

The role of nitrogen and phosphorus in the development of *Cladophora glomerata* (L.) Kutzing in the Manawatu River, New Zealand

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Keywords: *Cladophora*, periphyton, filamentous algae, nitrogen, phosphorus, physiological indicator tests, bioassays, Manawatu River, New Zealand

Abstract

Physiological indicators of nitrogen and phosphorus deficiency were used to determine the role of these nutrients in the development and proliferation of *Cladophora* in the Manawatu River, New Zealand. Nitrogen indicator tests showed that surplus nitrogen was available at all times. During a sustained low flow period when the dissolved reactive phosphorus was between 4–5 mg m⁻³, phosphorus indicator tests revealed that the *Cladophora* proliferations were phosphorus deficient. A downstream trend of reduced nitrogen and phosphorus availability was also observed during this period. Sudden high river flows were frequent and had a major influence on the *Cladophora* biomass.

Introduction

Proliferations of *Cladophora glomerata* (L.) Kutzing occur frequently during summer low flow periods in both North and South Island rivers of New Zealand. In the Manawatu River, summer growths can physically interfere with recreational river use, cause pungent odours as filaments rot on river edges, and affect the river's water quality with severe diel dissolved oxygen and pH fluctuations (Freeman & McFarlane, 1982).

Chemical monitoring of the Manawatu River has shown that dissolved reactive phosphorus (DRP) and nitrate nitrogen concentrations were frequently low, <30 mg m⁻³ and <50 mg m⁻³ respectively (Currie & Gilliland, 1980) compared to those found in British and North American rivers known to support prolific *Cladophora* growths (Bolas & Lund, 1974; Pitcairn & Hawkes, 1973; Wong & Clark, 1976). These nutrients were derived solely from diffuse agricultural run-off (Currie, 1977). Thus, as part of an overall study to determine the factors controlling *Cladophora* development and

proliferation, the role of nitrogen (N) and phosphorus (P) were examined.

This paper is concerned with using physiological indicators of N and P deficiency to directly establish the role of these nutrients in the development and proliferation of *Cladophora* in the Manawatu River above Palmerston North (Fig. 1).

Description of study sites

The Manawatu River (latitude 40°S, longitude 175°E) is situated in the lower half of the North Island of New Zealand (Fig. 1). The river is approximately 226 km long and has a catchment area of 4 950 km², encompassing parts of both the Tararua and Ruahine ranges. The mean flow is 54.6 m³ s⁻¹ and the 4% low flow is 12.8 m³ s⁻¹ (Currie, 1977). During 1972–1982, flows of greater than 1 000 m³ s⁻¹ were recorded, on average, 1.8 times per year (Man. Catch. Bd. + Reg. Water Bd. data). The maximum flow during this period was 2 433 m³ s⁻¹. The summer and winter average daytime river tempera-