

7.12 Search rates

One surprising feature of the system of linear equations underlying the Ecopath approach is that it can be used to estimate the Lotka-Volterra mass-action term a , which has the dimension of a volume searched per unit time by a given predator j seeking a certain prey i . If we start from the first Ecopath Master Eq.:

$$B_i \cdot (P/B)_i \cdot EE_i - \sum_j B_j \cdot (Q/B)_j \cdot DC_{ji} - C_i - E_i - BA_i = 0$$

where B is biomass, P production rate, EE the ecotrophic efficiency, C the catch rate, BA the biomass accumulation rate, E the net migration rate, Q the consumption rate, DC_{ji} the proportion i contributes to the diet of j (each of the consumers). Separating the biomass accumulation rate, BA , and re-expressing as a differential equation:

$$BA_i = \frac{dB}{dt} = B_i \cdot (P/B)_i \cdot EE_i - \sum_j B_j \cdot (Q/B)_j \cdot DC_{ji} - C_i - E_i - BA_i$$

$$\dots = B_i \cdot (P/B)_i \cdot EE_i - C_i - E_i - \sum_j Q_{ij}$$

where Q_{ij} expresses the consumption rate for consumer j of prey i . We can then solve for $a_{ij} = Q_{ij}/(B_j \cdot B_i)$, which defines the Lotka-Volterra mass-action term a the quotient of the amount of i consumed by j , divided by the product of their biomasses.

This mass-action term is used as a fixed support for the lever which, in Ecosim, regulates the consumption of predators, given the changing biomasses of their preys, and their own changing biomasses.

The values of a depend obviously on the units used, and the biomass units used in Ecopath render difficult a direct interpretation of the numbers in the Search rate table. However, they can easily be converted into values of a applying to single organisms, given that the ratio of the individual prey and predator weights are divided into the values of a for each pair of prey and predator.