

**FORAMINIFERAL ASSEMBLAGES IN THE  
MANGROVE SEDIMENTS OF KEMAMAN AND  
TUMPAT, EAST COAST OF PENINSULAR  
MALAYSIA**

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**MASTER OF SCIENCE  
UNIVERSITI MALAYSIA TERENGGANU  
MALAYSIA**

**2011**

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QL 368 .F6 R6 2011



1100084316

Foraminiferal assemblages in the mangrove sediments of  
Kemaman and Tumpat, east coast of peninsular Malaysia /  
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KEMAMAN AND TUMPAT, EAST COAST OF PENINSULAR MALAYSIA**

**ROKIAH BINTI SURIADI**

**Thesis Submitted in Fulfillment of the Requirement for the Degree of  
Master of Science in the Institute of Oceanography and Environment  
Universiti Malaysia Terengganu**

**August 2011**

Abstract of thesis presented to the senate of Universiti Malaysia Terengganu  
in fulfilment of the requirement for the degree of Master of Science

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KEMAMAN AND TUMPAT, EAST COAST OF PENINSULAR MALAYSIA**

**ROKIAH BINTI SURIADI**

**August 2011**

**Chairperson : Professor Mohd Lokman Husain, Ph.D.**  
**Member : Associate Professor Sulong Ibrahim, MSc.  
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**Institute : Institute of Oceanography and Environment**

Widely known for their importance in the oil exploration activities, the study of foraminifera is always the basis of finding a new oil rig or dating of rock fossils. Little is known about their ecological distribution, biological systems, as well as their response towards a variety of environments. Taking into account the limited number of studies on benthic mangrove foraminifera in Malaysia especially in the East Coast of Peninsular Malaysia, the objectives of this study are to investigate the species diversity and distribution of foraminifera in the mangrove sediments of Kemaman and Tumpat, as well as the species assemblages of foraminifera in that study areas. The relationships between foraminiferal distribution and the environmental parameters were also studied, to get a clear picture on how these faunal assemblages can establish a community based on their habitat preferences. Field sampling was conducted during July and August 2009. The sampling consists of sediment sample collection and environmental parameters data

collection. Porewater salinity, elevation with reference to mean sea level (MSL), and mangrove vegetation data were collected *in situ*. A separate portion of sediment samples (250 g) were analyzed from each location. The sediments were analyzed for total organic carbon (TOC) contents, grain size analysis, and the porewater pH. Shannon-Wiener diversity index,  $H_{(s)}$  and Evenness index, (E) showed that *Arenoparella mexicana* outnumbered the species abundance of foraminifera in the Kemaman-Chukai mangroves, and their species assemblage was dominated by the major association of *Arenoparella-Miliammina-Haplophragmoides* Association. This was similar for both surface and core sediments. Canonical Correspondence Analysis (CCA) showed that foraminiferal assemblages were significantly correlated with elevation level and sand fraction where high abundance of foraminifera were distributed in the sediment with high percentage of silt, low porewater salinity and pH, and low elevated area. In contrast to Kemaman-Chukai mangroves, the foraminiferal abundance in the Kelantan Delta mangroves was dominated by *Miliammina fusca* in the surface, and *Arenoparella mexicana* in the core sediments. The *Miliammina-Arenoparella* Association dominated the species assemblages of foraminifera in the surface and *Arenoparella* Association dominated the species assemblages in the core sediments. CCA analysis indicated that the foraminiferal assemblages from Kelantan Delta mangroves showed significant correlation with salinity, pH, and elevation level. Foraminiferal assemblages from both study areas showed negative correlation with TOC and vegetation densities. Overall, the relationships between foraminifera and their environmental parameters especially salinity and elevation in both Kemaman-Chukai and Kelantan

Delta mangroves were in agreement with studies done by other researchers from around the world.

Abstrak tesis yang dikemukakan kepada Senat Universiti Malaysia Terengganu sebagai memenuhi keperluan untuk ijazah Sarjana Sains

**HIMPUNAN KUMPULAN FORAMINIFERA DARI SEDIMEN HUTAN PAYA  
BAKAU KEMAMAN-CHUKAI DAN DELTA KELANTAN, PANTAI TIMUR  
SEMENANJUNG MALAYSIA**

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Lebih dikenali dengan peranannya yang penting dalam proses cari gali minyak dan juga penentuan usia batu batan fosil, kajian tentang foraminifera lebih banyak dilakukan oleh ahli paleontologi dan juga geologi. Masih sedikit maklumat yang boleh didapati tentang taburan ekologi, sistem biologi, dan tindak balas mereka terhadap keadaan persekitaran yang berbeza. Di Malaysia, masih terlalu sedikit kajian yang telah dilakukan tentang foraminifera bentik di dalam kawasan hutan bakau, terutamanya di kawasan pantai timur semenanjung. Oleh yang demikian, objektif kajian ini adalah untuk menentukan kepelbagaian spesis dan taburan foraminifera di dalam kawasan hutan bakau Kemaman-Chukai dan juga Delta Kelantan. Selain itu, kajian ini adalah bertujuan untuk melihat kumpulan-kumpulan spesis foraminifera yang berada di dalam kawasan tersebut, dan juga hubungan

yang wujud antara foraminifera dengan faktor persekitaran mereka. Kerja lapangan untuk mengumpul sampel-sampel telah dilakukan pada bulan Julai dan Ogos, 2009. Sampel yang dikumpul adalah sampel tanah untuk analisis foraminifera, dan juga data persekitaran iaitu bacaan nilai saliniti air tanah, data ketinggian tanah (*elevation*) berdasarkan bacaan *Mean Sea Level* dan juga data flora di dalam kawasan hutan tersebut. Selain itu, sampel tanah untuk analisis Jumlah Karbon Organik Keseluruhan (*TOC*), saiz partikel tanah, dan bacaan pH air tanah juga telah diambil, dan analisisnya telah dilakukan di dalam makmal. Nilai bacaan Indeks Kepelbagaian *Shannon-Wiener*,  $H_{(S)}$  dan Indeks Keseragaman, (*E*) menunjukkan spesis *Arenoparella mexicana* mendominasi jumlah foraminifera yang berada di kawasan hutan bakau Kemaman-Chukai. Manakala, kumpulan *Arenoparella-Miliammina-Haplophragmoides* menjadi kumpulan foraminifera major di kawasan tersebut. Pendominasian yang sama juga berlaku pada sampel teras di kawasan ini, di mana *Arenoparella mexicana* dan kumpulan *Arenoparella-Miliammina-Haplophragmoides* adalah dominan. Berdasarkan hasil analisis Canonical Correspondence Analysis (CCA), komuniti foraminifera di kawasan ini menunjukkan jalinan hubungan yang kuat dengan nilai ketinggian tanah (*elevation*) dan juga jumlah peratusan pasir; di mana, taburan foraminifera adalah tinggi di kawasan yang berlumpur, paras saliniti dan pH air tanah yang rendah, dan juga kawasan yang lebih rendah. Berbeza dengan hutan paya bakau Kemaman-Chukai, kawasan paya bakau di Delta Kelantan didominasi oleh spesis *Miliammina fusca* di kawasan permukaan, manakala *Arenoparella mexicana* di kawasan teras. Kumpulan *Miliammina-Arenoparella* menjadi kumpulan major di kawasan permukaan,



manakala kumpulan *Arenoparella* menjadi kumpulan major di kawasan sedimen teras. Berdasarkan hasil analisis CCA, komuniti foraminifera di kawasan hutan paya bakau Delta Kelantan mempunyai hubungan yang kuat dengan nilai ketinggian tanah (*elevation*), nilai saliniti air tanah dan pH. Walau bagaimanapun, jumlah kawasan yang dilitupi oleh pokok bakau dan peratusan TOC tidak mempengaruhi taburan mereka. Secara keseluruhannya, dapat disimpulkan bahawa bentuk hubungan di antara foraminifera dengan faktor persekitaran mereka terutamanya saliniti dan ketinggian tanah di kawasan bakau Kemaman-Chukai dan Delta Kelantan mempunyai persamaan dengan kajian yang telah dilakukan oleh ramai penyelidik dari kawasan-kawasan lain.