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Table of Contents

8.4 Vulnerabilities (flow control: foraging arena parameter) 3

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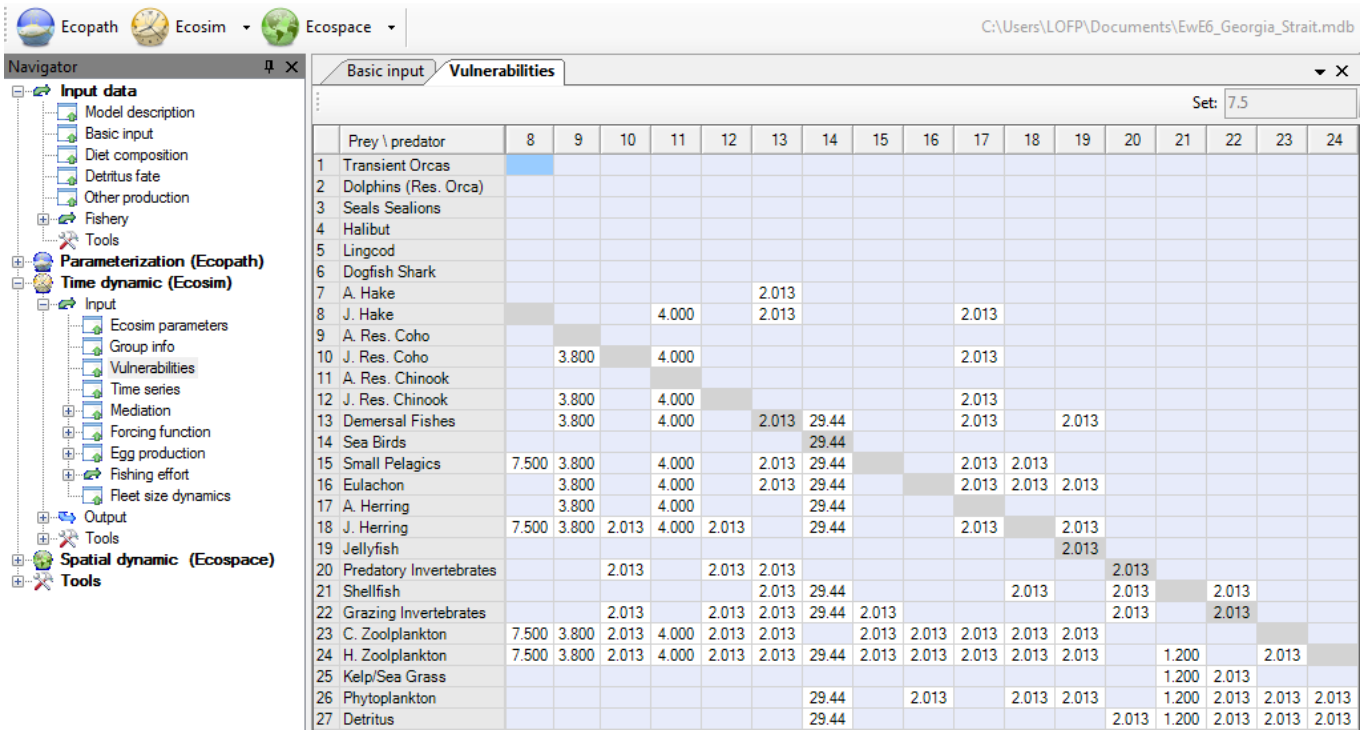
One of the most important features of Ecosim is its ability to allow exploring the implications on system dynamics of different views of how the biomass of different groups in the ecosystem is controlled. The two extreme views are ?predator? control? (also called top-down control) and ?prey control? (or bottom-up). We model this using ?vulnerabilities?, which represent the degree to which a large increase in predator biomass will cause in predation mortality for a given prey (see Vulnerabilities in Ecosim for details).

Low vulnerability (close to 1) means that an increase in predator biomass will not cause any noticeable increase in the predation mortality the predator may cause on the given prey. A high vulnerability, e.g., of 100, indicates that if the predator biomass is for instance doubled, it will cause close to a doubling in the predation mortality it causes for a given prey. The vulnerability parameters are among the most important parameters that can be changed to improve the agreement of the model?s predictions with historical data (see Time series fitting in Ecosim, Hints for fitting models to time series reference data and Effect of P/B (Z) and vulnerability for time series fitting). See also Fit to time series.

Vulnerabilities are entered on (or transferred from the time series fitting routine to) the *Vulnerabilities* form (*Time dynamic (Ecosim)* > *Input* > *Vulnerabilities*; see Figure 8.3). You must already have an Ecosim scenario loaded (see Ecosim menu?) before you can set vulnerabilities. You must set the vulnerabilities for each new scenario, as all new scenarios have a default setting of 2.0. Note that the default value of 2.0 is arbitrarily assigned. Choosing to keep the default values is as much a decision as setting them to a new value. See Vulnerabilities in Ecosim? for further scientific guidance on setting vulnerabilites.

Vulnerabilities can be set for the entire system (using the *Set* box in the upper right corner of the form). In general, because the vulnerability settings concern foraging behaviour, the same vulnerability is set for all of the prey of a certain predator (i.e., vulnerabilities are set column-wise). Individual values can be entered to characterize, e.g., the interactions of one (or several) predator/prey pair(s) under special conditions. We caution against setting different vulnerability parameters for every predator-prey interaction. While doing so may provide a better statistical fit to the time series data, it is unlikely that there is enough information in the data to distinguish among different parameter-combinations: i.e., the model will be overparameterized.

To transfer a set of vulnerabilities to a new scenario, use the *Save scenario as* option on the Ecosim menu to save an existing scenario and its associated vulnerabilities under a new name. Alternatively, use different scenarios to test for sensitivity to different sets of vulnerability values.



	Prey \ predator	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	Transient Orcas																	
2	Dolphins (Res. Orca)																	
3	Seals Sealions																	
4	Halibut																	
5	Lingcod																	
6	Dogfish Shark																	
7	A. Hake						2.013											
8	J. Hake				4.000		2.013				2.013							
9	A. Res. Coho																	
10	J. Res. Coho		3.800		4.000						2.013							
11	A. Res. Chinook																	
12	J. Res. Chinook		3.800		4.000						2.013							
13	Demersal Fishes		3.800		4.000		2.013	29.44			2.013		2.013					
14	Sea Birds							29.44										
15	Small Pelagics	7.500	3.800		4.000		2.013	29.44			2.013	2.013						
16	Eulachon		3.800		4.000		2.013	29.44			2.013	2.013	2.013					
17	A. Herring		3.800		4.000			29.44										
18	J. Herring	7.500	3.800	2.013	4.000	2.013		29.44			2.013		2.013					
19	Jellyfish												2.013					
20	Predatory Invertebrates			2.013		2.013	2.013							2.013				
21	Shellfish						2.013	29.44				2.013		2.013		2.013		
22	Grazing Invertebrates			2.013		2.013	2.013	29.44	2.013					2.013		2.013		
23	C. Zoolplankton	7.500	3.800	2.013	4.000	2.013	2.013		2.013	2.013	2.013	2.013	2.013					
24	H. Zoolplankton	7.500	3.800	2.013	4.000	2.013	2.013	29.44	2.013	2.013	2.013	2.013	2.013		1.200		2.013	
25	Kelp/Sea Grass														1.200	2.013		
26	Phytoplankton							29.44		2.013		2.013	2.013		1.200	2.013	2.013	2.013
27	Detritus							29.44						2.013	1.200	2.013	2.013	2.013

Figure 8.3 Ecosim vulnerability settings reflecting how far a consumer is from its carrying capacity with regards to a prey.