Encyclopédie de l'environnement

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Mathematical models can help to better manage fishing

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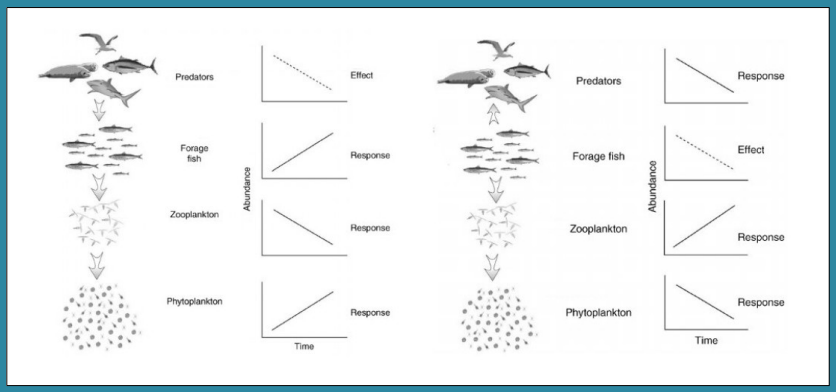
1. What issues do you associate with fishing? What elements should you keep in mind while working on the subject?

2. What would you do as a mathematician to help better manage fishing?

3. Which parameters should be taken into account?

1. Trophic interactions within marine ecosystems

4. Study the first two figures and draw a conclusion regarding a structuring element of marine ecosystems.



2. Basis of the fishing economy

5. Fill in the sentence with the following words:

level of abundance / cost / extinction / decreases / increases / exploitation / exploitation / species

In theory, the ..... of a ..... can lead to its ..... if its price ..... faster than the ..... of its ..... when the ..... .

3. A simple mathematical model of the evolution of the biomass of an exploited species

The management of marine resources must be based on decision-making tools that enable managers and decision-makers to take measures for the conservation and optimal exploitation of fisheries. Mathematical modelling makes it possible to develop such tools in order to predict the effects of coastal development and fisheries control measures. Mathematical models in fisheries are based on assumptions about the production and extinction mechanisms of harvested species.

6. Pay attention to the following mathematical model.

a. Identify the left member of the equation, as well as the two terms of the right-hand side of the equation.

b. Match the parameters (r, K, q, E), that are constants, with the elements they represent.

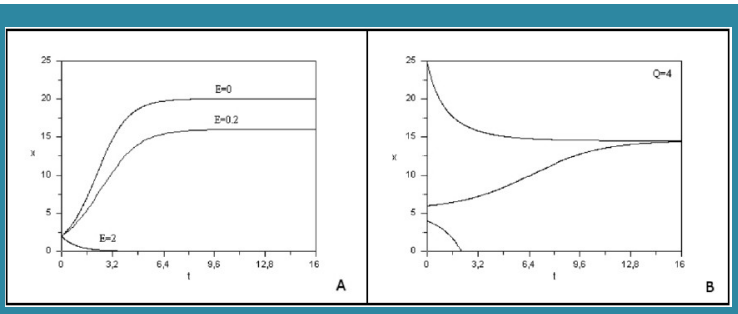
$$\frac{dx}{dt} = rx\left(1 - \frac{x}{K}\right) - qxE$$

r	Equilibrium biomass towards which the stock would tend in the absence of fishing.
K	Investment in fishing.
q	Catchability.
E	Rate of growth of the fish population.

7. Another method of exploitation is to set a fishing quota per unit of time. The previous model, assuming a catch with constant quota represented by parameter Q, is thus altered.

Looking at the figures below, would you advise unconstrained fishery or fixed quota fishery?

$$\frac{dx}{dt} = rx\left(1 - \frac{x}{K}\right) - Q$$

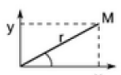
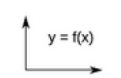
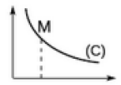
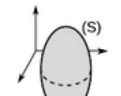


4. Taking economic aspects into account: bio-economic models

To go further, read the full article.

x, p	inconnue, paramètre ⇔ *unknown, parameter*
f(x) = p	équation ⇔ *equation*
f(x), p	[1er, 2e] membre de l'équation ⇔ *[1st, 2nd] member/side of the equation*
f(x) = 0 g(x, y) = 0	équation à [1 inconnue, 2 inconnues] ⇔ *equation in [1 unknown, 2 unknowns]*
types de fonctions ⇔ *types of functions*	
y = f(x)	fonction [explicite, implicite] ⇔ *[explicit, implicit] function*
f(x,y) = 0	(oralement) *f* de *x* [et y] ⇔ *(orally)* f *of* x *[and* y*]*
y = f(x) z = g(x,y)	fonction [d'une seule, de plusieurs] variable[s] ⇔ *function of [a single, several] variable[s]*
lien entre *x* et *y* ⇔ *link between* x *and* y	
y = f(x)	*y* est [une] fonction de *x* ⇔ y *is a function of* x *y* varie en fonction de *x* ⇔ y *varies as a function of* x *y* dépend de *x* ⇔ y *depends on/upon* x *y* est relié à *x* ⇔ y *is related with/to* x *x* et *y* sont reliés l'un à l'autre ⇔ x *and* y *are interrelated* relation biunivoque, corrélation ⇔ *one-to-one relation, correlation*
x ↗↘ ⇓ y ↗↘	faire varier *x* ⇔ *to make* x *vary (or) to vary* x [quand on fait varier *x*, en faisant varier *x*] on fait varier *y* ⇔ *[when* x *is varied, by varying* x*]* y *is made to vary* la variation de *x* [fait varier *y* , provoque la variation de *y*] ⇔ *the variation of* x *[makes* y *vary, causes* y *to vary]*

Vocabulary: *Do you Speak Science?*

	coordonnées ⇔ *coordinates//co-ordinates* cartésiennes, polaires, cylindriques, sphériques ⇔ *Cartesian, polar, cylindrical, spherical* *M* a pour coordonnées *x, y, z* ⇔ M *has coordinates* x, y, z *x* = abscisse ⇔ x-*coordinate (or) abscissa* *y* = ordonnée ⇔ y-*coordinate (or) ordinate* *z* = cote ⇔ z-*coordinate*
	porter *y* en fonction de *x* ⇔ *to plot* y vs. x *(ab. of "versus")* report de données ⇔ *data plot* report en coordonnées [*x-y*, logarithmiques] ⇔ x-y *plot, log-log plot*
	*(C)* a pour équation *y = f(x)* ⇔ (C) *has equation* y = f(x) *y = f(x)* est l'équation de *(C)* ⇔ y = f(x) *is the equation for* (C) *M* = point courant ⇔ *general point* faire une représentation graphique de l'équation *y = f(x)* ⇔ *to graph the equation* y = f(x)
	la courbe *(C)*, la surface *(S)* ⇔ *[the] curve* (C), *[the] surface* (S) *(C), (S)* = graphes des fonctions *y = f(x), z = g(x,y)* ⇔ *graphs of the functions* y = f(x), z = g(x,y) [courbe, surface] représentative ⇔ *[2D, 3D] graph*
y′ = dy/dx	dérivée de *y* par rapport à *x* ⇔ *derivative of* y *with respect to* x (ab.) *y* prime = *dy* sur *dx* ⇔ *(ab.)* y *prime* = dy *by* dx *(or)* dy *over* dx *(or)* dy dx