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PERIPHYTON AND WATER QUALITY

IN THE MANAWATU RIVER, NEW ZEALAND

A thesis presented in partial fulfilment of the
requirements for the degree of Doctor of Philosophy in
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ABSTRACT

The factors responsible for the establishment and summer proliferation of attached filamentous algae in the Manawatu River were investigated. The life cycle of the dominant alga *Cladophora* was observed to be closely linked with the seasonal river and climatic changes. The magnitude and frequency of flush events were the major factors responsible for reducing the attached algal biomass. During steady low flow conditions, the results of phosphorus nutrient availability tests demonstrated that phosphorus availability frequently limited the growth rate of the *Cladophora* proliferations. The concentration of dissolved reactive phosphorus during these periods was 3-4 mg P m⁻³. Dissolved inorganic nitrogen concentrations during steady low flow conditions were low, compared to overseas rivers that experienced similar filamentous algal proliferations, and the results of nitrogen nutrient availability tests never indicated nitrogen limitation of the *Cladophora* growth rate.

The water quality effects of these proliferations were also investigated. The two effects monitored were; diurnal fluctuations of Dissolved Oxygen (DO) and pH. These could become quite severe and consequently affect the river's ability to adequately assimilate effluent discharges from Palmerston North and its associated food industries. Of the two algal-induced fluctuations, DO was the more important. Frequently, maximum daily DO deficits (DOD_m) of 3.0 g m⁻³ were observed and these severely limited the river's ability to satisfy the oxygen demands of all discharges while maintaining the minimum desirable DO concentration.

A regression equation was developed using the data from both the 1981/82 and 1982/83 seasons to predict the daily DOD_m . The largest contribution to the total predicted DOD_m was from the total river community respiration followed by a seasonal effect, the river flow, the regression constant and the terrestrial insolation. The regression equation accounted for 72% of the observed variation in the daily DOD_m during the two seasons.

Fluctuations in the pH of the Manawatu River were also important, as a component of the effluent discharges is ammonia, the toxicity of which increases exponentially with a linear rise in pH. However, algal-induced pH fluctuations were reduced downstream of the discharges by bacterial respiration associated with the oxygen-demanding effluents. This phenomenon and the timing of both pH and ammonia fluctuations meant that toxic concentrations were not observed, although the temporal variation of ammonia was often erratic. However, future discharge changes may alter this situation, and continued surveillance of downstream pH and ammonia is warranted.

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TABLE OF CONTENTS

	<u>PAGE</u>
<u>ABSTRACT</u>	i
<u>ACKNOWLEDGEMENTS</u>	iii
<u>TABLE OF CONTENTS</u>	iv
<u>LIST OF FIGURES</u>	viii
<u>LIST OF TABLES</u>	xiii
<u>CHAPTER 1 INTRODUCTION</u>	1
<u>CHAPTER 2 LITERATURE REVIEW</u>	6
2.1 Introduction	6
2.2 Eutrophication and attached filamentous algae in rivers	7
2.3 Water quality effects of algal metabolism	8
2.3.1 Dissolved Oxygen	8
2.3.2 pH	12
2.3.2.1 pH and ammonia	16
2.4 River primary productivity	18
2.5 <i>Cladophora</i>	23
2.5.1 Introduction	23
2.5.2 Identification	23
2.5.3 Environmental parameters affecting the growth of <i>Cladophora</i>	23
2.5.3.1 Temperature	24
2.5.3.2 Light	25
2.5.3.3 Water movements	26
2.5.3.4 Nutrients	28
2.5.3.5 Substrates	32
2.5.3.6 Summary	32
2.5.4 Life cycle	32
2.5.5 Biomass and its measurement	33
2.6 Nutrient Availability Tests	36
2.6.1 Introduction	36
2.6.2 Phosphorus	37
2.6.2.1 Total Tissue Phosphorus	37
2.6.2.2 Extractive Phosphorus	40
2.6.2.3 Phosphorus Uptake Rate	41
2.6.2.4 Alkaline Phosphatase Activity	46
2.6.3 Nitrogen	47
2.6.3.1 Total Tissue Nitrogen	47
2.6.3.2 Ammonium Absorption Rate	47
2.7 Chemical estimations of biologically available nutrients	48
2.7.1 Phosphorus	48
2.7.2 Nitrogen	49
2.8 General conclusions drawn from the literature review	49
<u>CHAPTER 3 METHODS</u>	51
3.1 Algal identification	51
3.2 Algal biomass and distribution	51

	<u>PAGE</u>
3.2.1 Artificial substrates	52
3.2.2 Natural substrates	52
3.2.3 Measurement techniques	52
3.3 River site characteristics	54
3.3.1 Physical characteristics	54
3.3.2 Intersite substrate comparison	56
3.4 Light measurements	57
3.5 River nutrients	57
3.5.1 Phosphorus	58
3.5.2 Nitrogen	59
3.5.3 Quality assurance of chemical methods	60
3.6 Nutrient Availability Tests	61
3.6.1 Phosphorus	61
3.6.2 Nitrogen	62
3.7 Laboratory culturing	63
3.7.1 Introduction	63
3.7.2 Isolation techniques	63
3.7.3 Experimental methods	67
3.8 Dissolved Oxygen dynamics	68
3.8.1 Dissolved Oxygen and temperature	68
3.8.2 Primary productivity	70
3.9 pH and alkalinity	73
3.10 Data analysis	73
<u>CHAPTER 4 LABORATORY CULTURE EXPERIMENTS</u>	<u>74</u>
4.1 Introduction	74
4.2 Results and discussion	75
4.2.1 Transition from a surplus to a limiting nutrient situation	75
4.2.1.1 Phosphorus	75
4.2.1.2 Nitrogen	79
4.2.2 Transition from a limiting to a surplus nutrient situation	81
4.2.2.1 Phosphorus	81
4.2.2.2 Nitrogen	86
4.3 The application of Nutrient Availability Test results achieved in the laboratory, to their use in field studies	89
4.4 Conclusions and recommendations	92
<u>CHAPTER 5 RECONNAISSANCE SURVEY RESULTS 1980/81</u>	<u>94</u>
5.1 Introduction	94
5.2 <i>Cladophora</i> biomass density and distribution	94
5.3 River nutrients	98
5.4 Nutrient Availability Tests	101
5.5 Primary productivity and Dissolved Oxygen fluctuations	104
5.6 Ammonia and pH	105
<u>CHAPTER 6 RESULTS FROM THE 1981/82 AND 1982/83 <u>SEASONS</u></u>	<u>107</u>
6.1 Introduction	107
6.2 Physical site characteristics	107

	<u>PAGE</u>
6.3 Light and temperature conditions	110
6.4 <i>Cladophora</i> biomass density and periphyton distribution	112
6.5 Nutrients	118
6.5.1 Phosphorus	118
6.5.2 Nitrogen	124
6.6 Nutrient Availability Tests	127
6.6.1 Phosphorus	127
6.6.2 Nitrogen	133
6.7 Primary productivity and Dissolved Oxygen fluctuations	141
6.7.1 Introduction	141
6.7.2 Primary productivity	141
6.7.2.1 Primary productivity during the 1981/82 season	141
6.7.2.2 Primary productivity during the 1982/83 season	154
6.7.2.3 Spatial variation and apportioning primary productivity	162
6.7.3 Dissolved Oxygen Deficits	167
6.7.3.1 The impact of discharges on the Dissolved Oxygen profile	167
6.7.3.2 Upstream Dissolved Oxygen profiles and the maximum daily Dissolved Oxygen Deficits, 1981/82	172
6.7.3.3 Upstream Dissolved Oxygen profiles and the maximum daily Dissolved Oxygen Deficits, 1982/83.	182
6.8 pH and ammonia	195
6.9 Summary of results from the 1981/82 and 1982/83 seasons	205
6.9.1 Light and temperature conditions	205
6.9.2 <i>Cladophora</i> biomass density and distribution	205
6.9.3 River nutrients	206
6.9.4 Nutrient Availability Tests	206
6.9.5 Primary productivity and Dissolved Oxygen fluctuations	207
6.9.6 Maximum daily Dissolved Oxygen Deficits	207
6.9.7 pH and ammonia	208
 <u>CHAPTER 7 THE PRACTICALITIES OF LOTIC <i>CLADOPHORA</i> CONTROL STRATEGIES</u>	 209
7.1 Chemical control	209
7.2 Physical removal	209
7.3 Nutrient reduction	209
7.4 Summary	210
 <u>CHAPTER 8 AREAS THAT WARRANT FURTHER STUDY</u>	 211
 <u>CHAPTER 9 CONCLUSIONS</u>	 213
 <u>ABBREVIATIONS</u>	 217
 <u>REFERENCES</u>	 219

APPENDICES

	<u>PAGE</u>
1. Photographs	240
2. Computer programme for primary productivity analysis	243
3. Computer programme sample output	247
4. Monitoring the effects of attached filamentous algae on Dissolved Oxygen	254
5. Calculations showing the effect of compensating Net Areal Primary Productivity for the variation of k_2 with temperature	263
6. Intersite Phosphorus Nutrient Availability Test comparisons, testing the hypothesis of increased downstream phosphorus limitation occurring during 1982/83.	265
7. <i>Cladophora</i> biomass density, environmental parameters and primary productivity data, 1981/82.	266
8. <i>Cladophora</i> biomass density, environmental parameters and primary productivity data, 1982/83.	270

LIST OF FIGURES

<u>FIGURE</u>	<u>TITLE</u>	<u>PAGE</u>
1.1	Map of New Zealand	2
1.2	The Manawatu River showing sampling sites.	3
1.3	A portion of the flow duration curve for the Manawatu River.	4
2.1	A representation of major sources and sinks of Dissolved Oxygen in the Manawatu River.	9
2.2	Effect of differences in plant density and sunlight on river Dissolved Oxygen profiles at 15 ⁰ C.	10
2.3	The relationship between pH and the proportion of inorganic carbon species in solution.	13
2.4	Concentrations of total ammonia that contain 0.08 g m ⁻³ un-ionized ammonia-N .	17
2.5	The life cycle of <i>Cladophora</i> in the Manawatu River.	34
2.6	The relationship between Total Tissue Phosphorus (TTP) and the specific growth rate.	38
2.7	The relationship between Extractive Phosphorus (EP) and the specific growth rate (μ).	42
2.8	The factors controlling the phosphorus uptake kinetics.	41
2.9	The relationship between the Phosphorus Uptake Rate (PUR) and the Total Tissue Phosphorus (TTP).	44
2.10	The relationship between Phosphorus Uptake Rate (PUR) and the external Phosphorus (P).	44
2.11	The relationship between Extractive Phosphorus (EP) and the Phosphorus Uptake Rate (PUR).	45
3.1	Percentage cover scale for attached filamentous algal distribution.	55
3.2	Diagram of wedge-deflector and probe arrangement.	69
3.3	Schematic diagram of algal chamber.	72
4.1	Response of <i>Cladophora</i> Phosphorus Nutrient Availability Tests to gradual phosphorus depletion.	76

<u>FIGURE</u>	<u>TITLE</u>	<u>PAGE</u>
4.2	Response of <i>Cladophora</i> Phosphorus Nutrient Availability Tests to sudden phosphorus depletion.	78
4.3	Response of <i>Cladophora</i> Nitrogen Nutrient Availability Tests to sudden phosphorus depletion.	80
4.4	Response of <i>Cladophora</i> Phosphorus Nutrient Availability Tests to sudden phosphorus depletion. (Phosphorus Uptake Rate and Extractive Phosphorus).	82
4.5	Response of <i>Cladophora</i> Nitrogen Nutrient Availability Tests to changes in nitrogen availability.	83
4.6	Response of <i>Cladophora</i> Phosphorus Nutrient Availability Tests to changes in nitrogen availability.	84
4.7	Response of <i>Cladophora</i> Phosphorus Nutrient Availability Tests to cessation of phosphorus limitation. (Total Tissue Phosphorus and Extractive Phosphorus).	85
4.8	Response of <i>Cladophora</i> Phosphorus Nutrient Availability Tests to cessation of phosphorus limitation. (Phosphorus Uptake Rate and Alkaline Phosphatase Activity).	87
4.9	Response of <i>Cladophora</i> Nitrogen Nutrient Availability Tests to cessation of phosphorus limitation.	88
5.1	<i>Cladophora</i> biomass fluctuations at Site M, 1980/81.	95
5.2	The Manawatu River flow, 1980/81.	95
5.3	Total Nitrogen and Total Phosphorus fluctuations at site M, 1980/81.	100
6.1	A longitudinal profile of the Manawatu River bed height above sea level.	108
6.2	A comparison of the areas taken up by different stone sizes, at sites T, D and M.	109
6.3	Maximum river temperatures and surface light intensity, 1981/82.	111
6.4	Maximum river temperature and surface light intensity 1982/83.	111
6.5	<i>Cladophora</i> biomass fluctuations at sites T, D and M, 1981/82.	113

<u>FIGURE</u>	<u>TITLE</u>	<u>PAGE</u>
6.6	The Manawatu River flow 1981/82.	113
6.7	<i>Cladophora</i> biomass fluctuations at Sites T, D and M 1982/83.	114
6.8	The Manawatu River flow 1982/83.	114
6.9	An idealized representation of the development of a <i>Cladophora</i> assemblage.	116
6.10	The average (three sites) Total river Phosphorus and river flow, 1981/82.	120
6.11	A diurnal study of Total Nitrogen, Total Phosphorus, Total Tissue Phosphorus and Extractive Phosphorus at Site M, 23 February 1982.	122
6.12	Dissolved Inorganic Nitrogen (DIN), Dissolved Reactive Phosphorus (DRP) and the DIN/DRP fluctuations, 1982/83.	123
6.13	Dissolved Reactive Phosphorus fluctuations at sites T, D and M during a period of <i>Cladophora</i> proliferation 25 January - 7 February 1983.	125
6.14	The average (three sites) Total river Nitrogen fluctuations, 1981/82.	126
6.15	The average (three sites) Total river Phosphorus (TP) fluctuations, 1981/82.	128
6.16	<i>Cladophora</i> Total Tissue Phosphorus (TTP) fluctuations at Site M, 1981/82.	128
6.17	<i>Cladophora</i> Alkaline Phosphatase Activity (APA) at Site M, 1981/82.	129
6.18	<i>Cladophora</i> Extractive Phosphorus (EP) at Site M, 1981/82.	129
6.19	<i>Cladophora</i> Phosphorus Nutrient Availability Tests at Site T, 1981/82.	130
6.20	<i>Cladophora</i> Phosphorus Nutrient Availability Tests at Site D, 1981/82.	131
6.21	<i>Cladophora</i> Phosphorus Nutrient Availability Tests at Site M, 1982/83. (Total Tissue Phosphorus and Extractive Phosphorus).	134
6.22	<i>Cladophora</i> Phosphorus Nutrient Availability Tests at Site M, 1982/83. (Alkaline Phosphatase Activity and Phosphorus Uptake Rate).	134

<u>FIGURE</u>	<u>TITLE</u>	<u>PAGE</u>
6.23	Total Tissue Phosphorus in <i>Cladophora</i> at Sites T, D and M, 1982/83.	135
6.24	Extractive Phosphorus in <i>Cladophora</i> at Sites T, D and M, 1982/83.	136
6.25	Phosphorus Uptake Rate in <i>Cladophora</i> at Sites T, D and M, 1982/83.	137
6.26	Alkaline Phosphatase Activity in <i>Cladophora</i> at Site T, D and M, 1982/83.	138
6.27	<i>Cladophora</i> Nitrogen Nutrient Availability Tests at Site M, 1982/83.	139
6.28	Gross Photosynthesis (GP) and Total Respiration (TR) during 1981/82.	142
6.29	The relationship between Gross Photosynthesis and Total Respiration during 1981/82.	144
6.30	The variation in the P/R ratio during 1981/82.	145
6.31	Net Areal Primary Productivity (NAP) during 1981/82.	147
6.32	Daily Net Primary Productivity profiles for two-day periods, 1981/82.	148
6.33	Community description (Hornberger plot), 1981/82.	151
6.34	The daily Dissolved Oxygen fluctuations (ΔDO), 1981/82.	152
6.35	The relationship between Gross Photosynthesis and the Dissolved Oxygen fluctuation (ΔDO) 1981/82.	153
6.36	Gross Photosynthesis and Total Respiration, 1982/83.	155
6.37	The relationship between Gross Photosynthesis and Total Respiration, 1982/83.	156
6.38	The variation in the P/R ratio during 1982/83.	158
6.39	Net Areal Primary Productivity (NAP) during 1982/83.	160
6.40	Community description (Hornberger plot) 1982/83.	161
6.41	The daily Dissolved Oxygen fluctuations (ΔDO), 1982/83.	163
6.42	The relationship between Gross Photosynthesis and the Dissolved Oxygen fluctuation (ΔDO), 1982/83.	164

<u>FIGURE</u>	<u>TITLE</u>	<u>PAGE</u>
6.43	Comparison of Dissolved Oxygen profiles at sites T and D, 12-13 February 1982.	166
6.44	The Dissolved Oxygen (DO) fluctuations at sites T and K during 30 January 1982 - 4 February 1982.	168 & 169
6.45	Some Dissolved Oxygen profiles at sites T and C, 1982.	170
6.46	Some Dissolved Oxygen profiles at site T, 1981/82.	173
6.47	Average site biomass of <i>Cladophora</i> and observed maximum daily Dissolved Oxygen Deficit 1981/82.	178
6.48	Average site biomass of <i>Cladophora</i> and observed maximum daily Dissolved Oxygen Deficit 1982/83.	185
6.49	The relationship between predictors and the maximum daily Dissolved Oxygen Deficit (DOD_m), and the contribution each predictor makes to the total DOD_m , 1981/82.	190
6.50	The relationship between predictors and the maximum daily Dissolved Oxygen Deficit (DOD_m) and the contribution each predictor makes to the Total DOD_m , 1982/83.	191
6.51	pH fluctuations at various sites during 1981/82.	196
6.52	pH fluctuations at downstream sites during 1981/82.	196
6.53	Total ammonia fluctuations at sites T, D and K, 5-6 February 1982.	197
6.54	Total ammonia fluctuations at site K, 12-13 February 1982.	197
6.55	Daily pH fluctuations during 1982/83.	200
6.56	pH fluctuations at sites M and K during 2 February 1983 - 6 February 1983.	201
6.57	pH and ammonia fluctuations at sites M and K 14-15 January 1983.	202
6.58	pH and ammonia fluctuations at site K 27-28 January 1983.	202
6.59	pH and ammonia fluctuations at site K, 1-2 February 1983.	203

LIST OF TABLES

<u>TABLE</u>	<u>TITLE</u>	<u>PAGE</u>
1.1	Locations of the major dischargers to, and study sites of, the Manawatu River.	1
2.1	A summary of pH fluctuations reported from a variety of rivers.	15
2.2	A comparison of lotic primary productivity data.	22
2,3	Estimates of critical water phosphorus concentrations in various aquatic situations.	30
2.4	Examples of <i>Cladophora</i> biomass density in lakes and rivers.	36
2.5	Values of Phosphorus Nutrient Availability Tests for <i>Cladophora</i> associated with a limiting or surplus situation.	39
2.6	Values of Nitrogen Nutrient Availability Tests for <i>Cladophora</i> associated with a limiting or surplus situation.	48
3.1	Quality assurance of analytical methods, 1981/82.	60
3.2	Accuracy and precision of nitrogen and phosphorus digestion methods.	61
3.3	A comparison of the media used to culture <i>Cladophora</i> .	64
4.1	Values observed for laboratory Nutrient Availability Tests associated with a limiting or surplus situation.	89
4.2	A summary of laboratory Nutrient Availability Test response times.	90
5.1	A distribution survey of periphyton in the tributaries of the Manawatu River, 9 May 1981.	96
5.2	<i>Cladophora</i> biomass density variation on one sampling occasion, at site M, during a proliferation	97
5.3	A summary of nutrient data collected weekly during December and January 1980/81.	99
5.4	<i>Cladophora</i> Nutrient Availability Test results from site T during the 1980/81 season.	101
5.5	Periphyton survey, Phosphorus Nutrient Availability Tests and Total river Phosphorus from the Manawatu River and some of its tributaries, 9 May 1981.	103

<u>TABLE</u>	<u>TITLE</u>	<u>PAGE</u>
5.6	Primary Productivity data at site T during early 1981.	104
5.7	Ammonia concentration at various sites in early 1981.	106
5.8	Ammonia concentrations at site T 22-23 March 1981.	106
5.9	pH fluctuations at site M, 11 April 1981.	106
6.1	The range of average site velocities recorded during low flow periods.	107
6.2	Comparison of primary productivity at sites T and D 12-13 February 1982.	165
6.3	Correlation coefficient matrix of the maximum daily Dissolved Oxygen Deficits and some river and environmental variables, 1981/82.	173
6.4	The parsimonious regression equation and associated statistics for predicting the maximum daily Dissolved Oxygen Deficits, 1981/82.	179
6.5	Correlation coefficient matrix of the maximum daily Dissolved Oxygen Deficits and some river and environmental variables, 1982/83.	183
6.6	The parsimonious regression equation and associated statistics for predicting the maximum daily Dissolved Oxygen Deficits, 1982/83.	184
6.7	Correlation coefficient matrix of the maximum daily Dissolved Oxygen Deficits and associated variables in 1981/82 and 1982/83.	186
6.8	The parsimonious regression equation and associated statistics for predicting the maximum daily Dissolved Oxygen Deficits, 1981/82 and 1982/83.	187
6.9	A t-test comparison of the residuals from the regression equation for each season.	188
6.10	Data illustrating the influence of each term in the regression equation for 1981/82 and 1982/83	193
6.11	Ammonia concentrations and other relevant variables at site K during March 1982.	198
6.12	A comparison of some observed ammonia concentrations with the recommended values at ambient pH and 20°C.	204