

**ASSEMBLAGE, RECRUITMENT AND ECOLOGY OF FISH  
LARVAE IN MATANG MANGROVE ESTUARY AND  
ADJACENT WATERS, PENINSULAR MALAYSIA**

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## ABSTRACT

Spatio-temporal distribution of larval fish in the Matang mangrove estuaries and adjacent coastal waters was examined from monthly surface horizontal tows from May 2002 to October 2003 at seven stations located 10.6 km upstream to 16 km offshore. A total of 92,934 fish larvae, representing 19 families were identified. A further 3 families were recorded in the mangrove waters during diel studies but not found during monthly samplings. Larval fish community using mangrove estuaries and nearshore waters mainly consists of a few key families of residents (e.g. Gobiidae) and euryhaline fishes (e.g. Engraulidae), whereas the wider diversity of other fish families in the estuary that were not collected as larvae suggest that they must have entered the estuary as juveniles. Larval fish assemblages were dominated by Gobiidae (50.1%) and Engraulidae, mainly *Stolephorus baganensis* and *Thryssa kammalensis* (38.4%).

Larval fish abundance including their ontogenetic stages differed spatially and temporally. Three peaks of total larval fish were observed; March 2003 ( $992 \pm 986$  N.100m<sup>-3</sup>), October 2003 ( $980 \pm 1,440$  N.100m<sup>-3</sup>) and August 2002 ( $656 \pm 457$  N.100m<sup>-3</sup>). These peaks coincided with the intermonsoon periods of variable winds and high rainfall, except the August peak when wind forcing was high. Two peaks of recruitment time were identified for Gobiidae in March and October. Spawning and resulting preflexion larvae of Engraulidae occurred between June to December in offshore waters, followed by the higher abundance of postflexion larvae between October-January in mangrove estuaries. Estuarine preflexion gobiid larvae were ubiquitous in the mangrove estuaries and coastal waters. Larval stages of euryhaline species such as Engraulidae and Clupeidae that spawned in offshore waters were largely advected into mangrove estuaries at the postflexion stage. Larvae of other euryhaline fishes (e.g. Sciaenidae, Blenniidae and Ambassidae) that likely spawned inside the estuary were, however, exported to offshore waters.

Higher larval abundance was recorded during the wet period with twelve families identified for each period in the eight 24-hour samplings of surface and bottom layers in the lower estuary in July 2003 (dry period) and November 2003 (wet period). The yolk-sac stage of Gobiidae was more abundant at night during new moon when tidal inundation was highest. High numbers of preflexion gobiids were particularly observed at the end of ebb or flood tide (slack water), a strategy adopted for feeding

during reduced water movement so as to maintain their position and retention within the estuary. Total Engraulidae larvae were more abundant at neap tide and younger preflexion larvae tended to aggregate in surface water during flood tide and day time. Postflexion larvae remained at the bottom of the estuary during ebb tide. The engraulid larvae appear to adopt a strategy for upstream penetration using the selective tidal transport during flood tide.

Larval fish advection into or away from the estuary is by tidal currents but the final result of advection appears to be modulated by salinity and turbidity gradients, larval food availability, as well as larval stage and possibly larval behavior.

## ABSTRAK

Spatio-temporal bagi larva ikan di muara sungai bakau kawasan Matang dan perairan laut di sekitarnya dikaji. Penyampelan di permukaan air pada setiap bulan dari bulan Mei 2002 ke Oktober 2003 dilakukan di tujuh stesen yang terletak 10.6 km ke arah sungai dan 16 km ke arah laut. Sebanyak 92,934 ikan larva yang mewakili 19 famili telah dikenal pasti. Tiga lagi famili telah direkodkan dalam muara sungai dalam satu lagi kajian harian yang tidak direkodkan dalam kajian bulanan. Komuniti larva ikan yang menggunakan muara sungai bakau dan perairan laut sekitarnya terdiri daripada beberapa famili utama iaitu ikan pemastautin (contoh Gobiidae) dan ikan 'euryhaline' (contoh Engraulidae). Diversiti ikan lain yang didapati di dalam muara sungai yang tidak ditangkap sebagai larva ikan dianggapkan bahawa mereka mesti memasuki muara sungai pada peringkat juvana. Larva ikan diwakili oleh Gobiidae (50.1%) dan Engraulidae (38.4%) yang sebahagian besarnya terdiri daripada *Stolephorus baganensis* dan *Thryssa kammalensis*.

Kelimpahan larva ikan termasuk peringkat ontogenetik mereka adalah berbeza dari segi ruang dan waktu. Tiga puncak daripada jumlah ikan larva telah dikesan; Mac 2003 ( $992 \pm 986 \text{ N.100m}^{-3}$ ), Oktober 2003 ( $980 \pm 1440 \text{ N.100m}^{-3}$ ) dan Ogos 2002 ( $656 \pm 457 \text{ N.100m}^{-3}$ ). Puncak ini bertepatan dengan tempoh peralihan angin yang berubah-ubah dan hujan yang tinggi, kecuali puncak yang bulan Ogos di mana angin adalah kuat pada masa itu. Dua puncak masa perekrutan untuk Gobiidae telah dikenal pasti pada bulan Mac dan Oktober. Pembiakan ikan Engraulidae dan terhasilnya peringkat 'preflexion' yang tinggi berlaku antara bulan Jun hingga Disember di perairan luar pesisir. Ini diikuti oleh penghasilan banyak larva ikan peringkat 'postflexion' antara bulan Oktober-Januari di muara bakau. Peringkat 'preflexion' larva Gobiidae dikesan di sekitar muara bakau dan juga di perairan pantai. Sebahagian besar peringkat larva spesies *euryhaline* seperti Engraulidae dan Clupeidae yang biasanya membiak di perairan luar pesisir berhijrah ke muara bakau di peringkat 'postflexion'. Walau bagaimanapun, larva ikan 'euryhaline' yang lain (contohnya Sciaenidae, Blenniidae dan Ambassidae) yang berkemungkinan membiak di dalam muara sungai dieksport ke perairan luar pesisir.

Kelimpahan larva ikan yang lebih tinggi direkodkan dalam musim lembap, dengan dua belas famili dikenal pasti dalam lapan kajian 24-jam penyampelan di permukaan dan lapisan bawah di muara sungai pada bulan Julai 2003 (musim kering)

dan November 2003 (musim lembap). Lebih banyak larva ikan peringkat *yolk-sac* Gobiidae didapati pada waktu malam semasa bulan baru apabila air pasang surut adalah paling tinggi. Bilangan tinggi peringkat 'preflexion' Gobiidae biasanya didapati pada peringkat akhir air surut atau air pasang. Ini merupakan strategi pemakanan yang digunakan semasa pergerakan air adalah kurang untuk mengekalkan kedudukan mereka dalam muara. Larva ikan Engraulidae pula didapati lebih banyak pada air perbani dan peringkat 'preflexion' larva pula cenderung untuk berkumpul di permukaan air semasa air pasang di waktu siang. Larva peringkat 'postflexion' pula kekal di bawah muara sewaktu air surut. Larva ikan Engraulidae didapati menggunakan strategi untuk menembusi hulu sungai melalui aliran air pasang.

Pergerakan larva ikan ke dalam atau ke luar muara sungai dikawal oleh arus pasang surut tetapi hasil akhir daripada pergerakan ini dipengaruhi oleh cerun kemasinan dan kekeruhan air, makanan larva, peringkat hidup larva dan juga tingkah laku larva ikan.

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