Matlab code used in Ávila-Thieme et al 2021. M. Isidora Ávila-Thieme ([isidora.avila.thieme@gmail.com](mailto:isidora.avila.thieme@gmail.com)) & Fernanda S. Valdovinos ([fvaldovinos@ucdavis.edu](mailto:fvaldovinos@ucdavis.edu)). Example code used in the fisheries and plankton subsidy simulations.

1. Food web and parameter values data.

In the working directory of MATLAB there is a folder called “Data”. Into that folder there is a matlab data file called “ChileanIntertidal\_ECIMBiomass”, which contains the foodweb and the values of all the input parameters of the ATN model.

2. Running the code and output

Simulations are run and output is produced using the “webdriver\_…” command (what comes after “...” what comes after "..." depends on the scenario that the code is going to simulate, see point 4). All other Matlab scripts will be called automatically if everything is properly loaded into the same data folder.

To all “webdriver\_…” command, the output is a matrix of time series of each species’ biomass, which is automatically saved in the directory folder.

3. Defining the time steps and the system carrying capacity

Into each “webdriver\_…” command tspan defines the time steps of the model and Data.K.mean the system carrying capacity. In our example code the defined values are those used in Ávila-Thieme et al. 2021.

4. webdriver command description

There are three “webdriver\_…” command.

* “webdriver\_FISHERIES\_50\_80\_100” to simulate the fishing scenarios only. It begins by simulating a scenario without fishery and then continue simulating the three fishing scenarios described in Ávila-Thieme et al. 2021.
* “webdriver\_Subsidy” to simulate the disturbance scenarios in the plankton subsidy only. It begins by simulating a scenario without perturbation and continues simulating the six subsidy scenarios described in Ávila-Thieme et al. 2021.
* “webdriver\_F\_and\_S\_Both\_50\_80\_100” to simulate fishery scenarios and plankton subsidy changes simultaneously. The script is written to run the six subsidy scenarios described in Ávila-Thieme et al. 2021 in combination with a single fishing scenario. By default, the simulated fishing scenario decreases the biomass of all harvested species by 50%. To modify the code and simulate the other fishing scenarios, see point 5. “webdriver\_F\_and\_S\_Both\_50\_80\_100” command requires the output of without perturbation scenario (called “Before”) to be in the directory folder of MATLAB. “Before” file is automatically saved in the directory folder when any previous “webdriver\_…” command was run.

5. Modifying the code to simulate other fishing scenarios of “webdriver\_F\_and\_S\_Both\_50\_80\_100”.

In all “webdriver\_…” command, the ATN model and the fishing and subsidy scenarios are into the “atn\_ode\_biomass\_catch\_gainfish\_gain\_loss\_fast…” function (what comes after "..." depends on the scenario that the code is going to simulate).

Here it is specified which scenarios each function simulates. It also explains how to modify the fishing scenarios in the functions associated with the “webdriver\_F\_and\_S\_Both\_50\_80\_100”.

* **“atn\_ode\_biomass\_catch\_gainfish\_gain\_loss\_fast”** is the function that simulates a scenario without perturbation (fishing or subsidy)
* **“atn\_ode\_biomass\_catch\_gainfish\_gain\_loss\_fast\_H50”** is the function that simulates a 50% decrease of harvested species biomass by fishing
* **“atn\_ode\_biomass\_catch\_gainfish\_gain\_loss\_fast\_H80”** is the function that simulates a 80% decrease of harvested species biomass by fishing
* **“atn\_ode\_biomass\_catch\_gainfish\_gain\_loss\_fast\_H100”** is the function that simulates a 100% decrease of harvested species biomass by fishing
* **“atn\_ode\_biomass\_catch\_gainfish\_gain\_loss\_fast\_D50”** is the function that simulates a depletion of plankton subsidy by 50%.
* **“atn\_ode\_biomass\_catch\_gainfish\_gain\_loss\_fast\_D80”** is the function that simulates a depletion of plankton subsidy by 80%.
* **“atn\_ode\_biomass\_catch\_gainfish\_gain\_loss\_fast\_D100”** is the function that simulates a depletion of plankton subsidy by 100%.
* **“atn\_ode\_biomass\_catch\_gainfish\_gain\_loss\_fast\_E50”** is the function that simulates an enrichment of plankton subsidy by 50%.
* **“atn\_ode\_biomass\_catch\_gainfish\_gain\_loss\_fast\_E80”** is the function that simulates an enrichment of plankton subsidy by 80%.
* **“atn\_ode\_biomass\_catch\_gainfish\_gain\_loss\_fast\_E100”** is the function that simulates an enrichment of plankton subsidy by 100%.
* **“atn\_ode\_biomass\_catch\_gainfish\_gain\_loss\_fast\_HSd50”** is the function that simultaneously simulates the decrease of harvested species biomass by X% and the depletion of plankton subsidy by 50%. By default, this function simulates a 50% decrease of harvested species biomass by fishing. To simulate different fishing intensities, the proportion of biomass to remove by fishing should be modified in “ProducerFisheries” (the default value is 0.125), “Hconsumers” (the default value is 10), and “HfilandHerb” (the default value is 23) to macroalgae harvested species, consumers harvested species and filter and herbivores harvested species.
* **“atn\_ode\_biomass\_catch\_gainfish\_gain\_loss\_fast\_HSd80”** is the function that simultaneously simulates the decrease of harvested species biomass by X% and the depletion of plankton subsidy by 80%. By default, this function simulates a 50% decrease of harvested species biomass by fishing. To simulate different fishing intensities, follow the steps described in “atn\_ode\_biomass\_catch\_gainfish\_gain\_loss\_fast\_HSd50” function above.
* **“atn\_ode\_biomass\_catch\_gainfish\_gain\_loss\_fast\_HSd100”** is the function that simultaneously simulates the decrease of harvested species biomass by X% and the depletion of plankton subsidy by 100%. By default, this function simulates a 50% decrease of harvested species biomass by fishing. To simulate different fishing intensities, follow the steps described in “atn\_ode\_biomass\_catch\_gainfish\_gain\_loss\_fast\_HSd50” function above.
* **“atn\_ode\_biomass\_catch\_gainfish\_gain\_loss\_fast\_HSe50”** is the function that simultaneously simulates the decrease of harvested species biomass by X% and the enrichment of plankton subsidy by 50%. By default, this function simulates a 50% decrease of harvested species biomass by fishing. To simulate different fishing intensities, follow the steps described in “atn\_ode\_biomass\_catch\_gainfish\_gain\_loss\_fast\_HSd50” function above.
* **“atn\_ode\_biomass\_catch\_gainfish\_gain\_loss\_fast\_HSe80”** is the function that simultaneously simulates the decrease of harvested species biomass by X% and the enrichment of plankton subsidy by 80%. By default, this function simulates a 50% decrease of harvested species biomass by fishing. To simulate different fishing intensities, follow the steps described in “atn\_ode\_biomass\_catch\_gainfish\_gain\_loss\_fast\_HSd50” function above.
* **“atn\_ode\_biomass\_catch\_gainfish\_gain\_loss\_fast\_HSe100”** is the function that simultaneously simulates the decrease of harvested species biomass by X% and the enrichment of plankton subsidy by 100%. By default, this function simulates a 50% decrease of harvested species biomass by fishing. To simulate different fishing intensities, follow the steps described in “atn\_ode\_biomass\_catch\_gainfish\_gain\_loss\_fast\_HSd50” function above.