Indicative solution of the NE Bluefin Tuna case (EN)

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This deals with the overfishing of North-Eastern bluefin tuna and the (in)effectiveness of ICCAT policies. It should be noted that the current version of the case/model is just illustrative/educational: data and policies in the case/model are fictitious. This case is partly inspired / based on (Dudley 2008) and the Fishbanks Game.

First, student are asked to make a SFD of a partial model description (green variables in Figure 1(a)) and to write down the corresponding balance equation (as in Figure 1(b)). They also need to simulate this partial model for different values for the total number of ships (see Figure 2(a)).

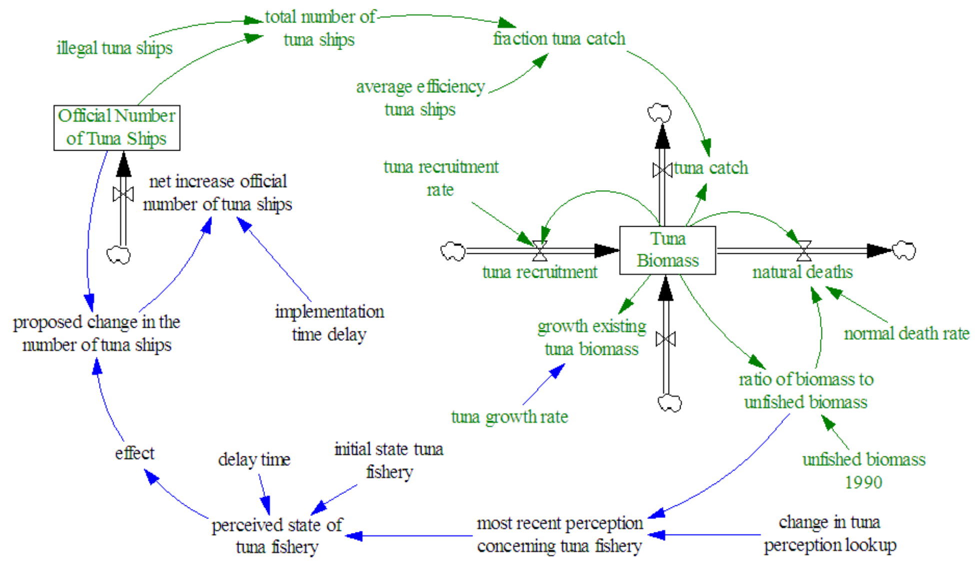
After extending the model (to all variables in Figure 1(a)), students need to simulate the model (Figures 3(a) and (b)), validate it, and test the sensitivity (Figures 3(c) to 3(f)). Their conclusion should be that the model is mainly numerically sensitive to parameter changes – even to a 10% change in the 'effect' lookup – but not behaviourally sensitive.

After realizing that these cases are insufficient – to say the least – students are asked to test whether the 'current policy' would be suffice if the number of *illegal tuna ships* would drop – through strict controlling and sanctioning– from 10000 to 0 in the year 2010: the blue curves in Figures 3(g) and 3(h) show that tuna biomass would take a very long time to recover to about 50% of the initial value and that –following the policy– the official fleets should remain close to zero for a very long time. A second what-if test –what if countries are unwilling to reduce their fleets– leads to even more disastrous consequences (green curves in Figures 3(a) and 3(b)).

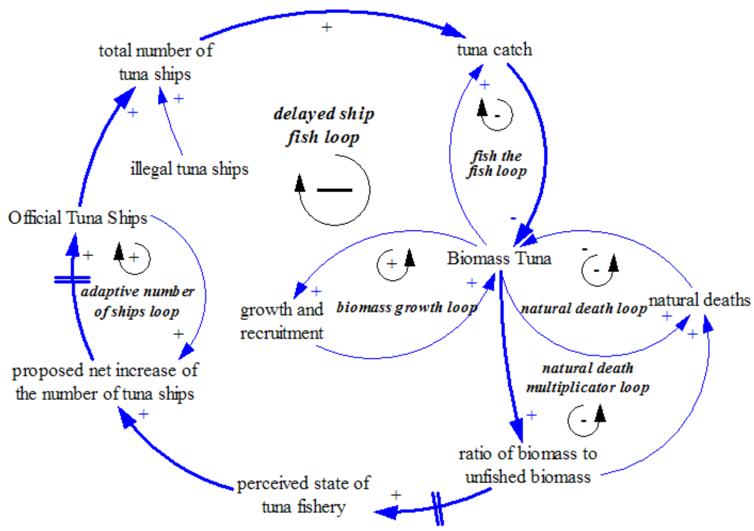
Students are asked to make a *causal loop diagram* that can be used to explain the link between structure and behavior to fishermen and policy makers alike: Figure 1(c) would be a rather detailed CLD for doing so. Finally, students are asked to design 2 policy measures that improve the sustainability of the ICCAT policy modeled before. Two final bonus questions aim at challenging excellent students.

References

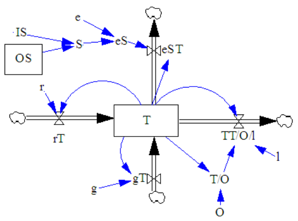
Dudley, R. (2008). A basis for understanding fishery management dynamics. *System Dynamics Review 24*, 129. doi: 10.1002/sdr.392. 1



(a) Stock flow diagram of NBF Tuna



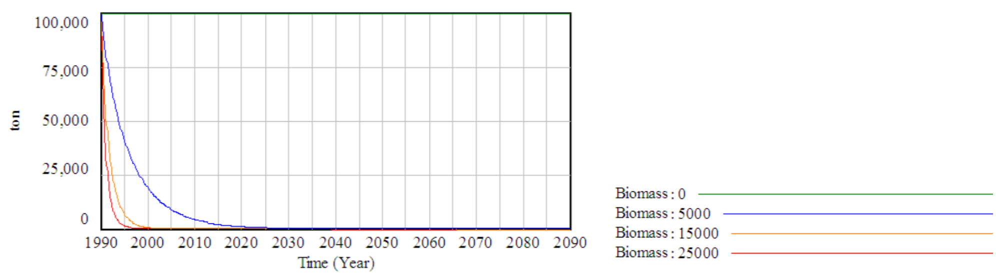
$$\frac{dT}{dt} = (r + g - eS - \frac{T}{O}/l) * T$$



(b) Balance equation

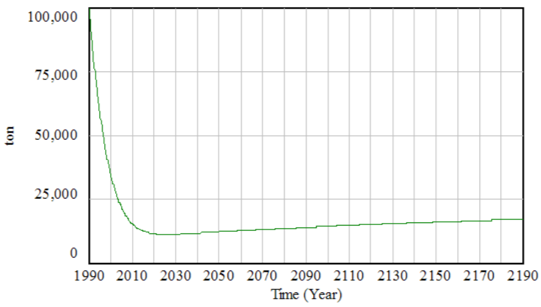
(c) Balance equation

Figure 1: Balance equation and SFD (green variables ∼ balance equation) of the NBF Tuna case

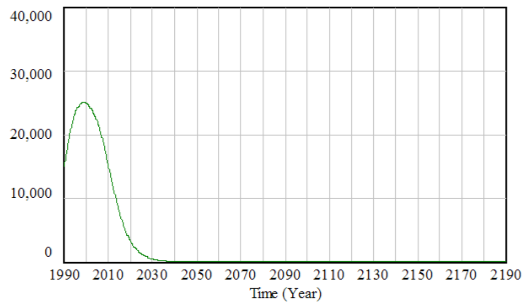


(a) Tuna biomass for 0, 5000, 15000, 25000 tuna fishing boats

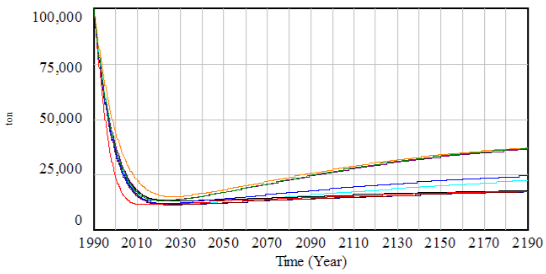
Figure 2: Partial model behavior for different numbers of tuna ships



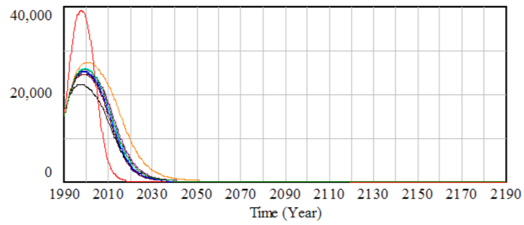
(a) Tuna biomass (base case)



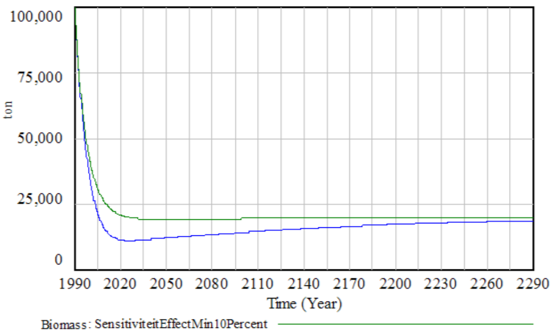
(b) Official tuna fishing boats (base case)



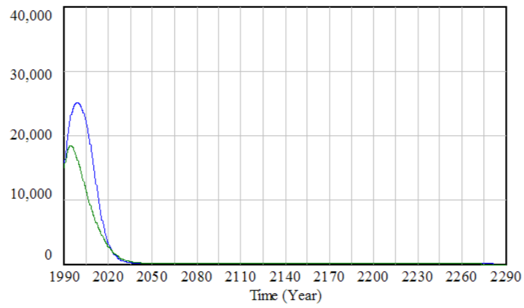
(c) Tuna biomass (parameter sensitivity)



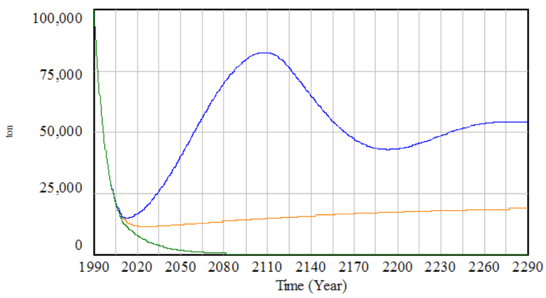
(d) Official tuna fishing boats (parameter sensitivity)



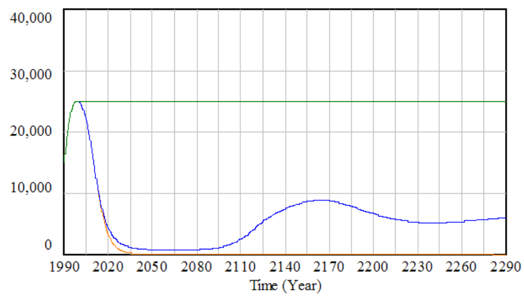
(e) Tuna biomass (lookup sensitivity)



(f) Official tuna fishing boats (lookup sensitivity)



(g) Tuna Biomass



(h) Official number of Tuna Ships

Figure 3: Base case behavior of the NBF Tuna model (a and b), parameter sensitivity (c and d), 'effect' lookup sensitivity (e and f), and what-if behavior (g and h) for the base case (orange), the base case without illegal fishing (blue), and the base case without downsizing of official fleets (green)