

Identification and morphometric descriptions of four dominant families of larval fishes in the estuary of Marudu Bay, Sabah, East Malaysia

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Introduction

Fish larvae are mostly ecologically and morphologically different in comparison with their adult counterparts along their development processes. They occupy different habitats, taking different food resources, and having different predators and different behaviour. During the larval phase, the fish develops from an egg to a larva which has all the fully functional organs. Many species have highly specialized larval morphologies, with various structures (e.g. strong spines on the head) that will be modified and lost upon transition towards adulthood (Leis and Carson-Ewart, 2000). Fish larvae

differ so much from their adults that they are often difficult to identify. Nonetheless, they need to be identified to some level of confidence if larval ecological studies are to be meaningful. Therefore, the positive identification of larvae is necessary. The identity and description of the early life stages of mangrove fish larvae is important to enable more research on fish larvae in the estuarine ecosystem. Apart from the taxonomic identification of larval fishes collected, the important morphological features of the specimens were also investigated. Unfortunately few studies on ichthyoplankton identification have been carried out in Malaysia (Whitfield, 1999). The main problem for the

identification of larvae is the lack of larval fish identification keys, but in most cases, fish larvae are at best identified to the family level (Blaber *et al.*, 2003).

Materials and methods

The present research was conducted in the coastal waters of Kota Marudu, Sabah, and East Malaysia (Fig. 1). The coastline of Kota Marudu is relatively shorter (70 km) compared to the ones in other districts in Sabah. Monthly sampling of fish larvae samples were collected at five different stations representing the distance from the river mouth to offshore from October 2012 to September 2013. Station1 (Stn 1) was the nearest station to the river mouth while Stn 5 was the farthest. The distance between sampling stations was about 1 kilometre. Fish larvae were sampled using plankton nets with a mesh size of 350 μm that was towed subsurface for 20 minutes behind a boat with a 14-horse power engine. Samples were sorted in the laboratory using Nikon dissecting microscope and preserved in 5 % formalin. For the identification of larval fishes up to the family rank, the works of Leis and Carson- Ewart (2000) and Kawaguchi (2002) were followed. The total length and standard length were the two selected morphometric characteristics taken using a Keyence Digital Microscope (VHX-500) (Fig. 2). Developmental stages of fish larvae were presented according to Russell (1976) and Takemura *et al.* (2004).

Four dominant families such as Sillaginidae, Engraulidae, Mugilidae and Sparidae were drawn using Camera Lucida, fixed to the stereomicroscope (Fig. 3).

Results and discussion

Morphometric Description

Sillaginidae: This family is one of the most diverse in the study area. Sillaginidae larvae are elongated ranging in total length between 2.40 to 2.50 mm with an average of 2.45 mm (Table 1). Their head is small to moderate with a pointed snout. The gut is straight, and has a large diameter. The mouth is small. The eyes are large to moderate. Melanophores also appear over the gut. Some samples are pigmented at the ventral midline of the trunk and tail (Fig. 3).

Engraulidae: Larvae are elongated and cylindrical while the head is slightly depressed. The total length in this family ranges from 3.22 to 6.30 mm with an average of 4.72 mm and the standard length measured ranges from 3.10 to 6.09 mm (Table 1). The gut is long and straight. The mouth is relatively small and inferior in position. The eyes are small to moderate. Body pigmentation is very light. There are also melanophores at the notochord tip (Fig. 3).

Mugilidae: The body of Mugilidae larva is deep and compressed.

Table 1: Number of fish larvae and two selected morphometric characteristics (mm) of four dominant families.

Characteristics	Sillaginidae N= 1707		Engraulidae N= 555		Sparidae N= 372		Mugilidae N= 481	
	Mean±SE	Range	Mean±SE	Range	Mean±SE	Range	Mean±SE	Range
TL	2.45±0.05	2.40-2.50	4.72±0.10	3.22-6.30	4.55±0.11	3.14-5.84	2.62±0.04	2.12-3.52
SL	2.30±0.04	2.10-2.43	4.69±0.06	3.10-6.09	4.47±0.09	3.10-5.80	2.60±0.05	2.09-3.40

TL: Total length, SL: Standard length.

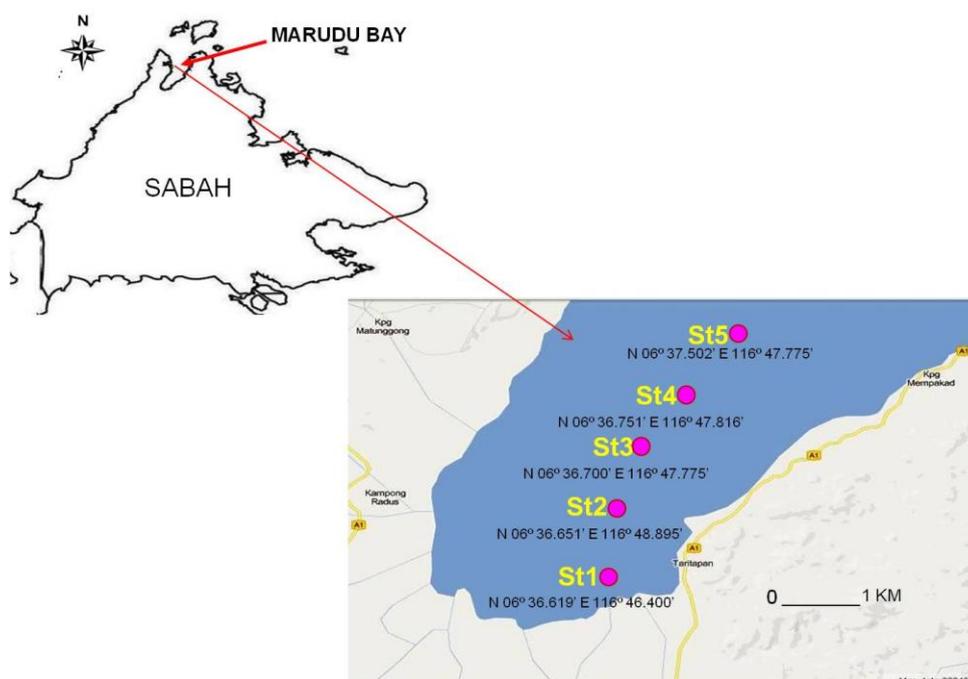


Figure 1: Geographical location of the sampling sites in the waters of Marudu Bay, Sabah, East Malaysia.

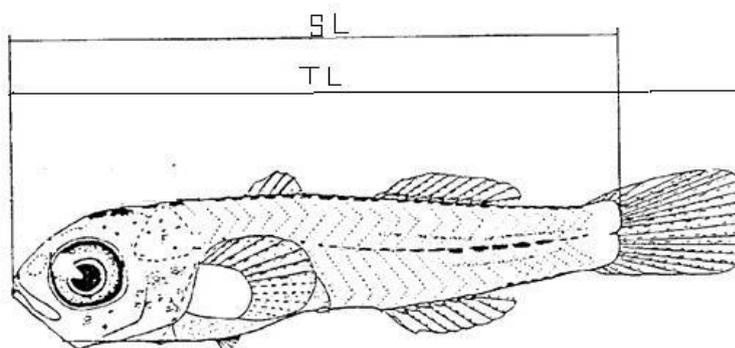


Figure 2: Morphometric measurements of fish larvae were measured using Keyence Digital Microscope (VHX-500). Standard length (SL), Total length (TL) (Leis and Carson-Ewart, 2000).

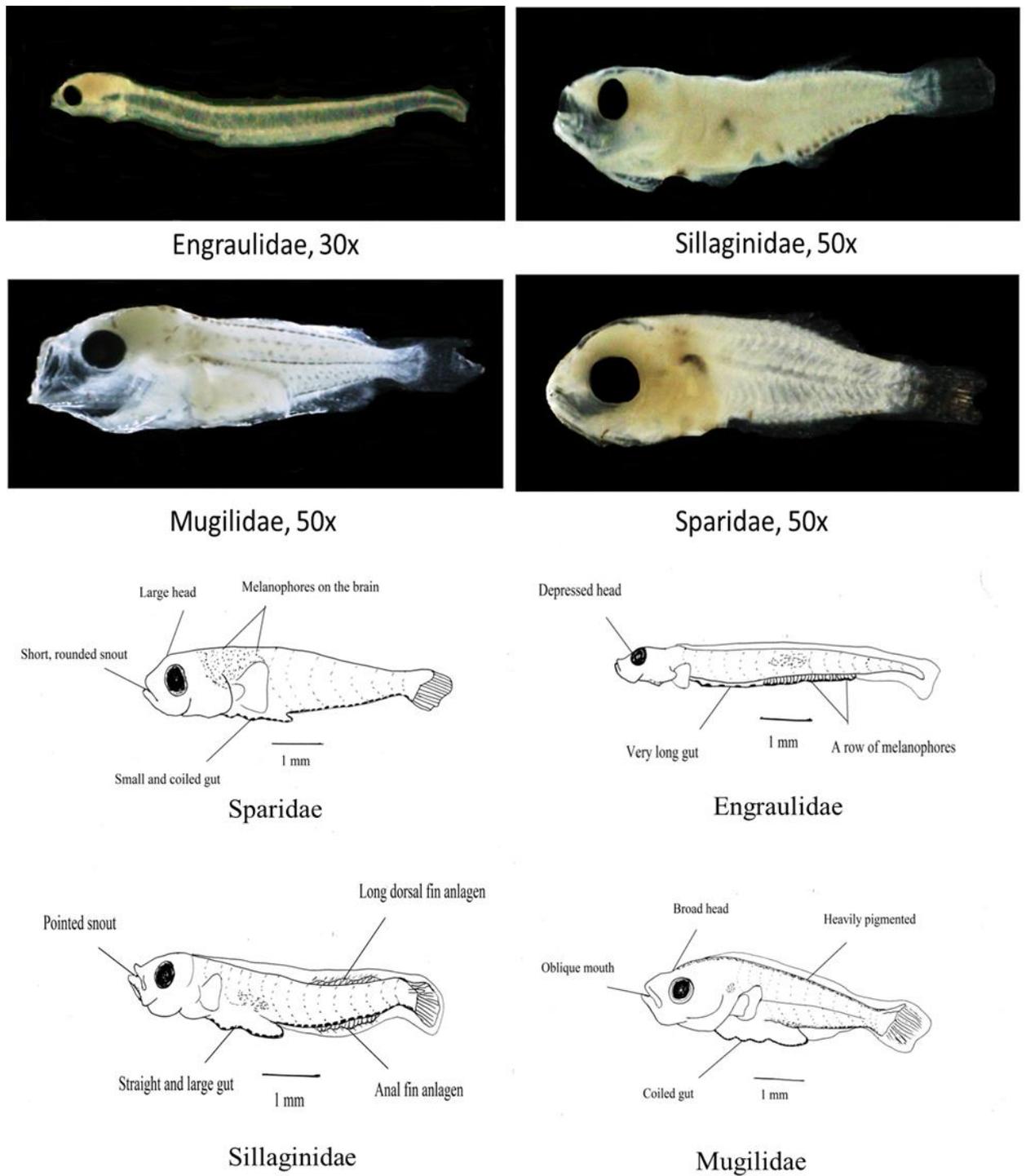


Figure 3: Photograph of four dominant families collected from the estuarine areas of Marudu Bay, Sabah, and East Malaysia.

The total length of the larvae varies from 2.12 to 3.52 mm with an average of 2.62 mm and the standard length is between 2.09 and 3.40 mm (Table 1). The gut is coiled. The head is broad.

Mugilid larvae have an oblique mouth with a short snout. The eyes are large. The larvae are heavily pigmented (Fig. 3).

Sparidae: Larvae are moderately compressed with an average total length of 4.55 mm (Table 1). The gut is small and coiled. The head is large with a short and rounded snout. The eyes are large. Pigmentation appeared on the ventral and dorsal surface of the gut, and also in the brain area (Fig. 3).

This study provides the first taxonomical study on fish larvae from the estuarine area of Marudu Bay and represents base line data for further related studies. Morphological descriptions of fish larvae are quite a difficult task especially for beginners. Some characteristics used in the description of larva disappeared during the growth process. The shape of the body, length of gut, mouth and head size are amongst the main characteristics used to identify the fish larvae. Other characteristics such as head spines, teeth and fin ray are inconsistent because they can get broken or sometimes are not fully developed. The comparison of the present morphological features of four dominant families of fish larvae with the works of past researchers particularly Ara *et al.* (2013) and Ooi and Chong (2011) are given below:

Family Sillaginidae is recognized by having an elongated body, large eyes, a straight gut and moderate to elongated head form. Larvae have very few pigments on the gut (Lies and Carson-Ewart (2000). Sillaginid larvae are the most abundant specimens in this study. This family is also reported from South China Sea (Termvidchakorn, 1997) and Johor Strait, Malaysia (Ara *et al.*, 2013). Family Engraulidae are recognized by their elongated and cylindrical body, long head, slightly depressed head and having two melanophores on the ventral midline of the gut (Janekarn and Boonruang, 1986; Leis and Carson-Ewart, 2000). Engraulid larvae are also reported by Ara *et al.* (2013) in the seagrass-mangroves ecosystem of Johor Strait, Malaysia, Ooi and Chong (2011) in Matang mangrove of Malaysia, Tzeng and Wang, (1992) in Taiwan and Blaber *et al.* (1997) in Sabah and Sarawak. Family Mugilidae are characterized by a compressed and elongated body, coiled gut, an oblique mouth and heavily pigmented. All morphological features agreed well with the Leis and Carson-Ewart (2000). Previously, it was also reported from Matang mangrove of Malaysia (Ooi and Chong, 2011), South China Sea (Termvidchakorn, 1997) and French Polynesia waters (Dufour and Galzin, 1993). Family Sparidae are easily identified by their deep body, large head, coiled and small gut, short and rounded snout and pigmented ventral and dorsal surface of the gut and also

on the brain (Leis and Carson-Ewart, 2000). This family was also reported from the South China Sea (Termvidchakorn, 1997).

The present study can be a basic method intended to facilitate the identification of fish larvae from the Marudu Bay. Morphological factors are still the main key to identification of fish larvae but to get systematic information on fish larvae one may need to use molecular methods and also morphological variation. Further detailed systematic studies on the fish larvae particularly with the adoption of both molecular methods and morphological variation are needed for more accurate identification and for the purpose of extensive information on fish larval diversity in Sabah waters.

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