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Yingcai Hu

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1 Introduction

2 Methods

2.1 Microbial Consumer-Resource Model (MiCRM)

Here we adopt the framework from Marsland, 2019: the energy per unit time or, The metabolic rate, J_{ij}^{in} of species i using resource j depends on the concentration of resource j, R_j and species preference on a particular resource type c_{ij}:

$$J_{ij}^{in} = w_j \sigma(c_{ij} R_j) \tag{1}$$

where the function $\sigma(x) = x_{\max} \frac{x}{k+x}$ is the Monod function that maps the resource availabe to the resources taken by bacteria. The total energy, J_i^{grow}, used for growth of biomass will be defined by setting a size-scaled fraction (l_j) of energy returned to the environment:

$$J_i^{grow} = \sum_{j=1}^{M} (1 - l_j) J_{ij}^{in} \tag{2}$$

We adopt a MiCRM from Marsland, 2019 based on early work of MacArthur R. Assuming there are N species and M types of resouces, the dynamics of biomass abundance C_i of species i^{th} and resource concentration R_j of type j^{th} is

$$\frac{dC_i}{dt} = \mu C_i \left(J_i^{grow} - m_i(C_i) \right) \tag{3}$$

$$\frac{dR_j}{dt} = \rho_j - k_{ab} \sum_{i=1}^{N} \left(C_i U_{ij}(C_i) R_j - \sum_{k=1}^{M} C_i U_{ik}(C_i) R_k l_{kj}(C_i) \right) \tag{4}$$

Here, U_{ij} is uptake rate of resource j by speceis i, l_{ij} is the leakage of resource j to the environment in the form of resource k. m_i is the maintainence required for species i. The terms are explained in Table 1.

Table 1: Definition and Units of Parametres

Symbols	Definition	Units
C	Biomass content	$mass$
R	Resouces content	$mass$
U	Uptake rate	$time^{-1}$
l	Fraction of leakage	$None$
m	Maintainence coefficient	$time^{-1}$
ρ	External resource supply	$mass/time$
μ	Constant that scales the resource uptake to growth	$mass^{-1}$
k_m	Constant that scales the maintanence	$mass^{-1}$
k_{ab}	Constant that scales the body mass and resource intake	$mass^{-1}$

Here $U_{ij}(C_i)$, $l_{jk}(C_i)$ and $m_i(C_i)$ are scaled by biomass for investigating the effect of biomass on population dynamics within the bacterial community.

2.2 Body mass Parametrisation on MiCRM