



DANIEL PAULY

ICLARM

Unanswered question: Whether reef fishes can be exploited to extinction and how.

5. *How can reef fishes be aged accurately?* It was agreed that daily otolith rings can be used to age even long-lived fishes reliably, but that this technique should be used mainly to validate estimates based on other methods.

6. *Can the population dynamics theories developed for temperate species be applied to coral reef fishes?* The few instances where this had been done showed that the reef fishes did not differ in essential properties from temperate fishes, and that the analyses had greatly contributed to the understanding of their dynamics. On the other hand, ecological theory can help in formulating the design of crucial experiments (such as caging).

7. *Do artificial reefs add to production or only concentrate the existing biomass?* It was reported that artificial reefs support "new" fishes when they are placed close enough to natural reefs to allow for settling of larvae and/or recruitment of juveniles, but distant enough to prevent incursions by adults from the natural reefs.

8. *How can spawning aggregations be used in exploiting and managing reef fish stocks?* Spawning aggregations, because they generally consist of large fishes, offer both the opportunity of good catch and of wiping out local stocks. Customary law in many Pacific islands deals specifically with such aggregations, and may thus represent a useful tool in management.

Questions concerning the effect of territoriality on fishing, whether reef fishes can be exploited to extinction and how, and whether reef fisheries should be continuous or "pulse" were also discussed without reaching conclusions.

Overall, the consultation was most helpful in reviewing the concepts and methodologies available for reef stock assessment, and in suggesting that nothing is preventing fishery biologists from applying their skills to a greater understanding of coral reef fish populations. ○

Coral reefs may produce as much as 10% of the annual world fish catch. Yet, very little investigation has been done on the biology of coral reef fishes, so that we know little about their growth rates and mortalities, vital parameters in the understanding of their population dynamics and, hence, of their exploitability.

The Fourth International Coral Reef Symposium, held in Manila 18-22 May 1981, gave an opportunity to address this problem and, in fact, a significant number of the papers presented did deal with applied fisheries issues.

The effect of reef fisheries on recruitment is the central question that has yet to be answered unequivocally for any stock or species. However, in other areas pertaining to stock assessment, it is possible to establish a broad consensus on methods and approaches. Considering that, ICLARM invited a number of the Reef Symposium participants to an *ad hoc* consultation 25-26 May: Dr. S. Amesbury (Guam); Drs. M. Hixon, J. Parrish and Mr. S. Ralston (Hawaii); Dr. D. Pauly and Mr. J. Ingles (ICLARM); Mr. J. MacManus (Philippines); Messrs. R. Rechebe and J. Villagomez (N. Marianas), and Dr. J. Munro (PNG). Discussions took the form of answers to specific topical questions as follows:

1. *What are the sustainable yields from coral reef fisheries?* It appears

that yields of 4.5 t/km², thought earlier to be typical, pertain rather to a certain type of reef and mode of exploitation (traps in this case). With use of different harvesting techniques in different reefs, sustainable annual yields may reach 20 t/km² or higher.

2. *Should selective cropping be used?* Although exploiting the large predators first is a tempting strategy (since this would leave more small fishes available), attempts should be made, rather, to fish at all trophic levels, to keep the community as similar as possible to an unexploited community where all available niches are used.

3. *Can food and feeding behavior studies help in stock assessment?* Such studies will be helpful, especially on large, transient reef predators (sharks, jacks, tunas), the roles of which have rarely been assessed quantitatively. Relevant large-scale (caging) experiments are presently being conducted in Hawaii.

4. *Can representative length-frequency samples be obtained from coral reef fish populations?* Such samples are generally difficult to obtain, and virtually all sampling methods commonly used are biased. However, various stock assessment methods which require length-frequency data are often fairly robust, i.e., they provide reasonable parameter estimates even with "bad" samples.