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The basics of Ecosim consist of biomass dynamics expressed through a series of coupled differential equations. The equations are derived from the Ecopath master equation (see Eq. 1 in Mortality for a prey is consumption for a predator), and take the form

\[ \frac{dB_i}{dt} = g_i \sum_j Q_{ji} - \sum_j Q_{ij} + I_i - (M_{0i} + F_i + e_i) B_i \]  

Eq. 50

where \( \frac{dB_i}{dt} \) represents the growth rate during the time interval \( dt \) of group \( i \) in terms of its biomass, \( B_i \), \( g_i \) is the net growth efficiency (production/consumption ratio), \( M_0 \) the non-predation ("other") natural mortality rate, \( F_i \) is fishing mortality rate, \( e_i \) is emigration rate, \( I_i \) is immigration rate, (and \( e_i B_i - I_i \) is the net migration rate). The two summations estimates consumption rates, the first expressing the total consumption by group \( i \), and the second the predation by all predators on the same group \( i \). The consumption rates, \( Q_{ji} \), are calculated based on the 'foraging arena' concept, where \( B_i \)'s are divided into vulnerable and invulnerable components (Walters et al., 1997 Figure 1), and it is the transfer rate \( (v_{ji}) \) between these two components that determines if control is top-down (i.e., Lotka-Volterra), bottom-up (i.e., donor-driven), or of an intermediate type.

The set of differential equations is solved in Ecosim using (by default) an Adams-Bashford integration routine or (if selected) a Runge-Kutta 4th order routine.

Further reading: Walters et al. 1997; Walters et al. 2000

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