7.1 Notes on parameterizing an Ecopath model

Below are some important considerations for parameterizing (i.e., balancing) your Ecopath model so that mass balance is achieved. Make sure you are also familiar with the introductory material on Ecopath parameterization: Mortality for a prey is consumption for a predator, The energy balance of a box, On the need for input parameters.

For more detailed notes on balancing your model we recommend you also read Balancing a model.

Ecopath parameterization

Once you have entered sufficient input parameters you can proceed to estimate the parameters of Ecopath by selecting *Basic estimates* under the *Parameterization node* in the *Navigator window*. The missing parameters will be estimated so that mass balance is achieved. The estimation is performed using a number of algorithms and a routine for matrix inversion described in the topic Mortality for a prey is consumption for a predator.

Once the program has estimated the parameters, the system balances the input and output of each group, using respiration for adjustments. The relationship used is:

Consumption = Production + Respiration + Non-assimilated food

where, Consumption is the total consumption of a group, i.e., biomass · (consumption / biomass);

Production excludes primary production, i.e., is defined by biomass · (production / biomass) · (1 - PP),

where PP is the proportion of total production that can be attributed to primary production (thus (1 - PP) = 0 in plants, 1 in heterotrophic consumers, and intermediate in e.g., corals or tridacnid clams);

Respiration is the part of the consumption that is not used for production or recycled as feces or urine. Respiration is nonusable currency, i.e., it cannot be used by the other groups in the system. Autotrophs with *Q/B* = 0 and detritus have zero respiration;

Nonassimilated food is an input parameter expressing the fraction of food that is not assimilated, (i.e., is egested or excreted). For models whose currency is energy, the default is 0.20, i.e. 20% of consumption for all groups, though this is most applicable for finfish groups (Winberg, 1956). The non-assimilated food is directed to the detritus.

If the model currency is a nutrient, there is no respiration. Instead, the model is balanced such that the non-assimilated food equals the difference between consumption and production.

Parameter evaluation

The program estimates the missing parameters and a number of indices without further input. Your model will probably not look very convincing the first time you run it. Keep an eye open for warning messages while you make your way through the forms. In the more serious cases, the parameter estimation will be aborted, and you will have to edit your data. To improve your chances of identifying problems, you will in some cases only get a warning and the program will continue.

Note: Warnings are displayed in the *Status panel*.

The sections below may help you evaluate the results of a run.

Are the EE's between 0 and 1?

When examining the output of a run, the first and perhaps most important items to consider are the ecotrophic efficiencies (which are usually calculated). The values should be between 0 and 1 (inclusive). Here, a value of zero indicates that any other group does not consume the group in the system, and neither is it exported. Conversely, a value near or equal to 1 indicates that the group is being heavily preyed upon or grazed and/or that fishing pressure is high, leaving no individuals to die of old age. The whole range of ecotrophic efficiencies can be found in nature. However, a generalization has emerged from previous modelling: for most groups, the *EE* should be close to one, the exceptions being top predators and primary producers.

If, in a first run, any of the *EE* values are larger than 1, something is wrong: it is not possible for more of something to be eaten and/or caught than is produced. The problem can of course be due to the equilibrium assumption not being met, e.g., when the model includes a new fishery on a previously unexploited stock. Unless this is known to be the case, you should have a closer look at the input parameters.

It may be worthwhile to check the food consumption of the predators, and the production estimates of the group. Compare the food intake of the predators with the production of their prey. Most often, the diet compositions will have to be changed - often the diets are more 'pointers' to, than reliable estimates of the real values.

Often 'cannibalism' in the sense of within-group predation causes problems. If a group contributes 10% or more to its own diet, this alone may result in consumption being higher than the production of the group. The solution to this is to split the group into juveniles and adults, with the adults acting as predator on the juveniles. The juveniles must then have a higher production rate than the adults, as production is almost always inversely related to size. Splitting groups into juveniles and adults is also useful for the Ecosim discussed later.

It is advisable to make one change at the time when editing input parameters. Make that one change, rerun the Basic estimates routine, re-examine the run, and if necessary re-edit the data, etc. Continue with one change at a time until you get a run you consider acceptable. Make sure, through the entry of remarks in the Remarks window, to record en route what you do and why.

Ecotrophic efficiency of detritus

The ecotrophic efficiency, *EE*, of a detritus group is defined as the ratio between what flows out of that group and what flows into it. Under steady-state assumption, this ratio should be equal to 1.

The fate of the detritus (DF) can be entered (Detritus fate form). If all detritus from a detritus group is directed to other detritus boxes the EE of the group will be 1.

Estimates of *EE* of less than 1 indicate that more is entering a detritus group than is leaving it.

Estimates of *EE* of more than 1 for a detritus group also require attention. They indicate that the primary production and/or the inputs to the lower parts of the food web are too small to support consumption from that group. It will be necessary to examine the basic inputs that define production and consumption of the lower parts of the food web closely, and to examine whether more detritus should be directed to the detritus group.

Of importance for the flow to detritus is the parameter for non-assimilated food. The default value of 0.2 often underestimates egestion, especially for herbivores and detritivores. For instance that a value of 0.4 for zooplankton often leads to more reasonable respiration/biomass ratios than 0.2. Higher parameter values means that a greater flow is directed to detritus and less to respiration for a given group.

Are the 'efficiencies' possible?

Recall that the gross food conversion efficiency, *GE*, is defined as the ratio between production and consumption. In most cases, production/consumption ratios will range from 0.1 to 0.3, but exceptions may occur, (e.g., bacteria, nauplii, fish larvae and other small, fast-growing organisms). If the *GE* values are unrealistic, check the input parameters, especially for groups whose production has been estimated. In such cases, carefully editing the diet composition of the predators of the problem groups will generally help.