Preliminary Analysis of the Exploitation of Groupers in Martinique

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ABSTRACT

Preliminary results and conclusions are presented about the status of the grouper resources in Martinique. The catch of groupers (134 T in 1987, or 9.7% of the demersal catch) was mainly taken by traps, and dominated by 3 small-sized species: *C. fulva*, *E. guttatus* and *A. afer*. CPUE (kg/trap) increased with depth for most species, which suggests a severe reduction of the biomass on the island shelf. Average sizes of catches of *C. fulva* and *E. guttatus* were small, with the largest individuals being absent; however, length cohort analysis showed that with the likely value of M/K for groupers, the stock of *C. fulva* is not subject to growth overfishing. The consequences for management, within the whole demersal fishery, are discussed.

INTRODUCTION

Grouper species have a very high economic importance in many fisheries of the Caribbean where they are the target of gears such as traps or handlines. In Martinique, they are only a part of the demersal catch and cannot be considered as target species; their price is not higher than many other species groups. As part of a wider assessment program focusing on the small-scale fisheries of Martinique (Figure 1), without any particular emphasis on any component of the fishery, data on catches of groupers were collected, allowing a preliminary assessment of the status of this resource. This paper presents preliminary results and conclusions.

METHODS

A 12-month sampling survey was conducted from February 1987 to January 1988. A rigorous sampling strategy (Gobert, 1988; Chevaillier and Gobert, in press) and adequate manpower resources allowed the estimation of activity (number of trips), fishing effort, catches, and length-structure of catches for the main species (Gobert, 1989; Chevaillier, 1990). Catches were estimated by species, fishing sector, and depth. Estimations of fishing effort were used to compute catch/unit effort (CPUE). A structural analysis was conducted by means of a length cohort analysis (Jones, 1984) and of simulations of exploitation patterns, with the ANALEN software (Chevaillier and Laurec,

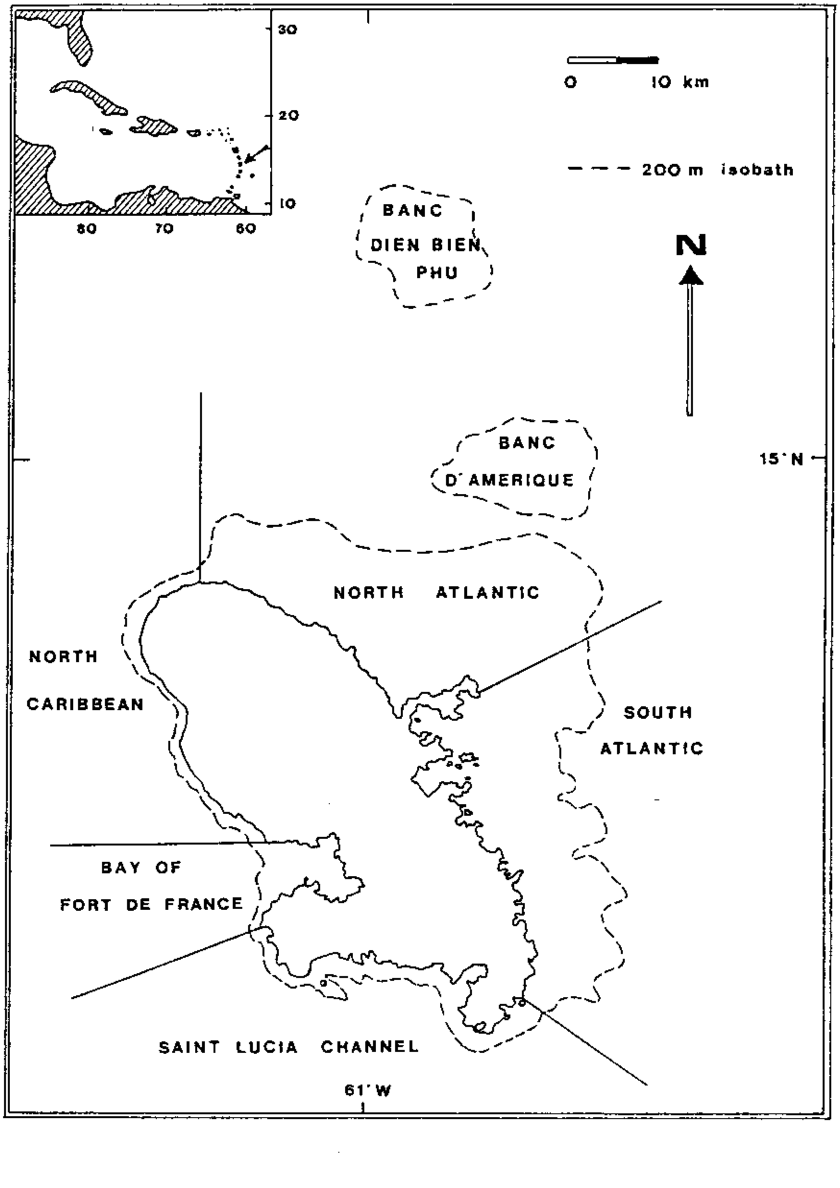

Figure 1. Map of Martinique.

1990). Biological parameters used in the analysis were found in the litterature (Munro, 1983; Ralston, 1987):the program being devoted to stock assessment, no attempt was made to estimate these parameters with the collected data, which were not adequate for this purpose.

RESULTS

Catches

The catch of Serranidae was about 134 T in 1987, and represented 9.7% of the demersal catch, and about 4% of the total catch (Table 1).

Table 1. Catches of groupers by gear type.

Fishery	Production (T)	% (/gear)	% (/catch)
Traps	94.9	11.0	70.4
"Tombé-levé"	14.4	66.6	10.7
Gillnets	7.5	3.8	5.6
Handlines	6.8	9.2	5.0
Trammels	4.4	4.2	3.3
Skindiving	3.1	3.8	2.3
Longlines	2.4	4.8	1.8
Total or average	134.8	9.7	100.0

The available data do not allow any reliable and detailed repartition of catches between fishing sectors and depths ranges. However, the west coast of the island produced a neglibible catch, whereas about two-thirds of the catch came from the two offshore banks situated north-east of Martinique.

Species composition

Three main species make up the bulk of the catch of serranids (Table 2). Noticeable features of this species composition are the importance of *A. afer* and the very low proportions of the largest species, belonging to the genus *Mycteroperca* and *Epinephelus* (*E. striatus* and *E. nigritus*). It appears that the catch is almost exclusively made of shallow, small-sized species.

Catch per unit of effort

All species put together, the average catch/trap increases with depth, reaching higher values on the offshore banks than on the island shelf.

Table 2. Composition of grouper catches.

	Traps	Tombe-leve	Others	Total
Cephalopholis fulva	28.5	4.2	6.0	38.7
Alphestes afer	21.4	9.4	6.5	37.3
Epinephelus guttatus	18.9	0.5	4.8	24.2
Epinephelus adsensionis	8.6		3.1	11.7
Paranthias furcifer	5.5	0.1	3.4	9.0
Petrometopon cruentatum	6.1	0.2	1.3	7.6
Mycteroperca interstitialis	4.4			4.6
Mycteroperca venenosa	1.0			1.0
Epinephelus striatus	0.4			0.4
Epinephelus nigritus	(-)		0.2	0.2
Other species	(-)			(-)

Species-specific patterns of CPUE variation with depth can be distinguished on the island shelf (Table 3).

Table 3. CPUE (g/trap) of groupers in the trap fishery.

Species	0-10 m	10-30 m	30-80 m	>80m
all species				
island shelf	39.6	83.7	120.0	265.3
offshore banks	-	-	-	746.9
Cephalopholis fulva	7.6	27.6	42.5	25.2
Alphestes afer	16.7	24.1	12.6	0.0
Epinephelus guttatus	2.5	15.1	25.2	113.5
Epinephelus adsensionis	8.7	2.1	12.8	13.8
Paranthias furcifer	0.0	5.1	5.6	15.7
Petrometopon cruentatum	2.1	8.8	5.8	61.9
Mycteroperca interstitialis	0.0	0.0	13.0	30.0

The decrease of CPUE for *A. afer* and its increase for the larger species (at least *M. interstitialis*) are consistent with their usual depth repartition, whereas one would have expected a decrease of CPUE for the shallow species, at least on the slope (>80 m). This, and the only moderate increase of the CPUE for the deeper species, suggests that the grouper biomass has been severely reduced on the shelf and that the deeper and larger species were reduced to the point that they do not seem to be dominant any more in their own preferential habitat.

Length-structure of catches

Length-frequency data were obtained in sufficient numbers only for the main three species (Table 4).

Table 4. Sample sizes of grouper species in 1987.

Species	Traps	Total
Cephalopholis fulva	567	1007
Alphestes afer	326	1310
Epinephelus guttatus	232	347
Epinephelus adsensionis	35	83
Paranthias furcifer	91	295
Petrometopon cruentatum	88	135
Mycteroperca interstitialis	7	8
Mycteroperca venenosa	7	12
Epinephelus striatus	5	5
Epinephelus nigritus	0	1

The global length-structures of catches of *E. guttatus* and *C. fulva* can only be understood when separating samples coming from the island shelf and from the offshore banks (Figure 2a and 2b), regardless of depth, which has only a minor importance. The low frequencies or the absence of the length-classes close to the maximum length reached by the species (respectively about 40 and 55 cm TL; Randall, 1968) confirm the idea of a high level of exploitation for these shallow species. However, there was no such sign for *A. afer* (Figure 2c)

Structural analysis

C. fulva was the only species for which the data allowed a more detailed analysis. Length-cohort analysis was applied to the catch of the main three gears catching the species: traps, gillnets, and "tombé-levé", and exploitation patterns were simulated, allowing fishing mortalities (vectors of length-specific F) to vary between 0.1 and 2 times their present values, and average selection length in traps from 13.5 to 21.5 cm TL, corresponding to 25 and 41 mm mesh sizes. The available growth rate, K, for this species (K=0.63:Munro, 1983) is questionable, being much higher than those of all the grouper species listed by Ralston (1987), and no reliable estimate of the natural mortality coefficient, M, is available. Therefore the analyses were done for 3 values (.5, 1.0, 2.0) of the

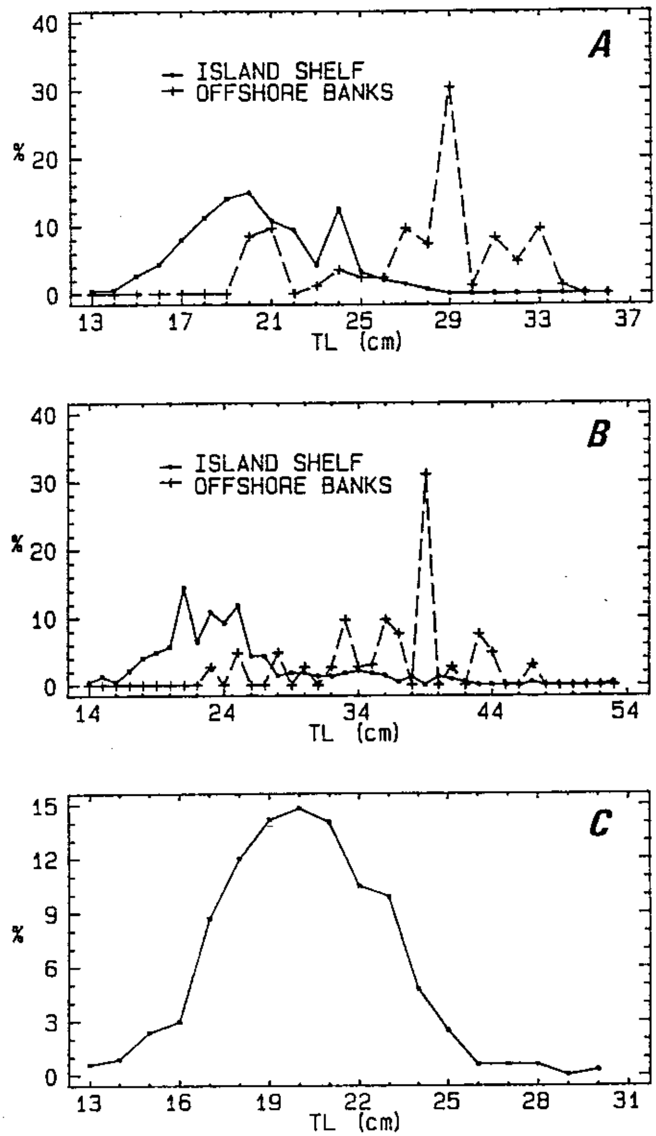

Figure 2. Average length-structure of trap catches for *C. fulva* (A), *E. guttatus* (B), and *A. afer* (C).

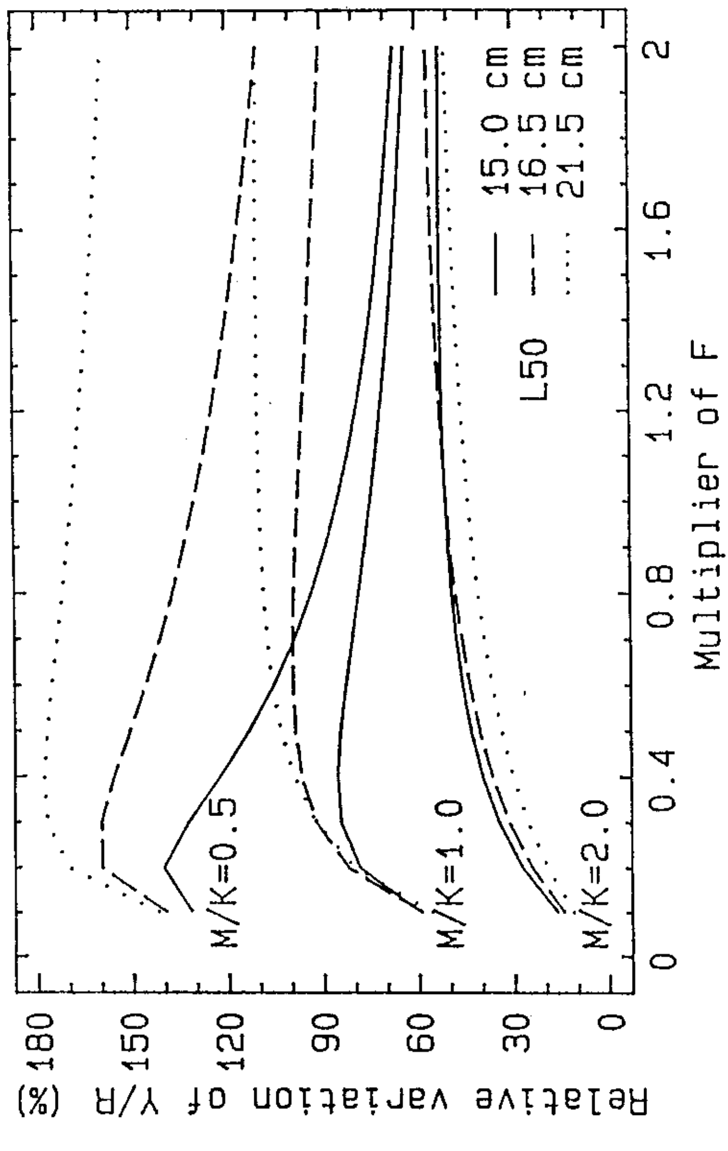

Figure 3. Yield-per-recruit analysis of *C. fulva*.

ratio M/K, which is in fact the key value in the yield-per-recruit analysis, rather than individual values of M and K.

Results (Figure 3) show that the yield-per-recruit could be significantly increased only if the natural mortality is low relative to the growth rate ($M/K<1$). If M/K is close to 2, which seems to be the case for groupers (Ralston, 1987), no increase in yield-per-recruit is to be expected of any of the situations simulated. However, the low slope of the Y/R curves for $M/K=2$ shows that the CPUE, and therefore the profitability of the fishery, would respond well to a decrease in trap fishing effort. The situation of non growth-overfishing for *C. fulva* may seem surprising given what was found on CPUE and length-structure. What it means is that, with the assumed natural mortality/growth ratio, the present average selection size is greater than or equal to the length at which the total weight of a cohort begins to decrease.

No such analysis could be performed on *E. guttatus* because of the small sample sizes. The global Z/K ratio, using Beverton and Holt's estimator, was close to 4 for both species, suggesting a similar level of fishing mortality; however, the lower average selection size for *E. guttatus* indicates that the fishing mortality is experienced during a larger part of the life span than for *C. fulva*. The analysis of length-frequencies of other species was limited to a qualitative description, either by lack of biological knowledge (*A. afer*), or because of the sample sizes. It is assumed from the length-structure of the catches of *A. afer* that this species is also not subject to heavy overfishing.

DISCUSSION

This kind of analysis is obviously restricted by the quality and quantity of available data. Raw data collected in 1987 are not thought to be biased, and confidence intervals are quite satisfactory for global estimates (the coefficient of variation of total catches was estimated to be about 4%). The problem may rather arise from the quantity of data, as confidence intervals and risks of bias grow larger and larger when detailed estimates are calculated, by species, fishing sector, depth range, etc. Furthermore, analyses were made using assumptions that might have been somewhat violated: constant catchability (CPUE analysis), steady-state of the fishery (length frequency analyses), etc., and only rough estimates of the biological parameters (growth and mortality) were used.

However, the results of the analysis lead to a meaningful and consistent interpretaion of the fishery, which should at least be used as a preliminary basis for management options. What seems to happen is that the large species have been brought to extremely low levels of abundance through recruitment overfishing, probably many years ago, whereas the smaller species are experiencing a high fishing pressure, yet not with selection sizes low enough to lead to growth overfishing nor, apparently, to recruitment overfishing. The data are lacking which would allow a firm confirmation of these preliminary conclusions. Length-frequency samples of the large species are very small, but most of the fish measured were juveniles; additional fishery-independant data would help in establishing the present status of these populations, and particularly whether there is still a limited spawning stock, or if the recruitment is provided by larvae spawned in an other, upstream, population. No information is presently avilable as to the possible existence of spawning aggregations of groupers in the past, which would have been fished out, leading to recruitment failure, at least for the larger species. The specific features of reproduction in many grouper species, and particularly those related to sex reversal and its density-dependance, are not sufficiently known to allow any tentative conclusion about risks of recruitment overfishing for the smaller species, given the modification of the population structure.

CONCLUSION

This analysis emphasized the opposition between the two main groups of species within the family, the large ones, virtually extinct in Martinique, and the small ones, which presently make up the bulk of the catch. As far as management is concerned, the main issue is the place of groupers within the whole demersal fishery. Therefore the objective is not to manage a grouper fishery by choosing between a fishery for small groupers and a fishery for large grouper; groupers are presently less than 10% of the demersal catch, and their market value is not higher than several other groups of species. Therefore the fishery has to be managed at a much more general level than groupers only, at least in the short run.

In the very short term, little or no increase in landings can apparently be expected for the smaller species, although a better profitability could be achieved by reducing the fishing effort. However this management strategy does not ensure an optimal use of the resource, since the production of the large species is completely given up, and, most important, it does not preserve the potential of the resource by leaving future options open, which is the fundamental objective of resource management in the long run. One of the yet unsolved problems in this case is simply whether rational exploitation (both long and short term) of these two groups of fishes are compatible objectives. In very practical terms, if a minimum size was decided for the larger species, could their juveniles survive many successive catches and releases (as undersized) in the trap fishery on the shelf, to eventually reach the legal size in a deeper fishery, for example with hooks and lines?

In any case, the present status of fishery management in Martinique requires a progressive and pragmatic approach in order to improve the overall situation, considering specific problems such as the ones for groupers, but first of all the fishery system as a whole, with all biological and non-biological implications of the possible management measures.

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