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Feeding Habits of Larval Fishes of the Family Clupeidae (*Actinopterygii: Clupeiformes*) in the Estuary of River Pendas, Johor, Malaysia

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ABSTRACT

Studies on feeding habits and seasonal variation of diet of fish larvae of family Clupeidae was conducted from October 2007 to September 2008 in the estuary of Sg. Pendas, Gelang Patah, Johor, Malaysia. The diet composition were grouped into seven major categories consisted of phytoplankton, zooplankton, plant-like matter, debris, fragment of copepod, algae and unidentified food items. The most predominant food items in the gut of clupeids was phytoplankton (82.53%), followed by plant-like matter (7.34%), debris (4.86%), fragment of copepods (2.69%), algae (0.92%), unidentified items (0.77%) and zooplankton (0.54%).

Key words: Stomach contents, Clupeidae larvae, Pendas river, Malaysia

INTRODUCTION

The fish from family Clupeidae is a member of the order Clupeiformes that are regarded as herring-like fish or clupeids. Herrings, shads, sardines, pilchards and menhaden are moderate-sized fishes under this group. The group includes a broad variety of species that lives in different habitat ranging from freshwater to marine. There are about 57 genera and 188 species world-wide under the family Clupeidae. These fishes usually have modified scales on the belly forming abdominal scutes with a saw-like edge. Most species have 2 long rod-like post-cleithra. The lateral line is usually absent or on only a few scales. Silvery cycloid scales are easily detached and are found only on the body. The mouth is usually terminal with jaws about equal in length. Teeth are small or absent but gill rakers are long and numerous for sieving plankton. Fins lack spines and there are no barbels. There is no adipose fin. The pectoral and pelvic fins have a large axillary scale. The caudal fin is deeply forked. The eye is partly covered by an adipose eyelid. The flesh is particularly oily and is highly nutritional. Members of this family often form immense schools in surface waters of the ocean and they feed on plankton. Usually, the larvae occupy different habitats than do the adults. The larvae can be found in the open waters of the continental shelf, older larvae may be found near the shore and estuarine channels and the juveniles occur in nurseries of estuarine sea grass beds.

Whitehead (1985) stated that clupeids are found in most shallow water habitats including fresh water body, brackish estuaries, coastal embayment and oceanic reefs. The clupeids are abundant and valuable food fishes. Some of them are of economic importance such as the anchovies and the wolf-herring. Ikan terubok ikan parang and ikan tamban are examples of fish in Clupeidae family

that are common in Malaysian waters (Chua and Mathias, 1978). The clupeids *Tenulosa toli* (ikan terubok) is potentially cultured species and commercially important tropical shad of the estuaries in Sarawak (Blabber *et al*., 1997).

Detailed study on fish larvae has not been attempted so far except the studies carried out by Ara *et al*. (2011) and Arshad *et al*. (2011). Some reports are available on the food and feeding habits of different fishes (Bhuiyan and Islam 1988; Bhuiyan *et al*., 2006; Chrisfi *et al*., 2007; Dadzie *et al*., 2000; Jardas *et al*., 2007; Ara *et al*., 2009, 2010) but little is known about diet of the fish larvae from family Clupeidae, especially for clupeid larvae in Malaysian waters. Therefore, the present study was undertaken to investigate the feeding habits and diet composition of clupeids larvae in the estuary of river Pendas, Gelang Patah, Johor.

MATERIALS AND METHODS

Study area and sampling: Monthly samples of fish larvae were collected from the estuary of river Pendas, Gelang Patah, Johor (Fig. 1) from October 2007 to September 2008. Specimens were collected using Bongo net with mesh size of 500 μm. Larval specimens were preserved in 5% formalin solution and transported to the laboratory for further study.

Stomach examination: Clupeids fish larvae (Fig. 2) were sorted from other larval specimens. The Total Length (TL) and Body Length (BL) were measured using Keyence Digital Microscope (VHX-500). In total, 64 stomach sacs were removed and diet compositions were examined during the twelve months study period. The stomach was carefully removed from the body under the

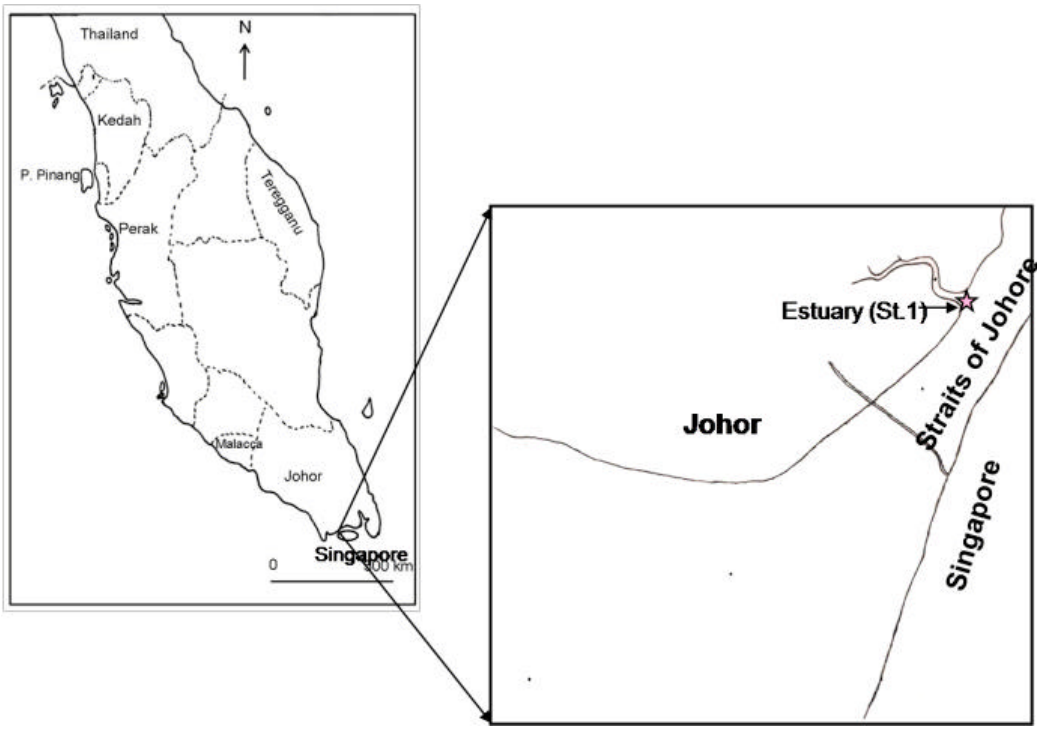

Fig. 1: Geographical location of the estuary of Pendas river, Gelang Patah, Johor, Malaysia

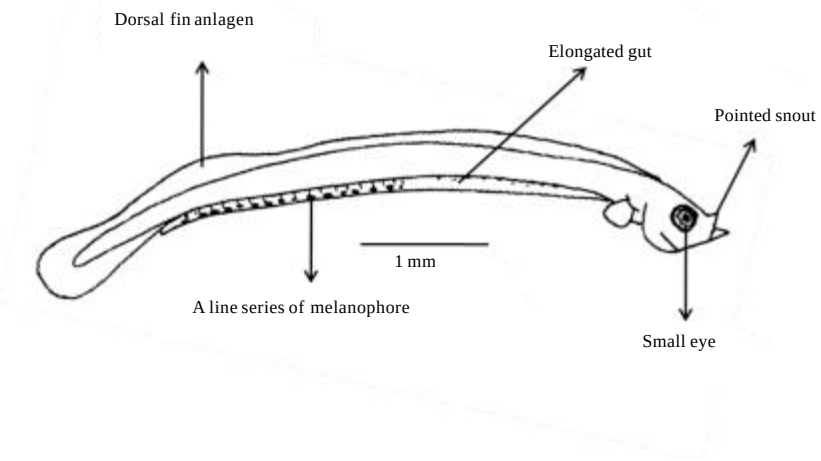

Fig. 2: Biological sketch of a Clupeidae larva

dissecting microscope. The stomach was later incised open onto a slide. A drop of distilled water was dripped on it and covered with a cover glass. The gut contents were counted and identified under a compound microscope to the lowest taxonomic group as possible.

Stomach content analysis: To analyze the composition of the stomach, percentage frequency of occurrence was followed (Chrisfi *et al*., 2007) which as:

$$\text{Percentage frequency of occurrence } (F_{pi}) = (N_{1i}/N_p) \times 100$$

where, N_{1i} is the number of the stomachs in which food item $_I$ was found and N_p is the number of non-empty stomachs.

RESULTS

Diet composition: Prey analyses of stomach contents identified 25 important items belonging to seven major taxa groups: Phytoplankton, zooplankton, algae, insects, plant-like matter, debris and unidentified matters (Table 1). Dominant preys were phytoplankton (82.53%) and this was followed by plant-like matter (7.34%), debris (4.86%), copepod fragment (2.69%), algae (0.92%), unidentified food items (0.77%) and zooplankton (0.54%).

Monthly variation of diet: Highest frequency of occurrence of phytoplankton was observed throughout the year (Table 1). The highest percentage frequency of occurrence (F_{pi}) of phytoplankton (97.13%) was found in July. *Nitzschia* sp. was the most frequent phytoplankton found in the stomach content. The presence of *Nitzschia* sp. was continuous throughout the year with two major peaks in March (76.03%) and November (65.75%), respectively. Plant-like matter was observed in every month of sampling except in May (Table 1). Among all sampling months, the highest percentage of occurrence (F_{pi}) was seen in October (46.77%). The highest percentage occurrence of 14.65% and 14.01%, respectively for both debris and fragments of copepod were recorded in December. For algae the highest percentage frequency of occurrence (F_{pi}) was in January (9.59%) and for unidentified food items was seen in June (3.31%). The occurrence of zooplankton was recorded for three months that include January (4.11%), February (0.56%) and April (1.82%).

Table 1: Monthly frequency occurrence (F *pi*) of food items in the gut of larval fishes of Clupeidae from the estuary of Pendas river, Johor

	Frequency of occurrence (%)												
	O	N	D	J	F	M	A	M	J	J	A	S	
	Number of guts												
Food Items	1	1	5	7	10	6	7	6	6	5	5	5	Average of (F pi)
Phytoplankton	45.16	84.21	57.96	75.35	93.83	90.08	85.45	95.90	89.93	97.13	89.00	86.36	82.53
-*Dacytyloccopsis fasicicularis*	1.61	-	7.01	5.48	29.78	6.61	18.18	58.08	42.51	54.51	39.00	30.30	24.42
-*Biddulphia sinensis*	-	-	21.66	10.96	6.18	0.83	30.00	-	-	-	4.00	6.06	6.64
-*Cerataulina bergonii*	-	-	1.27	1.37	-	-	-	0.20	-	1.64	7.00	-	0.96
-*Coscinodiscus sp.*	-	-	-	-	-	-	-	-	-	-	-	-	-
-*Fragilaria intermedia*	-	-	-	-	1.69	-	1.82	-	1.30	-	7.00	4.55	1.36
-*Fragilaria* sp.	-	-	-	1.37	-	-	-	-	-	-	-	-	0.11
-*Gonyaulax* sp.	-	-	-	-	-	-	-	-	-	-	-	-	-
-*Lauderia borealis*	20.97	15.79	4.46	15.07	5.06	-	5.45	-	0.58	-	-	-	5.62
-*Navicula* sp.	-	-	-	-	-	-	-	-	-	-	-	-	-
-*Nitzschia lanceolata*	-	-	-	-		-	7.27	-	-	-	-	-	0.61
-*Nitzschia* sp.	22.58	65.79	20.38	39.73	48.31	76.03	22.73	37.42	23.49	38.52	13.00	42.42	37.53
-*Rhizosolenia araturensis*	-	2.63	3.18	1.37	2.81	6.61	-	0.20	22.05	2.46	19.00	3.03	5.28
-*Thalassionella* sp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Zooplankton	-	-	-	4.11	0.56	-	1.82	-	-	-	-	-	0.54
-Copepoda	-	-	-	4.11	0.56	-	1.82	-	-	-	-	-	0.54
-Cladocera	-	-	-	-	-	-	-	-	-	-	-	-	-
-Larvaceans (appendicular)	-	-	-	-	-	-	-	-	-	-	-	-	-
-Larval stage (nauplii)	-	-	-	-	-	-	-	-	-	-	-	-	-
-Rotifera	-	-	-	-	-	-	-	-	-	-	-	-	-
-Siphonophores	-	-	-	-	-	-	-	-	-	-	-	-	-
-Thaliacian (tunicate)	-	-	-	-	-	-	-	-	-	-	-	-	-
Fragment of copepod	-	-	14.01	-	-	8.27	10.00	-	-	-	-	-	2.69
Algae	-	-	-	9.59	-	-	-	-	0.43	-	1.00	-	0.92
Plant-like matter	46.77	13.16	13.38	4.11	1.12	1.65	0.91	-	2.16	0.82	1.00	3.03	7.34
Debris	8.06	-	14.65	6.85	1.12	-	1.82	1.43	4.18	2.05	9.00	9.10	4.86
Unidentified Food Items	-	2.63	-	-	0.56	-	-	1.23	3.31	-	-	1.52	0.77

DISCUSSION

The food items are composed of seven major groups viz. phytoplankton, zooplankton, copepod fragment, algae, plant-like matter, debris and unidentified food items. According to the table ranked by frequency of occurrence (F_{pi}), the dominant food item in the stomach is phytoplankton. Phytoplankton was observed in the stomach of fish larvae in every month around the year. Hunter and Thomas (1972) stated that phytoplankton is probably important for only about the first week of feeding regime and a decline in percentage of phytoplankton in the gut of anchovy larvae is seen with an increase in size (Arthur, 1976) Phytoplankton is likely higher quality food for zooplankton and macro invertebrates as well as to the fish larvae. In this study, phytoplankton was represented by *Nitzschia* sp, *Dactylococcopis fascicularis* and *Biddulphia sinensis* and they were the common items in the stomachs of the specimens. *Nitzschia* sp were present in the diet at highest frequencies of (37.53%). The results are in contrast with those of Hunter and Thomas (1972). According to Hunter and Thomas (1972), the main item for phytoplankton in the stomach content was *Gymnodium splendens*. Plant-like matter (7.34%) is the second in ranking of percentage frequency of occurrence (F_{pi}), which meant it is the second, most important food items consumed by the fish

larvae from family Clupeidae. Zooplankton represented by copepod, cladocera, rotifer, larvacean (appendicular), larval stage of Crustacea (nauplii), siphonophores and thaliacian (tunicate). Zooplankton such as copepod nauplii were not a significant item in the diet of the fish larvae analyzed in this study, although they were significantly dominant in the planktonic environment. This contrasts with the composition of the diet of the majority of marine fish larvae which consume copepod nauplii at different frequencies, because of their great abundance in the environment as well as their appropriate size as food for fish larvae (Arthur 1976, Turner 1984, Watson and Davis, 1989). Pepin and Penney (2000) observed in their study that larval predation pressure on the zooplankton community was very low, but found that larval fish gradually shifted their diet to larger prey items, thus limiting competition.

Robichaud-LeBlanc *et al.* (1997) stated that different fishes consume different types of food and feeding habits of fishes varies from season to season. Variations in the dominant food items found in the stomachs of the fish larvae were more likely due to the temporal and spatial availability of the prey in the particular water mass. In this study, the samples of fish larvae were collected from estuary of Sg Pendas that have good distribution of phytoplankton. Based on the results, foraging mainly on phytoplankton may be one of the feeding strategies by the fish larvae from family Clupeidae. The inability to swim swiftly may have restricted them to catch bigger and moving prey such as the zooplankton.

CONCLUSIONS

The present study on food and feeding habits of fish larvae from family Clupeidae in the estuary of Pendas River, Gelang Patah, Johor indicates that clupeid larvae are herbivorous as the results showed that more than 80% of the food item was phytoplankton.

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