

## **EwE 6.5 release notes**

July 2016

EwE 6.5 contains a number of important changes. For a full list please refer to the [EwE change log](#). For a list of known issues with the software please refer to the [EwE ticket list](#).

### **Changes that will influence model results**

Per EwE 6.5, the Ecosim Sum of Squares will be computed differently for catch time series (types -6 and 6). These time series were incorrectly scaled in the computation of SS. The bug fix will affect the Sum of Squares computed for existing models with applied catch time series.

### **New capabilities**

A few major new features in EwE 6.5 are:

#### **Ecobase integration**

Users can now directly connect to the Ecobase model repository to download and upload their models. Access this functionality via Menu > File > Import and Menu > File > Export.

#### **Functional responses in Ecosim**

Ecosim can include any number of environmental driver + function response configurations similar to Ecospace. Whereas the Ecospace habitat foraging capacity uses maps as drivers to vary the foraging arena size per cell, the Ecosim environmental forcing system is driven by forcing functions to vary the search rate parameter in the foraging arena equations.

Earlier Ecosim scenarios with functional responses should produce similar results. For this, functional responses previously defined (in Ecosim > Group Info) using the three parameters optimum, below and above tolerances are converted to unique response functions with a normal distribution. Note that functional response curves are defined only once in EwE and are shared between Ecosim and Ecospace. However, function responses applied to Ecosim will not carry over to Ecospace and vice-versa.

#### **Monte Carlo**

Monte Carlo can perturb landings, discards and diets. By default, Monte Carlo will vary the original parameter set (B, BA, PQ, QB and EE) and will thus behave prior to EwE 6.5. New in EwE 6.5 is the option to decide which parameters to vary in the Monte Carlo settings tab.

Landings and discards are varied through mean, upper and lower CV values per group, per fleet. Diets are sampled differently. The uncertainties in the diet compositions are specified using Dirichlet distributions. The Dirichlet distribution is appropriate because it is a multivariate distribution where each element is sampled on the [0,1] interval and together they sum to 1. Each predator has its own Dirichlet distribution parameterized using a vector, with K number of elements, equal to the number of groups that it preys upon. Each parameter is calculated as the expected (mean) proportion that a prey will make up of its diet, multiplied by a multiplier. Increasing the value of the multiplier serves to decrease the dispersion around the expected proportions.

Figure 1 shows plots of what the marginal probability densities (multidimensional probability distributions plotted along one dimension) would be for a predator with three prey A, B & C where the mean proportion for each prey respectively is 0.6, 0.3 and 0.1. The plots show how by increasing the multiplier  $\lambda$  the dispersion around the means can be decreased. To determine an appropriate  $\lambda$  for each predator it is best to plot the Dirichlet distributions in this way, viewing them to consider which  $\lambda$  provides the right amount of uncertainty across as many prey groups as is possible. Note that in the EwE Tools folder contains an R script that can be used to produce such plots. Formally the variance of each element of the dirichlet distribution is expressed as:

$$Var[X_i] = \frac{a_i(a_0 - a_i)}{a_0^2(a_0 + 1)}$$

where  $a_0 = \sum_{i=1}^K a_i$

Due to numerical issues when using the diet proportion values, any values that are sampled below 0.000001 are set to zero. This has little impact on the results.

### **Marine protected areas**

Marine Protected Areas can now overlap. This provides increased flexibility to explore different protection scenarios in the same area.

### **Migration**

Starting with EwE 6.5 the Ecospace migration system no longer uses a centroid + concentration approach. Instead, migration target areas are specified as monthly maps, where migration maps will need to be provided for every month for a migratory species. Non-zero map cell values are migration target cells.

The values entered into the monthly migration maps are a user-defined preferred migration cell direction weight. This allows the user to enter a weighting scheme for the preferred movement direction of a group within a migratory area. These migration map values only set the direction of the movement. A new dispersal parameter "Migration in-area movement" determines how much movement there is within a migration area in addition to movement caused by the habitat foraging capacity or habitat preferences. This setup allows creatures to concentrate into a portion of the migration area when the migration pattern isn't changing much from month to month.

The "Barrier avoidance weight" parameter that already existed in prior versions of Ecospace acts as a dispersal multiplier to movement outside a migration area, and determines the concentration of movement in the direction of the migration area for that month.

Note that the migration code should produce better movement patterns when Ecospace is ran in IBM (Individual Behaviour Model) mode that provides better accounting of biomass movement between cells.

### **Plug-ins**

Several plug-ins have been added, such as Stepwise fitting (Scott et al 2016, Software X), Ecological Indicators (in prep), and a World Register of Marine Species (WoRMS) taxonomic search engine.

### **Known issues**

The Ecospace Advection calculations do not work. Although users can enter mixed layer depth, wind and upwelling patterns, the calculations that should use these data to compute the Ecospace transport layers do not work. We hope to address this before the release of EwE 6.5. In the interim, users are able to sketch the transport layers in Ecospace > Input > Maps > Advection order to move advected groups.

The EwE user manual is severely outdated and does not cover many new features in EwE. We are planning to rewrite and restructure the EwE manual, starting early 2017, and release the updated material one chapter at the time.

### **Acknowledgements**

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Development of EwE is coordinated through Ecopath International Initiative Research Association (Spain).

## Appendix - Figures

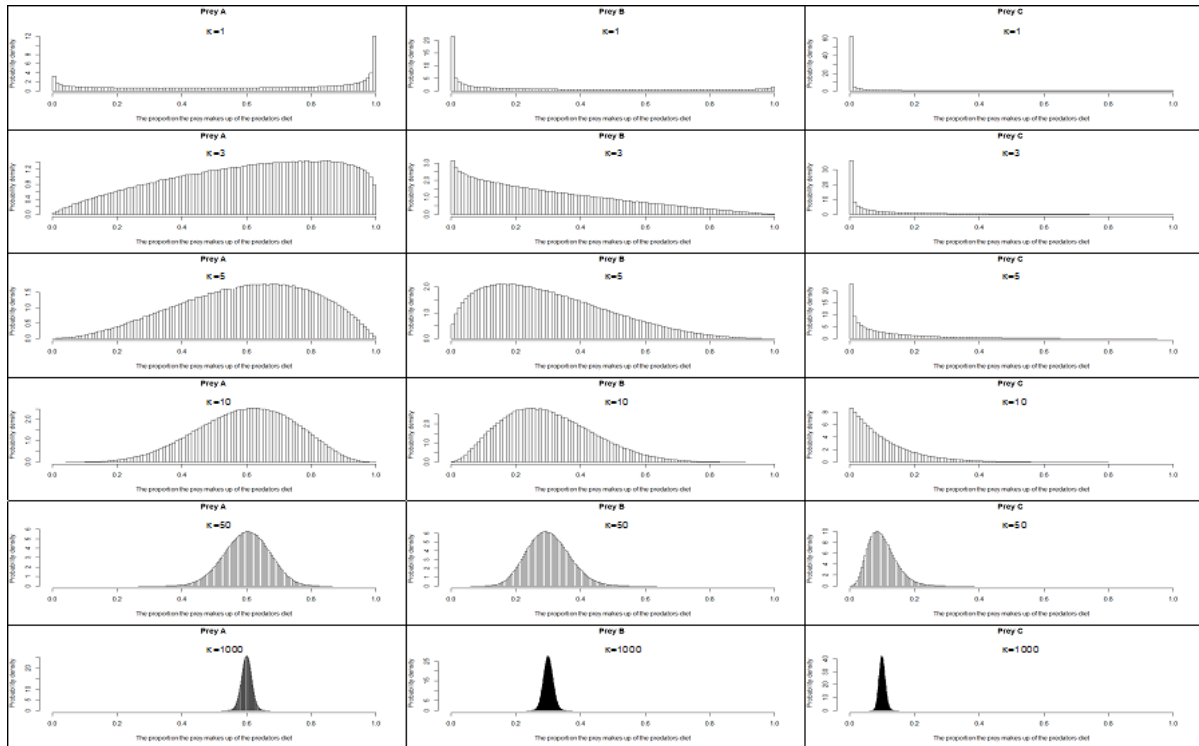


Figure 1 - Plots showing how the dispersion varies as the diet multiplier is varied.