Modeling Coral Reef Ecosystems[a]

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The notion of "modeling coral reef ecosystems" may appear sacrilegious to those who believe that the complexity and variability of coral reefs defy modeling, especially modeling of the sort advocated here. Whatever one's view of modeling, one cannot fail to note, however, that lots of coral reef researchers do fieldwork and publish their results based on the (tacit) assumption that their rate and state estimates (e.g., production of some invertebrate, standing stock of some fish) express some aspect of reality, for at least a certain (if generally unstated) period.

This work would greatly improve if one were to apply, to various, well-studied reefs, quantitative approaches through which an assessment can be made of how compatible such published state and rate

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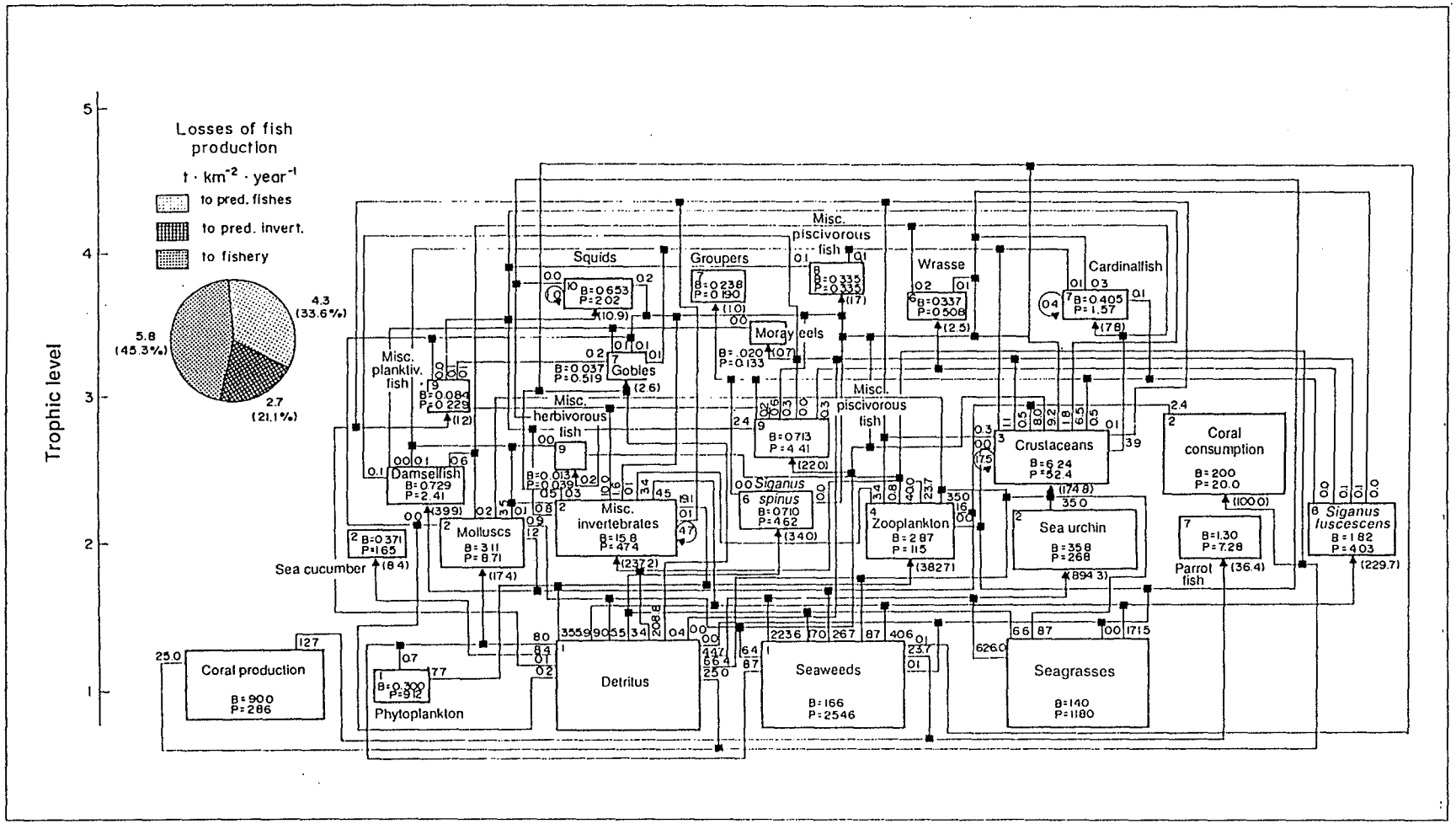

Fig. 6. Trophic model of the seagrass/reef flat area in Bolinao, Philippines, as constructed using the ECOPATH II modeling approach and software.

estimates are, and which can also be used to estimate "missing" values, i.e., fill in the gaps in one's representation of coral reef ecosystems.

Two such approaches are presently being developed at ICLARM:

1. the ECOPATH II software, for construction of steady-state models - this system has been applied to a large number of aquatic ecosystems, including several coral reefs; and
2. a form of length-structured Multispecies Virtual Population Analysis (MSVPA), for application (initially) to the Bolinao reef fishery, Philippines, and which, once tested, will be made available for analysis of coral reefs and other areas.

Numerous documents are available which document the ECOPATH II (2.1) program, its predecessor, J.J. Polovina's ECOPATH, and applications to coral reefs (Polovina and Ow 1983; Polovina 1984; Opitz 1991; Aliño et al. 1993; Christensen and Pauly 1992a, 1992b, 1993) (see Fig. 6 for an example).

The version of length-structured MSVPA presently being developed at ICLARM resembles "Phalanx Analysis" (Pope and Yang 1987), but differs in some major features.

We believe that the application of these two approaches to a number of reefs will help in achieving the following:

1. make use of published rate estimates for major reef organisms, throughout the world (see also documentation on FishBase and ReefBase);
2. identify gaps and compatibility problems in the corpus of literature in (3);
3. provide a formal framework for cooperation between various (groups of) coral reef researchers (to address issues in (2)); and
4. identify and quantify management options for coral reef fisheries (e.g., impact of closed areas, of closed seasons, of mesh size changes, of selective removal of apex predators, of forage fishes, etc.).

We hope that these models will indeed allow for close cooperation between ICLARM and other research groups in developing and developed countries, and also between biologists and social scientists. We anticipate that item (4) could provide a good basis for (bio)economic models and that this modeling effort, along with supportive comparative studies, should help overcome (via ReefBase) the present dearth of global assessment of the role of coral reefs as resource systems.