

DISTRIBUTION OF PHOSPHORUS IN TERENGGANU RIVER ESTUARY,
TERENGGANU

MOHD FAIZAL BIN MAT AHAN

FACULTY OF MARITIME STUDIES AND MARINE SCIENCE
UNIVERSITI MALAYSIA TERENGGANU
2008

**DISTRIBUTION OF PHOSPHORUS IN TERENGGANU RIVER ESTUARY,
TERENGGANU**

By

Mohd Faizal bin Mat Ahan

**Research Report submitted in partial fulfillment of
the requirements for the degree of
Bachelor of Science (Marine Science)**

**Department of Marine Science
Faculty of Maritime Studies and Marine Science
UNIVERSITI MALAYSIA TERENGGANU
2008**

This project report should be cited as:

Faizal, M. 2008. Distribution of Phosphorus in Terengganu River Estuary, Terengganu. Undergraduate thesis, Bachelor of Science (Marine Science), Faculty of Maritime Studies and Marine Science, Universiti Malaysia Terengganu, Terengganu. 92p.

No part of this project report may be reproduced by any mechanical, photographic, or electronic process, or in the form of phonographic recording, nor may it be stored in a retrieval system, transmitted, or otherwise copied for public or private use, without written permission from the author and the supervisor of the project.

1100061791



**JABATAN SAINS MARIN
FAKULTI PENGAJIAN MARITIM DAN SAINS MARIN
UNIVERSITI MALAYSIA TERENGGANU**

**PENGAKUAN DAN PENGESAHAN LAPORAN
PROJEK PENYELIDIKAN I DAN II**

Adalah ini diakui dan disahkan bahawa laporan penyelidikan bertajuk:

Distribution of Phosphorus in Terengganu River Estuary, Terengganu oleh Mohd Faizal Bin Mat Ahan, No. Matrik UK 12163 telah diperiksa dan semua pembetulan yang disarankan telah dilakukan. Laporan ini dikemukakan kepada Jabatan Sains Marin sebagai memenuhi sebahagian daripada keperluan memperoleh Ijazah Sarjana Muda Sains (Sains Samudera), Fakulti Pengajian Maritim dan Sains Marin, Universiti Malaysia Terengganu.

Disahkan oleh:

Penyelia Utama **DR. HING LEE SIANG**
Penyelaras Program
Nama: Sarjana Muda Sains (Sains Samudera)
Jabatan Sains Marin
Cop Rasmi: Fakulti Pengajian Maritim dan Sains Marin
Universiti Malaysia Terengganu
(UMT)

Tarikh: 3/5/08

Ketua Jabatan Sains Marin
Nama: **DR. RAZAK ZAKARIYA**
Ketua Jabatan Sains Marin
Cop Rasmi: Fakulti Pengajian Maritim dan Sains Marin
Universiti Malaysia Terengganu
(UMT)

Tarikh: 11/5/08

ACKNOWLEDGEMENTS

I would like to express my lovely appreciation to my supervisor Dr. Hing Lee Siang for all the guidance and advices given to finish this final year project. I really appreciate her encouragement to this research. Special thanks also to Dr. Norantonina, Dr Zainuddin Bachok and Dr. Juanita Joseph for they unlimited support and guidance.

I also like to thanks to all laboratory assistants of Oceanography Laboratory in UMT that allowing me use the apparatus and instruments when doing my experiments analysis.

I would also like to wish my thanks to my entire course mate especially Raja Shamsul Bin Raja Ismail and Effi Helmy Ariffin for helping me during sampling and accompany me during conducted laboratory analysis.

Lastly, I would like to sent my appreciation to my lovely family for their moral and financial support to ensured my succeed in completing this thesis. Special thanks also to all individual that has contributed direct or indirectly in this final year project.

TABLE OF CONTENTS

CONTENT	PAGE
TITLE PAGE	i
APPROVAL FORM	ii
ACKNOWLEDGEMENTS	iii
TABLE OF CONTENTS	iv
LIST OF TABLE	vii
LIST OF FIGURE	viii
LIST OF ABBREVIATION	x
LIST OF APPENDICES	xi
ABSTRACT	xiii
ABSTRAK	xiv
1.0 INTRODUCTION	1
2.0 LITERATURE REVIEW	5
2.1 Nutrient Elements	5
2.2 The Role of Nutrient	6
2.3 Phosphorus Compounds in Water	7
2.3.1 Orthophosphate	9
2.3.2 Condensed Phosphate	9
2.3.3 Organic Phosphorus	10
2.4 Phosphorus Cycle	10
2.5 Marine Pollutants and Their Sources	12
2.6 Sewage Treatment	13

3.0 MATERIALS AND METHODS	14
3.1 Study Area	14
3.2 Hydrological Parameters	16
3.3 Glassware	16
3.4 Sampling Technique	16
3.5 Analytical Technique	18
3.5.1 Dissolved Phosphorus Analysis	18
3.5.1a Orthophosphate Analysis	19
3.5.1b Stock Solution Preparation	19
3.5.1c Experimental Procedure	20
3.5.1d Reagents for Orthophosphate Analysis	20
3.5.2 Total Phosphorus Analysis	21
3.5.2a Experimental Procedure	22
3.5.2b Reagents for Total Phosphorus Analysis	23
3.6 Statistical Analysis	23
4.0 RESULT	24
4.1 Hydrological Parameters	24
4.2 Meteorological Parameters	26
4.3 Phosphorus Distribution during Pre-Monsoon	27
4.3.1 Orthophosphate	27
4.3.2 Total Phosphorus	29
4.4 Phosphorus Distribution during Northeast Monsoon	31
4.4.1 Orthophosphate	31
4.4.2 Total Phosphorus	33
4.5 Comparing Phosphorus Distribution between Pre-Monsoon and Northeast Monsoon	35
4.5.1 Orthophosphate	35
4.5.2 Total Phosphorus	36

5.0 DISCUSSION	40
5.1 Pre-monsoon	41
5.2 Northeast Monsoon	42
5.3 Comparison Phosphorus Concentration during Season	43
6.0 CONCLUSION	46
LITERATURE CITED	48
APPENDICES	52
VITAE CURICULUM	92

LIST OF TABLES

TABLE		PAGE
3.1	Position of sampling stations at Terengganu River Estuary	15
4.1	Hydrological parameters reading during Pre-monsoon and Northeast monsoon season at Terengganu River Estuary	25
4.2	Mean rainfall, mean temperature and mean wind during September and November 2007 at Sultan Mahmud Airport, Kuala Terengganu	26
4.3	Orthophosphate mean concentration (μM) and standard deviation according station at Terengganu River Estuary during Pre-monsoon season	28
4.4	Total phosphorus mean concentration (μM) and standard deviation according station at Terengganu River Estuary during Pre-monsoon season	30
4.5	Orthophosphate mean concentration (μM) and standard deviation according station at Terengganu River Estuary during Northeast monsoon season	32
4.6	Total phosphorus mean concentration (μM) and standard deviation according station at Terengganu River Estuary during Pre-monsoon season	34

LIST OF FIGURES

FIGURE	PAGE
2.1 Phosphorus cycle in terrestrial ecosystem	10
2.2 Phosphorus cycle in aquatic ecosystem	11
3.1 Terengganu River Estuary map	15
3.2 Van Dorn water sampler	17
3.3 Global Positioning System (GPS)	17
4.1 Distribution of Phosphorus mean concentration (μM) at Terengganu River Estuary during Pre-monsoon season	27
4.2 Distribution of Total Phosphorus mean concentration (μM) at Terengganu River Estuary during Northeast monsoon season	31
4.3(a) Comparison Orthophosphate concentration at Terengganu River Estuary between Pre-monsoon and Northeast monsoon season	37
4.3(b) Comparison Total Phosphorus concentration at Terengganu River Estuary between Pre-monsoon and Northeast monsoon season	37
4.4(a) Comparison of Orthophosphate distribution during Pre-monsoon season at Terengganu River Estuary	38
4.4(b) Comparison of Orthophosphate distribution during Northeast monsoon season at Terengganu River Estuary	38

4.5(a)	Comparison of Total Phosphorus distribution during Pre-monsoon season at Terengganu River Estuary	39
4.5(a)	Comparison of Total Phosphorus distribution during Northeast monsoon season at Terengganu River Estuary	39
5.1	Comparison Orthophosphate concentration during Pre-monsoon and Northeast monsoon season	44
5.2	Comparison Total Phosphorus concentration during Pre-monsoon and Northeast monsoon season	45

LIST OF ABBREVIATIONS

%	-	percentage
°C	-	degree centigrade
ppm	-	part per million
ppt or ‰	-	part per thousand
mg/L	-	milligram per Liter
mm/day	-	millimeter per day
μM	-	micromolarity
μg-at P.L ⁻¹	-	microgram atom phosphorus per liter
cm	-	centimeter
m	-	meter
g	-	gram
mg	-	milligram
L	-	Liter
mL	-	milliliter
M	-	Molarity
N	-	Normality
TP	-	total phosphorus
P	-	Phosphorus
Ave.	-	Average
w/v	-	weight per volume
DO	-	Dissolved Oxygen

LIST OF APPENDICES

APPENDIX		PAGE
1	Position, weather condition and tide for sampling station	52
2	Hydrological parameters reading	55
3	Tide table for Kuala Terengganu	57
4	Meteorological parameters data	58
5	Standard curve of Orthophosphate analysis in water	60
6	Absorbance water colour for Orthophosphate during Pre-monsoon	61
7	Orthophosphate concentration (ppm) for Pre-monsoon	62
8	Total Phosphorus concentration (ppm) during Pre-monsoon	63
9	Absorbance water colour for Orthophosphate during Northeast monsoon	67
10	Orthophosphate concentration (ppm) for Northeast monsoon	68
11	Total Phosphorus concentration (ppm) during Northeast monsoon	69
12	Mean concentration of Orthophosphate and Total Phosphorus from ppm to μM for Pre-monsoon	72
13	Mean concentration of Orthophosphate and Total Phosphorus from ppm to μM for Northeast monsoon	73

14	Univariate analysis of variance for Orthophosphate (Pre-monsoon)	74
15	Univariate analysis of variance for Total Phosphorus (Pre-monsoon)	79
16	Univariate analysis of variance for Orthophosphate (Northeast monsoon)	83
17	Univariate analysis of variance for Total Phosphorus (Northeast monsoon)	88

ABSTRACT

This study was done to determine distribution and concentration of phosphorus in Terengganu River Estuary. Two samplings were conducted during this study. Water samples were collected during pre-monsoon season (10 September 2007) and Northeast monsoon (16 November 2007). 10 stations were chosen for pre-monsoon while 9 stations in monsoon. Orthophosphate was determined by Acid Ascorbic Method while total phosphorus by Persulfate Digestion Method. For pre-monsoon, average mean concentration orthophosphate was $2.219 \pm 0.979 \mu\text{M}$. Highest concentration was detected at Station 8 which $3.618 \mu\text{M}$ and lowest was $1.145 \mu\text{M}$ at Station 10. Average mean concentration total phosphorus was $3.958 \pm 0.637 \mu\text{M}$. Station 7 has the highest concentration with $4.619 \mu\text{M}$ while lowest $2.653 \mu\text{M}$ at Station 10. For monsoon, average mean concentration orthophosphate was $1.125 \pm 0.109 \mu\text{M}$. Highest concentration is Station 9 which $1.277 \mu\text{M}$ and lowest was $0.953 \mu\text{M}$ at Station 1. Average mean concentration total phosphorus was $5.333 \pm 0.249 \mu\text{M}$. Highest concentration is Station 4 which $5.602 \mu\text{M}$ while lowest was $4.914 \mu\text{M}$ at Station 5. Both seasons, orthophosphate and total phosphorus have significant differences ($P < 0.05$) among sampling stations but no significant differences ($P > 0.05$) for depth level. Concentration of orthophosphate was decreased from pre-monsoon to monsoon season while total phosphorus was increased. ANOVA two-ways showed significant differences ($P < 0.05$) between orthophosphate and total phosphorus concentration to pre-monsoon and monsoon seasons. Average phosphorus concentration was exceeded than safety level. This indicated the water quality was polluted by phosphorus and will encourage eutrophication.

ABSTRAK

Kajian ini adalah untuk menentukan taburan dan kepekatan fosforus di Muara Sungai Terengganu. Dua persampelan dilakukan dalam kajian ini. Sampel air diambil semasa musim pra-monsoon (10 September 2007) dan monsoon Timur Laut (16 November 2007). 10 stesen dipilih pada pra-monsoon manakala 9 stesen pada monsoon. Ortofosfat ditentukan oleh Kaedah Asid Askorbik manakala jumlah fosforus melalui Kaedah Pencernaan Persulfat. Pada pra-monsoon, purata min kepekatan ortofosfat ialah $2.219 \pm 0.979 \mu\text{M}$. Kepekatan tertinggi dikesan pada Stesen 8 iaitu $3.618 \mu\text{M}$ dan terendah ialah $1.145 \mu\text{M}$ di Stesen 10. Purata min kepekatan jumlah fosforus ialah $3.958 \pm 0.637 \mu\text{M}$. Stesen 7 mempunyai kepekatan tertinggi iaitu $4.619 \mu\text{M}$ manakala terendah iaitu $2.653 \mu\text{M}$ di Stesen 10. Pada monsoon, purata min kepekatan ortofosforus ialah $1.125 \pm 0.109 \mu\text{M}$. Kepekatan tertinggi ialah Stesen 9 iaitu $1.277 \mu\text{M}$ dan terendah ialah $0.953 \mu\text{M}$ di Stesen 1. Purata min kepekatan jumlah fosforus ialah $5.333 \pm 0.249 \mu\text{M}$. Kepekatan tertinggi ialah Stesen 4 iaitu $5.602 \mu\text{M}$ manakala terendah ialah $4.914 \mu\text{M}$ di Stesen 5. Pada kedua-dua musim, ortofosforus dan jumlah fosforus mempunyai perbezaan ($P < 0.05$) antara stesen persampelan tetapi tiada perbezaan ($P > 0.05$) untuk paras kedalaman. Kepekatan ortofosfat berkurangan daripada pra-monsoon kepada musim monsoon manakala jumlah fosforus meningkat. ANOVA dua-hala menunjukkan perbezaan ($P < 0.05$) antara kepekatan ortofosfat dan jumlah fosforus dengan pra-monsoon dan musim monsoon. Purata kepekatan fosforus adalah melebihi daripada paras keselamatan. Ianya menunjukkan kualiti air telah tercemar oleh fosforus dan boleh menggalakkan eutrofikasi.