

**Summary of Papers Presented at the Grouper Symposium of
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YVONNE SADOVY

*Fisheries Research Laboratory
Department of Natural Resources
Mayagüez, Puerto Rico 00708*

The 18 presentations comprising the grouper symposium focused on a wide range of topics relating to grouper resources, exploitation and management in the central western Atlantic area. The presentations clearly reflected the interest in, and concern for, the condition of these resources. John Tucker has summarized those papers dealing with life history and culture. The present summary covers the status and data needs for management of grouper stocks of the region as identified both by the speakers of the symposium, as well as by questions which arose in the discussion following the presentations. The bibliography of grouper publications covering the geographic region, presented at the symposium, should prove to be an invaluable tool to researchers and fisheries managers alike.

Grouper species are believed to be particularly vulnerable to heavy fishing pressure because of such biological characteristics as long life, slow growth, and hermaphroditism. The stock assessments and experiences of many workers presented during the symposium clearly supported this belief and indicate that, in a number of areas, stocks are being heavily exploited, or are overfished. For example, particular concern exists for the status of the jewfish in Florida, numbers of which species have declined markedly in recent years. A very low spawning stock biomass per recruit is indicated for the warsaw grouper in the southeastern United States, and the Nassau grouper has shown marked declines, or has all but disappeared, in an alarming number of locations. Other species have exhibited declines in catches and in mean size. In a number of island nations we are seeing a decline in the relative importance of larger grouper species in commercial catches, and thus an increase in the emphasis on smaller grouper species, a trend recorded from locations as far apart as Martinique and Bermuda.

Much information has been presented on the well-known habit of various grouper species to aggregate for spawning. This behavior has been formally recorded for relatively few species, a number which may have increased today following presentation of deepwater observations on the behavior of gag and scamp in southeastern U.S.A. Such focus on aggregations derives not only from their dramatic nature, but also because they are very likely of considerable

significance to the annual reproductive success of a number of important species, and, if so, critical for the survival of the fishery.

Just how important these aggregations are is a key issue. It is clear that they are very vulnerable to heavy fishing pressure because of their consistency in time and space, as well as their easy accessibility to fishermen in many locations. Evidence presented indicates recent marked declines of captures and sizes taken from known aggregations. This apparently recent trend is despite a long history of fishing in some areas, such as sites in Mexico, and may be due to increased efficiency of fishing methods such as introduction of the speargun, or easier access for more fishermen. To what extent the declines in catches at aggregations reflect the fishing pressure over the aggregations themselves, the annual fishing pressure in the area, or some combination, is not known.

One of the difficulties in determining the relative importance of grouper aggregations for annual reproductive success is that those workers concentrating on aggregations do not generally have the time or manpower to simultaneously determine whether spawning is occurring outside aggregation areas. For the same reason, it has not been determined whether all adult individuals reproduce every year. Nor do we know whether heavily-fished aggregations re-form at alternative sites, or recover if protected, nor indeed what may be the biological significance of the physical locations of spawning sites. We have little idea of population sizes participating in, nor of the geographic areas "serviced by" specific aggregations, although limited tagging results show that individuals of some species can travel 100 miles or more, and hence that single stocks may cover a broad geographic area. In the case of red hind stocks in Martinique, no known spawning aggregations have been recorded in the vicinity of the island, the closest being off Venezuela, to the south, or in the British Virgin Islands to the north. Where local red hind recruit from in this French territory is unknown. Information on the importance of aggregations and on stock size and geographic extent is essential to identify appropriate management units, and to protect exploited stocks.

An impediment to the assessment of available information for addressing these kinds of issues comes, in part, from the lack of consistency in the manner in which data have been collected. This often precludes meaningful comparisons between aggregations at different locations, and among years at one site. For example, the rapid build-up and decline of many aggregations requires very careful records of capture dates and locations, and gears used, to ensure that data are strictly comparable from year to year. Despite such problems, however, a general pattern appears to be emerging that more heavily fished aggregations exhibit increasingly female-biased sex ratios, smaller mean lengths, and reduced numbers.

Since we know for at least one species, the red hind, taken by hook and line, that commercially-caught samples do appear to reflect reality in terms of sex

ratio and size-frequencies, the question arises as to why we appear to see progressively female-biased shifts in sex ratio at aggregations as levels of exploitation increase. If fishing is not selective for size or sex, then what accounts for an increasing female bias in heavily fished aggregations? One possibility is that heavy fishing disrupts social structure and possibly interferes with cues necessary to induce sex change (if sex change is socially-induced or initiated at the time of the aggregation), ultimately leading to a female bias in the population as a whole. Another possible explanation is that aggregations are more likely to be heavily fished when the fishery in general is heavily exploited over the rest of the year, and that other gear types used or areas fished outside of aggregations select for larger individuals, thus skewing the reproductive sex ratio. These kinds of questions, among many others, need to be addressed to determine whether protection of spawning aggregations is likely to be an effective or adequate management measure, and emphasize the need for careful documentation and standardization of data.

The other half of the battle to maintain viable stocks is communication of the need for implementation of management measures to the right people. In many cases, the problems perceived by fishermen, fisheries managers and biologists need to be emphasized and presented appropriately so that legislators are fully aware of the status of stocks under their charge. There is still a widespread belief, at least among island nations, that fisheries resources in general are inexhaustible, or even worse, disbelief that such declines can and do occur. Hence there is little attempt to solve the issues of declining stocks. Indeed, despite strong evidence of overfishing, top government officials in a number of Caribbean nations still believe that the only explanation for low production levels is a lack of sophisticated fishing gear, vessels, and infrastructure. On the other hand, because of low productivity and the resulting low input of fisheries into island economies, little money is available for research or for the enforcement of existing laws.

The papers presented today touched little on the practical matters of resource use and management, which probably reflects the fact that this aspect of fisheries is in general not addressed adequately. Far more effort is needed to communicate resource problems to the general public, and to public officials, to force them to direct attention to these issues. Grouper should be understood not only to be important commercially and recreationally, but also to be of considerable ecological significance and an important component of reef and live bottom communities in general.

In conclusion, a number of important biological and political issues need to be resolved enabling appropriate management measures to be implemented, if we are to ensure that what remains of many of the stocks is not confined to the beautiful pictures and videos presented at the symposium today.