7.6 Mortality coefficients

The *Mortality coefficients form* (Figure 7.1) is one of the most important forms on the *Parameterization menu* and it is, as a rule, the first one that should be checked when balancing a model.

This form gives the Ecopath-predicted values of each type of mortality for each group in the model (see below). During balancing, the *Mortality coefficients form* will guide you in identifying where problems are (e.g., if it's fishing or predation mortality that is too high). If predation mortality is too high, then you can use the Predation mortality form to identify which predators are causing the problem.

Components of mortality in Ecopath

Under equilibrium, each group can be represented by an average organism, with an average weight. This makes it possible to use equations for estimating mortality in numbers, even when dealing with biomass. One such equation is

$$N_t = N_0 \cdot e^{-Zt}$$ **Eq. 25**

where N_0 is a number of organism at time = 0; N_t is the number of survivors at time = *t*; and Z is the instantaneous rate of mortality.

Under the assumption that Z_i, the mortality of group *i*, is constant for the organisms included in i, it turns out that, for a large number of growth functions (including the von Bertalanffy Growth Function, or VBGF):

$$Z_i = (production / biomass)_i = P/B_i$$ **Eq. 26**

or instantaneous mortality equals total production over mean biomass (Allen, 1971).

The mortality coefficient can be split into its components following a procedure well known among fisheries biologists, i.e.,

$Z_i = P/B_i =$ Fishing mortality + Predation mortality + Biomass accumulation + Net migration + Other mortality

or

$$P/B_i = F_i + M2_i + BA_i + E_i + M0$$ **Eq. 27**

In some models, (e.g., the Multispecies Virtual Population Analysis model of the North Sea, Sparre, 1991), the 'other mortality' component is split between $M1_i$, i.e., predation by predators not included in the model, and $M0_i$, 'other mortality', caused by diseases, senescence, etc. In Ecopath, *M1* is not included, as all predation mortality should be described explicitly. Further, $M0_i$ is not entered directly, but is computed from the ecotrophic efficiency, EE_i, Thus:

F_i is the Fishing mortality coefficient;

$M2_i$ is the Predation mortality coefficient;

BA_i is the Biomass accumulation coefficient;

E_i is the Net migration coefficient (immigration less emigration).

$M0_i$ is the Other mortality coefficient.

Ecopath-predicted values for these coefficients are given on the *Mortality coefficients* form. The mortality coefficients are estimated from the following equations:

$Z_i = P/B_i$

$M2_i = (?B_i \cdot Q/B_i \cdot DC_{ji}) / B_i$

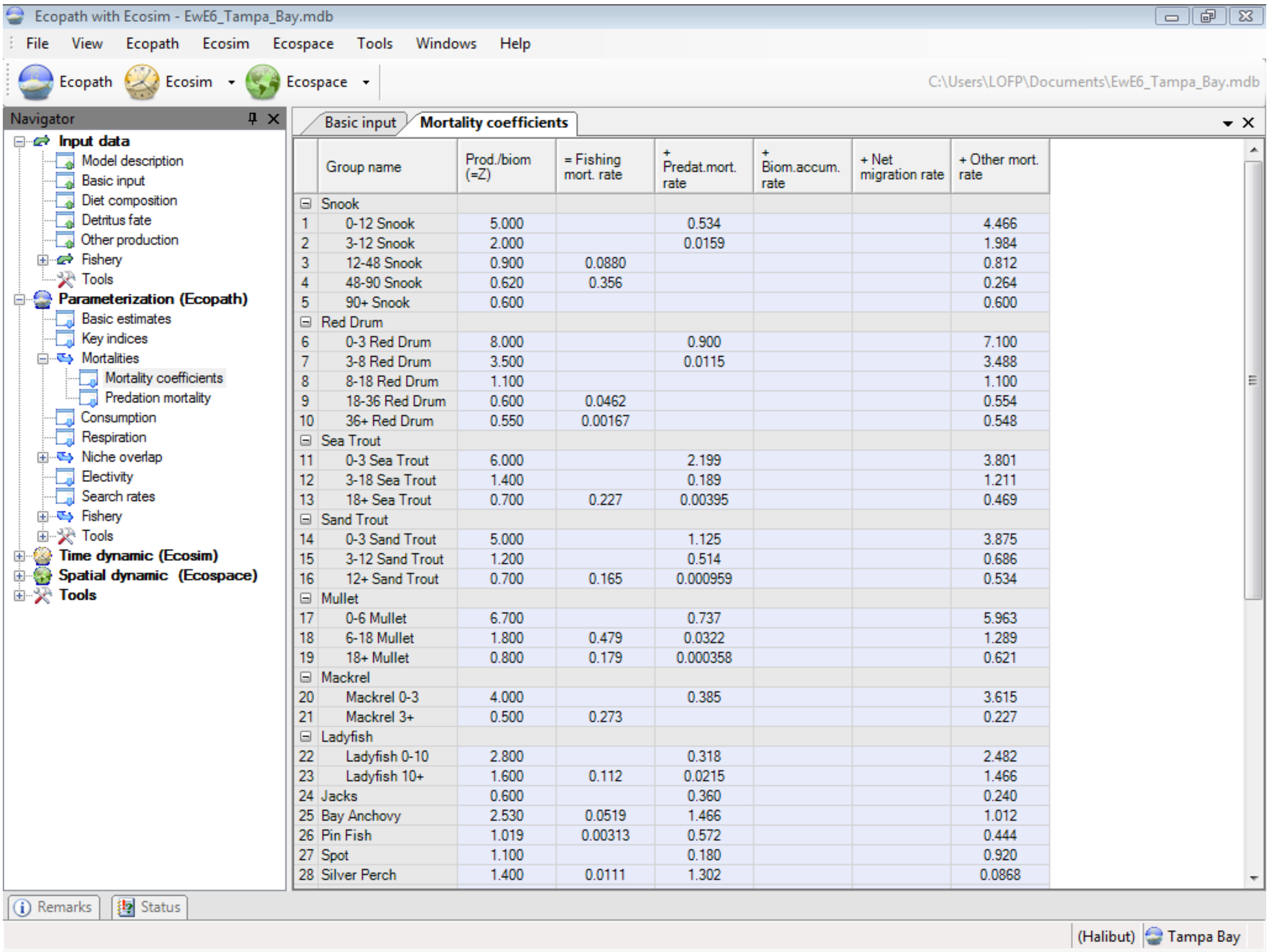
$F_i = Y/B_i$

$M0_i = (1-EE_i) \cdot P/B_i$

where Q/B_j is the consumption/biomass ratio of predator j; DC_{ji} is the proportion prey *i* constitutes to the diet of predator *j*, B_i is the average biomass of *i*, and C_i is the catch of *i*. The biomass accumulation term, BA_i, is a basic input term.

If any component of the system is harvested, a summary of the mortality coefficients can be displayed, which presents total mortality (*Z* = *P/B*) and its component: fishing mortality (*F*), other exports (*E*), other mortality (M_0), and predation mortality (*M2*). Predation mortality is further broken down to show the contribution of each consumer groups to the total predation mortality of each prey group.

See also introductory material on Production, Consumption, Dealing with open system problems and Other mortality.



	Group name	Prod./biom (=Z)	= Fishing mort. rate	+ Predat.mort. rate	+ Biom.accum. rate	+ Net migration rate	+ Other mort. rate
⊟	Snook						
1	0-12 Snook	5.000		0.534			4.466
2	3-12 Snook	2.000		0.0159			1.984
3	12-48 Snook	0.900	0.0880				0.812
4	48-90 Snook	0.620	0.356				0.264
5	90+ Snook	0.600					0.600
⊟	Red Drum						
6	0-3 Red Drum	8.000		0.900			7.100
7	3-8 Red Drum	3.500		0.0115			3.488
8	8-18 Red Drum	1.100					1.100
9	18-36 Red Drum	0.600	0.0462				0.554
10	36+ Red Drum	0.550	0.00167				0.548
⊟	Sea Trout						
11	0-3 Sea Trout	6.000		2.199			3.801
12	3-18 Sea Trout	1.400		0.189			1.211
13	18+ Sea Trout	0.700	0.227	0.00395			0.469
⊟	Sand Trout						
14	0-3 Sand Trout	5.000		1.125			3.875
15	3-12 Sand Trout	1.200		0.514			0.686
16	12+ Sand Trout	0.700	0.165	0.000959			0.534
⊟	Mullet						
17	0-6 Mullet	6.700		0.737			5.963
18	6-18 Mullet	1.800	0.479	0.0322			1.289
19	18+ Mullet	0.800	0.179	0.000358			0.621
⊟	Mackrel						
20	Mackrel 0-3	4.000		0.385			3.615
21	Mackrel 3+	0.500	0.273				0.227
⊟	Ladyfish						
22	Ladyfish 0-10	2.800		0.318			2.482
23	Ladyfish 10+	1.600	0.112	0.0215			1.466
24	Jacks	0.600		0.360			0.240
25	Bay Anchovy	2.530	0.0519	1.466			1.012
26	Pin Fish	1.019	0.00313	0.572			0.444
27	Spot	1.100		0.180			0.920
28	Silver Perch	1.400	0.0111	1.302			0.0868

Figure 7.1 Mortality rates. *Z* is total mortality; *F* is fishing mortality; *M0* other mortality; and *M2* predation mortality. *Z* = *P/B* = *F* + *E* + *M0* + *M2*.