

## **ECOPATH II - An Approach and a Software for Construction of Ecosystem Models and Food Web Analysis\***

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### **Background and Theory**

ECOPATH II is both an approach for constructing ecosystem models and a Public Domain PC software released as part of the ICLARM Software Project. ECOPATH II is developed from the ECOPATH model of Dr. J. Polovina, SWFC, Hawaii, and is designed for the construction and parametrization of static ecosystem models. It includes routines for balancing of flows in an ecosystem and for estimating indices for ecosystem characterization (ascendency, cycling, efficiencies, etc). These indices are primarily estimated from network analysis based on the theory developed by Prof. R.E. Ulanowicz, Chesapeake Biological Laboratory, University of Maryland.

In the ECOPATH approach it is assumed that input equals output for the time period considered. In a new version of ECOPATH II this assumption has however been modified to accept accumulation and depletion of biomasses during the time period modelled.

ECOPATH II models are constructed so that there is mass balance, i.e.

$$Q = P + R + U$$

where Q is consumption, P production, R respiration, and U unassimilated food. Of these parameters the production is estimated from

$$P_i = M2_i + M0_i + EX_i + BA_i$$

where  $M2_i$  is the predation mortality of group (i),  $M0_i$  is the non-predation mortality of (i),  $EX_i$  is the export of (i), and  $BA_i$  is the biomass accumulated (or depleted) of (i).

### **Applications**

The ECOPATH II system has been applied to a large number of ecosystem worldwide. Presently some 50 system descriptions are either published or under publication. Notable here is the publication "Trophic Models of Aquatic Ecosystems" which is based on an ICES

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Theme Session held in 1990, which is edited by the present authors, and from which further information can be obtained.

### **User Support/Training Activities**

ECOPATH II can be copied and distributed freely, yet we encourage registration as we inform all registered users of related publications, upgrades, etc. So far upgrades have been free of charge. Users are encouraged to contact the ICLARM Software Project with problems and experiences. We will be happy to examine models and manuscripts and give guidance based on experience from other models. We have had a number of scientists visiting us for short-term hands-on training.

Only few training courses have been conducted so far, but we anticipate that this activity will be strengthened. A two-week course organized by the Brazilian Institute for the Environment and Renewable Natural Resources was held in Fortaleza, Brazil, August 1991, for sixteen Brazilian scientists. This course is expected to be followed up by an advanced course in 1993.

The Center for Tropical Marine Ecology (ZMT) will be holding an ECOPATH II course on 8-19 March 1993 in Germany. For further information, please contact Dr. Matthias Wolff, ZMT, Universitätsallee GW1/A, D-2800 Bremen 33.

### **Distribution**

The system with documentation is distributed at a nominal cost (presently US\$20) to cover packaging and airmail. User's manuals for the system are available in English, French and Spanish, while a Portuguese version is under preparation. ECOPATH II has been distributed to close to 250 scientists or groups of scientists worldwide. The development of ECOPATH II is funded by the Danish International Development Agency (DANIDA) through a project for global comparisons of aquatic ecosystems.

### **Key Publications on ECOPATH**

- Christensen, V. and D. Pauly. 1992. A guide to the ECOPATH II software system (version 2.1). ICLARM Software 6, 72 p. International Center for Living Aquatic Resources Management, Manila.
- Christensen, V. and D. Pauly. 1992. ECOPATH II - A software for balancing steady-state models and calculating network characteristics. *Ecol. Modelling* 61:169-185.
- Christensen, V. and D. Pauly, Editors. Trophic models of aquatic ecosystems. ICLARM Conf. Proc. 26, 000 p. (In press).
- Polovina, J.J. 1984. Model of a coral reef ecosystems. I. The ECOPATH model and its application to French Frigate Shoals. *Coral Reefs* 3(1): 1-11.
- Polovina, J.J. and M.D. Ow. 1983. ECOPATH: a user's manual and program listings. Nat. Mar. Fish. Serv., NOAA, Honolulu Admin. Rep. H-83-23, 46 p.
- Ulanowicz, R.E. 1986. Growth and development: ecosystems phenomenology. Springer-Verlag, New York. 203 p.