shape of stomach as well as number, arrangement and form of pyloric caeca (Table 4).

The morphometric characters tend to vary with size (Thomson, 1954; Van Der Elst and Wallace, 1976) and the gill raker count is useful in specimens above 50 mm only. However, the lateral line scale count and the nature of labial dentition have been observed to be quite reliable identification characters (Van Der Elst and Wallace, 1976). Shape of stomach and the number + nature of pyloric caeca do not change with growth and as such are highly reliable in confirming the identity of seed (Zismann, 1981).

DISCUSSION

Despite the taxonomic confusion, owing to the extreme range of variations and overlapping characters exhibited by its members, adults (above 100 mm) of several species of Mugilidae can be identified with considerable amount of certainty. Similarly, juveniles (60 to 100 mm) of certain species can be assigned to respective adults, specially from fisheries point of view. However, information on fry (15 to 60 mm) which is the seed stage for stocking the farms, is very inadequate (Thomson, 1981) and much of the available data is restricted mainly to the South African and mediterranean species (Van Der Elst and Wallace, 1976; Zismann, 1981).

TABLE 3. Nature of chin region in the fry of four mullet species off Ratnagiri

Characters	<i>Liza parsia</i>	<i>Liza tade</i>	<i>Valamugil seheli</i>	<i>Ellocheilichthys vaigiensis</i>
Ventral view				
Shape of lower jaw	Broadly rounded with a prominent median notch.	Rather triangular without a median notch.	Narrowly rounded with a rather shallow median notch.	Narrowly rounded without a median notch.
Shape of exposed portion of maxilla	Sigma-shaped.	Sigma-shaped.	Lower portions of both proximal and distal arms exposed, apparently resembling a wheat grain.	Only lower portion of proximal arm exposed and seen as an elongated V-shaped structure.
Lateral view				
Shape of maxilla as seen when mouth is open	Upper half slender; lower half stouter, sigma-shaped, ending in a posteriorly directed knob.	Lower tip of maxilla ending in a knob.	Uniformly slender.	Uniformly slender.

TABLE 4. Comparison of laboratory observations on the fry of four mullet species off Ratnagiri

Characters	<i>Liza parsia</i>	<i>Liza tade</i>	<i>Valamugil seheli</i>	<i>Elocheilon vaigiensis</i>
Total length	=3.7 to 4.6	5.1	4.6 to 5.1	4.1 to 4.5
Height of body				
Lateral line scale count	27 to 34	32	27 to 30	24 to 26
Gill raker count				
Upper arm	17 or 18	22	14	16
Lower arm	31 to 33	36	25	27
Labial teeth				
Upper jaw	Teeth blunt with broadly rounded or squarish tips and arranged in continuous row.	Well developed sharp, conical teeth compactly arranged along edge of lips (seen as clubshaped structures in dorsal view).	Teeth absent.	Teeth conical, pointed and are arranged in a continuous row.
Lower jaw	Teeth absent.	Teeth absent.	Teeth still embedded in musculature; long, narrow and rather sparsely arranged.	Teeth smaller than those on upper jaw and still embedded in musculature; conical, sharply pointed and sparsely arranged.
Roof of buccal (oral) cavity	Teeth absent.	Could not be studied (due to damage).	Teeth absent.	Teeth arranged as shown in figure.
Lingual teeth	Less in number and arranged in 4 smaller anterolateral and 1 larger posterolateral basal plates.	Fairly good in number and arranged in 5 subequal basal plates.	Fairly good in number and arranged in 2 pairs of broad anterior and 3 pairs of smaller posterolateral plates.	Mostly without basal plates and arranged more towards tip.
Stomach	Quite large, triangular and about 1.75 times as long as broad.	Fairly large, spherical and about 1.55 times as long as broad.	Fairly large, spherical, and about 1.8 times as long as broad.	Quite small, but long and slender being about 3.3 times as long as broad.
Pyloric caeca				
Number	5 (unbranched)	5 (unbranched)	8 (unbranched)	3 (branched)
Nature	Almost equal and quite large being about 0.4 — times the length of stomach.	Almost equal, shorter than those of <i>parsia</i> , being about 0.33 — times the length of stomach.	Almost equal, shorter as compared to <i>parsia</i> and <i>tade</i> , being about 0.2 — times the length of stomach.	Unequal, formed by 3 main stalks, possessing 14 branches having a total of 24 tubules; very short being just about 0.1 — times the length of stomach.

As far as Indian species are concerned, only brief accounts of seed of following seven species are available: *Rhinomugil corsula*, *Mugil cephalus*, *Liza parsia*, *L. tade*, *L. macrolepis* (= *troschelii*), *Osteomugil cunnesius* and *Ellochelon vaigiensis*. However, even within such a limited amount of works great deal of confusion exists. In fact except for *R. corsula*, which is characterised by a straight upper profile and bulging eyes, no two accounts of any one of the above species tally with each other creating further difficulty in correctly identifying the seed as discussed below:

(i) As regards *Ellochelon vaigiensis*, the dorsal transverse bars on back and black pectoral fins (Rangaswamy, 1978 and present observation) have not been reported by Chidambaram and Kuriyan (1952). However, the dark bordered dorsal fins as well as yellow tinted pectoral and pelvic fins clearly indicate that the fry examined by latter workers definitely belong to *vaigiensis*.

(ii) As for as *Liza macrolepis* is concerned, the spotted dorsal and caudal fins as well as blotched pectoral fin described by Chidambaram and Kuriyan (1952) are not mentioned by Rajyalakshmi (1980) as her account lacks note on colour. Besides, there is no evidence to suggest that the fry studied in both works belong to the same species.

(iii) The characteristic ventral profile of body in *Osteomugil cunnesius* noted by Sarojini (1958) is not mentioned by Rangaswamy (1985). Moreover the relative body proportions given by the two workers differ considerably. Nevertheless, the common presence of axillary scale indicates that the two materials, in all probabilities, belong to one and the same species.

Further, although Rangaswamy (1985) categorically states that the preorbital in *O. cunnesius* is 'not curved' with the aid of illustration

(Fig. 1 on page 971), on the very next page the preorbital is clearly shown as a distinctly curved structure (Fig. 2 on page 972).

(iv) As regards *Liza parsia* and *L. tade*, the black lateral line reported by Rajyalakshmi (1980) has not been mentioned by Sarojini (1958) and is not observed during the present study also. Although Rajyalakshmi (1980) mentions the presence of such line only in the above two species, her figures (Fig. 30 C, D on page 63) show it to be present even in *M. cephalus* and *R. corsula*.

(v) Even in the most widely studied species like *Mugil cephalus* there is confusion. Though according to Rajyalakshmi (1980) its 'head is bigger in comparison to other mullets and in relation to its body length', the morphometric measurements (Sarojini, 1958) clearly reveal that this is not true. Even the occurrence of black spot at pectoral fin base as mentioned by Rajyalakshmi (1980) has been disputed by Zismann (1981).

It is thus seen that much of the confusion regarding identification of mullet seed is mainly due to their inadequate and sometimes even erroneous descriptions which are merely based on colouration, profile of body and morphometric measurements. However, none of the above three characters are really reliable since they are variable. Therefore, in the present work detailed description is given on fry of four species with special emphasis on characters which do not alter with age such as lateral line scale count, position of anal fin, number of anal fin elements, shape and nature of maxilla, shape of stomach, number and arrangement of pyloric caeca, etc. Further, in order to correctly assign these fry to their respective species, the known mullets off Ratnagiri have been thoroughly studied and identified based on Thomson (1954), Pillay (1962 a, b), Luther (1982), Fischer and Bianchi (1984) and Talwar and Kacker (1984).

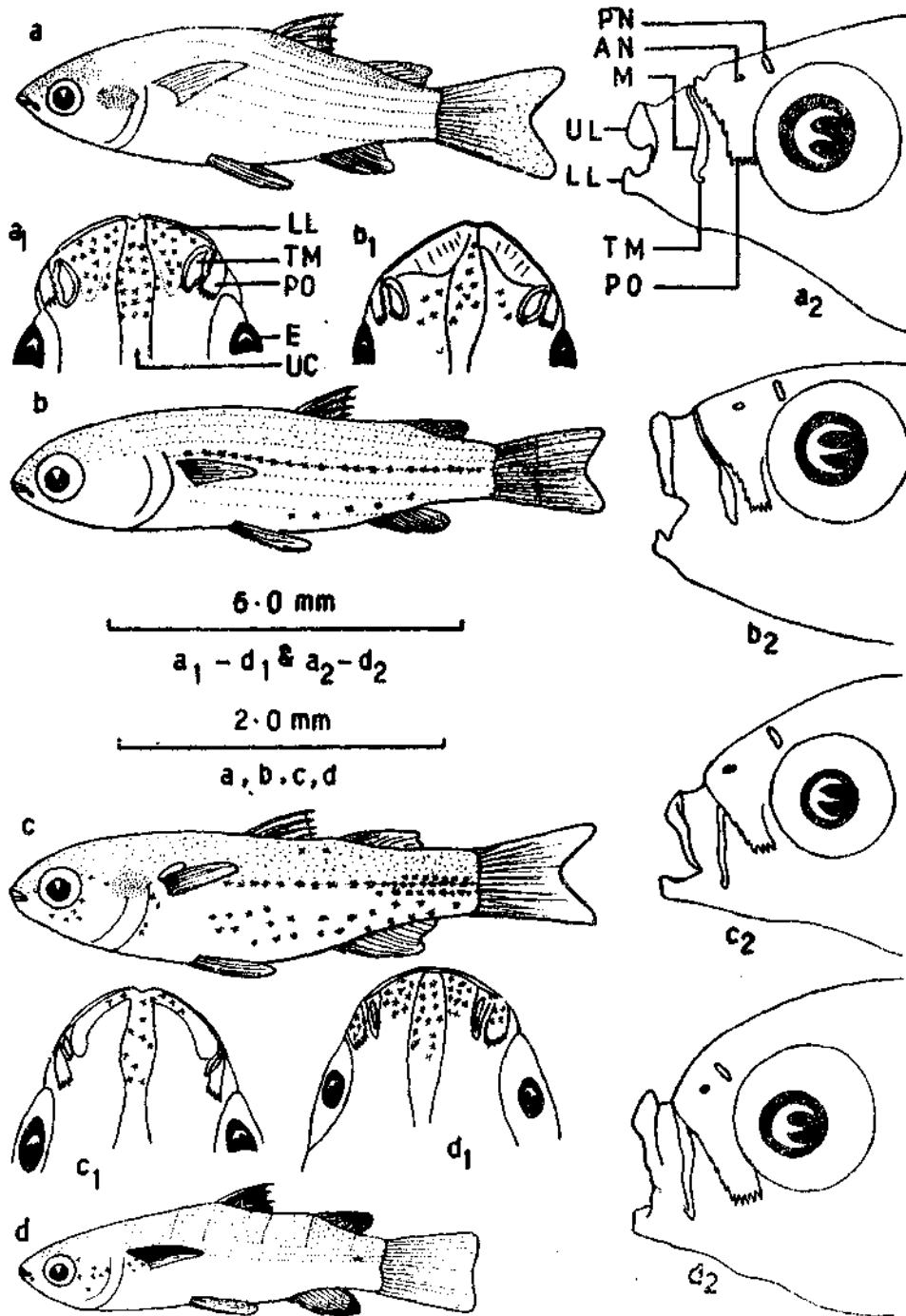


Fig. 1. a. *Liza parsta*, b. *Liza tade*, c. *Valamugil seheli* and d. *Ellochelon vaigiensis* (suffix 1. chin region, suffix 2. front lateral view when mouth is opened, UL — upper lip, LL — lower lip, PO — preorbital, TM — tip of maxilla, AN — anterior nostril, PN — posterior nostril, UC — uncovered chin space, M — maxilla, E — eye).

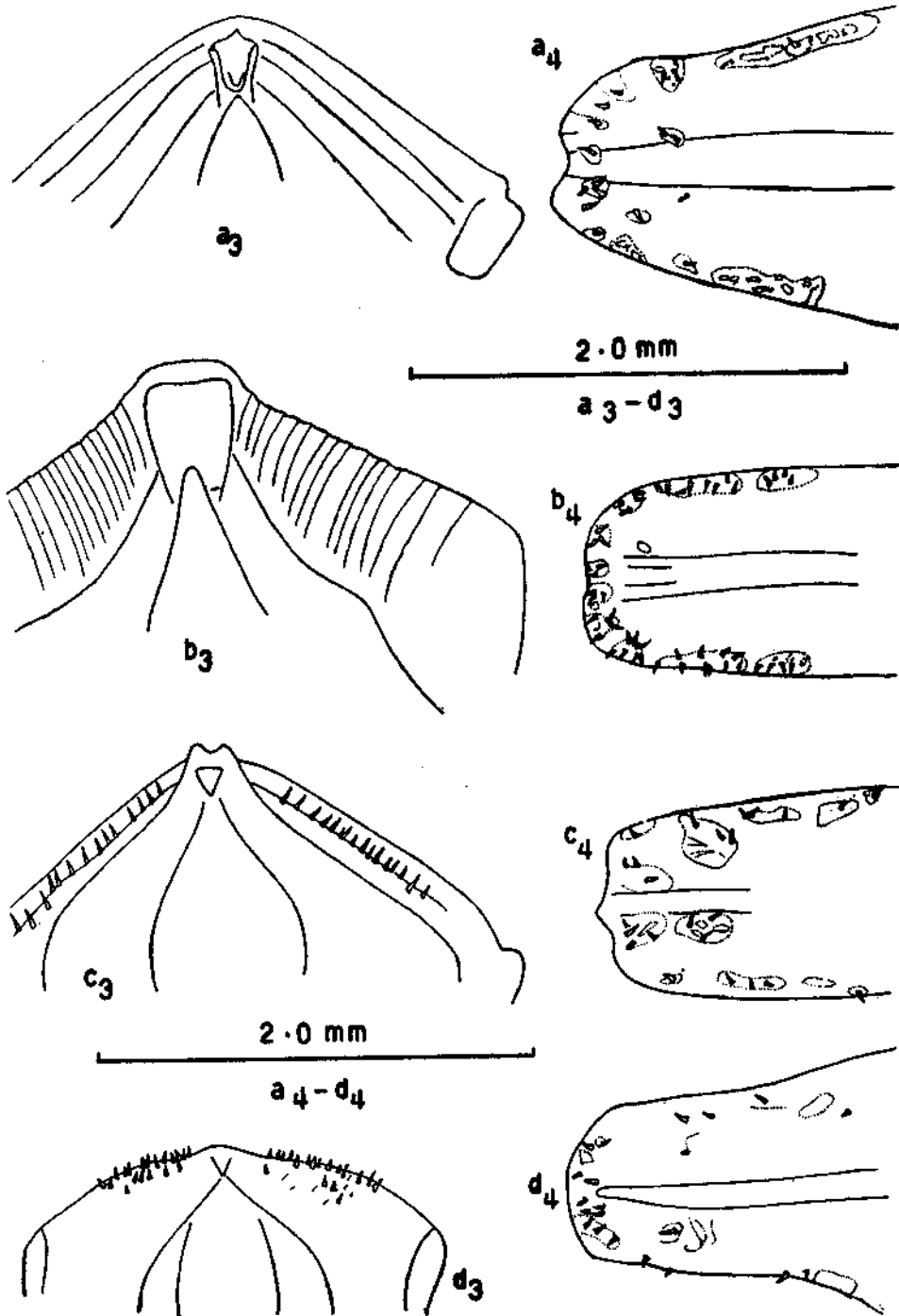


Fig. 2. a. *Liza parva*, b. *Liza tade*, c. *Valamugil seheli* and d. *Ellochelon vaigiensis* (suffix 3 — inner view of lower lip, suffix 4 — tongue and lingual dentition).

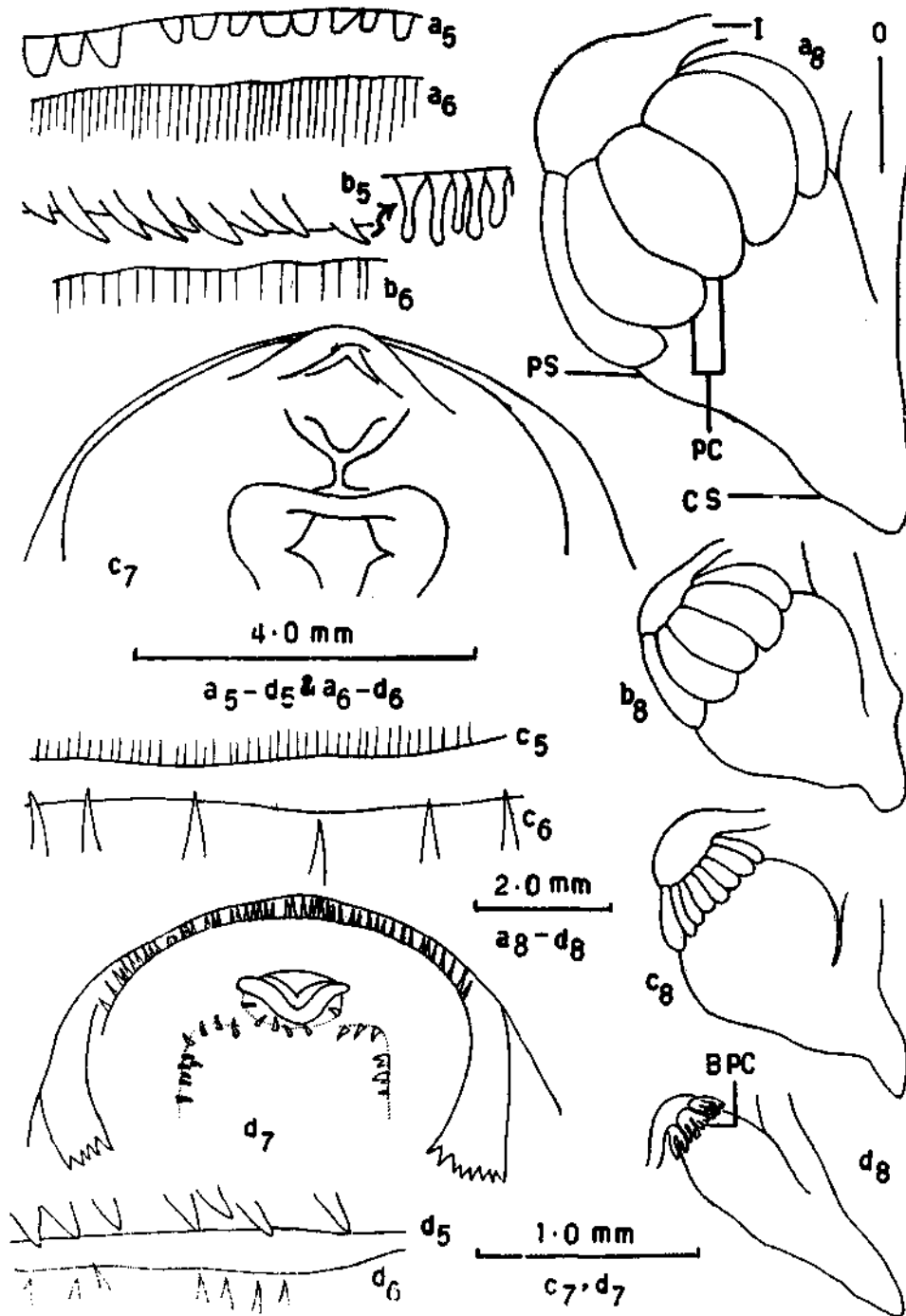


Fig. 3 a. *Liza parsia*, b. *Liza tade*, c. *Valamugil seheli* and d. *Ellochelon vaigtensis* (suffix 5 — upper lip dentition, suffix 6 — lower lip dentition, suffix 7 — oral roof dentition, suffix 8 — stomach and pyloric caeca, O — oesophagus, CS — cardiac stomach, PS — pyloric stomach, PC — pyloric caeca, BPC — branched pyloric caeca, I — intestine).

In view of the direct application in management of brackishwater farming, such studies need to be undertaken in different regions of India on local species.

A FIELD KEY FOR THE IDENTIFICATION OF MULLET SEED OFF RATNAGIRI COAST

1. Almost entire first dorsal, most of second dorsal and pectoral fins pitch black. Pelvic fin orange - yellow. Body dorsally with 3 offwhite or yellow transverse bars. Anal fin elements 11. Caudal fin not forked, but only slightly emarginate, truncated.
 *Ellochelon vaigiensis*

Dorsal and pectoral fins either white or dusky. Pelvic fin white. Body dorsally without any transverse bars. Anal fin elements 12. Caudal fin distinctly forked.

2. Pectoral fin with a well developed axillary scale. Origin of anal fin opposite to that of second dorsal fin and that of first dorsal fin almost midway between snout tip and caudal base. Stellate melanin pigments densely distributed along lateral line and ventral half of body. Profile of head smoothly curved.
 *Valamugil seheli*

Pectoral fin without axillary scale. Origin of anal fin well in front of second dorsal fin and that of first dorsal fin distinctly nearer to caudal base than

to snout tip. Stellate melanin pigments either absent on lateral side or at the most distributed along lateral line, with a few scattered ones below it. profile of head rather flat. 3

3. Most common species, found in plenty throughout the year. Body rather stout (being 3.7 to 4.6 times as long as height) and both margins convex. Laterally with 4 or 5 indistinct horizontal lines. A slightly yellowish patch on upper half of operculum. Pectoral fin white, without any dark spot at its base and falling just short of origin of first dorsal fin. Both dorsal fins almost white with dusky borders. Anal fin almost white. Stellate melanin pigments absent laterally, but arranged in 3 crowded patches along the chin region. *Liza parsia*

2 Very rare species, appearing occasionally in summer. Body rather slender, elongated (being about 5-times as long as height); ventral margin almost straight while dorsal gradually sloping behind head. Laterally with 5 to 7 distinct horizontal lines. Operculum without any yellowish patch. Pectoral fin dusky with a black spot at its base and falling considerably short of origin of first dorsal fin. Both dorsal fins fairly dark while anal fin dark only in distal half. Stellate melanin pigments arranged all along lateral line and in 3 small patches in the chin region, *Liza tade*

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