

# Development of a rapid *Hormosira banksii* bioassay using chlorophyll *a* fluorescence

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## ABSTRACT

A wealth of information exists for chlorophyll *a* fluorescence applications in ecophysiology. However, the use of chlorophyll *a* fluorescence in marine ecotoxicology has been limited and this is especially true of macroalgal ecotoxicology.

The primary objective of this thesis was to develop and describe a bioassay protocol that uses improvements on past macroalgal assay techniques to allow the photosynthetic capacity of *Hormosira banksii* gametes to be assessed using chlorophyll *a* fluorescence measurements. Two protocols (using *H. banksii* eggs or sperm) have been developed that allow for rapid assessment of toxic impact (less than 8 h) on macroalgal gametes. This rapid time-to-result allows for timely management decisions to be made. This is significant since past macroalgal bioassays have necessitated up to a 48 h delay before results are available to decision makers.

In addition to this much improved rapidity of result, comparison between a germination based endpoint and the fluorescence endpoint has shown the fluorescence measure to be more sensitive to some classes of toxicant, more precise (in terms of Coefficient of Variation), and can also offer information on mechanistic pathways of toxicants.

In order to validate 'real-world' use of the new fluorescence protocol, the sperm fluorescence bioassay was effectively applied to the assessment of interactive effects displayed by mixtures of anti-foulant compounds. Furthermore, a level of eco-relevance was demonstrated for the chlorophyll *a* fluorescence endpoint %PSII Inhibition. This is significant in that eco-relevance has not previously been experimentally demonstrated for a chlorophyll *a* fluorescence endpoint in ecotoxicology and the demonstrated link to higher level effects may have favourable implications as to future acceptance of fluorescence data into water quality guidelines.

Essentially, this work describes the development of, and also the successful application of, a novel, fluorescence macroalgae bioassay that not only has advantages over currently employed methods, but also offers a powerful tool in both the rapid assessment of toxic impact on near-shore macroalgal communities, and as an effective toxicity screening tool.

## TABLE OF CONTENTS

Certificate	i
Acknowledgements	ii
Abstract	v
Table of Contents	vi
List of Figures	x
List of Tables	xii
<b>Chapter 1</b>	<b>1</b>
<b>1.0 General Introduction</b>	<b>2</b>
1.1 Biological Testing for Marine Contaminants	2
1.2 Ecotoxicological Bioassays	4
1.2.1 Macroalgal Bioassays	8
1.3 Role of <i>Hormosira banksii</i> in Ecotoxicological Bioassays	13
1.3.1 Overview of <i>Hormosira banksii</i> Ecophysiological	13
1.3.2 <i>Hormosira banksii</i> Ecotoxicology	15
1.4 Chlorophyll <i>a</i> Fluorescence – A Measure of Photosynthesis	20
1.4.1 Analysis of Chlorophyll <i>a</i> Fluorescence Signal	22
1.5 Chlorophyll <i>a</i> Fluorescence as Indicator of Toxic Impact	24
1.5.1 Current Applications of Chlorophyll <i>a</i> Fluorescence in Ecotoxicology	26
1.6 Research Objectives and Significance	29
1.7 References	30
<b>Chapter 2</b>	<b>42</b>
<b>2.0 Development and Optimisation–Including Common Protocols</b>	<b>43</b>
2.1 Introduction	43
2.2 Development and Optimisation	43
2.2.1 Population Selection	43
2.2.2 Toxicants and Solutions	47
2.2.3 <i>Hormosira banksii</i> Collection and Spawning	48
2.2.4 The ToxY-PAM Fluorometer	50

2.2.5	Common Protocols.....	54
2.3	References .....	63
<b>Chapter 3</b>	.....	<b>65</b>
<b>3.0</b>	<b><i>Hormosira banksii</i> Egg Bioassay .....</b>	<b>66</b>
3.1	Abstract.....	66
<b>3.2</b>	<b>Introduction.....</b>	<b>67</b>
3.3	Material and Methods .....	71
3.3.1	Test Solutions .....	71
3.3.2	Instrumentation .....	72
3.3.3	Gamete Collection.....	73
3.3.4	Germination Bioassay Protocol.....	74
3.3.5	Fluorescence Bioassay Protocol.....	75
3.3.6	Statistical analysis .....	76
3.4	Results .....	77
3.5	Discussion .....	80
3.6	Conclusions.....	86
3.7	References .....	87
<b>Chapter 4</b>	.....	<b>92</b>
<b>4.0</b>	<b><i>Hormosira banksii</i> Sperm Bioassay .....</b>	<b>93</b>
4.1	Introduction.....	93
4.2	Materials & Methods.....	95
4.2.1	Test Solutions .....	95
4.2.2	Fluorescence Assessment.....	96
4.2.3	Gamete Collection.....	97
4.2.4	Bioassay Protocol.....	98
4.2.5	Statistical Analysis.....	99
4.3	Results .....	102
4.4	Discussion .....	106
4.5	References .....	111
<b>Chapter 5</b>	.....	<b>116</b>
<b>5.0</b>	<b>Applied use of Method: Interactive Effects of Mixtures .....</b>	<b>117</b>

5.1	Introduction.....	117
5.2	Materials & Methods.....	120
5.2.1	Test Solutions .....	120
5.2.2	Collection and Preparation of Macroalgae.....	121
5.2.3	Individual Toxicant Bioassays.....	121
5.2.4	Toxicant Interaction Bioassays.....	121
5.3	Results .....	123
5.3.1	Individual Toxicant Bioassays.....	123
5.3.2	Toxicant Interaction Bioassays.....	125
5.4	Discussion .....	126
5.5	References .....	130
<b>Chapter 6.....</b>		<b>135</b>
<b>6.0</b>	<b>Eco-relevance of Chlorophyll a Fluorescence Endpoints.....</b>	<b>136</b>
6.1	Introduction.....	136
6.2	Materials & Methods.....	139
6.2.1	Test Solutions .....	139
6.2.2	Collection and Preparation of Macroalgae.....	140
6.2.3	Photosynthetic Condition of Germinating Gametes Exposed to Toxicant Stress .....	140
6.2.4	Manipulations of Gamete $\Delta F/F_m'$ and Corresponding Germination Success .....	141
6.2.5	Effect of Parental Toxic Exposure on Gamete Condition .....	143
6.3	Results .....	145
6.3.1	Photosynthetic Condition of Germinating Gametes Exposed to Toxicant Stress.....	145
6.3.2	Manipulations of Gamete $\Delta F/F_m'$ and Corresponding Germination Success .....	147
6.3.3	Effect of Parental Toxic Exposure on Gamete Condition .....	148
6.4	Discussion .....	150
6.4.1	Photosynthetic Condition of Germinating Gametes Exposed to Toxicant Stress.....	150
6.4.2	Manipulations of Gamete $\Delta F/F_m'$ and Corresponding Germination Success .....	152

6.4.3	Effect of Parental Toxic Exposure on Gamete Condition .....	153
6.5	Conclusions.....	154
6.6	References .....	156
<b>Chapter 7.....</b>		<b>158</b>
<b>7.0</b>	<b>General Conclusions .....</b>	<b>159</b>
7.1	Development of Chlorophyll <i>a</i> Fluorescence Bioassay with <i>Hormosira banksii</i> Gametes.....	159
7.2	Experimental Demonstration of Eco-Relevance for a Chlorophyll <i>a</i> Fluorescence Endpoint .....	160
7.3	Application of Bioassay Method to Applied Research.....	161
7.4	Future Research Directions .....	162
7.5	Final Conclusions.....	163
7.6	References .....	164

## LIST OF FIGURES

Figure 1.1	Life cycle for the furoid macroalgae <i>Hormosira banksii</i> .....	12
Figure 1.2	Photo of <i>Hormosira banksii</i> thallus, showing holdfast and receptacles. .....	14
Figure 1.3	De-excitation pathways for Photosystem II (PSII; LHC represents light harvesting complex). .....	21
Figure 2.1	New South Wales coastline showing Sydney beaches: Dee Why, Fairlight Beach, and Paradise Beach.....	46
Figure 2.2	Photograph of Bilgola rock platform showing vast population of <i>Hormosira banksii</i> .....	47
Figure 2.3	Effective Quantum Yield of <i>Hormosira banksii</i> gametes over time, as measured with ToxY-PAM at 5 min intervals.....	49
Figure 2.4	Fluorescence signal (A) and effective quantum yield (B) of <i>Hormosira banksii</i> eggs with increasing elevation of cuvette (n=1). .....	51
Figure 2.5	Left: Diagram of custom-built collars used to elevate cuvettes and raise collected eggs into fluorescence measurement field. Right: Comparison between cuvette with and without collar as used with the ToxY-PAM unit.....	52
Figure 2.6	Effective quantum yield ( $\Delta F / F_m'$ ) of <i>Hormosira banksii</i> eggs in relation to fluorescence signal (F) being used as proxy for egg concentration. .	56
Figure 2.7	Effective quantum yield ( $\Delta F / F_m'$ ) of <i>Hormosira banksii</i> sperm in relation to sperm concentration.....	59
Figure 2.8	Effective quantum yield ( $\Delta F / F_m'$ ) of <i>Hormosira banksii</i> sperm after 2 h exposure to various light levels.....	59
Figure 3.1	Dose-response relationships for %PSII Inhibition of <i>Hormosira banksii</i> eggs exposed (for 2 h) to Irgarol 1051, Diuron, or Bromacil (A, B and C, respectively). .....	78
Figure 4.1	Dose-response relationships for %PSII Inhibition of <i>Hormosira banksii</i> sperm exposed (for 2 h) to Diuron, copper, or water soluble fraction (WSF) of Masa crude oil (A, B and C, respectively).....	102
Figure 4.2	Minimal and maximal fluorescence for Diuron, copper and Masa crude oil bioassays. Each panel (A, B and C) shows minimal (F or F1) and maximal ( $F_m'$ or $F_m'1$ ) fluorescence response with increasing toxicant exposure for Diuron, copper and Masa crude oil, respectively.. .....	104
Figure 5.1	Dose-response relationships for %PSII Inhibition of <i>Hormosira banksii</i> sperm exposed (for 2 h) to copper, Irgarol 1051, or Diuron (A, B and C, respectively).....	124
Figure 5.2	%PSII Inhibition of <i>Hormosira banksii</i> sperm exposed (for 2 h) to mixtures of Diuron and Irgarol 1051, Diuron and copper, and Irgarol 1051 and copper.....	125

Figure 6.1	Diagram for the method of manipulating gamete solutions to give varying degrees of health, and subsequent assessment of germination success. ....	143
Figure 6.2	Photosynthetic condition of <i>Hormosira banksii</i> gametes throughout germination process.....	145
Figure 6.3	Photosynthetic condition of <i>Hormosira banksii</i> gametes throughout germination process.....	146
Figure 6.4	Effect of gamete health on ability to germinate.....	148
Figure 6.5	Effective quantum yield of adult <i>Hormosira banksii</i> throughout Irgarol 1051 exposure and 'collection' process.. ....	149
Figure 6.6	Effective quantum yield of gametes spawned from toxicant exposed adult <i>Hormosira banksii</i> .....	150

## LIST OF TABLES

Table 1.1	Desirable characteristics of an ideal test species for ecotoxicological testing. ....	17
Table 3.1	Summary Parameter Table. Shows EC <sub>50</sub> values for all cumulative paired tests and associated Coefficient of Variation (CV) values.....	79
Table 4.1	Summary of test protocol for the <i>Hormosira banksii</i> fluorescence bioassay. ....	101
Table 4.2	Summary parameter table showing EC <sub>50</sub> value for each toxicant tested and associated Coefficient of Variation (CV) value. ....	103
Table 5.1	Summary parameter table showing EC <sub>50</sub> value for each toxicant tested and associated 95% Confidence Intervals (CI).....	124
Table 5.2	Summary interaction table showing RI values for each toxicant mixture tested and associated interaction term (n=3). ....	126

*“affranchissant l’esprit et pesant les mondes sans haine, sans peur,  
sans pitié, sans amour et sans Dieu.”*

‘releasing the spirit and weighing up worlds without bitterness, without fear,  
without pity, without love and without God.’

Description of the scientific mind  
Gustav Flaubert (1821-1880)

“I have gotten a lot of results. I know several thousand things that won’t work.”

Thomas Edison (1847-1931)

“Hey, back off man. I’m a scientist.”

Dr. Peter Venkman (Bill Murray)  
Ghostbusters, 1984