

MARINE BIODIVERSITY OF INDONESIA; LARVAL FISH PERSPECTIVE

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ABSTRACT

Marine life of Indonesia is very well known as a high diversity according to Ekman's hypothesis. However, from the larval fish perspectives, this hypothesis seems to be rejected according to the comparative results of larval fish studies during the Snellius Expedition (1984-1985) in Banda Sea and the larval fish observation related to the East Australian Current (1998-1999) off New South Wales coast in Australian waters. Larval fish diversity from some previous studies over the world is also included. Several suggestions are also recommended to enhance our knowledge in marine biodiversity including improvement in marine biodiversity observation such as, research programs, field and laboratory facilities and numbers of taxonomists, and also collaborative works among research institutes, universities, and non-governmental organizations.

Keywords: Marine biodiversity, Larval fish, Indonesia

INDONESIAN HOTSPOT OF MARINE BIODIVERSITY

As a maritime country covering with 70% seawaters, and be situated in the Indo-West Pacific region, Indonesia is very well known as one tropical state in the faunistic centre according to Ekman's concept (Ekman, 1953). This concept was then developed by Briggs (1974) and Hayden *et al.* (1984). The attractiveness of marine biodiversity in Indonesia has been created numbers of expeditions and observations on fauna and flora long time before Indonesian state declared (Hutomo and Moosa, 2005), for instance, L'Uranie (1818-1819), Challenger (1872-1876), Siboga (1899-1900), Albatross (1906-1909), Snellius (1921-1930), Mortensen Kai Island (1922), and Mortensen Java-South Africa (1929). Therefore, Indonesian archipelago may be categorized as a hotspot of marine biodiversity in the world.

Most results on previous expeditions were concluded that Indonesian waters deposits a huge diversity of marine life. At least two evidences were approved this statement, one is diversity of

stony coral (<80 genera and <450 species) in the Indo-West Pacific (Veron, 1986) and the other is numbers of pomacentrid species (after Allen, 1975). Thus, the high biodiversity of Indonesia marine life is not only the slogan, but also this is reality.

From larval fish perspective, the hotspot of marine biodiversity in Indonesia faces vague impression. It is quite interesting to discuss and may raise a lot of questions. I think this perspective may little support Ekman's hypothesis. In general, larval fish studies in Indonesia are limited extremely, however many world studies on larvae referring to some previous findings of Delsman's works between 1921 and 1938 in Jawa Sea (Delsman, 1972). This paper is reviewed previous studies of larval fish in Indonesia waters, and also reported the Snellius Expedition finding on larval fish in Banda Sea (Soewito and Schalk, 1990), and then compared the larval fish study in Eastern Australia (Syahailatua, 2005, Figure 1). Therefore, the hotspot of marine biodiversity in Indonesia may be questioned from larval fish perspective.

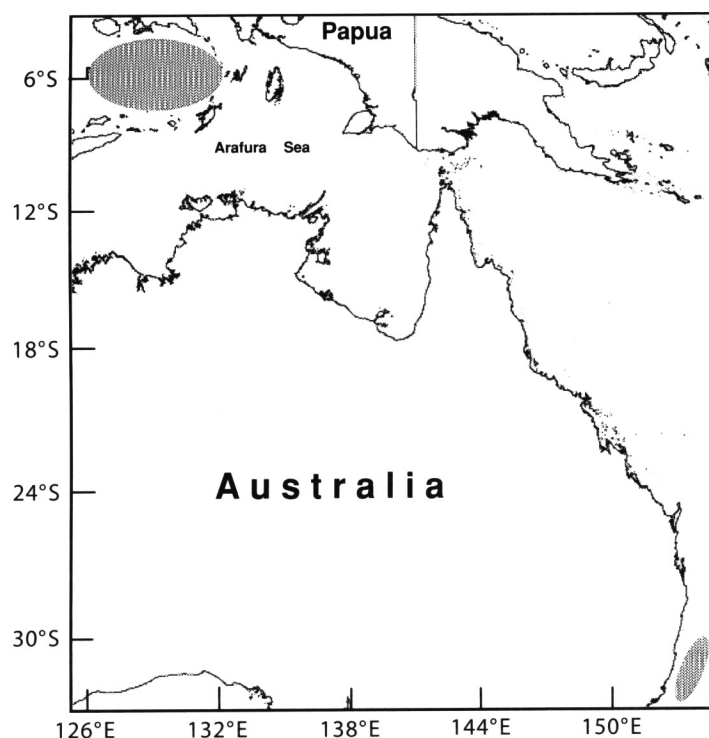


Figure 1. Map indicates sampling sites (shadow) in Banda Sea and Eastern Australia

LARVAL FISH STUDIES IN INDONESIAN SEAS

Dr H.C. Delsman can be called as a pioneer in larval fish study in Indonesia waters, and his works are really appreciated over the world. Most of his larva samples were collected in the coastal areas of Jawa sea, especially north Jawa, and he focused on taxonomic of fish eggs and larvae (Delsman, 1972). He described about 10 genera of fish eggs and larvae, and also illustrated them. Nowadays, his descriptions and illustrations on ichthyoplankton are commonly referred by many marine scientists.

Delsman's works on larval fish may be a spectacular evidence for marine ichthyologists in Indonesia as well as worldwide, unfortunately, information regarding larval fish in Indonesia, especially related to oceanographic features is very insignificant. The other study that compared to Delsman's works is probably larval collection during the Carlsberg Foundation Oceanographical Expedition 1928-1930 (Jespersen, 1942). The Carlsberg's expedition had information on eel larvae (*Leptocephalus*), and it has been re-examined since 2001 by Indonesian and Japanese scientists (Wouthuyzen, 2004, pers. comm.).

Till the end of the 20 century, larval fish information from Indonesian waters was updated by the results of larval study during the 2nd of Snellius Expedition, 1984-1985 (Soewito and Schalk, 1990), however larval taxonomic from Indonesian waters is very limited.

SNELLIUS EXPEDITION 1984—1985 (SOEWITO AND SCHALK, 1990).

For the period of the Snellius Expedition in Banda Sea (1984-1985), larval fishes were sampled horizontally and vertically (up to 500m depth) during day and night with a Rectangular Midwater Trawl (RMT) 1 (mesh 320 μ m) and RMT 8 (mesh 450 μ m) at 12 stations laid 128-134°E and 4-7°S. There were 78 families identified from the samples, and families of Myctophidae and Gonostomidae were found abundantly during the southeast-monsoon (August 1984), while Acathuridae, Myctophidae and Gonostomidae were in great numbers of specimen during the northwest-monsoon (February/March 1985). This study also concluded that larval composition of both seasons was slightly different due to possibility in water mass displacement (Soewito and Schalk, 1990).

COMPARISON OF LARVAL DIVERSITY BETWEEN LOW AND HIGH LATITUDES

A comparative assessment of larval fish diversity from the two regions with latitudinal differences is very rare or maybe never done, because we understand that it should be different in numbers of taxa (species or families). However, I made this comparison due to a spectacular findings of larval fish in eastern Australia (EA) waters (152°30'-153°E and 30-32°S, see Fig. 1) observed during 2 weeks each of spring in November 1998 and of summer in January 1999. Larval samples were collected using neuston net (mesh 500 μ m) and EZ net (multiple opened-closed net, mesh 500 μ m) only during night (after sunset till sunrise) at 6 stations (3 sites each of 50m and 100m isobath). I identified 111 families with

relative abundance of Carangidae, Labridae, Lutjanidae, Microcanthidae, Myctophidae and Scombridae were associated to the East Australian Current (EAC) or oceanic water masses, while the Callionymidae, Clupeidae, Platycephalidae, Sillaginidae and Teraponidae were mostly found in the surface or deep upwelled/uplifted water masses (Syahailatua, 2005).

I re-analyzed the two set of data, and found that EA had more families' numbers than BS and the ANOVA result shows significantly difference in family numbers (Fig. 2, Table 1). This evidence is supported by the Bray-Curtis similarity index (<50%) of larval composition from both regions (Fig. 3). Also, from the combined data, 65 families were not caught from BS, while only 26 families were not found in EA. Conversely, the Shannon-Wiener diversity index was no significant difference indicating larval composition in family level comparable (Fig. 2, Table 1).

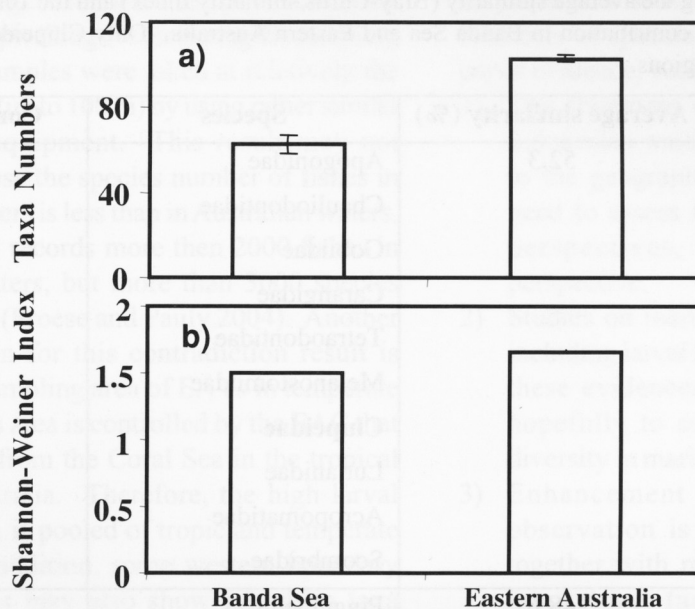


Figure 2. Total taxa numbers (a) and Shannon-Weiner Diversity Index (b) for larval samples of Banda Sea and Eastern Australia. The ANOVA results of these two sampling sites showing in Table 1.

Table 1. The ANOVA results of larval samples collected in Banda Sea (1984-1985) and Eastern Australia (1998-1999).

**=significant different at $P < 0.01$; NS=not significant at $P > 0.05$.

Sources	DF	MS	F	P
a. Taxa numbers				
Regions	1	1600.00	160.00	0.006 **
Residual	2	10.00		
Total	3			
b. Shannon-Weiner Diversity Index				
Regions	1	0.25	0.00	0.999 NS
Residual	2	254520.50		
Total	3	254520.75		

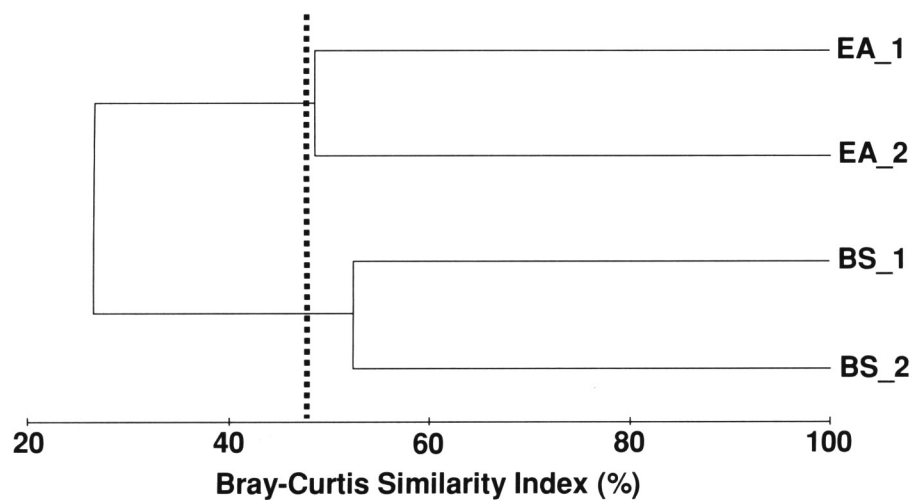


Figure 3. Cluster dendrogram shows the split of larval taxa from the two regions (EA, Eastern Australia; BS, Banda Sea) at less than 50% of Bray-Curtis Similarity Index. Percentage individual numbers were used and standardized without transformation.

Table 2. Simper results showing the average similarity (Bray-Curtis similarity Index) and the 10th dominant taxa giving the significant contribution in Banda Sea and Eastern Australia. Only Clupeidae was occurred dominantly in both regions.

Region	Average similarity (%)	Species	Contrib. (%)
Banda Sea	52.3	Apogonidae	11.7
		Chauliodontidae	8.9
		Gobiidae	7.2
		Carangidae	6.3
		Tetraodontidae	4.7
		Melanostomiidae	4.6
		Clupeidae	4.6
		Lutjanidae	4.5
		Acropomatidae	4.1
		Scombridae	3.9
Eastern Australia	48.6	Pinguipedidae	6.0
		Serranidae	5.9
		Acanthuridae	4.1
		Dactylopteridae	4.1
		Callionymidae	4.1
		Gerreidae	3.9
		Bothidae	3.7
		Triglidae	3.4
		Monacanthidae	3.4
		Clupeidae	3.3

Table 3. List of family numbers of larval fishes from western boundary current region

Latitude	Western boundary current region	Notes	No. families	Authors
34S	Off Sydney Australia	2 cruises in 4 months	111	Smith & Suthers 1999
34S	Off Sydney Australia	over 4 years	119	Gray & Miskiewicz 2000
27N	Gulf of Mexico	over 33 days	100	Richards et al. 1993
	Great Barrier Reef	over 3 years	99	Leis & Goldman 1987
36N	Cape Hatteras	Spring 1996	78	Grothues & Cowen 1999
35N-43N	East coast United States and Canada		92	Fahay 1983
6S	NE Brazil	1 month	74	Ekau et al. 1999
20S	Brazil Current	1978, 1995	77	Nonaka et al. 2000
32S	Angulas	1 year	139	Beckley 1993

Theoretically, high latitude region may have a large number of families or species, however the evidence of this assessment is not confirmed. It is fairly puzzling, because these two studies areas dominated by upwelling events during the sampling periods, and samples were taken at relatively the identical depth (up to 100 m) by using rather similar mesh net of equipment. This result may not surprise, because the species number of fishes in Indonesian waters is less than in Australian waters. FishBase 2004 records more than 2000 fishes in Indonesian waters, but more than 3000 species from Australia (Froese and Pauly 2004). Another possible reason for this contradiction result is although the sampling area of EA as in temperate region, and this area is controlled by the EAC that moving south from the Coral Sea in the tropical region of Australia. Therefore, the high larval numbers in EA is pooled of tropic and temperate fish taxa. In addition, some western boundary current regions may also show a high in taxa number of larval fishes, however sometimes samples were taken more than 1 year (Table 3). All findings from those region are confirmed my findings in eastern Australia, and may supported this paper presuming.

CONCLUSION REMARKS AND RECOMMENDATIONS

A high in marine biodiversity of Indonesian waters is probably recognized elsewhere, and from some points of view, it is true, for example, species numbers of Pomacentrids (Allen 1975) or genera

and species numbers of stony coral (Veron, 1986). However from larval fish perspectives, it seems that this biodiversity phenomenon is imprecise. This may open to discussion why it could be occurred. Numbers of speculation may be raised from this paper evidence, such as:

- 1) The statement of high marine diversity in Indonesian waters is a general perception due to the geographical facts, however we still need to assess this perception from several perspectives, for instance larval fish perspective.
- 2) Studies on marine biodiversity in Indonesia including larval fishes is in progress, therefore these evidences may vary frequently, and hopefully to support the statement 'high diversity in marine life'.
- 3) Enhancement in marine biodiversity observation is considered in some ways together with research programs, field and laboratory facilities and numbers of taxonomists.
- 4) Collaborative works among research institutes, universities, and non-governmental organizations should be designed to figure out the potential of marine biodiversity in Indonesia.

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