



Universiteit
Leiden
The Netherlands

The resilience of tropical intertidal seagrass meadows, grazed by dugongs, and the impact of anthropogenic stressors

Anugrah Aditya Budiarsa, A.

Citation

Anugrah Aditya Budiarsa, A. (2025, September 23). *The resilience of tropical intertidal seagrass meadows, grazed by dugongs, and the impact of anthropogenic stressors*. Retrieved from <https://hdl.handle.net/1887/4261999>

Version: Publisher's Version

License: [Licence agreement concerning inclusion of doctoral thesis in the Institutional Repository of the University of Leiden](#)

Downloaded from: <https://hdl.handle.net/1887/4261999>

Note: To cite this publication please use the final published version (if applicable).

**The resilience of tropical intertidal seagrass meadows, grazed by dugongs,
and the impact of anthropogenic stressors**

ISBN. 9789051912173

Anugrah Aditya Budiarsa

**The Resilience of Tropical Intertidal Seagrass Meadows, grazed by dugongs, and the
impact of anthropogenic Stressors**

Proefschrift

ter verkrijging van
de graad van doctor aan de Universiteit Leiden,
op gezag van rector magnificus prof.dr.ir. H. Bijl,
volgens besluit van het college voor promoties
te verdedigen op dinsdag 23 september 2025
klokke 14.30 uur

door

Anugrah Aditya Budiarsa

geboren te Nunukan, North Kalimantan, Indonesia
in 1983

Promotores:

Prof. dr. P. M. van Bodegom

Prof. dr. ir. H. H. De Iongh

Promotiecommissie:

Prof. dr. M. Vijver

Prof. dr. G. de Snoo

Prof. dr. N. de Voogd

Dr. M. Christianen – Wageningen University

Dr. A. Vonk - University of Amsterdam

Contents

Chapter 1

General Introduction

1.1.	Intertidal seagrass species	1
1.2.	The importance of seagrass ecosystems	3
1.3.	Seagrass--mega-herbivore interactions	4
1.4.	Anthropogenic disturbance of seagrass ecosystems	7
1.5.	Research Aims and research questions	9
1.6.	Study area and site selection	10
1.7.	Thesis outline	11
	References	11

Chapter 2

Dugong foraging behavior on tropical intertidal seagrass meadows: The influence of climatic drivers and anthropogenic disturbance		16
Abstract		17
2.1.	Introduction	18
2.2.	Material and Methods	19
2.2.1.	Study Area	19
2.2.2.	Data collection and analyses	20
2.2.3.	Statistics	22
2.3.	Results	23
2.3.1.	Seagrass composition and distribution	23
2.3.2.	Seasonal dugong tracks distribution and its dimensions	25
2.3.3.	Spatiotemporal dynamics in <i>H. pinifolia</i> biomass	27
2.4.	Discussion	28
References		

Chapter 3

The resistance of intertidal seagrass to oil pollution and the potential impact on mega-herbivores in Balikpapan Bay, Indonesia		35
Abstract		36
3.1.	Introduction	37
3.2.	Material and Methods	38
3.2.1.	Study Area	38
3.2.2.	Data collection and analyses	40
3.2.3.	Statistics	41
3.3.	Results	41
3.3.1.	Spatial distribution of tPAH	41
3.3.2.	Dynamics in seagrass biomass before and after the oil spill.	43
3.3.3.	Dynamics in dugong grazing before and after the oil spill	46
3.4.	Discussion	47
References		

Chapter 4

The effects of sedimentation on the seagrass <i>Halodule pinifolia</i> in intertidal flats and tidal pools in Balikpapan Bay, Indonesia		53
---	--	----

Abstract	54
4.1 Introduction.....	55
4.2 Methods.....	56
4.2.1. The study area of the experiment.....	56
4.2.2. Experimental design and procedure	57
4.2.3. Statistics.....	58
4.3 Results.....	59
4.4 Discussion	63
4.4.1. Effect of sediment burial	63
4.4.2. Effect of tidal system and desiccation	64
4.4.3. Implications	65

References

Chapter 5

Contribution of seagrass clonality to the survival of *Halodule pinifolia* in intertidal habitats in Balikpapan Bay, Indonesia.....69

Abstract

5.1 Introduction.....71

5.2 Methods.....72

 5.2.1. Study area

 5.2.2. Experimental design

 5.2.3. Statistics.....74

5.3 Results.....74

 5.3.1. Loss in Biomass.....74

5.4 Discussion.....79

References

Chapter 6

Synthesis.....84

6.1 Relevance of the thesis.....85

6.2 The importance of seagrass meadows for dugongs and carbon sequestration.....87

6.3. Intertidal seagrass meadows and impacts of oil spill

6.4. The effects of sedimentation on *Halodule pinifolia* in intertidal flats and in tidal pools in Balikpapan Bay, Indonesia.....91

6.5 Clonality: A potential survival strategy in changing environments

6.6 Implications for conservation.....92

6.7. Scientific implications.....93

6.8. Conclusions

References

Summary

Samenvatting

Acknowledgements