2.2 The energy balance of a box

A group (box) in an Ecopath model may be a group of (ecologically) related species, a single species, or a single size/age group of a given species. See Defining the system for more about defining groups.

In a model, the energy input and output of all living groups must be balanced. The basic Ecopath equation includes only the production of a box (see Mortality for a prey is consumption for a predator). Here production equals predation + catches + net migration + accumulated biomass + other mortality. When balancing the energy balance of a box, other flows should be considered. After the 'missing' parameters have been estimated so as to ensure mass balance between groups energy balance is ensured within each group using the equation

Consumption = production + respiration + unassimilated food **Eq. 14**

This equation is in line with Winberg (1956) who defined consumption as the sum of somatic and gonadal growth, metabolic costs and waste products. The main differences are that Winberg (along with many other bioenergeticists, see Ney, 1990) focused on measuring growth, where we focus on estimating losses, and that the Ecopath formulation does not explicitly include gonadal growth. The Ecopath equation treats this as included in the predation term (where nearly all gonadal products end up in any case).

We have chosen to perform the energy balance so as to estimate respiration from the difference between consumption and the production and unassimilated food terms. This mainly reflects our focus on application for fisheries analysis, where respiration rarely is measured while the other terms are more readily available. To facilitate computations we have, however, included a routine ('alternative input') where the energy balance can be estimated using any given combination (including ratios) of the terms in the equation above.

Ecopath can work with energy - as well as with nutrient-related currencies (while Ecosim and Ecospace only work with energy related currencies). If a nutrient based currency is used in Ecopath, the respiration term is excluded from the above equation, and the unassimilated food term is estimated as the difference between consumption and production.

From Eq. 14 respiration can be estimated as a difference, and replace another parameter in model construction (see Help System, Appendix 4, algorithm 9). If the model currency is a nutrient, there is no respiration, and the proportion of food that is not assimilated will be higher.

The mass balance constraint implemented in the two master equations of Ecopath (see Eq. 1 and Eq. 14) should not be seen as questionable assumptions but rather as filters for mutually incompatible estimates of flow. One gathers all possible information about the components of an ecosystem, of their exploitation and interaction and passes them through the 'mass balance filter' of Ecopath. The result is a possible picture of the energetic flows, the biomasses and their utilization. The more information used in the process and the more reliable the information, the more constrained and realistic the outcome will be.