Gascuel D., Christensen V., Pauly D. 2007. EcoTroph: modelling marine ecosystem functioning and impact of fishing. Abstract, 6th European Conference on Ecological Modelling - ECEM'07. Trieste, Italy, November 27-30, 2007, p. 179.

The 6th European Conference on Ecological Modelling

ECEM '07

ISEM-EU

Trieste

November 27-30, 2007

Conference proceedings

Challenges for ecological modelling in a changing world: Global Changes, Sustainability and Ecosystem Based Management

OGS

ICTP

Oceans

EUROPEAN COMMISSION
DIRECTORATE-GENERAL
Joint Research Centre

ies

IMBER

GLOBEC

SOLAS

ECOTROPH: MODELING MARINE ECOSYSTEM FUNCTIONING AND IMPACT OF FISHING

Gascuel D.[1,2], Christensen V.[2], Pauly D.[2]

(1) Fisheries and Aquatic Sciences Center, Agrocampus Rennes, 65 rue de Saint Brieuc, CS 84215, 35042 RENNES cedex, FRANCE. Didier.Gascuel@agrocampus-rennes.fr

(2) Fisheries Centre, University of British Columbia, 2202 Main Mall, Vancouver BC, V6T 1Z4,CANADA

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.