Preliminary Results on the Efficiency and Selectivity of the Chervron-Shaped Trap, A Traditional Fishing Device in Guadeloupe

BENOIT BELIAEFF , MAX LOUIS , et JOSÉ SOUPRAYEN
Laboratoire de biologie animale
Université des Antilles et de la Guyane
97159 Pointe-à-Pitre Cedex, Guadeloupe (F.W.I.)

ABSTRACT

The authors studied the results of trap fishing for a 10 months period from October 1986 to July 1987, in three different sectors of the Grand Cul-de-Sac Marin in the North of Guadeloupe. Two or three field trips per week were made with a professional fisherman and enabled the census of 1500 fish traps (about 20 traps per trip).

Some crustaceans, molluscs and fishes were caught. A total of 80 species of fishes belonging to 26 families were observed during the study. Out of 60 censused species, about 3/4 represented only 10% of the total number and 14% of the total biomass. Nearly half of the marketable catches were composed of herbivorous (essentially Acanthuridae and Scaridae) fishes.

The selectivity was followed for the most abundant species (*Sparisoma chrysopterum, S. viride* and *S. aurofrenatum*). Although the trap seems well adapted to coral bottoms, its yield is weak : about 500 g of commercial fishes and 30 g of lobsters per trap, for a period of immersion of two to four days.

From the studies of selectivity of the trap and from the sorting made on the boat by the fisherman, we can conclude that the increase of the mesh size from 34 to 38 mm and even 42 and 54 mm would not represent an important loss for the fisherman. This increase would be desirable and even necessary for the survival of species and for preserving the small fishing industry in Guadeloupe.

RESUME

Les auteurs ont étudié durant dix mois, de octobre 1986 à juillet 1987, les résultats des pêches effectuées au casier dans trois secteurs du Grand Cul-de-Sac Marin au nord de la Guadeloupe. Deux à trois sorties en mer par semaine ont été effectuées avec un pêcheur professionnel et ont permis de visiter au total plus de 1500 casiers à raison d'une vingtaine à chaque sortie.

Des crustacés, des mollusques et des poissons ont été capturés. Au total, 80 espèces de poissons regroupées en 26 familles ont été observées au cours des différentes sorties. Sur une soixantaine d'espèces échantillonnées, environ les 3/4 ne représentaient que 10% des effectifs totaux et 14% des biomasses totales. Près de la moitié des prises commercialisables sont constituées par des herbivores (Acanthuridae et Scaridae essentiellement).

La sélectivité a pu être suivie pour les espèces les plus abondantes (*Sparisoma chrysopterum, S. viride* et *S. aurofrenatum*). Bien que le casier se soit révélé bien adapté aux fonds coralliens, son rendement reste faible, de l'ordre de 500 g de poissons commercialisables et 30 g de langoustes par casier,

pour une durée d'immersion de 2 à 4 jours.

A partir des études de sélectivité de l'engin et du tri effectué sur le bateau par le pêcheur, on peut avancer que l'augmentation de la maille du casier, de 34 à 38, voire 42 et même 54 mm ne représenterait pas de préjudice important pour le pêcheur. Cette augmentation serait souhaitable voire même indispensable pour la survie des espèces et le maintien de la petite pêche en Guadeloupe.

INTRODUCTION

An important part of the resources of Guadeloupe island comes from fishing activities. The small artisanal fishery remains with the coastal fishery one of the main activities. Among the different devices used by the artisanal fishery, the chevron-shaped trap called the "Antillean trap" by Munro (1974), remains the most common one. According to the fishermen, the yield has decreased a lot for the last 15 years, which led them to possess more and more traps. The number of traps per fisherman sometimes exceeds 150 and even reaches 250.

In 1986, the Department of Marine Affairs censused 1403 registered fishermen in Guadeloupe and the number of equipped boats for fishing was 1157. However, taking into account the number of fishermen with "no status", this number can reach about 2800.

The annual catch of fishes in Guadeloupe has remained stable for years (in 1984 : 8400 t with 4750 t from traps, in 1985 : 8370 t with 4800 t from traps). This yield is far from satisfying the important local annual consumption evaluated at 14 000 t, that is to say 40 kg/inhabitant/year.

The present study, dealing with the fish traps, presents the first results of a study made on their efficiency and selectivity with the aim of a better management and control of that method of exploitation of reef fishes.

MATERIAL AND METHODS

Observations were carried out during a 10 month period, from October 1986 to July 1987. Two or three field trips per week were made in order to follow the trap fishing of a professional fisherman, in three different areas of the Grand Cul-de-Sac Marin, in the North of Guadeloupe island (Fig. 1). One third of the fish traps was sampled at each sea trip. Three areas (I, II, III) respectively correspond to the outer reef slope of the barrier reef, to the channels and to the lagoon areas. The main features of each area are summed up in Table 1. During the period of strong tradewinds, between November and April-March, the fishermen put their traps in a safe area in the lagoon. A total of 1500 traps were visited with about 20 traps per sea trip. The period of immersion of the traps varied from 2 to 4 days. Some traps were sometimes immersed during 7 consecutive days in zone I.

The average life time of a trap is from 6 to 8 months. Once in the water, the trap will never be taken back again on the shore. The repairs were made directly

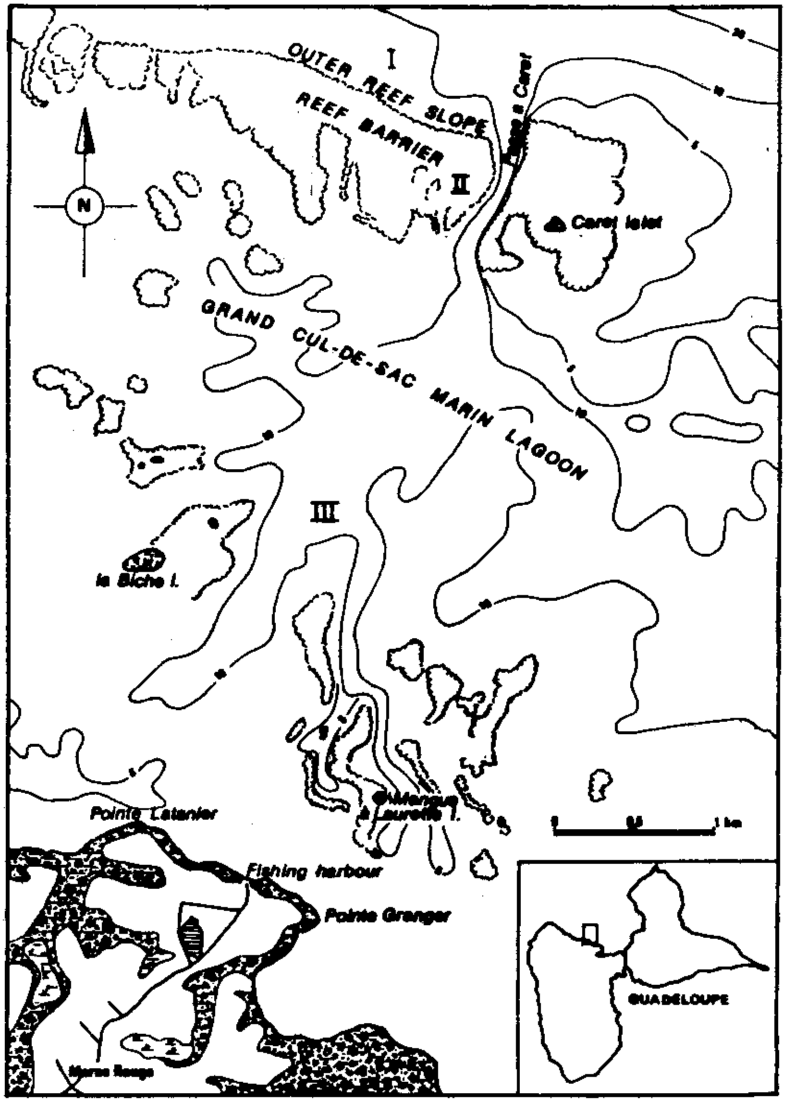


Figure 1. The study areas in the Grand Cul-de-Sac Marin. I: The Outer Reef Slope II: The Barrier Reef and the Channels III: The Lagoon

Table 1. Main features of areas investigated. The small traps used in the channels (area II) are usually meant to catch the lobsters.

AREA	DEPTH	SUBSTRATE	TURBIDITY	TRAP CATEGORY
I	20-30 m	coral	low	large + several medium sizes
II	1.5-4 m	reef with isolated coral heads	low	medium and small sizes
III	5-12 m	seagrass, muc, isolated coral heads	high	medium and large sizes

on board the boat. Three types of traps, differing by their sizes, were used during the study. The volume of the traps were 0.36 m^3 for the small traps (S), 0.95 m^3 for the medium ones (M) and 2.4 m^3 for the large ones (L). The trap was made with a wooden-frame covered with a mesh of galvanized wire. The aperture of the wire mesh used is 34 or 38 mm. Once immersed, the trap is spotted from the surface with a buoy tied to it with a rope. At each trip, the traps are visited, emptied on board and put back in the water immediately. The catches are then identified, numbered and weighted. Some target species were chosen to be measured and weighted individually. At each trip, the species richness, the number of individuals per species and their biomass are noted. The data analysis enable the determination of the efficiency and selectivity of the fishing device.

To complete these observations and in order to evaluate the efficiency of the trap from the recruitment, the mortality and the escapement, a set of 5 individually numbered traps were permanently immersed during 20 days and visited by SCUBA diving. The term of efficiency corresponds here to an optimum fishing time and catch rate for all the species together. At each dive, the species and the number of fishes are counted without being collected or released. The number of living fishes are censused in each trap. The mortality is evaluated through the number of dead fishes in the trap whereas the recruitment is calculated by totalling the living, dead or escaped individuals. The poor knowledge of the distribution types of the considered variables (mortality and recruitment), the low values of the number of traps used (5) and of the number of sampling days, led us to use non-parametric tests : the Kendall test to evaluate the homogeneity of the samples and the test of tendency (concerning recruitment and mortality) and relying on the exact distribution of Gleissberg (1945). The test of tendency, based on the number of turning points and enabling the estimation of probabilities was combined with Fisher test to determine the random character of recruitment and mortality.

RESULTS

Species Richness and Abundance

A total of 80 species was censused during the study, and 68 among them were sampled. The 12 species which were not observed in the samples correspond to rare species, the importance of which remains negligible in number as well as in biomass.

Among the 68 sampled species, only 19 (28%) represented 90% of the total number and 16 (23%) represented 86% of the total biomass. The dominant species were mainly herbivorous fishes (Scarids and Acanthurids). The most valued species (Lutjanidae, Pomadasyidae and Serranidae) only represented 18% of the number and 17% of the total fished biomass (Fig. 2). These percentages remain almost the same if they are calculated compared to commercial species (Fig. 3).

The average weights and numbers caught per trap were calculated after a three day immersion period. Concerning the variation of average biomass per trap, 2 distinct periods were recognized :

- the first period from October 1986 to February 1987, corresponds to a period where the catches fluctuate much. During this period, when the tradewinds blow and when the storms are more frequent, the fishing takes place inside the lagoon and in the channels ;
- the second period which starts in March 1987, the catches are stable with a general tendency to a progressive increase of the catches.

Concerning the variations of the average number of fishes caught per trap (Fig. 4b), the division in two periods is less obvious. However, from May, a clear increase of the catches is noted, corresponding to an important recruitment at that period.

Efficiency

The random character of the catches (Table 2) was verified by the test of Kendall (W = 0.114 then reaching 0, which $S_{oberved}$ = 105.2 and $S_{critical}$ = 213.2 ; then $S_o < S_c$). This allowed us to pool the data of the 5 traps (Table 3). However, before drawing general conclusions on these traps, the test of tendency on the recruitment and the mortality within trap combined with a Fisher test shows that the two variables are two random variables at a risk α = 5% inside the same trap ($X^2_{observed}$ = 2.717 for mortality and 9.469 for recruitment with degree of freedom=2n=10 for a minimum level of the X^2 = 18.307).

When plotting on a same graph (Fig. 5) the curves corresponding to the average evolution of the number of caught fishes, of the mortality, and of escapement, we noticed that the optimum time of immersion of the traps,

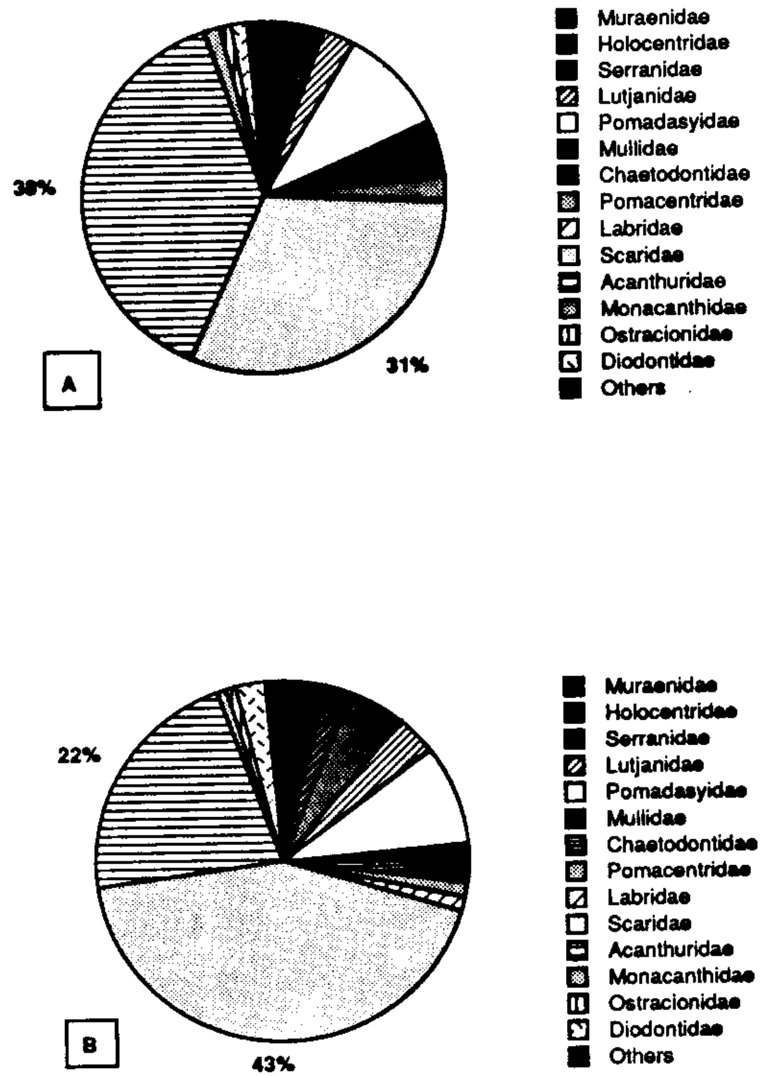


Figure 2. Percentages in numbers (A) and in the biomass (B) of the different species caught

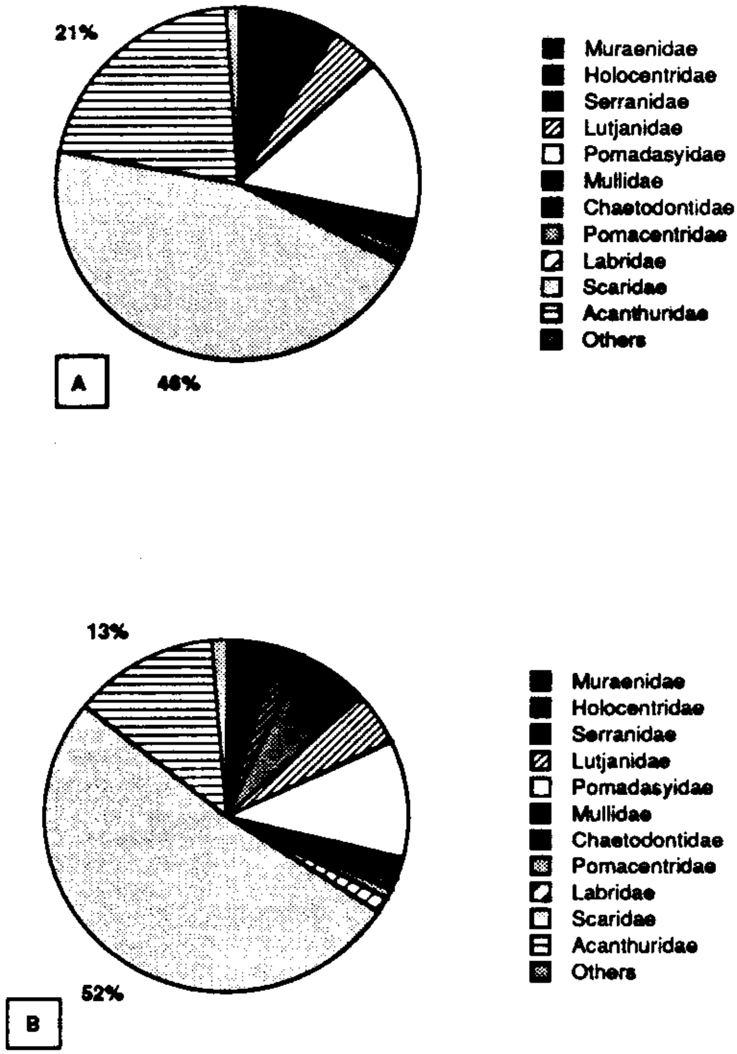
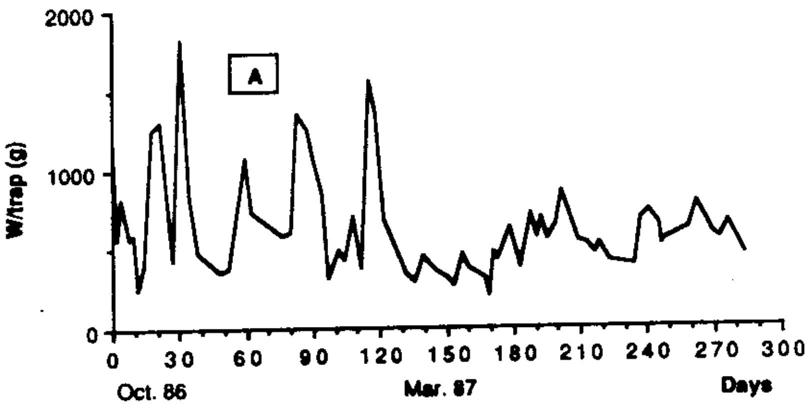


Figure 3. Percentages in number (A) and in biomass (B) of the main species among the marketable fishes caught.



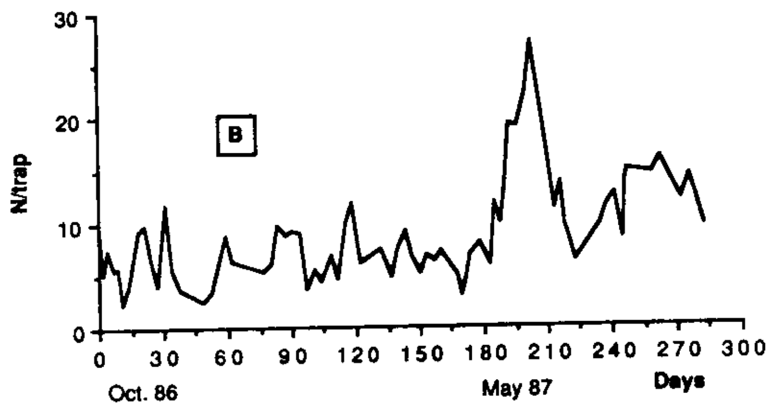


Figure 4. Average catch per trap, in biomass (A) and number (B).

Table 2. Variations in each fish trap (A, B, C, D, and E) of the number of living fishes (N), captured (C), dead (D), and escapement (E) during 20 consecutive fishing days.

	Trap A				Trap B				Trap C				Trap D				Trap E			
Days	N	C	D	E	N	C	D	E	N	C	D	E	N	C	D	E	N	C	D	E
1	3	4	1	0	0	0	0	0									0	0	0	0
2	7	4	0	0	1	1	0	0	7	7	0	0	1	1	0	0	5	5	0	0
3	8	2	0	1	3	3	1	0	10	5	1	1	2	1	0	0	3	0	1	1
4	12	6	2	0	4	2	1	0	11	2	1	0	2	1	1	0	7	4	0	0
5	11	1	2	0	6	3	1	0	16	5	0	0	2	1	1	0	7	0	0	0
6	17	6	0	0	4	2	3	1	17	2	0	1	4	2	0	0	11	5	1	0
9	44	27	0	0	11	9	1	1	21	5	1	0	5	3	2	0	13	6	2	2
10	49	7	1	1	15	5	0	1	28	15	8	0	6	9	7	1	13	4	4	0
12	49	3	3	0	17	5	3	0	25	2	2	3	7	4	3	0	14	6	4	1
20	56	14	4	3	20	7	4	0	17	4	3	9	20	13	0	0	22	12	4	0
Total:		74	13	5		37	14	3	31	18	4	0	34	20	3	3		42	16	4

Table 3. Variations in the number of living, recruited, dead and escaped fishes during 20 consecutive fishing days. The numbers correspond to average values per trap obtained from 5 traps.

Days	Average number of living fishes per trap	Captured		Dead		Escaped	
		Total	Cumulative %	Total	Cumulative %	Total	Cumulative %
1	2.2	12	4.4	1	1.3	0	0.0
2	5.0	16	10.3	1	2.5	1	3.3
3	5.4	8	13.2	4	7.5	2	10.0
4	8.2	18	19.8	4	12.5	0	10.0
5	9.0	8	22.7	3	16.3	1	13.3
6	11.6	21	30.4	7	25.0	1	16.7
9	20.4	66	54.6	18	47.5	4	30.0
10	21.8	22	62.6	10	60.0	5	46.7
12	23.4	31	74.0	13	76.3	10	80.0
20	32.6	71	100.0	19	100.0	6	100.0
TOTAL	139.6	273		80		30	

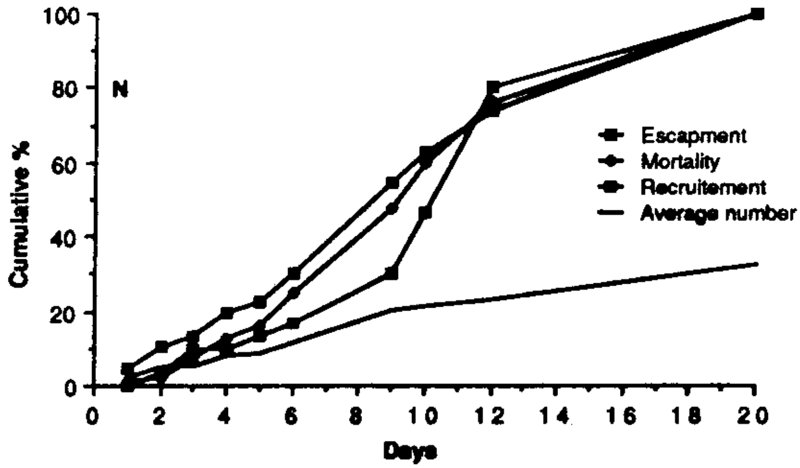


Figure 5. Variation of the average number of living fishes caught, of the recruitment, of the mortality and of the escapement per trap during 20 consecutive fishing days (sample of 5 traps).

determined by the inflection point of the curve, is from 6 to 7 days ; this corresponds well to the intuitive fishing practice of never leaving a trap more than a week without visiting it.

Selectivity

The selectivity is shown by the catches curve of the most representative species. These are the Scaridae (*Sparisoma viride, S. chrysopterum* and *S. aurofrenatum*), the Acanthuridae (*Acanthurus bahianus, A. chirurgus* and *A. coeruleus*), the Pomadasyidae (*Haemulon plumieri*) and the Lutjanidae (*Ocyurus chrysurus*). The computations were made only for the period between October 1986 to February 1987. Half of the Acanthurids caught had a total length under 14 cm (Fig. 6) ; particularly *A. coeruleus* for which the percentage only represents smaller individuals of less than 13 cm of total length. Concerning *Haemulon plumieri* and *Ocyurus chrysurus* (Fig. 7), the catches curves are more spread, with two inflection points concerning individuals between 18 and 24 cm of total length. Concerning the Scarids, the S curves are less evident (Fig. 8), particularly for *S. viride* where 2 inflection points are observed : the first for the individuals of 20 cm of total length and the second for the individuals of 24 cm of total length. These two patterns do not correspond to a sexual dimorphism as

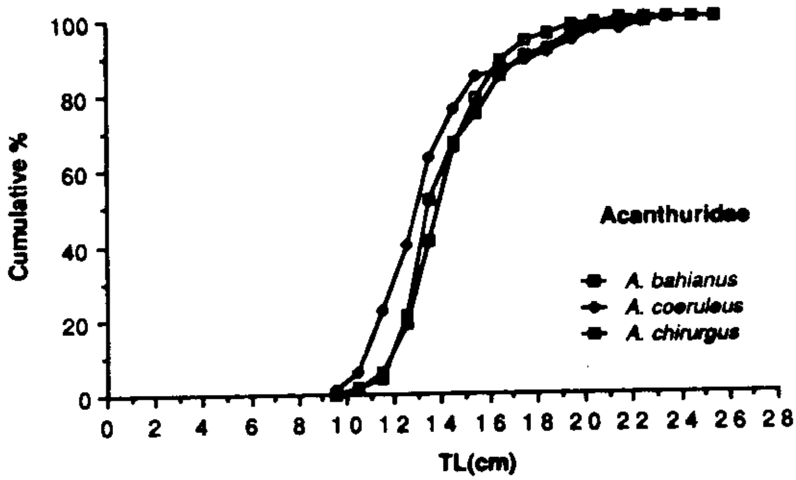


Figure 6. Cumulative frequencies of the catch size of Acanthuridae.

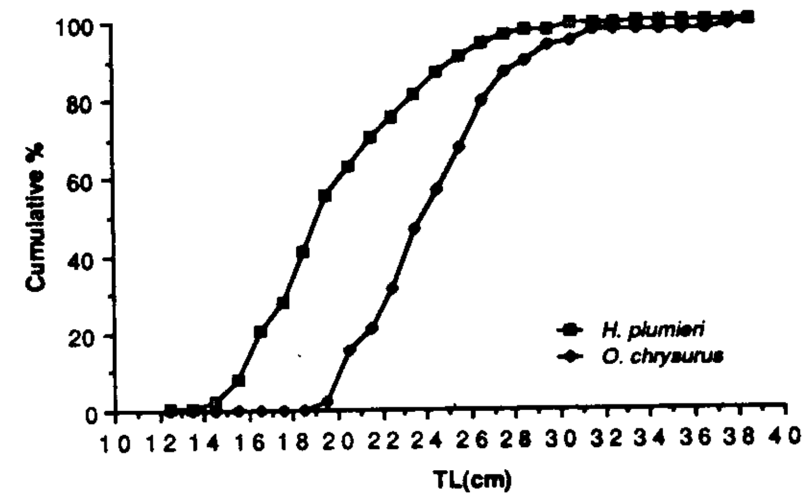


Figure 7. Cumulative frequencies of the catch size of *Haemulon plumieri* and *Ocyurus chrysurus*.

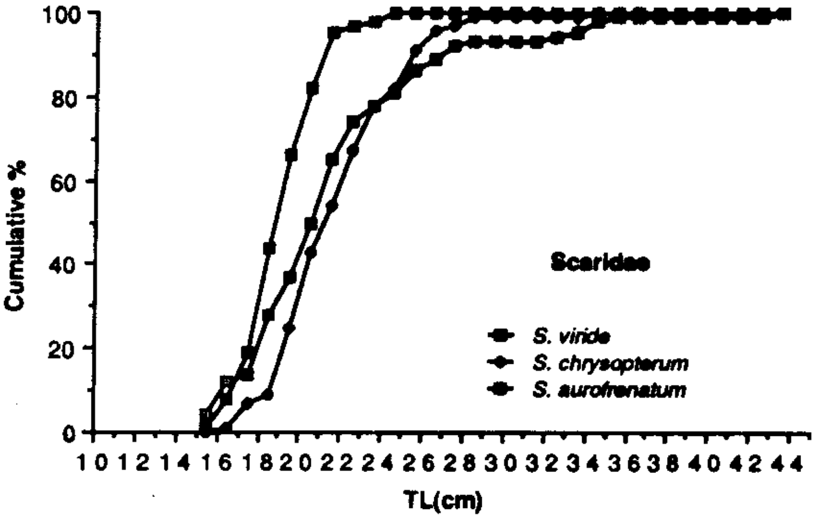


Figure 8. Cumulative frequencies of the catch size of *Sparisoma viride, S. chrysargyreum* and *S. aurofrenatum.*

it is shown by Figure 9, where the catches curve of males and females are perfectly superimposed. They correspond to two different cohorts.

DISCUSSION AND CONCLUSION

The 80 species observed during the present study only represent a small proportion of the ichthyofauna of the Grand Cul-de-Sac Marin where 246 species were censused (Baelde *et al.*, 1988). Three reasons could account for this. The first reason is that several species are not approachable, as they are never present in the particular zones where the traps are set (for example, *Centropomus undecimalis* which is restricted to the mangrove areas) or which are not present during the period of the year when the study was carried out (for example, *Caranx latus*). The second reason is the non vulnerability of certain species, essentially due to their behavior near the trap (example of *Priacanthus cruentatus*). The third reason concerns the selectivity of the trap which cannot catch all the small species whose maximal size is too small for the mesh size (Pomacentridae, Labridae, etc.).

It has already been pointed out that the species caught were more or less abundant, according to the areas (outside, in the channels or inside the lagoon). The more stable communities of the outer reef slope are expressed by less

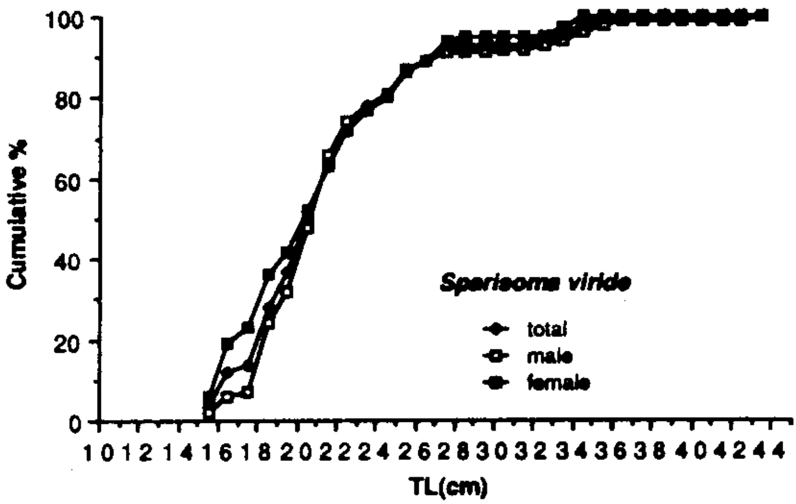


Figure 9. Cumulative frequencies of the catch size of *Sparisoma viride* (male, female, and total number).

important variations of the catches in that zone ; contrary to the channels and the lagoon where numerous species move during their trophic or reproductive migrations (Louis and Baelde, 1987). However, from April, where fishing is made outside, a regular tendency of the increase of the fished biomass is noted with maximal values around June (bigger Acanthurids, Scarids and *Ocyurus chrysurus*).

The catches curve in numbers remain more stable during all the fishing period, with however a maximal increase in May, due to an important recruitment of vulnerable individuals on the outer reef slope at that time (essentially Acanthurids).

Once the traps are emptied on board, the fisherman sorts the fishes before returning to the harbour. One third of the biomass caught (corresponding to more than 35% of the numbers) is not marketable. The average weight of a non marketable fish (64 g) is inferior to the weight of a fish of the entire sample (120 g) and even more the one of a marketable fish (152 g). The non marketable fishes are thrown back in the water. These are essentially fishes belonging to the following families : Diodontidae, Aulostomidae, Chaetodontidae, some Scaridae, Acanthuridae and Pomadasyidae which are too small. The marketable fishes are separated into two batches. The first batch is composed of first category fishes which are sold 45 F/Kg (Lutjanidae, Mullidae, Scaridae, Serranidae and some bigger Acanthuridae). The second batch named "charity batch" (sold 10 F/Kg) is composed of species less valued as food (Muraenidae) but also by small individuals of species belonging to the first batch (Pomadasyidae, Scaridae and Acanthuridae). It must be noted that the Acanthurids are part of the second batch from a minimal size of 15 cm and of the first batch from a minimal size of 19 cm, which is rather rare. For the Scarids, the respective minimal sizes are 16 cm and 18 cm. This is also the case for *Haemulon plumieri*. The small individuals of that species are often caught in important groups. The respective minimal sizes for that species are 13-14 cm (about 70 g) then 15-16 cm (about 90 g). Considering that case, an increase of the size of the mesh for the traps would allow the juveniles of that species to escape and would not represent an important prejudice for the fisherman. Moreover, the sorting of fishes on the boat would be facilitated and the cost of traps constructed with a larger mesh would be less.

The average and minimal sizes of sexual maturity of species are now known from the studies of Gaut and Munro (1983), Reeson (1983a, 1983b), Thomson and Munro (1983) on the biology, ecology and bionomy of these species. It appears that in all cases these sizes are far greater to the average sizes which are captured. In the same way, the visual observation of the gonads of *Ocyurus chrysurus* and *Haemulon plumieri* have shown that almost all the fishes caught were juveniles. It then seems obvious that, taking into account the regular increase of the fishing effort, the stocks will rapidly impoverish if the mesh size is not increased in an important way. The Department of Marine Affairs in Guadeloupe has fixed the minimal size of the mesh at 38 mm instead of 34 mm for fishing above 50 m deep and at 45 mm instead of 41 mm for the depths greater than 50 m. Henceforth, it appears that these increases, after several years of debate, still remain insufficient. The use of the coefficient of selectivity (Gulland, 1969) used to determine the size of the mesh of the nets, adapted to the trap gives a minimal size of 50 mm for the mesh to be recommended for the building of the traps.

LITERATURE CITED

Baelde, P., Bouchon-Navaro, Y., Louis, M. 1988. The fish communities of the Northern Bay of Guadeloupe. *Proc. VI Congr. europ. Ichthyol., Budapest* : 5 pp.

Gaut, V. C., Munro, J. L. 1974. The biology, ecology and bionomics of the Grunts, Pomadasyidae. In J.L. Munro. (ed.) *Caribbean Coral Fishery Resources*. ICLARM Studies and Reviews. 7:110-161.

Gleissberg, P. 1945. About some distributions : analysis technics. *Biometriks* (1982), 2: 420-422.

Gulland, J. A. 1969. Manuel des méthodes d'évaluation des stocks d'animaux aquatiques. Première partie : Analyse des populations. FAO *Man. Fish.*

Sci. (Fr), **4** : 160 pp.

Louis, M., Baelde, P. 1987. Fish communities in Guadeloupe mangroves. *Proc. V Congr. europ. Ichthyol.*, Stockholm : 175-180.

Munro, J.L. 1974. The mode of operation of Antillean fish traps and the relationships between ingress, escapement, catch and soak. *J. Cons., Cons. Int. Explor. Mer.* **35**: 337-350.

Reeson, P.H. 1983a. The biology, ecology and bionomics of the parrotfishes, Scaridae. In J.L. Munro. (ed.) *Caribbean Coral Fishery Resources.* ICLARM Studies and Reviews. **7**: 166-177.

Reeson, P.H. 1983b. The biology, ecology and bionomics of the surgeonfishes, Acanthuridae. In J.L. Munro. (ed.) *Caribbean Coral Fishery Resources*. ICLARM Studies and Reviews. **7**: 178-190.

Thompson, R., Munro, J.L. 1983. The biology, ecology and bionomics of the Snappers, Lutjanidae. In J.L. Munro. (ed.) *Caribbean Coral Fishery Resources*. ICLARM Studies and Reviews. **7**: 96-109.