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SEALIFEBASE AS A SUPPORT SYSTEM FOR MODELLING MARINE ECOSYSTEMS

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Many models of marine ecosystems have been, and continue to be, published which are based on detailed representations of the upper trophic levels of the ecosystem in question (composed mainly of fishes, seabirds and marine mammals), but which include only rudimentary representations of the planktonic and benthic primary consumers, often pooled into boxes labeled 'zooplankton' and 'zoobenthos', respectively. One reason for this (beyond the obvious reason that these models are being constructed mainly by fisheries scientists), which has a strong, deleterious effect on the dynamic properties of the ecosystem models thus constructed, is that information on body sizes, feeding habits, predators and population dynamics (growth, natural mortality) of the species which make up invertebrates benthos and zooplankton in different parts of the world are not readily available (at least not as for fish, for which FishBase can export the parameters required for model construction; see www.fishbase.org).

This presentation will focus on the main features of an online database called SeaLifeBase (www.sealifebase.org), which is meant to address this issue, and accelerate the construction of models of marine ecosystems, and hence the transition to ecosystem-based management. SeaLifeBase makes full use of the products of a vibrant community of experts in taxonomy and bio-informatics, who have standardized the scientific names and classification of essentially all metazoan marine biota (200,000 + spp). Thus, SeaLfeBase can provide species lists for the Exclusive Economic Zone of each maritime country, and for each of 66 large marine ecosystems, to which are attached, so far they are available, key parameters needed by ecosystem models. Some applications are presented, with emphasis on generalizations that can be drawn from the database as it now stands.

References

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ECOTROPH: MODELING MARINE ECOSYSTEM FUNCTIONING AND IMPACT OF FISHING

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EcoTroph is an approach for analysis and simulation of trophic functioning of marine ecosystems, incorporating both ecological and fisheries concern. The model considers biomass distribution across the ecosystem biomass centred on the trophic level (TL) concept. Biomass moves from lower to higher trophic levels because of predation and ontogenetic processes. At the particle level, the process is characterized by abrupt jumps from one TL to the upper one, caused by predation. We explain why this process has to be regarded as a continuous process, when overall biomass flow is considered. Thus, the trophic flow may be regarded as a debit (expressed in $t \cdot year^{-1}$), which passes through each trophic level; it is also characterised by kinetics that quantifies the velocity of biomass transfers towards top predators (in $TL \cdot year^{-1}$). As a consequence, the ecosystem biomass present at a given trophic level may be estimated from two simple equations; one regards the biomass flow, and the other related to the flow kinetics.

Analogy of such an approach with the well-known Ecopath model allows us to consider the production/biomass ratio (P/B) as a measure of the flow kinetics and to use a mean empirical model expressing the trophic flow kinetics as a function of both the trophic level and the mean water temperature. Additionally, the flow kinetic of preys partly depends on the abundance of their predators and an equation related to this top-down effect has to be considered in the model. Based on these relationships, we simulate fishing impact on a virtual ecosystem, according to various exploitation patterns. We especially show that the EcoTroph approach is able to reconstruct the theoretical effects of increased fishing effort on ecosystem biomass and on its food web distribution. The model illustrates complex patterns such as cascade effects, earlier overexploitation of top predators, and 'fishing down the food web'. It provides diagnostic tools regarding generic relationships between catch and fishing effort at the ecosystem scale. It also highlights the effects of strong top-down controls and fast flow kinetics on ecosystems resilience.

Finally, complementarities between the EcoTroph and Ecopath approaches are illustrated, showing how they can be applied to a case study. Both approaches rely on the same trophic processes. Ecopath thus provides a demonstrative and comprehensive understanding of relationships between ecological groups, while EcoTroph is as a synthetic, more theoretical approach for a heuristic examination of the ecosystem state and of fishing impact. It therefore appears as a useful tool for further model development.