WASTEWATER EFFECTS ON EPILITHON, PARTICULARLY SEWAGE FUNGUS, AND WATER QUALITY IN THE MANAWATU RIVER, NEW ZEALAND

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ABSTRACT

Epilithon development, in relation to the discharge of domestic sewage, dairy factory and meatworks wastewaters, and its effects on water quality were studied in laboratory channels and in the Manawatu River. During the three year period of the study the organic material inputs to this river were progressively reduced to meet the requirements of water rights designed to limit the in-river BOD_5 to 5 $g.m^{-3}$ at the end of a defined mixing zone with the objective of maintaining adequate oxygen levels and controlling sewage fungus growth.

Laboratory channel studies demonstrated that, for a given BOD_5 addition, untreated dairy factory wastewater increased the heterotrophic growth 2-3 times more than primary treated meatworks wastewater. Similar observations were made in the Manawatu River. These varied growth responses could be accounted for by the different relative contributions of dissolved and low molecular weight (< 1000 daltons) organic compounds in the different wastewaters. The dissolved or low molecular weight (determined after sample ultrafiltration) BOD_5 therefore provide more reliable general sewage fungus control parameters than BOD_5.

Current velocity and spates had marked influences on the development of benthic communities. Maximum sewage fungus biomasses on the natural bed were observed at current velocities of 0.2 to 0.45 $m.s^{-1}$. Short heterotrophic fronds occurred at the maximum current velocity investigated of 1.16 $m.s^{-1}$. Small spates of up to 50 to 70 $m^3.s^{-1}$ caused preferential sloughing of heterotrophs over epilithic phototrophs which had developed on concrete plates at river flows of approximately 25 $m^3.s^{-1}$. Flows in excess of approximately 150 $m^3.s^{-1}$ removed growths of *Cladophora glomerata* which had developed at sites where the pre-spate current velocity was 0.3 to 0.4 $m.s^{-1}$. Much higher flows, in excess of 400 $m^3.s^{-1}$, were required to remove

the dense growths of the macrophyte *Potamogeton crispus*.

Observations of sewage fungus biomass at various depths in the Manawatu River and growth rates on both upper, sunlight-exposed, and lower, shaded, surfaces of concrete plates suspended in the water column indicated that solar radiation inhibition of heterotrophic growth is not important in the Manawatu River.

These heterotrophic growths in the river were replaced by heavy phototroph-dominated epilithon as organic concentrations were reduced. Both communities had significant impacts on the suspended biomass and dissolved oxygen levels in the river.

A computer model simulating summer low flow conditions in the Manawatu River predicted that the river can sustain average respiration rates of 20 and 24 g O_2 m^{-3} d^{-1} at mean river temperatures of 21°C to 12°C respectively without breaching the statutory minimum permissable dissolved oxygen concentration of 5 $g.m^{-3}$. A multiple regression model of the factors influencing epilithon respiration was developed from *in situ* chamber studies of a range of epilithic community types. This gave adequate predictions when tested against measurements over reaches below the discharges and predicted that the benthic biomass resulting in the maximum permissible respiration rates decreased from approximately 143 g AFDW m^{-2} at 12°C to 34 g AFDW m^{-2} at 21°C.

A management strategy limiting the organic, but not the nutrient, inputs to the Manawatu River was shown to be unlikely to ensure consistent maintenance of the statutory minimum dissolved oxygen concentration.

The implications for management of the river are discussed.

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