The nearshore shunt and phosphorus demand of nuisance attached algae

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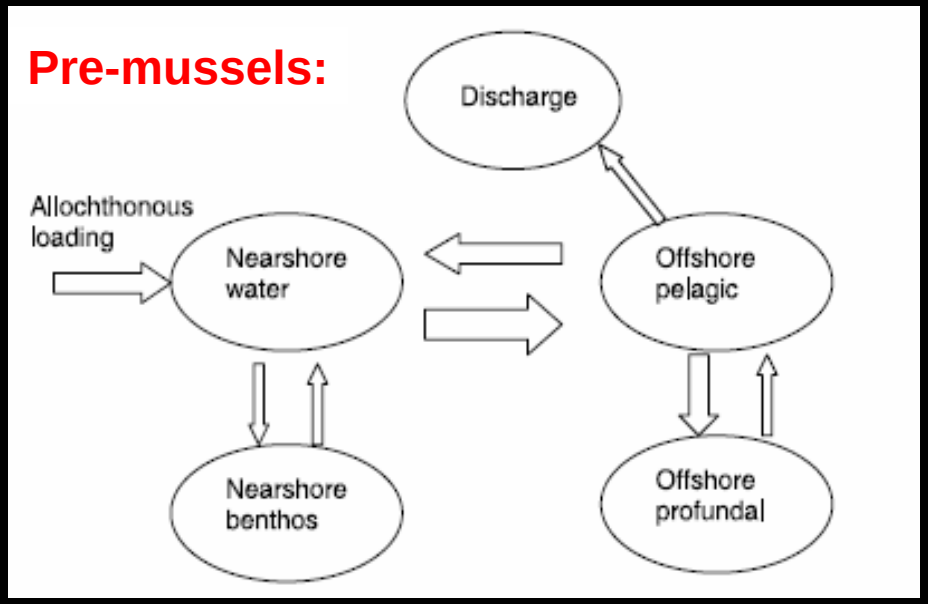
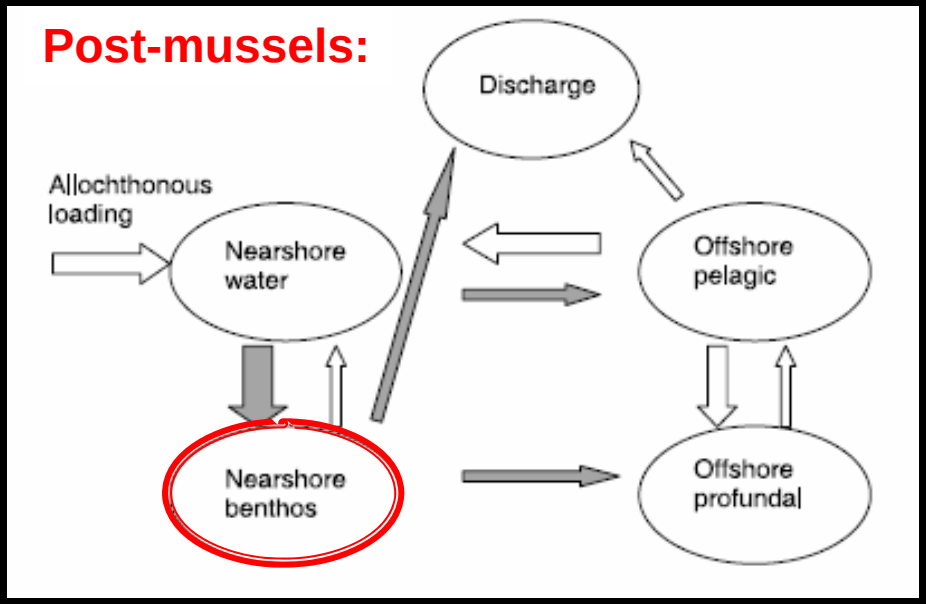
Invasive species can compete for resources and alter fitness of native species e.g. dreissenid mussels cause pelagic-littoral shift in energy flow and near shore environmental conditions (Hecky et al. 2004).

…dreissenid mussels have been credited with re-engineering nutrient flux and distribution in the lower Great Lakes





Nearshore Shunt Hypothesis: Hecky et al. 2004

Cladophora growth is patchy (at various scales), but coverage is often up to 100% in areas underlain by hard substrata.

Cladophora is a nuisance from summer into autumn

Growth of *Cladophora*: a modeling approach

$$dx/dt = [\ \mu - R - L\ ] \cdot X$$

μ = Gross specific growth rate
R = Diurnal specific respiration rate
L = Specific loss rate (sloughing)
X = Biomass

ultiple dynamic variables

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ight intensity at depth

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emperature

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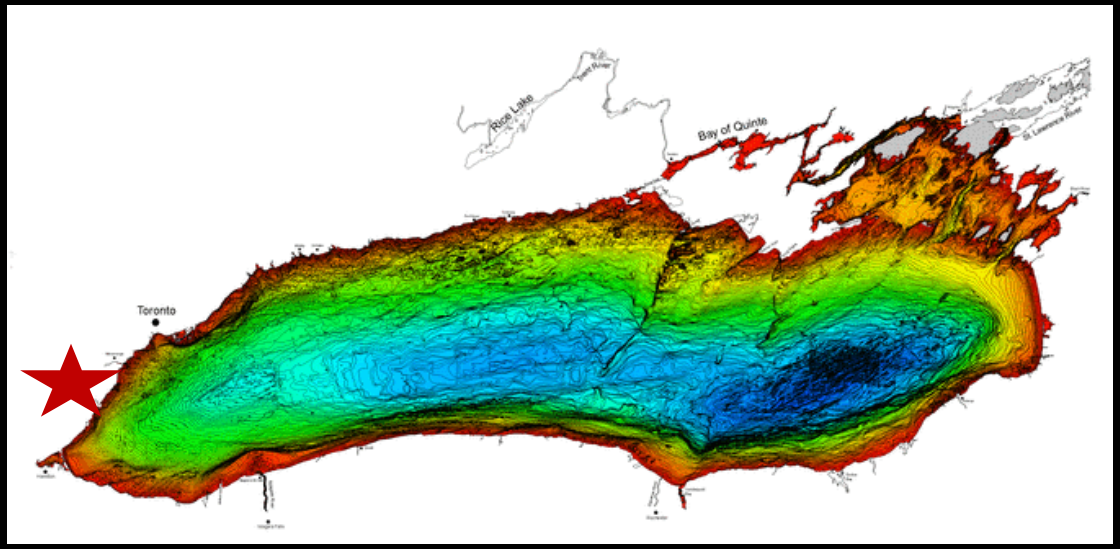
issue phosphorus

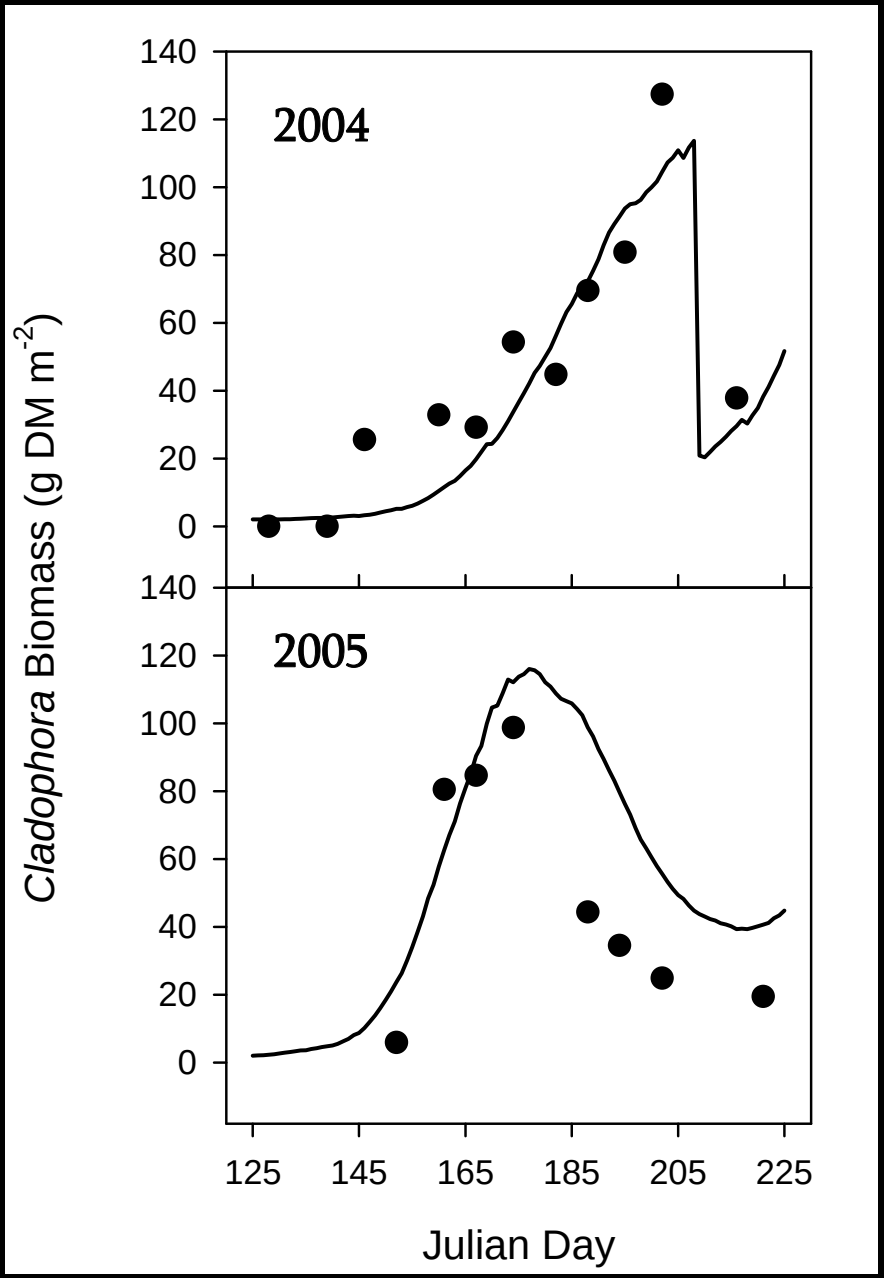
Auer and Canale 1982

Growth of *Cladophora*: a modeling approach

Calibrated and validated with direct harvests of *Cladophora* through 2 growing seasons in Halton, Lake Ontario



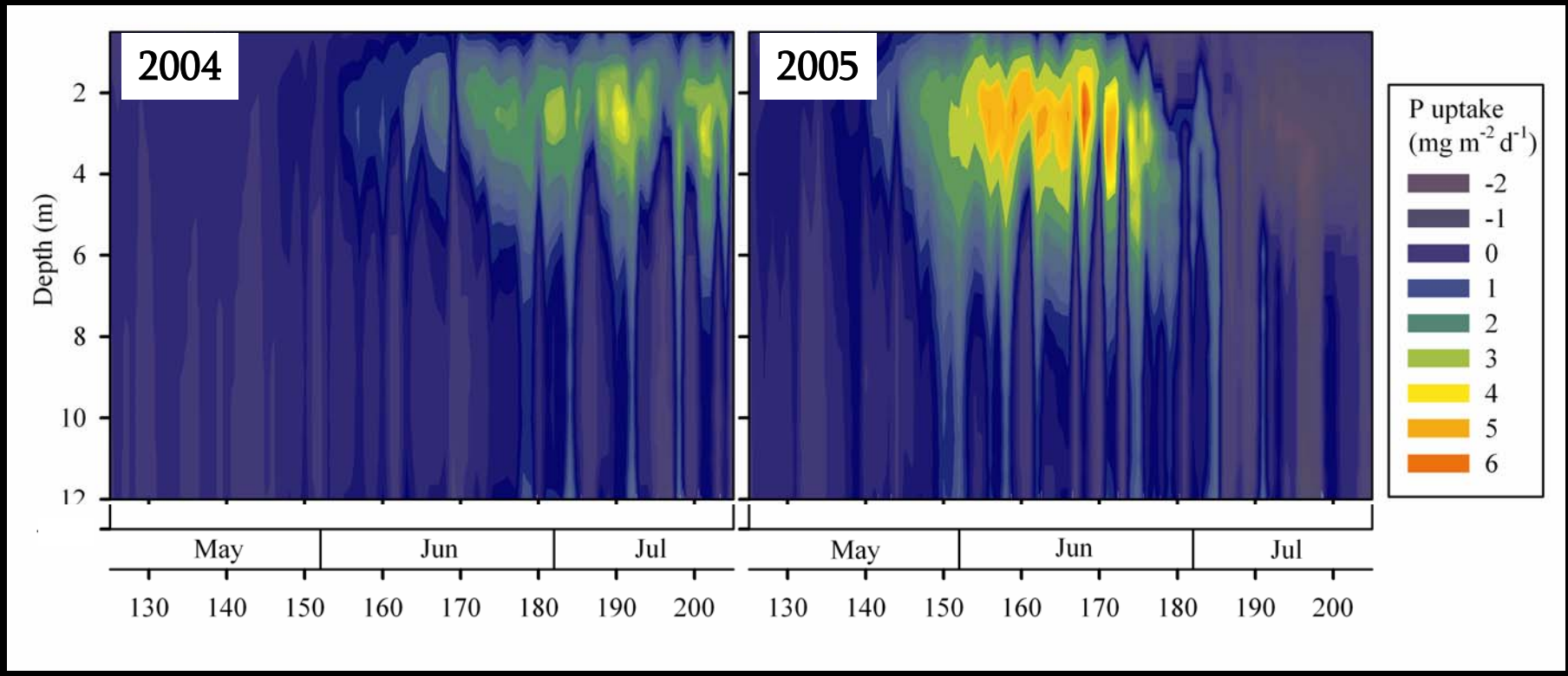
Malkin, Hecky and Guildford 2008, *in press*



Application of the model with refinements required for catastrophic sloughing successfully predicts timing of biomass increase and maximum biomass in two very different years at a 2m site in Halton.

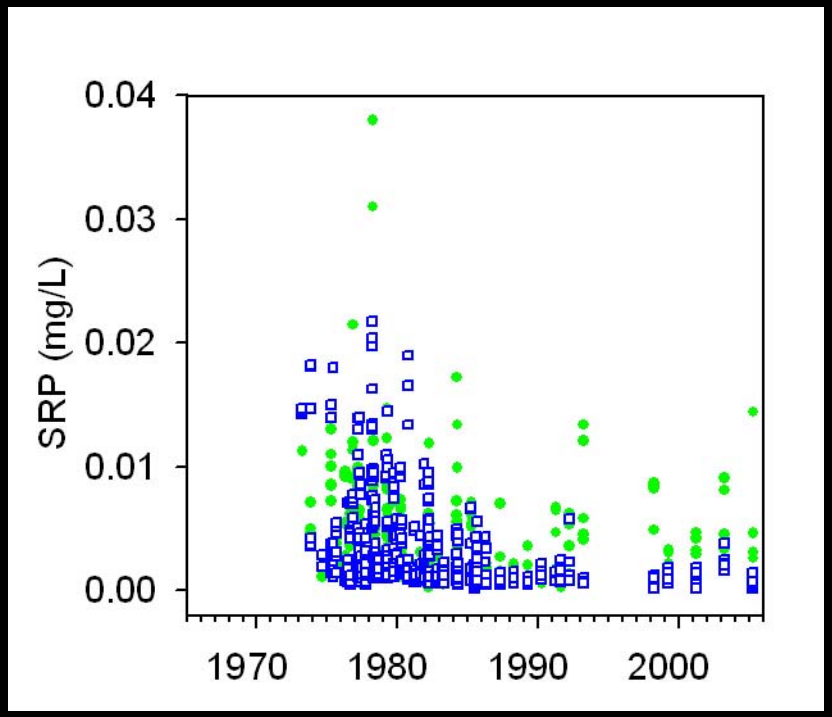
This establishes confidence in the model for estimating biomass over depth and for use in hindcasting or forecasting growth under prior or future conditions.

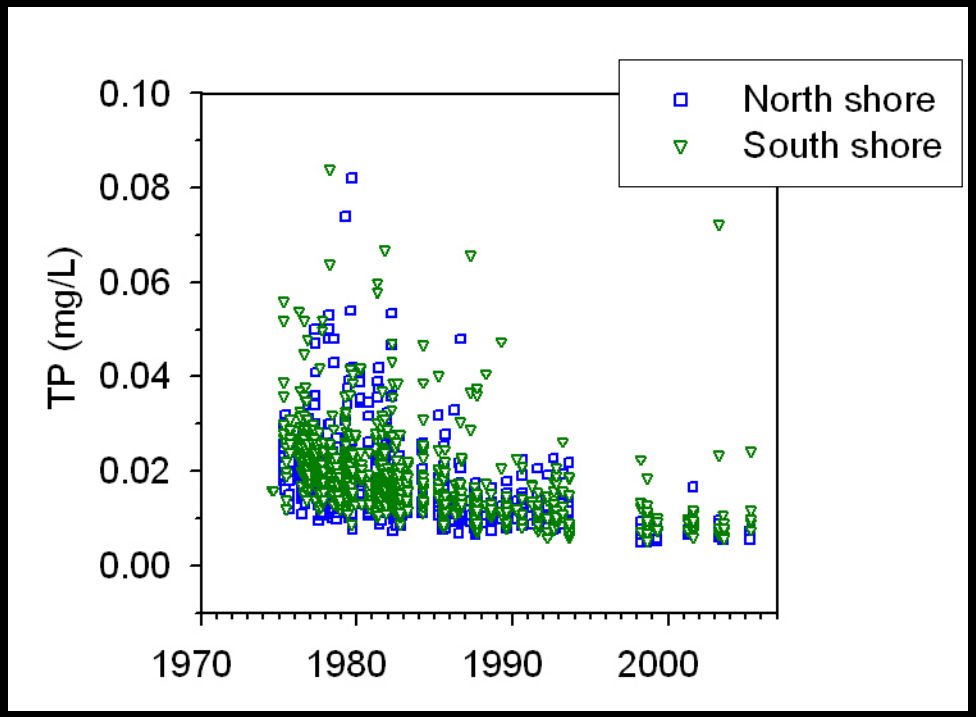
Seasonal and depth-specific P uptake by *Cladophora*



P uptake is estimated as product of measured C:N:P stoichiometry of *Cladophora* tissue and modelled growth rates per day.

Long term trends in nearshore (< 20 m) phosphorus, Lake Ontario

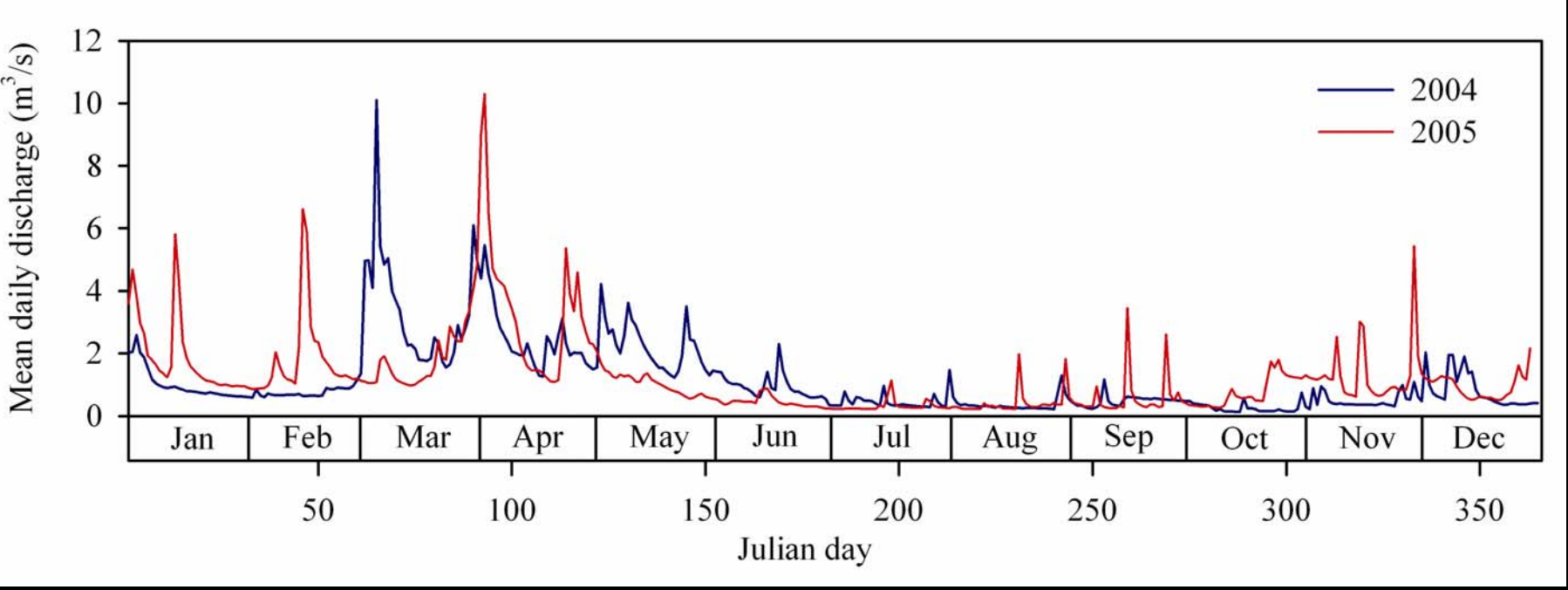




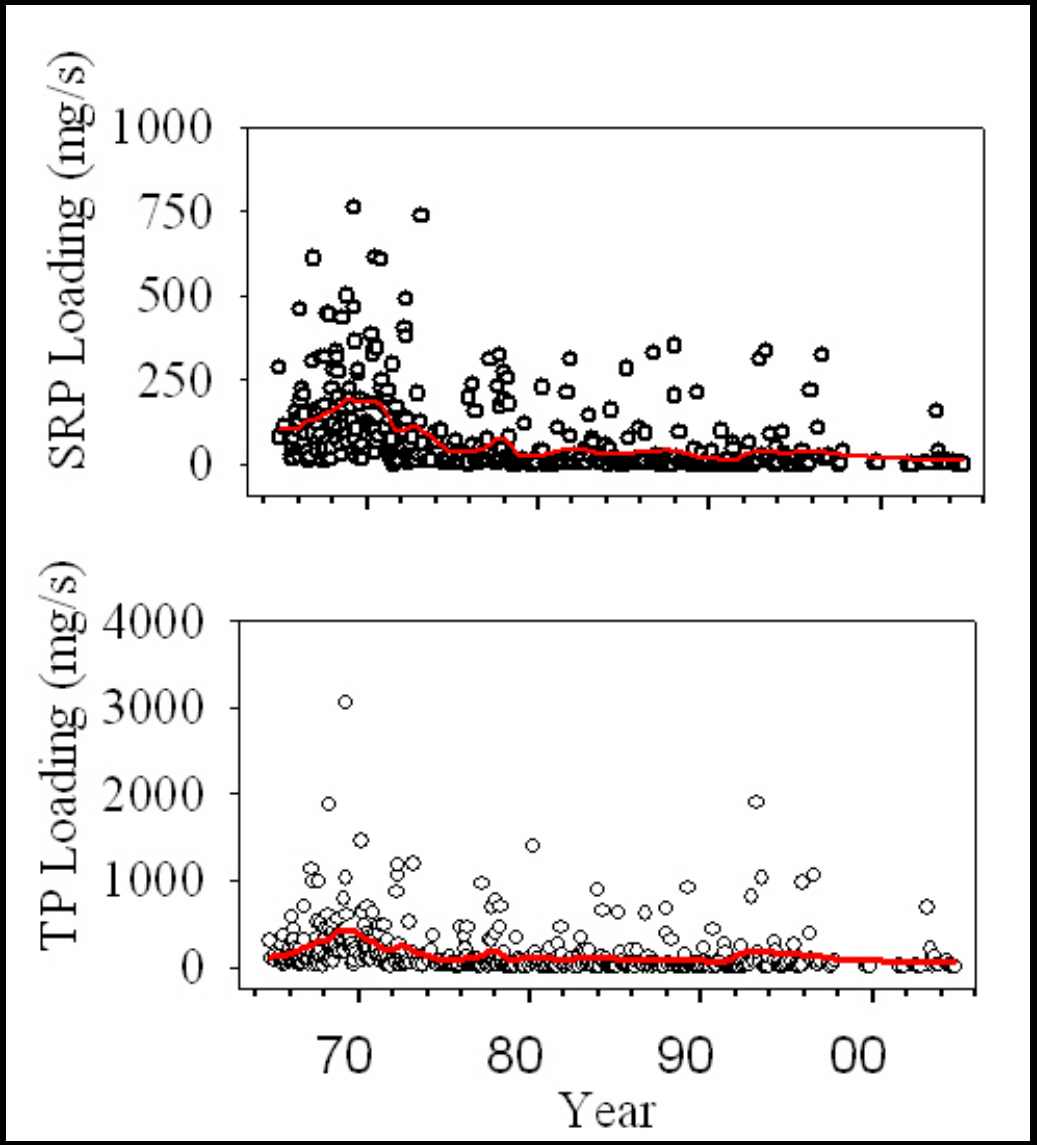
Coastal water quality is generally improving, and better than ever in western Lake Ontario re: P concentration.

Data: STAR database Environment Canada

Discharge from 16 Mile Creek, Halton

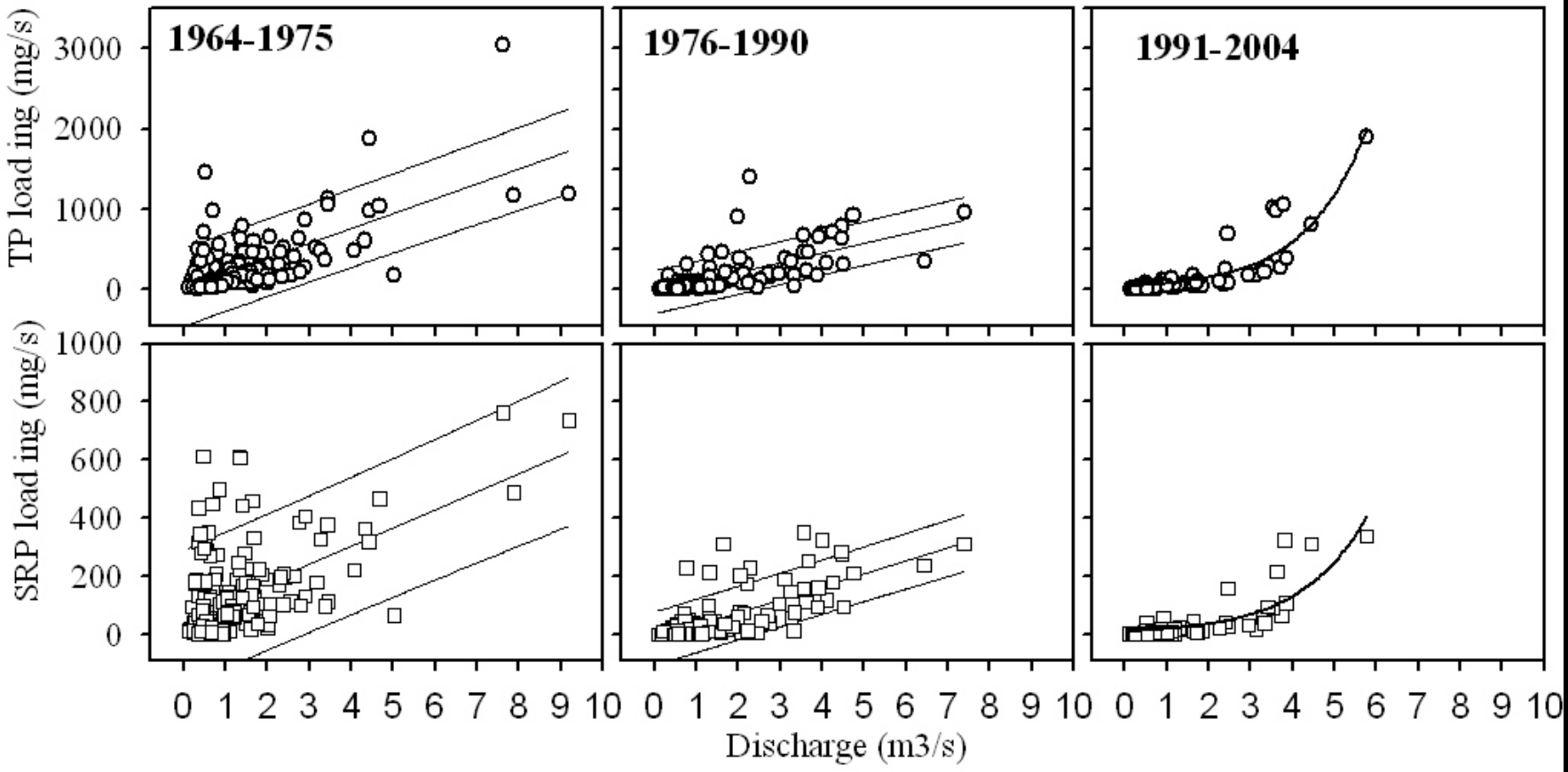


Loading from 16 Mile Creek, Halton



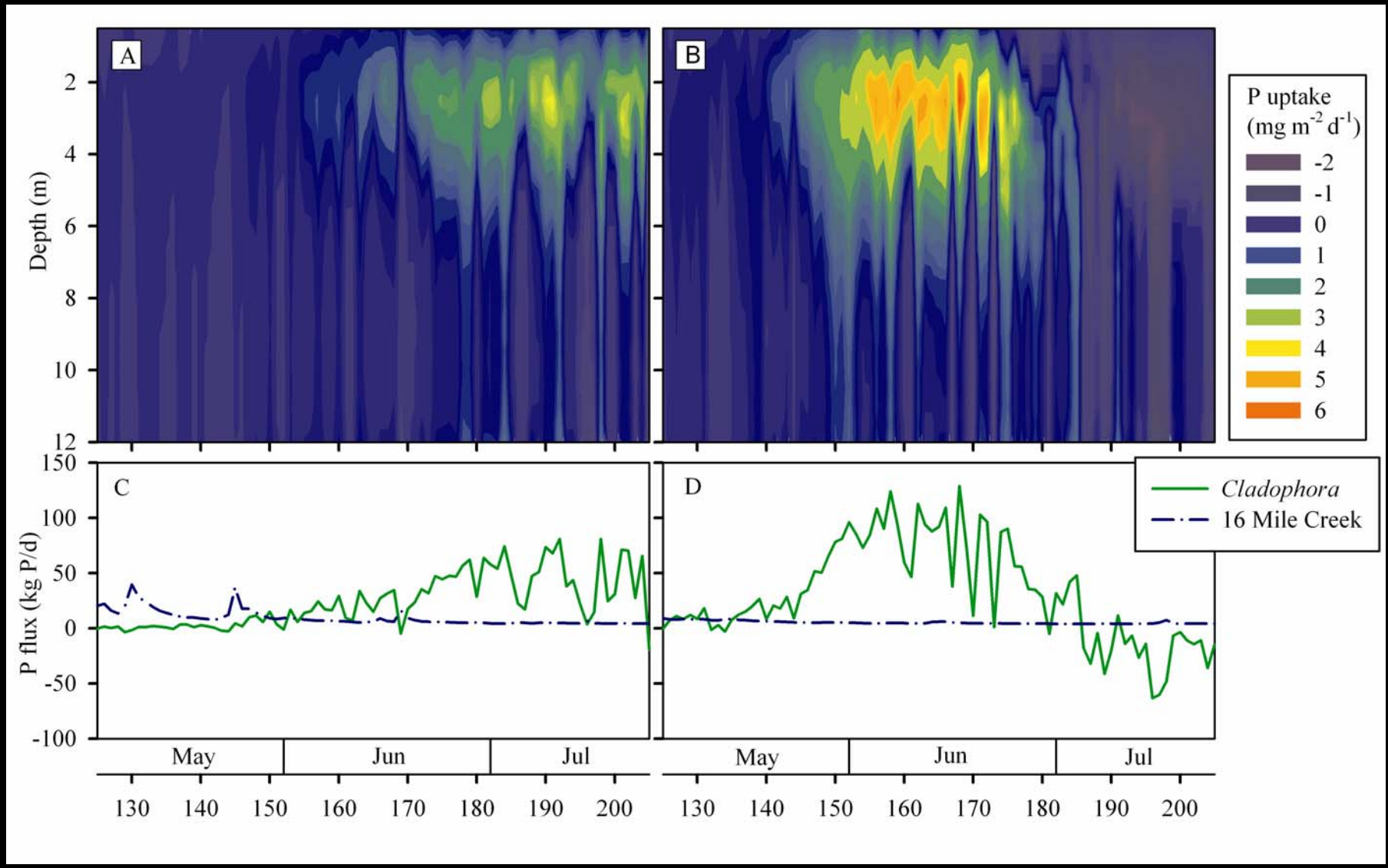
Data calculated from: WSC and PWQMN

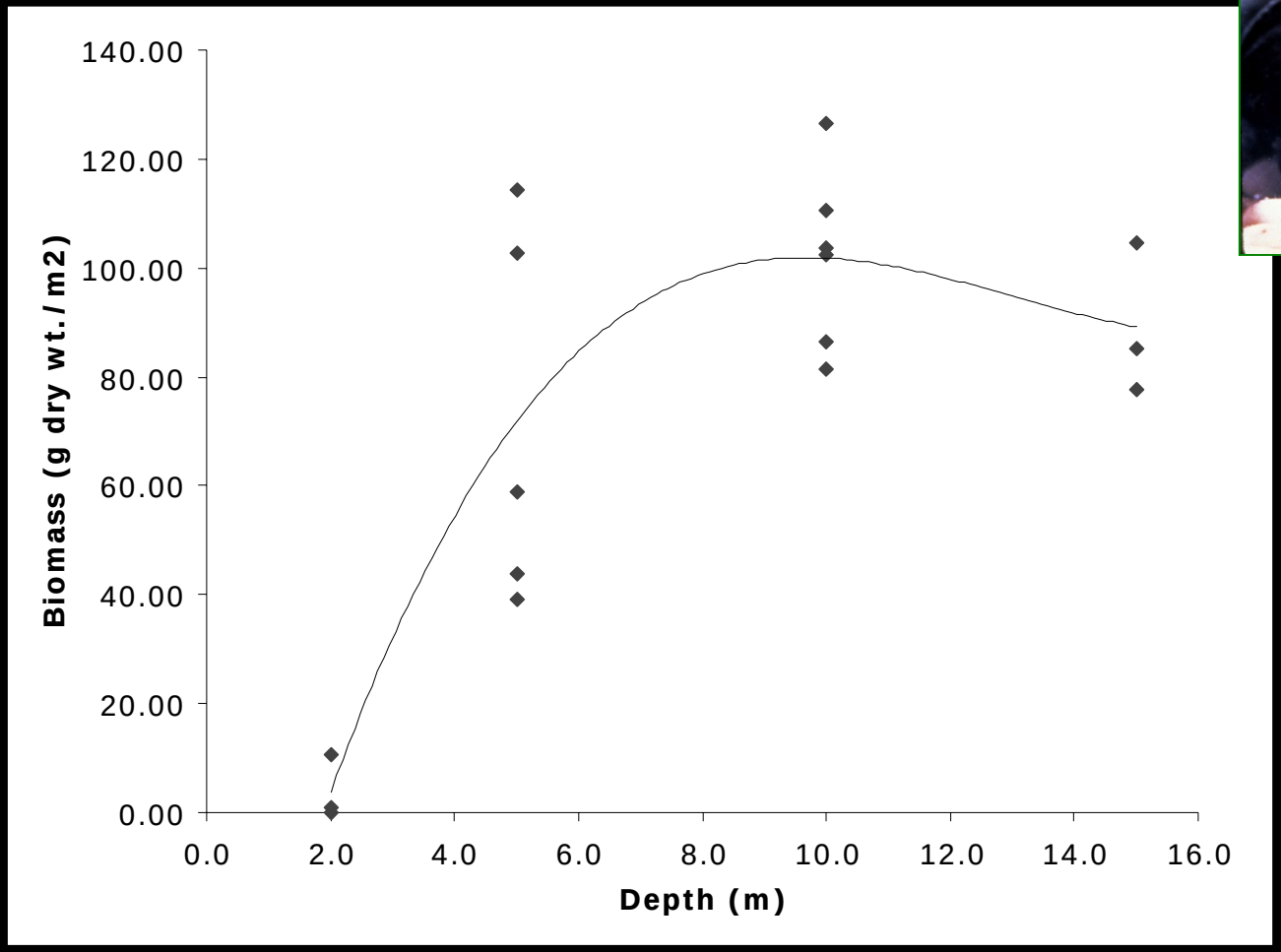
Discharge from 16 Mile Creek, Halton



Discharge is used to calculate nutrient loading. During Peak *Cladophora* growth, nutrient loading from tributaries are at their annual minimum.

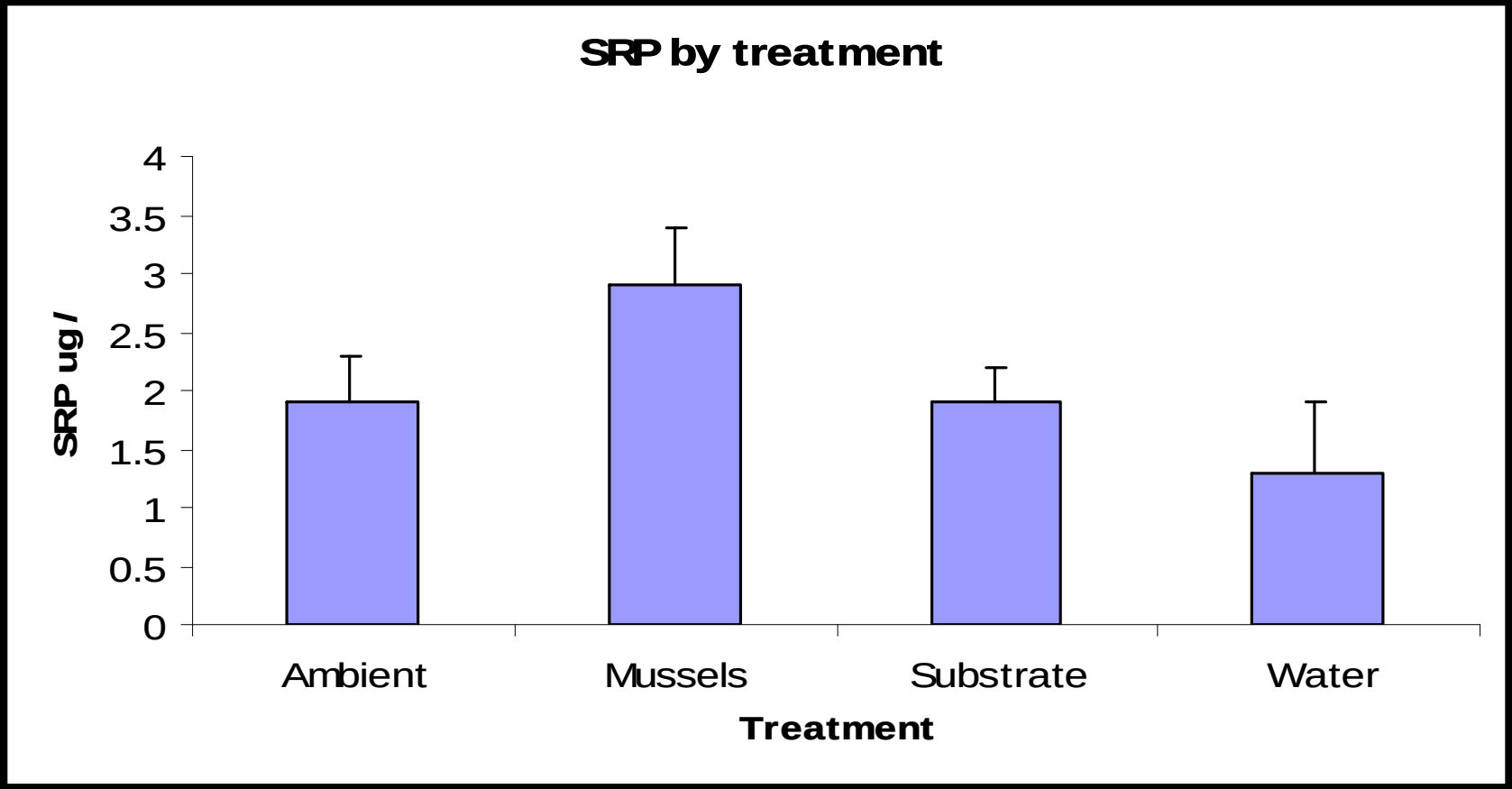
P loading from 16 Mi Creek vs. *Cladophora* demand



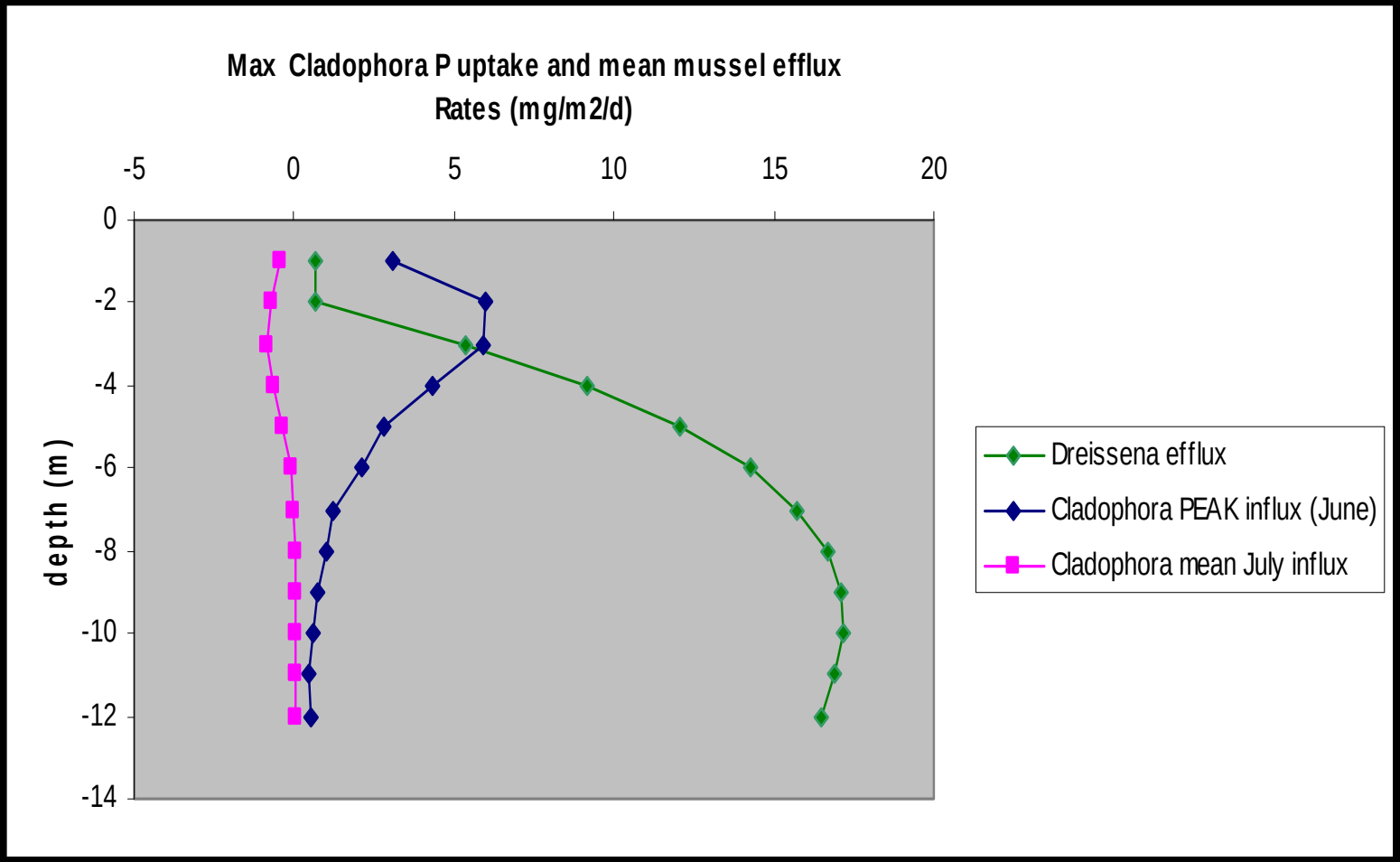


Based on surveys with video deployment, we estimate 28,000 tonnes of shell free biomass between 0-12 m along Halton shorelines (represents 8.9 T of P).

SRP efflux by mussels



Mussel excretion meets or exceeds the demand of *Cladophora* at all but shallowest depths during peak growth and P demand



Mussels not only increase transparency in near shore coastal area but also provide sufficient P necessary to meet P uptake by *Cladophora*