

**MICROPLASTIC INGESTION BY
ZOOPLANKTON FROM TERENGGANU
RIVER ESTUARY TO OFFSHORE
WATERS**

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**Thesis Submitted in Fulfillment of the Requirement for the
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DEDICATION

In the Name of Allah, The All-Merciful, The Ever Merciful,

I would like to dedicate this special journey-

To my father, Daoud Taha

For his advice, his patience and his supporting,

As he always my friend, brother and father.

To mother, Nisrein Ali

For her unwavering support.

To my grandfather soul, Taha Almashaqba

For everything that he did for our family.

To supervisor, Dr. Roswati Md Amin

For giving me this opportunity and always believed in me.

And above all,

All praise to the God, The Most Gracious and The Most Compassionate.

Abstract of thesis presented to the Senate of University Malaysia Terengganu in fulfilment of the requirement for the degree of Master of Science.

Microplastic ingestion by zooplankton from Terengganu River estuary to offshore waters

Zakaria Daoud Taha Almashaqqa

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Main Supervisor : Roswati Md Amin, Ph.D

Co- supervisor : Associate Professor Tuan Nurul Sabiqah Tuan Anuar, Ph.D

Faculty : Faculty of Science and Marine Environment

Large number of plastics in various forms have been unloaded in different ecosystems; because of many improper control systems in plastic and its waste management, or incurious human behaviour. It is a matter of concern that plastics do not degrade biologically but are divided into small particles called microplastics under ultraviolet radiation or mechanical abrasion. Microplastics (<5 mm) are a common and global contaminant of aquatic ecosystems. Due to their small size, microplastic are ingested by a range of marine organisms, including zooplankton. The effect of microplastic on zooplankton and their interaction with these particles in their natural environments is still under consideration. This study presents the first report showing the microplastic ingestion by seven zooplankton taxa in the offshore waters of southern South China Sea and Terengganu River estuary as well as the extent of surface seawater contamination by microplastics. Among the zooplankton taxa groups are Calanoida, Cyclopoida, Harpacticoida, Mysids, Decapoda, Clodocera and Aphragmophora. No significant difference of ingested microplastic density among different zooplankton groups was detected between Terengganu River estuary and offshore waters. Two types of microplastic (fibres and fragments) were found in zooplankton in both study areas. The fibres were the most common type of ingested microplastic in the offshore (94%) and

Terengganu River estuary (77.7%). The average sizes of ingested fibres and fragments were $361.7 \pm 226.8 \mu\text{m}$ and $96.8 \pm 28.1\mu\text{m}$, respectively. Microplastic concentrations in zooplankton varied from 0.01 ± 0.002 particle/individual (Harpacticoida) to 0.2 ± 0.14 particle/individual (Aphragmophora). No significant correlation was observed between the density of the ingested microplastic and microplastic density in the surface seawater, indicating that other biotic and abiotic factors can influence the bioavailability of microplastic to zooplankton. The results provide basic information for better understanding of microplastic ingestion levels by zooplankton within Terengganu River estuary and the offshore water of southern South China Sea for future research.

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

**PENGAMBILAN MIKROPLASTIK OLEH ZOOPLANKTON DARI MUARA
SUNGAI TERENGGANU KE PESISIR LAUT LUAR**

Zakaria Daoud Taha Almashaqpa

2021

Penyelia Utama : Roswati Md Amin, PhD

Penyelia bersama : Profesor Madya Tuan Nurul Sabiqah Tuan Anuar, PhD

Fakulti : Fakulti Sains dan Sekitaran Marin

Sebilangan besar plastik dalam pelbagai bentuk telah dibuang ke dalam ekosistem yang berbeza; disebabkan kekurangan sistem pengurusan plastik dan sisanya yang betul, atau akibat tindakan manusia. Apa yang membimbangkan adalah plastik ini tidak akan terurai secara biologi tetapi akan menjadi partikel kecil yang dipanggil mikroplastik akibat radiasi ultraungu atau hakisan mekanikal. Mikroplastik (<5mm) dianggap sebagai bahan pencemar yang biasa dijumpai secara global dalam ekosistem akuatik. Mikroplastik telah dikenalpasti untuk dimakan oleh organisma marin, termasuk zooplankton. Kesan mikroplastik kepada zooplankton dan interaksi mereka terhadap partikel ini di persekitaran semulajadi masih lagi dalam kajian. Kajian ini merupakan yang pertama merekodkan pengambilan mikroplastik oleh tujuh kumpulan taksa zooplankton di kawasan pesisir laut luar, selatan Laut China Selatan dan muara Sungai Terengganu serta pencemaran mikroplastik di permukaan air. Antara kumpulan taksa zooplankton tersebut ialah Kalanoida, Siklopoida, Harpaktikoida, Mysida, Dekapoda, Kladosera dan Aphanizomenon. Tiada perbezaan yang ketara dikesan dalam kepadatan mikroplastik yang ditelan oleh kumpulan zooplankton antara muara Sungai Terengganu dan pesisir laut luar. Dua jenis mikroplastik (fiber dan serpihan) ditemui pada zooplankton di

kedua-dua kawasan kajian. Fiber adalah jenis mikroplastik yang paling kerap dijumpai di pesisir laut luar (94%) dan muara Sungai Terengganu (77.7%). Saiz purata mikroplastik jenis fiber dan serpihan yang ditelan masing-masing adalah 361.7 ± 226.8 μm dan 96.8 ± 28.1 μm , masing-masing. Kepadatan mikroplastik dalam zooplankton bervariasi daripada 0.01 ± 0.002 partikel / individu (Harpaktikoida) hingga 0.2 ± 0.14 partikel / individu (Aphragmofora). Tiada korelasi yang jelas dilihat antara kepadatan mikroplastik yang tertelan dan kepadatan mikroplastik di permukaan air laut, menunjukkan faktor biotik dan abiotik lain boleh mempengaruhi ketersediaan mikroplastik ke atas zooplankton. Hasil kajian ini memberikan maklumat asas dalam memahami tahap pengambilan mikroplastik oleh zooplankton di muara Sungai Terengganu dan pesisir laut luar, selatan Laut China Selatan untuk kajian pada masa hadapan.