Growth of mussels Mytilus edulis at algal (Rhodomonas salina) concentrations below and above saturation level for reduced filtration rate

Average filtration and growth rates of groups of juvenile Mytilus edulis (n = 2545 of 22-35 mm shell length) were measured at different concentrations of an algal cell monoculture in 9 laboratory experiments of duration 14-30 days, 4 experiments below and 5 above the limit of incipient saturation concentration (Csat ≈ 6000-7000 Rhodomonas salina cells ml⁻¹). From a nearly constant filtration rate (F ≈ 30 ml min⁻¹ for a 30 mm shell length) at measured algal concentrations below Csat the steady-state filtration rate decreased approximately as 1/C for increasing algal concentrations (C) above Csat to levels as low as 12-9 % of the former value. Corresponding calculated gross ingestion rates (I = F x C) increased linearly below Csat and remained nearly constant above Csat. However, the measured weight-specific growth rates (μ) decreased sharply above Csat from a maximal value of about 9.5 % day⁻¹ to about 1.5 % day⁻¹. Below Csat on the other hand, measured μ values increased linearly with increasing algal concentration which was in good agreement with an earlier advanced bioenergetic growth model. The overall functional response of M. edulis resembles a Type I in terms of gross ingestion, but with a rapid decrease instead of a constant above Csat in terms of actual ingestion and growth. The physiological implications of the functional response remain uncertain. The response to increasing food concentration with possible regulation of net ingestion appears only to come into play when Csat is exceeded and then as partial valve closure and reduced filtration and growth rates along with production of pseudofaeces. A survey of naturally occurring phytoplankton biomass in the sea shows that this is generally below Csat except for the short spring bloom periods; hence mussels generally feed at optimal rates depending on the composition and concentration of biomass exceeding the minimal concentration below which the mussels close their valves and reduce or cease filtering.