ASPECTS OF THE BIOLOGY AND UTILISATION OF *PTEROCLADIA* AND *GRACILARIA*

DAVID MORLEY LUXTON

A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy in Botany, University of Auckland, June 1977.

ACKNOWLEDGEMENTS

My special thanks go to my supervisor, Professor V.J. Chapman for his assistance and guidance in all phases of this study.

A major portion of this work was carried out at the Leigh Marine Research Laboratory; the support of the Director, Dr W.J. Ballantine and Associate Director, Dr F.J. Taylor is gratefully acknowledged. I would also like to thank Dr J.R. Walsby (Research Fellow), for his personal interest and helpful advice. I am also indebted to Mr T. Wustenberg for his technical assistance.

The study was financed by a grant from Davis Gelatine (N.Z.) Limited and I wish to extend my sincere gratitude to Mr J.R. McGimpsey, General Manager. I am also extremely grateful for the use of facilities at the Davis Gelatine laboratory and access to seaweed records. In addition helpful discussions with Mr C. Hintz are also acknowledged.

Thanks are also due to fellow students, Mr K. Johnson and Mr T. Ayling for their valuable assistance in the field. I am also grateful to Mr C. Hay for providing samples of *Pterocladia lucida* from Kaikoura.

I would also like to express my gratitude to Mrs Raylee Johnston for typing.

ABSTRACT

Pterocladia lucida (R. Br.) J. Ag. is the prinipal raw material for agar production in New Zealand. Since collection commenced in 1943 the annual harvest has never stabilised and over recent years there has been a general decline, which has inhibited expansion of the indigenous industry.

Field and laboratory studies have been made in order to obtain information on the biology of *P. lucida*. Form variability is considered in detail and a relationship between external morphology and wave exposure of the habitat is proposed. The culture of *P. lucida* from spores in a running seawater system is described in detail. Results on carpospore and tetraspore germination, and sporeling growth under light and temperature regimes are presented. Germination of both spore types was inhibited at $10^{o}C$ while at higher temperatures germination was greatest under 4 klux. Spore germination and sporeling development in culture is described. Only sterile prostrate thalli possessing rhizoidal haptera were obtained and a hypothesis relating the appearance of surface haptera to the direction of irradiation is proposed.

The development of an outdoor wave tank for culturing is described and the growth rate and development of sporelings is

discussed with reference to water movement. Sporelings were maintained in culture for up to 22 months. Cultured sporelings have also been transplanted into different habitats. Creeping axes established from carpospores produced erect fronds, which produced tetraspores after seven to ten months *in situ*. This confirmed part of a *Polysiphonia*-type life history for the first time in a Gelidioid species. Axis elongation rate *in situ* was estimated to be less than 10cm $year^{-1}$ at Leigh. It was concluded that the collection of attached weed could not be sustained annually, but controlled harvesting in specific areas every two years is advocated.

Seasonal variation in agar yield and gel strength from wave exposed and sheltered populations of *P. lucida* was studied. Agar levels varied throughout the year, being greatest in spring and summer, while gel strengths showed a similar trend.

The feasibility of utilising indigenous *Gracilaria secundata* Harvey forma *pseudoflagellifera* May has been studied. The yield and gel properties of agar were determined from different alkali pretreatments. There was a marked increase in gel strength when weed was pretreated in alkali, the maximum gel strength being obtained from a weed treatment of 3 percent NaOH for three hours at $80^{o}C$. The gel properties of agar from *G. secundata* f. *pseudoflagellifera* are compared with agar from other sources. The agar was suitable for commercial use,

but exhibited a greater resilience than that from *Pterocladia lucida*.

The vegetative regeneration of *G. secundata* f. *pseudoflagelli-fera* in the Manukau Harbour has been studied and an experimental harvest of 0.68t is described. During spring 100 percent regeneration from hand cleared and raked areas occurred after eight to thirteen weeks. Based on regeneration results, mechanical harvesting four times a year of *Gracilaria* mats in the Manukau Harbour is advocated.

The predicted sustainable yield is 1084-1304t $year^{-1}$.

The extraction and gel properties of agar from *Melanthalia abscissa* (Turn.) Hook. et Harv. are reported for the first time, but the commercial collection of this species is not advocated.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES