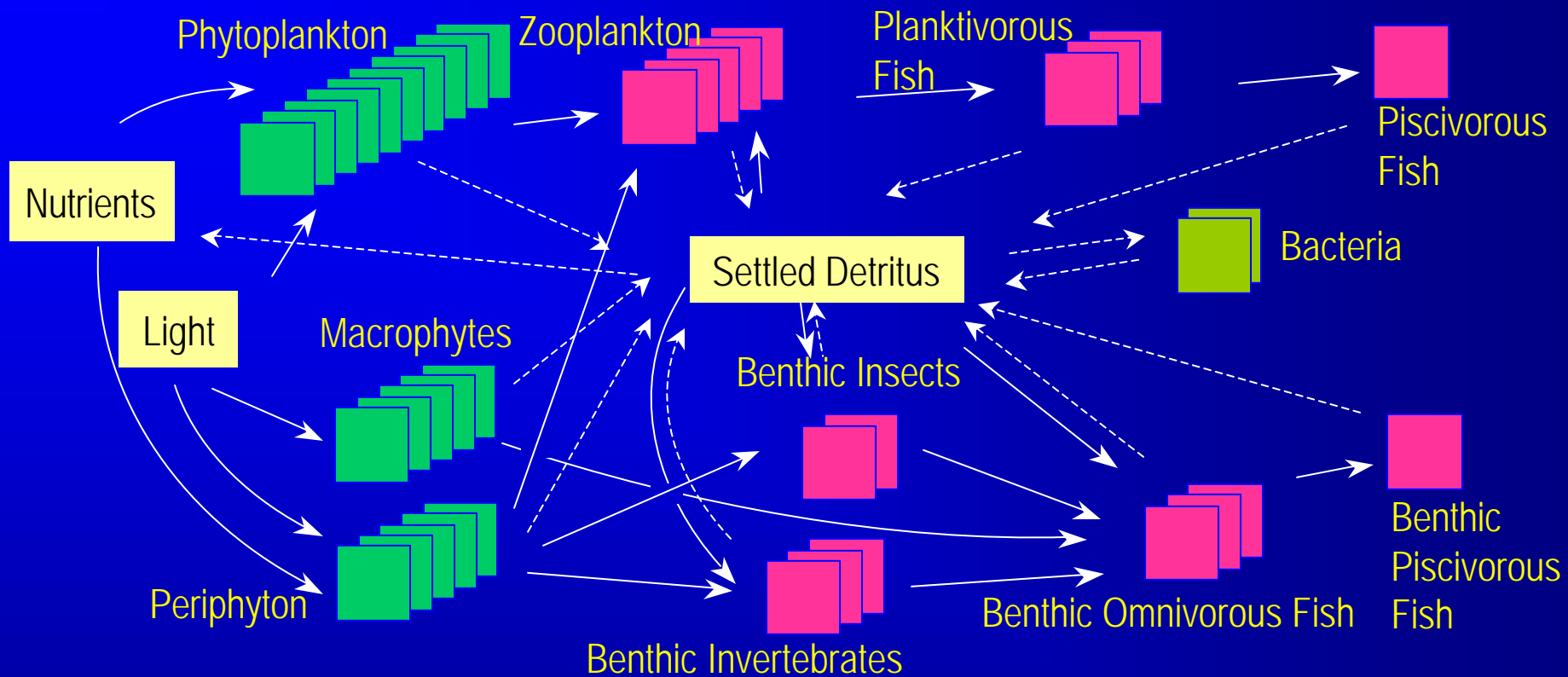


Comprehensive Aquatic Systems Model (CASM) for Lake Biwa



The production dynamics are simulated using bioenergetics-based growth equations.

Equations for Primary Producers

$$\frac{dB_i}{dt} = B_i \left\{ \underbrace{P_m \cdot f(N, P, Si) \cdot g(I) \cdot h(T)}_{\text{Photosynthesis}} - R \cdot h(T) - S - M - G \right\}$$

$$f(N, P, Si) = \min\{N / (k_N + N), P / (k_P + P), Si / (k_{Si} + Si)\}$$

$$g(I) = \frac{0.316[\exp\{-I / I_s\} \exp(-0.2z - 0.1Z)] - \exp(-I / I_s)]}{(0.2 + 0.1Z)}$$

$$h(T) = \{(T_o + 10 - T) / 10\}^{1.5} \exp\{1.5 - 1.5(T_o + 10 - T) / 10\}$$

B : biomass [g-C/m²]

P_m : photosynthesis rate constant [d⁻¹]

R : respiration rate constant [d⁻¹]

S : sinking rate constant [d⁻¹] (for phytoplankton only)

M : mortality rate constant [d⁻¹]

N, P, Si : concentrations of nitrogen, phosphorus,
and silica [μg/L], respectively

I : daily light intensity [E/m²·h]

T : water temperature [°C]

Equations for Consumers

$$\frac{dB_i}{dt} = B_i \left\{ \underbrace{C}_{\text{Consumption}} (1 - D - U) - R - h(T) - M - G \right\}$$

$$C = C_m h(T) \sum_j \left\{ a_{ij} w_{ij} B_j / (B_i + \sum_j w_{ij} B_j) \right\}$$

$$G = \sum_k \left\{ C_{m_k} h(T) w_{ki} B_k / (B_k + w_{ki} B_i + \sum_k w_{kl} B_l) \right\}$$

B : biomass [g-C/m²]

D : the specific dynamic action constant [-] (for fish only)

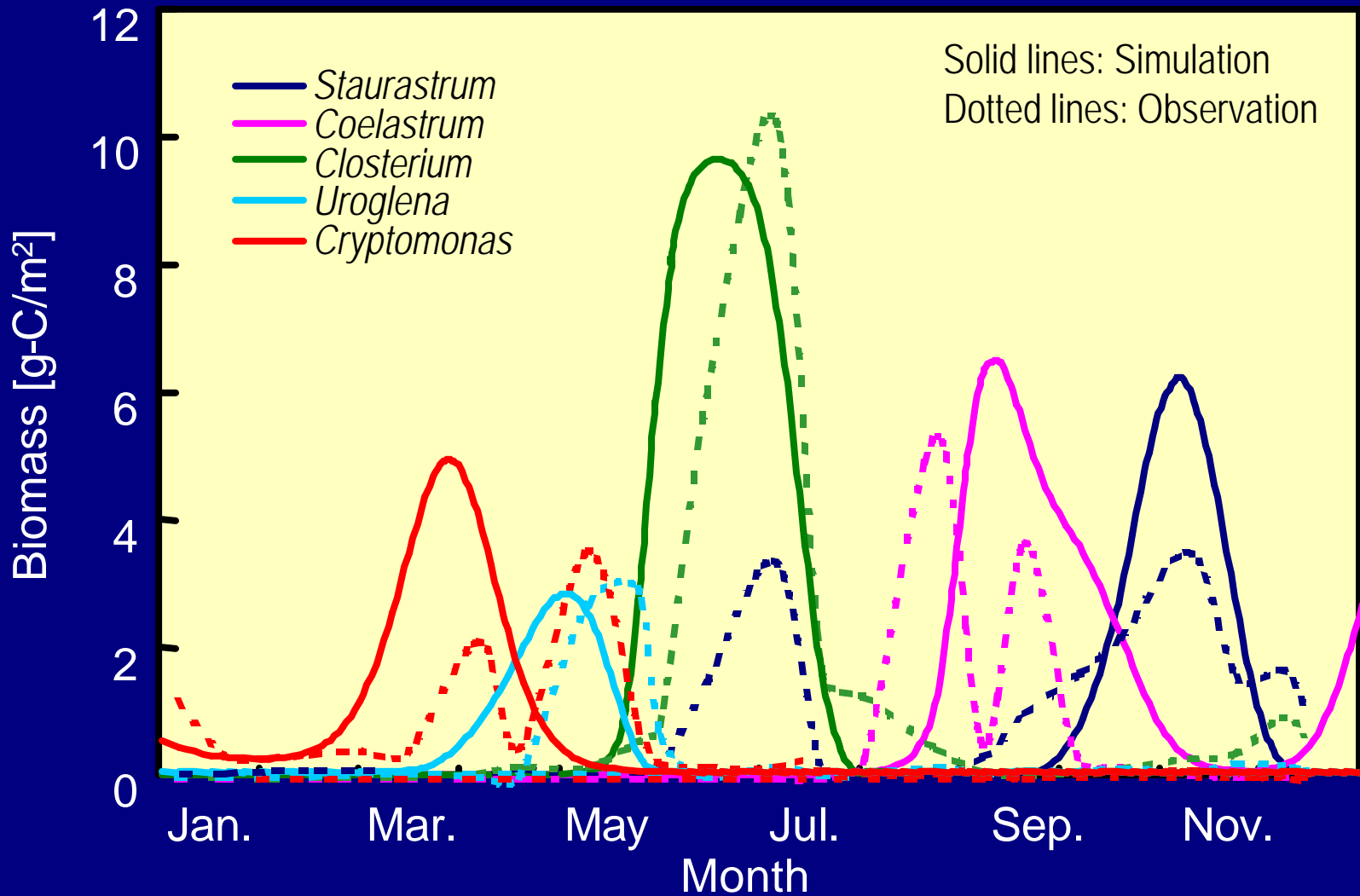
U : the excretion constant [-]

C_m : maximum consumption rate constant [1/d]

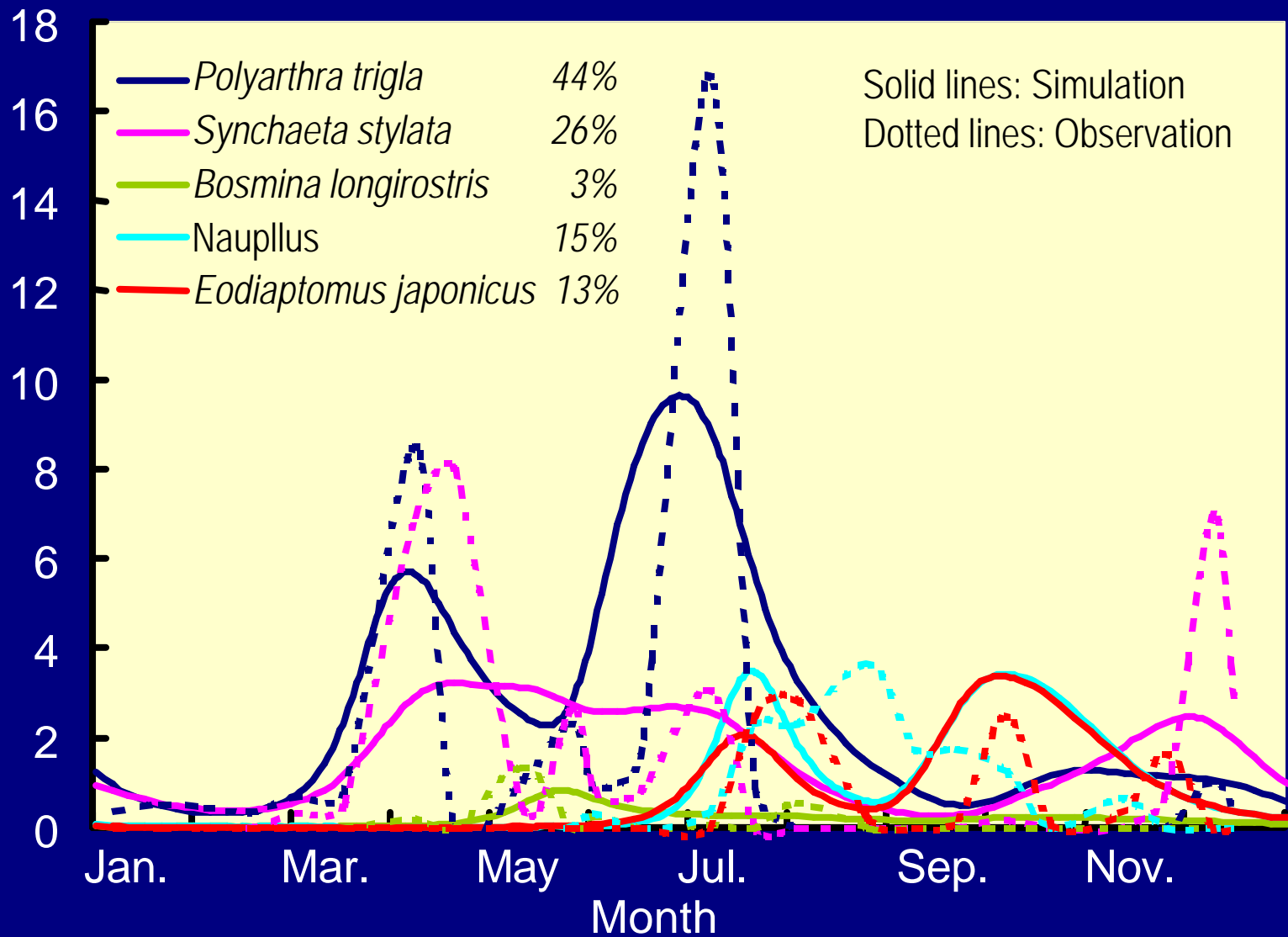
a_{ij} : the assimilation of prey j by population i [-]

w_{ij} : the preference of predator i for prey j [-]

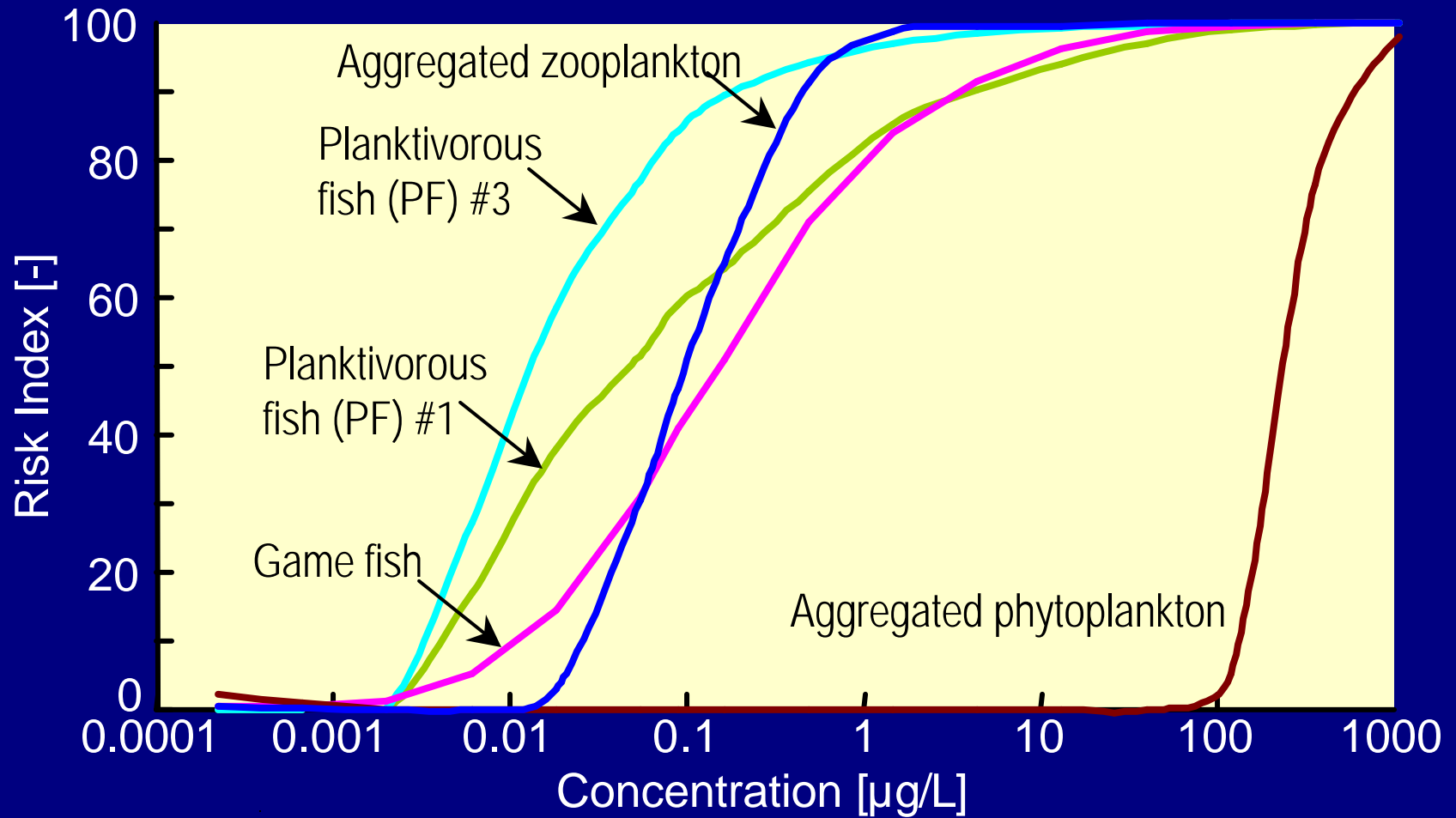
The subscripts i , j , k , and l indicate target population, prey for the target population, predator for the target population, and prey of population k other than the target population, respectively.



Seasonal changes in the biomass observed in Lake Biwa and in the simulated biomass



Seasonal changes in the biomass observed in Lake Biwa and in the simulated biomass



Effects of predator-prey interactions (DDT)