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THE DISTRIBUTION OF THE GRAYSBY PETROMETOPON CRUENTATUM (LACEPEDE) ON THE
CORAL REEF AT THE SOUTHWEST COAST OF CURACAO

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ABSTRACT

The vertical distribution of the Graysby, Petrometopon cruentatum (Lacepede), was studied on the coral reef at the southwest coast of Curacao. Counts were made at 14 different depths, varying from 10 to 120 feet. Most Graysbys were found at depths of 25 and 30 feet. With aid of data on Rotenone poisonings it was found that the number of Graysbys actually present in a transect of 240 m² at a depth of 30 feet is 24 fishes.

Measurements were made of the percentage of bottom cover and of the quantity of coral structure. A strong correlation was found between both. For the studied coral reef in Curacao a high percentage of bottom cover means also a high quantity of structure thus of hiding places of the Graysbys. A very strong correlation ($p < 0.01$) was found between the mean number of P. cruentatum and the mean percentage of bottom cover of the coral species Montastrea annularis and Agaricia sp. Both coral species have an important influence upon the vertical distribution of P. cruentatum by their growth form, which supplies hiding possibilities, e.g., holes, overhangs, crevices.

KEY WORDS: Vertical Distribution, Petrometopon cruentatum, Counts, Bottom Cover, Quantity of Structure, Transect.

THE DISTRIBUTION OF THE GRAYSBY PETROMETOPON CRUENTATUM (LACEPEDE) ON THE CORAL REEF AT THE SOUTHWEST COAST OF CURACAO

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Introduction

Knowledge about the distribution of groupers on coral reefs and the relationship between groupers and their habitat is rather scarce.

Talbot (1) found a very clear relationship between quantity of fish and percentage of bottom cover by living coral. Tyler (2) noted, that several fish showed preference for some species of corals. Luckhurst (3) found a positive correlation between several species of coral fish and the percentage of cover of Porites porites. Nagelkerken (4) found a striking preference of a number of species of fish for either Millepora or Acropora palmata-fields.

One of the most common groupers on the coral reef along the southwest coast of Curaçao is the Graysby, Petrometopon cruentatum, a relatively small grouper with a maximum length of about 30 cm. Because of its abundance it was possible to collect a sufficiently large number of specimens to study the biology of this species.

In this paper a preliminary note is given on some aspects of the vertical distribution of P. cruentatum. All data concerning the distribution of this species, will be published next year as a part of a more extended study of the biology of P. cruentatum.

Vertical distribution of P. cruentatum

The coral reef in Curaçao is found mainly from a depth of 5 feet to a depth of 120 feet. To get information about the vertical distribution of P. cruentatum, counts were made in transects of a length of 40 m and a width of 6 m parallel to the reef at 14 different depths, namely at 120, 110, 100, 90, 80, 70, 60, 50, 40, 30, 25, 20, 15 and 10 feet. The transect-area surveyed of 40 x 6 meters was chosen for reasons of convenience, as it allowed data collection at the 14 mentioned depths during one SCUBA dive of about 45 minutes.

The length of the transect was indicated by a nylon line of 40 m laid parallel to the reef. The width of 6 m appeared to be more or less the distance between the different mentioned depths and this distance was always estimated visually during the counts.

Due to the steepness of the slope of the reef from 120 feet to 30 feet, the transects with a width of 6 meter were adjacent to each other in that depth range. Above 30 feet (the blue-edge) the slope becomes flatter, so that the reef transects between 30 and 20 feet and 20 and 10 feet were no longer adjacent. Therefore intermediate areas at a depth of 25 feet and 15 feet were counted in order to prevent gaps in the counting.

To increase the precision, counts were made

by 2 divers, who swimming side by side, were counting simultaneously.

Data were collected at 9 different stations, but most data are from the stations Pos Spaño and Portomarie. A total of 96 counts, giving the number of Graysbys, were made at each depth.

In Fig.1 total number of fish (96 counts) per 40 m transect is plotted against depth.

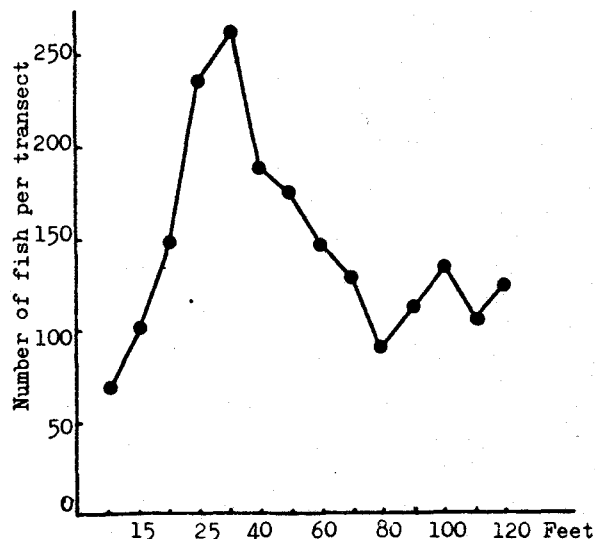


Fig.1. Total number of counted Petrometopon cruentatum per 40 m transect at 14 different depths. Each dot represents the total number of Graysbys or 96 counts.

This graph shows, that most Graysbys are found at depths of 25 and 30 feet. At depths more than 30 feet the number of Graysbys decreases gradually, with a suggestion of a second, lower maximum at a depth of 100 feet.

To estimate the total actual population of P. cruentatum per transect and per depth and to study the distribution of juveniles, collections were made with the help of Rotenone poisoning at 33 stations at different depths. In all cases, representative sampling areas of 4 x 4 m were chosen, since, according to Scheer (5), an inventory of such an area gives a reliable impression of the type of coral field as a whole.

Table 1 shows the mean number of counted fish, the mean number of collected fish and the percentage of both for four depths. The collected fish show the same vertical distribution as the counted fish. At a depth of 30 feet for instance 32% of the number of counted fish and 34% of the number of collected fish was found.

Juveniles occur exclusively from 40 up to 10 feet, with the greatest number at 20 feet. At this depth juveniles were primarily found in

Table 1. Mean number of counted fish, mean number of collected fish and the percentages of both. Percentages are given for counted and collected fishes for the mentioned four depths for a good comparison between both.

Feet	Mean number of counted fish	% of the counted fish	Mean number of collected fish	% of the collected fish
20	1.6	18	2.5	21
25	2.5	28	2.9	24
30	2.8	32	4.0	34
40	2.0	22	2.5	21

small crevices and spaces of the coral species Montastrea annularis. At this depth probably also mating occurs, because the majority of the fish population was observed to move to this depth, before and during the spawning season.

With the aid of the data of the Rotenone stations (16 m²) it was possible to calculate the number of fish actually present in areas of 240 m² at different depths. Because the inventories with Rotenone were done only at places where the cover of the two species of coral Montastrea annularis and Agaricia sp. was very high and were not done at sandy bottom because of absence of Graysbys, a correction factor was introduced to get around this difficulty.

It appeared, that the number of Graysbys actually present in a transect of 240 m² at a depth of 30 feet is 24 fishes. This number is a factor of 8.6 higher than that of the counts. This difference is caused by the great number of fishes smaller than 12 cm, which tend to hide much more in the corals than the bigger fishes, and are therefore not observed during the counts. It appears, that the Graysbys are living more in the corals than outside, which is corroborated from many field observations of holes and crevices in the corals.

Vertical distribution of *P. cruentatum* in relation to its habitat

Randall (6) suggests, that the structure and composition of the reef itself is of great importance for attracting and maintaining a population of fishes. The higher and more complex the structure and the more hiding places it provides, the greater will be the number of fishes that will live in it. Talbot (1) found a very clear relationship between quantity of fish and percentage of cover and concluded: "By the increase of both numbers of individuals and numbers of species it is clear that increased coral cover of the bottom is both enlarging niche size and also adding new niches".

For *P. cruentatum* a high percentage of coral cover not necessarily means an enlargement of the habitat because that depends on the structure of the coral species as well; for instance a field of *Madracis mirabilis* can have a high percentage of cover, but a very small quantity of coral skeleton in comparison with a field of *Montastrea annularis* (an abundant coral species in the habitat of *P. cruentatum*) with the same percentage of cover. The Graysby preferentially dwells between and under corals. The higher the coral the more places to dwell for the Graysbys. Therefore in this study the correlation between the number of fish and the percentage of coral cover is studied as well as the correlation between the number of fish and the height, resp. the quantity of the corals. Because a high quantity, derived from the height of the corals, means many hiding places, this is a measure for availability of shelter for the Graysbys.

According to Loya (7) and Porter (8) measurements were made of the percentage of bottom cover as living coral, dead coral, sponges. A measuring rope of 10 meters, divided into centimeter marks, was laid parallel to the reef and the number of centimeters covering each coral species or each other kind of bottom cover, was counted. This was done at all 14 mentioned depths.

The heights of the coral structures was measured along the same 10 meter rope. At each half meter of the rope an iron measuring rod, divided into decimeter marks, was pushed to the bottom and the height of the structure was read on the rod and noted. Using these figures the area of this profile was calculated in square meters. With the aid of the width of the transects (6 m) a calculation could be made in cubic meters of quantity of structure (i.e. quantity of shelter) available for the Graysbys. The measurements of quantity of structure were made at the 9 stations, mentioned earlier, along the southwest coast of Curaçao, where Graysbys were counted.

In Fig.2 the mean quantity of structure in the transects is plotted against the percentage of bottom cover. The regression line was calculated. A strong correlation was found between both parameters ($r=0.90$). For the studied coral reef in Curaçao, it can be also concluded, that a high percentage of cover means a high percentage of structure and thus of hiding places. It should be mentioned, that although a linear regression was computed, the data indicate a better fit with some non-linear relation, in which the quantity of structure increases more rapidly than the % bottom cover.

In Fig.3 the mean number of counted fish per 40 m transect, the mean quantity of structure and the percentage of total bottom cover are plotted against depth.

The figures in the graph show a similar vertical distribution. The correlation between the mean number of fish and the mean quantity of structure as well as the mean number of fish and the percentage of total bottom cover was significant at the 0.05 level.

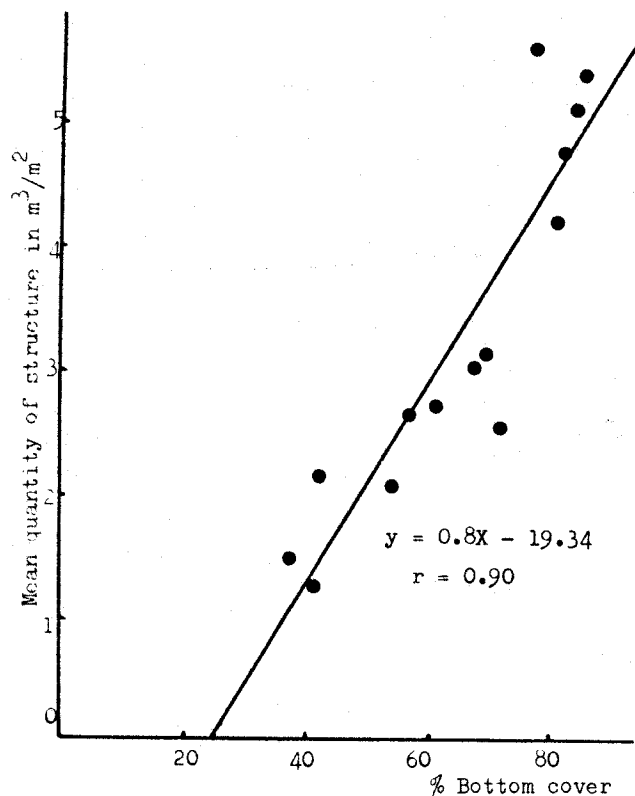


Fig.2. Relationship between the mean quantity of structure and the percentage of bottom cover for all stations ($n=9$).

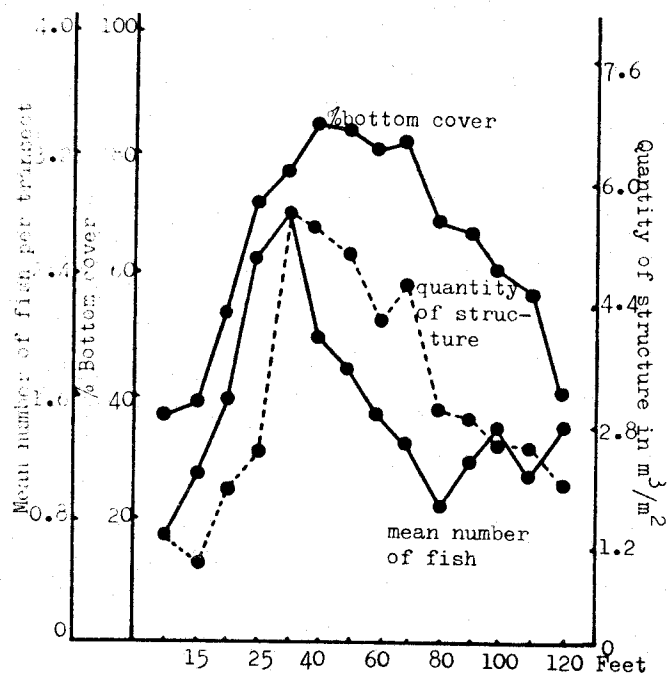


Fig.3. Relationship between the vertical distribution of the mean number of Graysbys ($n=96$), the mean % of bottom cover and the mean quantity of structure.

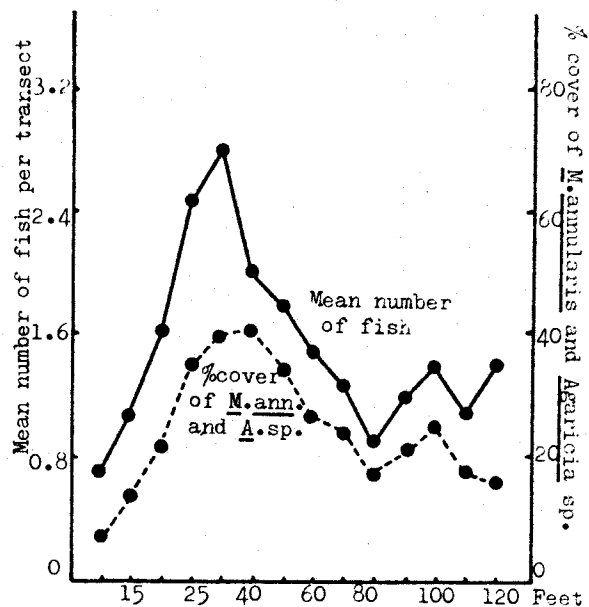


Fig.4. Relationship between the vertical distribution of *P. cruentatum* and the % bottom cover of two species of coral *Montastrea annularis* and *Agaricia* sp. for all stations ($n=9$).

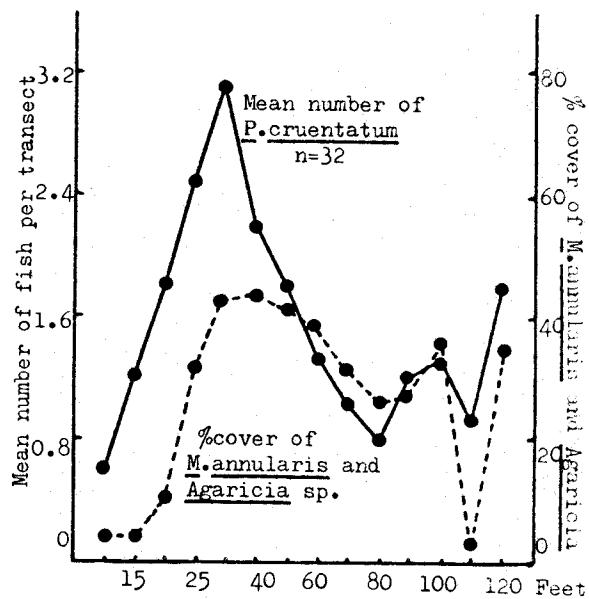


Fig.5. Relationship between the vertical distribution of *P. cruentatum* and the % bottom cover of two species of coral *Montastrea annularis* and *Agaricia* sp. for the station Pos Spaño.

It appears that the coral species *Montastrea annularis* and several species of *Agaricia* (*Agaricia* sp.) because of their growth form, are particularly suited to supply hiding places for the Graysbys.

In Fig.4 the mean number of *P. cruentatum* and

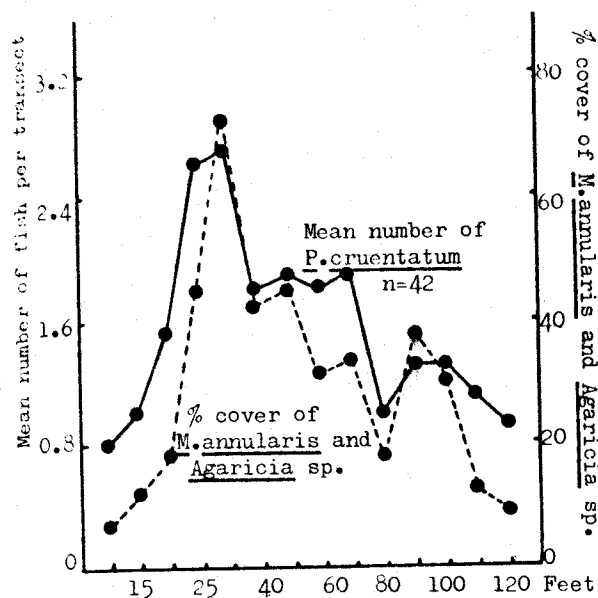


Fig.6. Relationship between the vertical distribution of *P. cruentatum* and the % bottom cover of two species of coral *Montastrea annularis* and *Agaricia* sp. for the station Portomarie.

the mean percentage of bottom cover of *M. annularis* and *Agaricia* sp. is plotted against the different depths. A very strong correlation was found between both ($p < 0.01$).

The earlier mentioned secondary maximum of the number of fish at a depth of 100 feet, appears here to be correlated with a peak in the percentage of bottom cover of these coral species. At this depth the higher percentage of cover is especially caused by the coral *Agaricia* sp. (1% bottom cover of *M. annularis* and 24% bottom cover of *Agaricia* sp. respectively).

This correlation also can be found when data of some well sampled separate stations are presented. Therefore, in Fig.5 and Fig.6 the mean number of fish and the percentage of bottom cover of *M. annularis* and *Agaricia* sp. are plotted against depth for the station Pos Spaño and Portomarie respectively. At both stations a high correlation was found between the mean number of fish and the percentage of bottom cover of both coral species ($p < 0.01$).

Conclusion

It can be concluded, that the corals *Montastrea annularis* and *Agaricia* sp. have an important influence upon the vertical distribution of *P. cruentatum* by their growth form, which supplies hiding possibilities e.g. holes, overhangs, crevices.

For the coral reef in Curaçao this quantity of hiding possibilities can be derived from the percentage of cover, because a strong correlation was found between percentage of cover and

quantity of structure.

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References

- (1) F. H. Talbot, 1965. A description of the coral structure of Tutia reef (Tanganyika territory, East Africa), and its fish fauna. *Proc. Zool. Soc. London* 145: 431-470.
- (2) J. C. Tyler, 1971. Habitat preferences of the fishes that dwell in shrub corals on the Great Barrier Reef. *Proc. Acad. Nat. Sci. Phila.*, Vol. 123, no. 1.
- (3) B. Luckhurst, 1972. Reef fish populations on small coral heads with special reference to the territoriality of *Eupomacentrus fuscus*. Thesis, McGill University, Montreal, Quebec.
- (4) W. P. Nagelkerken, 1974. On the occurrence of fishes in relation to corals in Curaçao. *Stud. Fauna Curaçao*, Vol. XLV: 118-141.
- (5) G. Scheer, 1967. Über die Methodik der Untersuchung von Korallenriffen. *Z. Morph. Oekol. Tiere* 60: 105-114.
- (6) J. E. Randall, 1963. An analysis of the fish populations of artificial and natural reefs in the Virgin Islands. *Caribb. J. Sci.* 3: 31-47.
- (7) Y. Loya, 1972. Community structure and species diversity of hermatypic corals at Eilat, Red Sea. *Mar. Biol.* 13: 100-123.
- (8) J. W. Porter, 1972. Patterns of species diversity in Caribbean reef corals. *Ecology* 53: 745-748.