3.5 Predicting consumption

Ecosim bases the crucial assumption for prediction of consumption rates on a simple Lotka-Volterra or 'mass action' assumption, modified to consider 'foraging arena' properties. Following this, prey can be states that are or are not vulnerable to predation, for instance by hiding, (e.g., in crevices of coral reefs or inside a school) when not feeding, and only being subject to predation when having left their shelter to feed, (see Figure 3.3 in Vulnerabilities in Ecosim). In the original Ecosim formulations (Walters et al 1997, 2000) the consumption rate for a given predator *i* feeding on a prey *j* was thus predicted from,

$$C_{ij} = \frac{a_{ij} \cdot v_{ij} \cdot B_i \cdot P_j}{2v_{ij} + a_{ij} \cdot P_j}$$ **Eq. 51**

where, a_{ij} is the effective search rate for predator *i* feeding on a prey *j*, v_{ij} base vulnerability expressing the rate with which prey move between being vulnerable and not vulnerable, B_i prey biomass, P_j predator abundance (N_j for split pool groups discussed later, and B_j for other groups).

The model as implemented argues that 'top-down vs. bottom-up' control is in fact a continuum, where low ***vs implies bottom-up and high v's top-down control.***

Early experience with Ecosim has led to a more elaborate expression to describe the consumption:

$$C_{ij} = \frac{a_{ij} \cdot v_{ij} \cdot B_i \cdot P_j \cdot T_i \cdot T_j \cdot S_{ij} \cdot M_{ij} / D_j}{v_{ij} + v_{ij} \cdot T_i \cdot M_{ij} + a_{ij} \cdot M_{ij} \cdot P_j \cdot S_{ij} \cdot T_j / D_j}$$ **Eq. 52**

where, T_i represents prey relative feeding time, T_j predator relative feeding time, S_{ij} user-defined seasonal or long term forcing effects, M_{ij} mediation forcing effects, and D_j represents effects of handling time as a limit to consumption rate,

$$D_j = \frac{h_j \cdot T_j}{1 + \sum_k a_{kj} \cdot B_k \cdot T_k \cdot M_{kj}}$$ **Eq. 53**

where h_j is the predator handling time. The feeding time factors are discussed further in *Foraging time and predation risk*. A vulnerability setting of 1 will result in consumption being estimated using bottom-up conditions only through

$$C_{ij} = a_{ij} \cdot B_i \cdot T_j \cdot S_{ij}$$