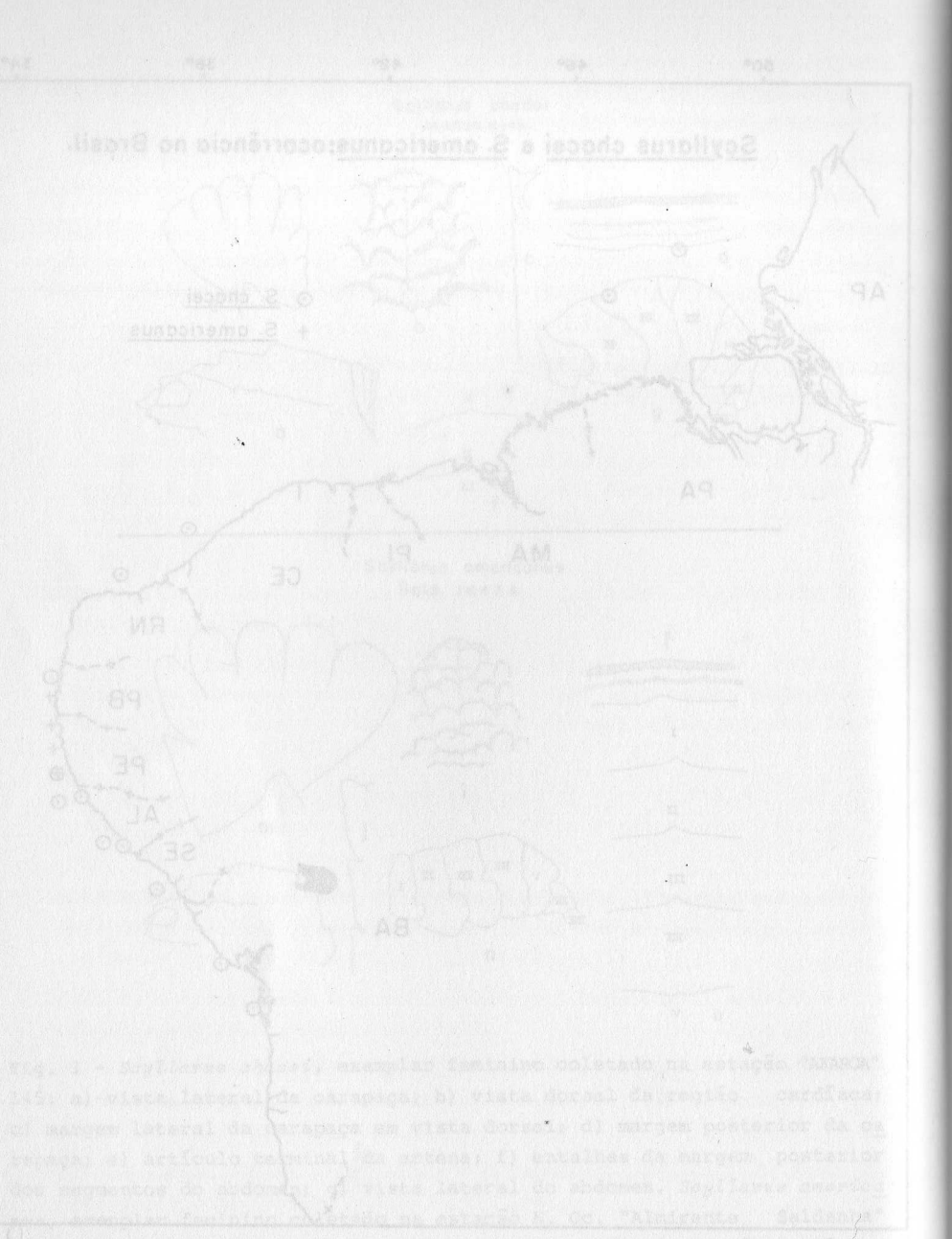

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RECRUITMENT OF COLONIES OF *CAMPANULARIA MARGINATA* (ALLMAN, 1888) (HYDROZOA, HYDROIDA)*

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SUMMARY

Recruitment experiments were made with the calyptoblastic hydroid *Campanularia marginata* (Allman, 1888) in habitat of marine Phanerogams. The site chosen was infralitoral of the "inner sea" of the beach of Bom Jesus on the Island of Itamaracá (northern Coast of the state of Pernambuco). Besides the *Halodule* Endlicher, 1841 itself, we used artificial substrata, which were placed in various selected subareas. We observed these subareas during four periods and counted the colonies. Yet we were not always able to gather the substrata that we had placed, for they frequently were lost.

Parallel to these field experiments, we made others in the laboratory, verifying the selection of the planulae of *C. marginata* with substrata identical to those used by us in the field and with others that were not used there.

Although the results are only partial, it was possible to verify that in general (except for *Halodule*) the substrata chosen in the laboratory were the same as those that were chosen on the field.

* Trabalho realizado no Departamento de Oceanografia da UFPE.

SINOPSE

Foram realizados experimentos de recrutamento com o hidróide Calyptoblástico *Campanularia marginata* (Allman, 1888) em um prado de Fanerógamas marinhas. O local escolhido foi o infralitoral do "mar-de-dentro" da praia do Bom Jesus na Ilha de Itamaracá (litoral norte do Estado de Pernambuco). Utilizamos além da própria *Halodule* Endlicher, 1841, substratos artificiais, que foram colocados em várias subáreas escolhidas. Durante quatro períodos observamos estas subáreas e contamos colônias. No entanto, não tivemos sempre os substratos por nós colocados, porque freqüentemente houve perda dos mesmos.

Paralelamente a estes experimentos de campo, realizamos outros em laboratório, verificando a seleção da plânula de *C. marginata*, por substratos idênticos aos usados por nós em campo e outros que não utilizamos em campo.

Apesar de termos um resultado parcial, foi possível verificar que em geral (com exceção da *Halodule*) os substratos escolhidos em laboratório, foram os mesmos escolhidos em campo.

INTRODUCTION

The purpose of this work was to verify in the planulae of this hydroid were affixing themselves to the rhizomes of *Halodule* because there was no other option at the site or if there was really an intentional choice of substrata on the part of the larvae, thus coming to a better understanding of the behaviour of the colonies. Parallel studies on the selection of substrata were also made. For this reason we made experiments with *Halodule* and with artificial substrata.

Initially we made some experiments with the purpose of verifying if the techniques were applicable at the site.

SITE OF THE WORK

The site chosen for the experiments in situated on the infralitoral of the "inner sea" of the beach of Bom Jesus (island of Itamaracá), approximately 500 meters from the coast. The bottom is constituted of fine quartzous sand, rich in $CaCO_3$ due to the presence of mollusk shell fragments and of the algae Chlorophyceae *Halimeda* Lamouroux, 1812. This area is the habitat of marine phanegorams of the species *Halodule* which however do not come to form a thick matlike ("matte") net of rhizomes (like those cited by Laborel-Deguen, 1963), on the Pernambucan infralitoral zone which is rarely uncovered by the low

tide. The plants of *Halodule* vary in height between 10 and 40 centimeters.

MATERIAL AND METHODS

FIELD

The colonies of *C. marginata* studied were found affixed to rhizomes of *Halodule*. After the initial experiments which were to ensure the viability of this study, four subareas were initially chosen and later eight subareas (each 2/2 or 1,5 by 1,0 meters in size). Each subarea received an equal treatment. *Halodule* plants were pulled from a square of 400 cm^2 and all the colonies of *C. marginata* were removed from their rhizomes. The plants were replanted, and a band of sand about 50 centimeters wide was left around them. Around this band another, approximately 30 centimeters wide, was left, containing *Halodule* plants with *C. marginata* in reproduction. Within the band of *Halodule* with *C. marginata* in reproduction were placed artificial substrata such as tire, glass (smooth and rough), eternit (asbestos - cement roofing material), cement (blocks), straw, PVC, Calcareous algae (dead blocks) and wood. The artificial substrata and the plants of *Halodule* were examined after 15, 30, 45, 60 and 90 days, and number of young colonies was counted in an area 20 cm by 20 cm in each artificial substratum as well as in a similar area containing the plants of *Halodule*. The analysis of variance (Test F) (Snedecor & Cochran, 1977) was made to compare the number of colonies per substratum in each experiment when it was necessary to decide if the apparent difference between the values of two substrata were significant or not a *t* test was applied for samples of unequal size. This type of test was made use of due to the frequent loss of substrata, which did not permit us to compare samples of equal size.

LABORATORY

Colonies of *C. marginata* in reproduction were brought to the laboratory and all the remaining predators were removed (some had been removed at the site of the collection) as well as the rest of the epifauna. Next the colonies were distributed among aquariums or crystallizers with seawater circulating in their interior and with adequate aeration. The salinity was similar to that encountered on the field. The aquariums were maintained at room temperature (26-29°C) and covered with sheets of glass in order to avoid excessive evaporation and

the consequent increase in salinity.

The planulae were removed from these aquariums or crystallizers with pipettes, and placed in the crystallizers or aquariums properly prepared with substrata. The planulae were considered to be affixed to the substratum after they had remained immobile for 24 hours and were already showing modifications in their shape.

RESULTS

FIELD

The number of colonies of *C. marginata* with colonized each of the substrata in each subarea during the four periods, is recorded in tables 1 throungh 4. Table 5 presents the total of the colonies per substratum in each observation period while table 6 contains the values of X and S per substratum in each observation period. The analysis of the variance among the substrata is found in table 7. Fig. 1 to 4 presents semilogarithmic graphs of the average number of colonies per substratum in each observation period. Figs. 5 to 8 are semilogarithmic graphs of the average number of colonies per subarea in each period of observation.

The analysis of variance indicates significant differences between the diverse substrata in any of the experiments.

The first period of observation and analysis of variance (table 7) shows that after 15 days, when only those on the substrata of tire, PVC and "eternit" were counted, no significant difference was observed 0,05 between these. During subsequent countings (30, 45, 60 and 90 days) not only did the values obtained for "eternit" and tire increase substantially, but also the entrance of *Halodule* occurred. There the difference were significant at 0,01. After 15 days the order of preference was "eternit" (not a significant difference from the other substrata), tire and PVC. After 30 and 45 days the most preferred were *Halodule* and "eternit", them tire and finally PVC. After 60 days and 90 days *Halodule* was first (average much grater, but not a significant difference from "eternit"), second came "eternit", then tire and last PVC. During the second period of observation the ana - lysis of variance (table 7) shows that significant difference always occured between the diverse substrata. The order of preference for substrata (Fig. 1-4) follows. After 15 days the first was smooth glass (but not significantly different from the second), secondly came

Table 1 Number of colonies of *C. marginata* per substratum in each subarea during the period of November 1976 to January, 1977.

- = lost substratum

0 = rejected substratum

§ = colonies not counted

3rd Subarea

Days	tire	PVC	Asbestos-Cement roofing material	Cement	*Halodule*	Calcareous algae	Wood	Straw
15	3	-	11	0	§	-	0	0
30	7	-	11	0	15	-	0	0
45	7	-	12	0	15	-	0	0
60	7	-	12	0	15	-	0	0
90	7	-	12	0	15	-	0	0

Days	tire	PVC	Asbestos-Cement roofing material	Cement	*Halodule*	Calcareous algae	Wood	Straw
15	9	3	13	0	§	-	0	0
30	9	5	13	0	15	-	0	0
45	9	5	14	0	21	-	0	0
60	9	5	14	0	21	-	0	0
90	9	5	15	0	25	-	0	0

Table 1 Number of colonies of *C. marginata* per substratum in each sub-area during the period of November 1976 to January 1977. (Cont.)

- = lost substratum
0 = rejected substratum
§ = colonies not counted

1st Subarea

Days	Tire	PVC	Asbestos-cement roofing material	Cement	*Halodule*	Calcareous algae	Wood	Straw
15	3	2	4	1	§	3	0	0
30	9	3	23	1	30	3	0	0
45	9	3	21	1	33	3	0	0
60	9	3	21	1	40	3	0	0
90	9	3	21	1	41	3	0	0

2nd Subarea

Days	Tire	PVC	Asbestos-cement roofing material	Cement	*Halodule*	Calcareous algae	Wood	Straw
15	3	1	3	0	§	-	0	0
30	5	2	15	0	15	-	0	0
45	7	1	23	0	17	-	0	0
60	7	1	22	0	17	-	0	0
90	7	1	19	0	21	-	0	0

Table 2 Number of colonies of *C. marginata* per substratum in each sub-area during the period of March to May 1977.

- = lost substratum
0 = rejected substratum
§ = colonies not counted

1st Subarea

Days	tire	PVC	Asbestos-Cement roofing-Cement	Cement	Glass rough	Glass smooth	*Halodule*	Calcareous algae	Wood	Straw
15	2	2	4	0	2	5	§	-	0	0
30	7	2	4	0	2	11	15	-	0	0
45	7	5	7	0	-	-	23	-	0	0
60	7	5	9	0	-	-	23	-	0	0
90	7	5	9	0	-	-	23	-	0	0

2nd Subarea

Days	tire	PVC	Asbestos-Cement roofing-Cement	Cement	Glass rough	Glass smooth	*Halodule*	Calcareous algae	Wood	Straw
15	-	-	3	0	-	-	§	7	0	0
30	-	-	5	0	-	-	9	9	0	0
45	-	-	9	0	-	-	11	9	0	0
60	-	-	9	0	-	-	11	9	0	0
90	-	-	9	0	-	-	11	9	0	0

Table 2 Number of colonies of *C. marginata* per substratum in each subarea during the period of March to May 1977 (Cont.)

- = lot substratum
0 = rejected substratum
§ = colonies not counted

3rd Subarea

Days	tire	PVC	Asbestos-Cement roofing-Cement	Cement	Glass rough	Glass smooth	*Halodule*	Calcareous algae	Wood	Straw
15	-	3	7	0	-	-	§	3	0	0
30	-	7	15	0	-	-	11	15	0	0
45	-	7	17	0	-	-	11	17	0	0
60	-	9	17	0	-	-	11	17	0	0
90	-	11	17	0	-	-	11	20	0	0

4th Subarea

Days	tire	PVC	Asbestos-Cement roofing-Cement	Cement	Glass rough	Glass smooth	*Halodule*	Calcareous algae	Wood	Straw
15	3	5	6	0	5	10	-	0	0	0
30	7	9	11	0	9	14	-	0	0	0
45	7	11	11	0	11	23	-	5	0	0
60	7	11	11	0	11	23	-	15	0	0
90	7	11	11	0	10	23	-	15	0	0

Table 2 Number of colonies of *C. marginata* per substratum in each subarea during the period of March to May 1977 (Cont.).

- = lost substratum
0 = rejected substratum
§ = colonies not counted

5th Subarea

Days	tire	PVC	Asbestos-Cement roofing material	Cement	Glass rough	Glass smooth	*Halodule*	Calcareous algae	Wood	Straw
15	2	7	7	0	-	7	§	0	0	0
30	1	7	9	0	-	9	10	3	0	0
45	2	7	9	0	-	15	15	7	0	0
60	2	7	9	0	-	15	19	7	0	0
90	2	7	9	0	-	17	19	9	0	0

6th Subarea

Days	tire	PVC	Asbestos-Cement roofing material	Cement	Glass rough	Glass smooth	*Halodule*	Calcareous algae	Wood	Straw
15	2	3	3	0	7	10	§	-	0	0
30	3	5	5	0	9	15	15	-	0	0
45	3	5	5	0	9	17	21	-	0	0
60	3	5	5	0	9	17	21	-	0	0
90	3	5	5	0	9	17	21	-	0	0

Table 2 Number of colonies of *C. marginata* per substratum in each subarea during the period of March to May 1977 (Cont.).

- = lost substratum
0 = rejected substratum
§ = colonies not counted

7th Subarea

Days	tire	PVC	Asbestos-Cement roofing material	Cement	Glass rough	Glass smooth	*Halodule*	Calcareous algae	Wood	Straw
15	2	3	9	0	7	13	§	0	0	0
30	2	4	11	0	9	17	12	0	0	0
45	2	4	13	0	9	19	13	7	0	0
60	2	7	13	0	9	19	13	7	0	0
90	2	7	15	0	9	21	15	7	0	0

8th Subarea

Days	tire	PVC	Asbestos-Cement roofing material	Cement	Glass rough	Glass smooth	*Halodule*	Calcareous algae	Wood	Straw
15	1	2	7	0	3	9	§	-	0	0
30	1	5	9	0	7	21	15	-	0	0
45	1	5	9	0	7	27	15	-	0	0
60	1	5	9	0	11	27	15	-	0	0
90	1	5	11	0	11	31	15	-	0	0

Table 3 Number of colonies of *C. marginata* per substratum in each subarea during the period of September to November 1977.

- = lost substratum
0 = rejected substratum
§ = colonies not counted

1st Subarea

Days	tire	PVC	Asbestos-Cement roofing material	Glass rough	Glass smooth	*Halodule*	Wood	Straw
15	-	2	5	0	4	§	0	0
30	-	3	11	0	11	11	0	0
45	-	3	11	1	11	15	0	0
60	-	7	11	3	11	17	0	0
90	-	7	13	3	11	17	0	0

2nd Subarea

Days	tire	PVC	Asbestos-Cement roofing material	Glass rough	Glass smooth	*Halodule*	Wood	Straw
15	1	3	5	0	0	§	0	0
30	1	3	5	0	7	12	0	0
45	1	3	6	3	9	12	0	0
60	1	3	6	5	9	12	0	0
90	1	3	6	5	9	12	0	0

Table 3 Number of colonies of *C. marginata* per substratum in each sub - area during the period of September to November 1977 (Cont.)

- = lost substratum
0 = rejected substratum
§ = colonies not counted

3rd Subarea

Days	tire	PVC	Asbestos-Cement roofing material	Glass rough	Glass smooth	*Halodule*	Wood	Straw
15	0	2	7	0	9	§	0	0
30	0	2	7	0	9	11	0	0
45	3	7	7	0	9	11	0	0
60	3	7	7	3	11	13	0	0
90	3	9	7	3	11	13	0	0

Days	tire	PVC	Asbestos-Cement roofing material	Glass rough	Glass smooth	*Halodule*	Wood	Straw
15	1	1	1	1	5	§	0	0
30	1	1	1	1	9	14	0	0
45	1	1	3	1	9	14	0	0
60	1	1	3	1	11	14	0	0
90	3	1	3	2	14	14	0	0

Table 3 Number of colonies of *C. marginata* per substratum in each sub - area during the period of September to November 1977 (Cont.)

- = lost substratum
0 = rejected substratum
§ = colonies not counted

5th Subarea

Days	tire	PVC	Asbestos-Cement roofing material	Glass rough	Glass smooth	*Halodule*	Wood	Straw
15	0	-	0	3	9	§	0	0
30	0	-	0	3	9	11	0	0
45	0	-	7	3	9	14	0	0
60	0	-	7	3	11	14	0	0
90	0	-	7	7	11	17	0	0

6th Subarea

Days	tire	PVC	Asbestos-Cement roofing material	Glass rough	Glass smooth	*Halodule*	Wood	Straw
15	3	1	5	1	3	§	0	0
30	5	3	9	1	7	7	0	0
45	5	3	9	1	15	9	0	0
60	5	3	13	1	17	9	0	0
90	5	3	13	1	17	9	0	0

Table 3 Number of colonies of *C. marginata* per substratum in each sub - area during the period of September to November 1977 (Cont.)

- = lost substratum
0 = rejected substratum
§ = colonies not counted

7th Subarea

Days	tire	PVC	Asbestos-Cement roofing material	Glass rough	Glass smooth	*Halodule*	Wood	Straw
15	1	0	3	4	6	§	0	0
30	1	0	3	4	9	13	0	0
45	1	0	3	4	9	13	0	0
60	1	0	3	7	9	13	0	0
90	1	7	8	7	12	13	0	0

8th Subarea

Days	tire	PVC	Asbestos-Cement roofing material	Glass rough	Glass smooth	*Halodule*	Wood	Straw
15	2	3	0	4	10	§	0	0
30	5	8	0	4	16	0	0	0
45	5	11	11	5	16	11	0	0
60	5	11	11	5	16	19	0	0
90	5	11	16	5	22	19	0	0

Table 4 Number of colonies of *C. marginata* per substratum in each sub - area during the period of December 1977 to February 1978.

- = lost substratum
0 = rejected substratum
§ = colonies not counted

1st Subarea

Days	tire	PVC	Asbestos-Cement roofing material	Glass rough	Glass smooth	*Halodule*	Wood
15	3	5	3	3	10	§	0
30	3	5	5	3	15	7	0
45	3	8	11	7	27	12	0
60	3	10	21	9	33	20	0

Days	tire	PVC	Asbestos-Cement roofing material	Glass rough	Glass smooth	*Halodule*	Wood
15	1	3	7	5	15	§	0
30	1	3	11	5	25	15	0
45	1	3	17	5	33	15	0
60	1	9	21	6	41	22	0

Table 4 Number of colonies of *C. marginata* per substratum in each during the period of December 1977 to February 1978 (Cont.).

- = lost substratum
0 = rejected substratum
§ = colonies not counted

3rd Subarea							
Days	tire	PVC	Asbestos-Cement roofing material	Glass rough	Glass smooth	*Halodule*	Wood
15	3	1	6	1	18	§	0
30	3	7	6	1	23	18	0
45	5	8	6	5	23	18	0
60	7	8	6	5	28	24	0

4th Subarea							
Days	tire	PVC	Asbestos-Cement roofing material	Glass rough	Glass smooth	*Halodule*	Wood
15	1	3	11	3	19	§	0
30	1	7	17	3	28	11	0
45	1	16	17	3	33	14	0
60	5	16	20	8	37	14	0

Table 4 Number of colonies of *C. marginata* per substratum in each sub - area during the period of December 1977 to February 1978 (Cont.).

- = lost substratum
0 = rejected substratum
§ = colonies not counted

5th Subarea							
Days	tire	PVC	Asbestos-Cement roofing material	Glass rough	Glass smooth	*Halodule*	Wood
15	3	0	4	1	21	§	0
30	3	0	8	7	27	15	0
45	3	0	8	9	36	23	0
60	3	0	15	9	41	23	0

6th Subarea							
Days	tire	PVC	Asbestos-Cement roofing material	Glass rough	Glass smooth	*Halodule*	Wood
15	-	-	7	-	-	§	0
30	-	-	9	-	-	9	0
45	-	-	9	-	-	10	0
60	-	-	9	-	-	12	0

Table 4 Number of colonies of *C. marginata* per substratum in each sub - area during the period of December 1977 to February 1978(Cont.).

- = lost substratum

0 = rejected substratum

§ = colonies not counted

7th Subarea

Days	tire	PVC	Asbestos-Cement roofing material	Glass rough	Glass smooth	*Halodule*	Wood
15	-	5	0	-	-	§	0
30	-	5	0	-	-	5	0
45	-	5	7	-	-	16	0
60	-	5	7	-	-	16	0

8th Subarea

Days	tire	PVC	Asbestos-Cement roofing material	Glass rough	Glass smooth	*Halodule*	Wood
15	-	-	3	-	0	§	0
30	-	-	3	-	11	9	0
45	-	-	3	-	11	9	0
60	-	-	3	-	19	12	0

rough glass, calcareous algae, "eternit" and PVC, while tire came third. After 30 days the order was smooth glass and *Halodule* (not significantly different from calcareous algae, although the values were very variable, and from "eternit"), then calcareous algae and "eternit" (very variable values, not significantly different from the third) and thirdly rough glass, PVC and tire. After 45 days the foremost were smooth glass and *Halodule* (not a significant difference from calcareous algae, which however had very variable values, and from "eternit"); second came calcareous algae and "eternit" (very variable values which did not differ significantly from the third ones) and rough glass (wich was significantly different from PVC); third were PVC and tire. After 60 days the smooth glass was leading (not significantly different from *Halodule*); second was *Halodule* (although the difference from calcareous algae "eternit" was not significant); third came calcareous algae and "eternit" (with no significant difference from the fourth) and rough glass (which differed notably from the fourth); fourth was PVC (not significantly different from tire); fifth was tire. After 90 days the foremost was the smooth glass (not significantly different from *Halodule*); second was *Halodule* (although the difference from calcareous algae and "eternit" was not significant); third were calcareous algae and rough glass; fourth was PVC (not significantly different from tire); fifht was tire.

During the third period the analysis of variance (table 7) shows that significant differences between the various substrata always ocurred in any of the experiments. The order of preference for the substrata (Fig. 3) was as follows. After 15 days the first was smooth glass, the second were "eternit", smooth glass and PVC (not significant differences) and the third was tire. After 30 days *Halodule* came first with smooth glass (with no significant differences), then came "eternit" (with no significant difference from smooth glass) and third were tire, PVC and rough glass. After 45 days the foremost were *Halodule* and smooth glass (no significant difference), second were "eternit" (no significant difference from the smooth glass) and PVC, and third were tire and rough glass. After 60 days the leaders were *Halodule* and smooth glass; second were "eternit" (not significantly different from smooth glass) and PVC; third were rough glass and tire (significant differences from "eternit" and not significant ones from PVC). After 90 days the first were *Halodule* and smooth glass, the second were "eternit" (not significantly different from the first) and PVC, while the third were rough glass and tire (no significant difference only from PVC). During the fourth observation period the analysis of variance (table 7) shows that significant differences bet

ween the various substrata always occurred in any of the experiments. The order of preference for the substrata (Fig. 4) was as follows. After 15 days the foremost was smooth glass the second were "eternit", PVC and rough glass, and the third was tire (not significantly different from PVC and rough glass). After 30 days the order was smooth glass, then *Halodule* (not significantly different from tire), and third tire. After 45 days, the first was smooth glass; the second was *Halodule* (not significantly different from the third ones, although the average was much better); the third were "eternit" and PVC (not significantly dif - ferent from the fourth ones); the fourth were rough glass and tire. After 60 days, the first was smooth glass, the second was *Halodule* (not significantly different from the third ones, but the average is much better), the third were "eternit", PVC and rough glass while the fourth was tire.

The significant of the differences between every two substrata was verified by a *t* test, with a probability of error equal to or less than 0,05.

When we compared the diverse subareas in the periods conside - red, we did not take into account the quality of the substratum, but rather the average number of colonies in each subarea, with the purpose of comparing the various subareas with each other (Fig. 5-8). The great standard deviation is attributed to the large difference between the colonization of the glasse substrata and *Halodule* (after 15 days) and the rest.

LABORATORY

In the laboratory diverse experiments were made on the choice of substrata by the planulae.

The analysis of variance indicates significant diferences among the diverse substrata in any of the experiments (to the level of 0,01). In the laboratory tests, the diferences between the substrata were proved by a *t* test and the result was significant to 0,01.

The order of preference of the substrata follows. In the first experiment the foremost was smooth glass, second came PVC, third was calcareous algae, the fourth was "eternit", the fifth was rough glass, the sixth was ceramic roofing tile, the seventh was plastic, and the eighth was tire. In the second experiment the leader was smooth glass, second "eternit", third calcareous algae, fourth PVC, fifth rough glass, sixth ceramic roofing tile and plastic. In the third experiment the first was smooth glass, second "eternit", third PVC, fourth calcareous

Table 5 Total number of colonies of C. mespinata per substratum during each period of observation.

- = lost substratum
0 = rejected substratum
§ = colonies not counted

Nov.-Dec./76 - Jan./77

Days	tire	PVC	Asbestos-Cement roofing material	Cement	*Halodule*	Calcareous algae	Wood	Straw
15	18	6	11	1	§	0	0	0
30	30	10	62	1	75	3	0	0
45	32	9	70	1	86	3	0	0
60	32	9	69	1	93	3	0	0
90	32	9	67	1	102	3	0	0

March-April-May/1977

Days	tire	PVC	Asbestos-Cement roofing material	Glass rough	Glass smooth	Cement	*Halodule*	Calcareous algae	Wood	Straw
15	12	25	43	24	54	0	§	10	0	0
30	21	39	51	36	87	0	87	27	0	0
45	22	44	80	36	101	0	109	45	0	0
60	22	49	82	40	101	0	113	55	0	0
90	22	51	85	39	109	0	115	64	0	0

Table 5 Total number of colonies of *C. marginata* per substratum during each period of observation (Cont.).

- = lost substratum
0 = rejected substratum
§ = colonies not counted

Sept.-Oct.-Nov./1977

Days	tire	PVC	Asbestos-Cement roofing material	Glass rough	Glass smooth	Cement	*Halodule*	Calcareous algae	Wood	Straw
15	7	12	26	13	46	0	§	-	0	0
30	13	17	36	13	77	0	83	-	0	0
45	16	28	57	18	87	0	99	-	0	0
60	16	32	61	28	95	0	111	-	0	0
90	21	41	73	33	107	0	114	-	0	0

Dec./77 - Jan.-Fev./1978

Days	tire	PVC	Asbestos-Cement roofing material	Glass rough	Glass smooth	Cement	*Halodule*	Calcareous algae	Wood
15	11	17	41	13	83	0	§	0	0
30	11	27	59	19	129	0	89	0	0
45	13	40	75	29	163	0	117	0	0
60	19	55	102	37	199	0	143	0	0

Table 6 Values of X and S per substratum during each observation period.

November-December/1976 - January/1977

Days	tire		PVC		Asbestos-Cement roofing material		*Halodule*	
	X	S	X	S	X	S	X	S
15	4.50	3.00	2.00	1.00	7.75	4.99	18.75	7.50
30	7.50	1.92	3.33	1.53	15.50	5.26	21.50	8.06
45	8.00	1.15	3.00	2.00	17.50	5.32	21.50	8.06
60	8.00	1.15	3.00	2.00	17.25	4.99	23.25	11.44
90	8.00	1.15	3.00	2.00	16.75	4.03	25.50	11.12

March-April-May/1977

Days	tire		PVC		Asbestos-Cement roofing material		Glass rough		Glass smooth		*Halodule*		Calcareous algae	
	X	S	X	S	X	S	X	S	X	S	X	S	X	S
15	2.00	0,63	3,57	1,81	5,75	2,19	4,80	2,28	9,00	2,77	-	-	5,00	2,83
30	3,50	2,81	5,57	2,29	8.63	3,78	7,20	3,03	14,50	4,28	12,43	2,57	9,00	6,00
60	3,67	2,65	7,00	2,31	10,25	3,74	10,00	1,15	20,20	4,82	16,14	4,88	11,00	4,69
90	3,67	2,65	7,29	2,69	10,75	3,77	9,75	0,96	21,80	5,76	16,42	4,72	12,80	4,71

Table 6 Values of X and S per substratum during each observation period (Cont.).

September-October-November/1977

Days	tire		PVC		Asbestos-Cement roofing material		Glass rough		Glass smooth		*Halodule*	
	X	S	X	S	X	S	X	S	X	S	X	S
15	1,40	0,89	2,00	0,89	4,33	2,07	2,60	1,52	6,57	2,76	-	-
30	2,60	2,19	3,33	2,42	6,00	3,74	2,60	1,52	9,62	2,87	11,28	2,21
45	2,67	1,97	4,67	3,67	7,12	3,14	2,57	1,62	9,50	2,78	12,37	1,99
60	2,67	1,97	5,33	3,67	7,62	3,74	3,50	2,07	11,87	3,00	13,87	3,04
90	3,00	1,63	5,86	3,63	9,12	4,39	4,12	2,23	13,37	4,24	13,87	3,24

December/1977 - January-February/1978

Days	tire		PVC		Asbestos-Cement roofing material		Glass rough		Glass smooth		*Halodule*	
	X	S	X	S	X	S	X	S	X	S	X	S
15	2,20	1,10	4,00	2,10	5,86	2,85	2,60	1,67	16,60	4,28	-	-
30	2,20	1,10	5,40	1,67	8,42	4,61	3,80	2,28	21,50	6,92	11,12	4,49
45	2,60	1,67	8,00	4,95	9,86	5,43	5,80	2,28	27,16	9,22	14,62	4,35
60	3,80	2,28	9,17	3,76	12,75	7,38	7,40	1,82	34,17	9,89	17,87	5,01

Table 7. Analysis of the variance between substrata on the field

15 days — Period: Nov-Dec/76-Jan/77

Source	G. L.	S. Q.	Q. M.	F
Total	10	325,64		
Substrata	2	11,89	5,94	0,15 m/s 0,05
Plates/Substratum	8	313,75	39,21	

30 days

Source	G. L.	S. Q.	Q. M.	F
Total	15	877,00		
Substrata	4	609,55	152,38	6,27 s/0,01
Plates/Substratum	11	267,45	24,31	

45 days

Source	G. L.	S. Q.	Q. M.	F
Total	15	1158		
Substrata	4	866	216,50	8,16 s/0,01
Plates/Substratum	11	292	26,54	

60 days

Source	G. L.	S. Q.	Q. M.	F
Total	15	1.471,75		
Substratum	4	992,25	248,06	5,69 s/0,01
Plates/Substratum	11	479,50	43,60	

Table 7. Analysis of the variance between substrata on the field(cont.)

90 days — Period: Nov-Dec./76-Jan./77

Source	G. L.	S. Q.	Q. M.	F.
Total	15	1.611,44		
Substratum	4	1.179,69	294,92	7,51 s/0,01
Plates/Substratum	11	431,75	39,25	

15 days — Period: March-April-May/77

Source	G. L.	S. Q.	Q. M.	F.
Total	33	320,88		
Substratum	5	165,49	33,10	5,96 s/0,01
Plates/Substratum	28	155,39	5,55	

30 days

Source	G. L.	S. Q.	Q. M.	F.
Total	41	1.258,57		
Substratum	6	577,47	96,24	4,94 s/0,01
Plates/Substratum	35	681,10	19,46	

45 days

Source	G. L.	S. Q.	Q. M.	F.
Total	41	1.564,12		
Substratum	6	1.076,83	179,47	12,90 s/0,01
Plates/Substratum	35	487,29	13,92	

Table 7. Analysis of the variance between substrata on the field(cont.)

60 days — Period: March-April-May/77

Source	G. L.	S. Q.	Q. M.	F.
Total	41	1.534,00		
Substrata	6	1.051,51	175,25	12,72 s/0,01
Plates/Substrata	35	482,49	13,78	

90 days

Source	G. L.	S. Q.	Q. M.	F.
Total	41	1.777,41		
Substrata	6	1.219,69	203,28	12,76 s/0,01
Plates/Substratum	35	557,72	15,93	

15 days — Period: Sept.-Oct.Nov. /77

Source	G. L.	S. Q.	Q. M.	F.
Total	28	196,00		
Substrata	4	109,60	27,40	7,61 s/0,01
Plates/Substratum	24	86,40	3,60	

30 days

Source	G. L.	S. Q.	Q. M.	F.
Total	36	633,19		
Substrata	5	513,21	102,64	26,52 s/0,01
Plates/Substratum	31	119,98	3,87	

Table 7. Analysis of the variance between substrata on the field (cont.)

90 days — Period: Nov-Dec./76-Jan./77

Source	G. L.	S. Q.	Q. M.	F.
Total	15	1.611,44		
Substratum	4	1.179,69	294,92	7,51 s/0,01
Plates/Substratum	11	431,75	39,25	

15 days — Period: March-April-May/77

Source	G. L.	S. Q.	Q. M.	F.
Total	33	320,88		
Substratum	5	165,49	33,10	5,96 s/0,01
Plates/Substratum	28	155,39	5,55	

30 days

Source	G. L.	S. Q.	Q. M.	F.
Total	41	1.258,57		
Substratum	6	577,47	96,24	4,94 s/0,01
Plates/Substratum	35	681,10	19,46	

45 days

Source	G. L.	S. Q.	Q. M.	F.
Total	41	1.564,12		
Substratum	6	1.076,83	179,47	12,90 s/0,01
Plates/Substratum	35	487,29	13,92	

Table 7. Analysis of the variance between substrata on the field (cont.)

60 days — Period: March-April-May/77

Source	G. L.	S. Q.	Q. M.	F.
Total	41	1.534,00		
Substrata	6	1.051,51	175,25	12,72 s/0,01
Plates/Substrata	35	482,49	13,78	

90 days

Source	G. L.	S. Q.	Q. M.	F.
Total	41	1.777,41		
Substrata	6	1.219,69	203,28	12,76 s/0,01
Plates/Substratum	35	557,72	15,93	

15 days — Period: Sept.-Oct.Nov. /77

Source	G. L.	S. Q.	Q. M.	F.
Total	28	196,00		
Substrata	4	109,60	27,40	7,61 s/0,01
Plates/Substratum	24	86,40	3,60	

30 days

Source	G. L.	S. Q.	Q. M.	F.
Total	36	633,19		
Substrata	5	513,21	102,64	26,52 s/0,01
Plates/Substratum	31	119,98	3,87	

Table 7. Analysis of the variance between substrata on the field(cont.)

45 days — Period: Sept./Oct.-Nov./77

Source	G. L.	S. Q.	Q. M.	F.
Total	42	893,63		
Substrata	5	633,62	126,72	18,05 s/ 0,01
Plates/Substratum	37	260,00	7,02	

60 days

Source	G. L.	S. Q.	Q. M.	F.
Total	44	1.173,58		
Substrata	5	865,88	161,17	17,10 s/ 0,01
Plates/Substratum	39	367,70	9,42	

90 days

Source	G. L.	S. Q.	Q. M.	F.
Total	45	1.335,42		
Substrata	5	870,92	174,18	15,00 s/ 0,01
Plates/Substratum	40	464,50	11,61	

15 days — Period: Dec./77-Jan.-Feb./78

Source	G. L.	S. Q.	Q. M.	F.
Total	26	875,00		
Substrata	4	725,70	181,42	26,75 s/ 0,01
Plates/Substratum	22	149,30	6,78	

Table 7. Analysis of the variance between substrata on the field(cont)

30 days — Period: Dec./77-Jan.-Feb./78

Source	G. L.	S. Q.	Q. M.	F.
Total	35	1.949,23		
Substrata	5	1.404,23	280,84	15,46 s/ 0,01
Plates/Substratum	30	545,00	18,16	

45 days

Source	G. L.	S. Q.	Q. M.	F.
Total	35	2.968,30		
Substrata	5	2.139,30	427,86	15,48 s/ 0,01
Plates/Substratum	30	829,00	27,63	

60 days

Source	G. L.	S. Q.	Q. M.	F.
Total	37	4.225,10		
Substrata	5	3.201,00	640,20	20,00 s/ 0,01
Plates/Substratum	32	1.024,00	32,00	

algae, fifth rough glass, sixth ceramic roofing tile, seventh plastic, and eighth tire. In the fourth and fifth experiments only three substrata were used (smooth glass, rough glass and plastic). We observed the settling and fixation of the planulae on the plastic, substratum not preferred in the previous experiments.

DISCUSSION

The significant difference in the number of colonies among the diverse subareas in our collection experiments, probably is due to the local currents which impeded the settling of a greater number of the planulae in determined subareas. According to Riedl (1971), the distribution and the reproduction of species with scarcely mobile stages can be impeded by water currents.

The experiments showed that there really did not occur a specific choice of a particular substratum by the planulae. However there was a certain preference for some and rejection of others, although this rejection may still be questionable.

The planulae of *C. marginata* made a specific choice only in relation to the mobility of the substratum. They affixed themselves to immobile substrata and rejected mobile substrata (leaves of *Halodule*, straw baskets). They made no specific choice with respect to the texture of the substratum adhering to both smooth and rough surfaces. This indifference to the texture of the surface of the substratum had already been observed in various marine animals by Crisp and Ryland (1960).

According to Williams (1965) the species of hydroids are limited by the substratum. This author studied the planula of the hydroid *Clava squamata* e verified that the distribution of the colonies indicates that the planula probably have clearly defined patterns of behaviour which help them to localize appropriate substrata for colonization. Nishihira (1967) speaks about the selection of algae by planulae of the hydroid *Sertularella miurensis*, and states that the selectivity of the planula determines its ecological distribution. It seems to us from the studies done until this time, that (if not all), many hydroids have their distribution limited by substrata. We must, however, take into consideration the fact that the planulae of some hydroids like the *Sertularella miurensis* have a large swimming phase, and may have more specific demands; and that other planulae like the *C. marginata* studied by us, only have a "dragging" phase. Tus it is a selection without many demands a little uncertain. The planulae of *C. marginata* do not dispose of a large period in which to decide on what substratum they will remain

because, besides having only a "dragging" phase, they also go through metamorphosis rapidly. Thus if they should an unfacourable find substratum, there is no metamorphosis. Nishihira (1968a) made new experiments with larvae, but with the hydroid *Coryne uchidai* (Stechow), and also called attention to the selection made by these, larvae of certais algae. According to Nishihira (op. cit.) it is possible that chemical substances influence the settling of the larvae. He continues to say that it is deffi cult to analyze this problem of selection of substratum, working both in the field and in the laboratory. It is true making the analysis of the selection of the substratum both in the field and in the laboratory presents results which are not always satisfactory and leave various questions unanswered. I would say that the results obtained were partially satisfactory, leaving us with a better insight into the problem. Williams (1965) agrees with Nishihira (op. cit.) with relation to the interpretation of the results obtained. He states: "The interpretation of the significance of this behaviour under natural conditions is subject to the usual difficulties encountered when behaviour is analyzed under laboratory conditions. However when considered in relation to the distribution of the species in nature the probable importance of some of these become apparent". Nishihira (1968b) worked with the extracts of algae, in order to verify the preferences of the larvae of *Coryne uchidai*. We worked with artificial substrata for the most part and what was taken into consideration for the choice by the planulae of *C. marginata*, were the texture and mobility of the substratum. We did not verify this analysis the liberation of chemical substances by *Halodule*, which probably does occur, in this study, because of the result obtained in the laboratory. Several more experiments would be necessary in order to obtain a more satisfactory result. At the moment we leave the question open.

According to Campbell (1974), the planulae normally settle within a few days. In our case, it was hours. Nevertheless, if they do not encounter favourable conditions, they do not undergo metamorphosis and eventually (within days or months, according to the species) they die. At the moment of sttling, in the larva stage, the first problem is the fight for survival and the search for an available place for the installation (True, 1970). According to True (op. cit.), the method of using artificial substrata seems to be the most valid solution to be effected. The substrata chosen by the planulae of *C. marginata*, in the laboratory, were practically the same as those observed in the collection on the field. Up to what point was the field selection uncertain? Some planulae presented a definite preference for certain substrata. In according with the observations of Schijfsma (1939), the planulae of *Hydractinia echinata* (Flem.) prefer to settle on granular surfaces or on sutures, fissures,

etc. In the case of the planulae of *C. marginata* we did not really observe a definite choice.

The experiments of recruitment on the field and the choice of the substratum in the laboratory showed that there really was no definite choice of as specific substratum by *C. marginata* planulae. In the laboratoty the planulae had better conditions to chosen the substratum, because there were no currents that could influence the choice. Yet, since light has a striking influence on the behaviour of the planulae of *C. marginata*, we may suppose that light was responsible for what we observed with respect to the plastic deposits. It is possible that the luminous intensity influences the behaviour of the planulae to the point even of the choice of substratum accentuating a positive geocinese.

Generally the chosen substrata in the laboratory were the same as on the field. Nishihira (1967a) also observed this, in the laboratory and on the field, with *Sertularella miurensis*. In the laboratory, the substratum of calcareous algae was well colonized. The same probably might have happened on the field if there had not been a partial loss of this substratum. Of the substrata used, on the field and in the laboratory, the smooth glass was preferred. Future, more elaborate studies may explain in the fact that the *Halodule* was rejected by the planulae in the laboratoty.

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Fig. 1 Average number of colonies per substratum during the first period of observation.

Period: November-December 1976
January 1977

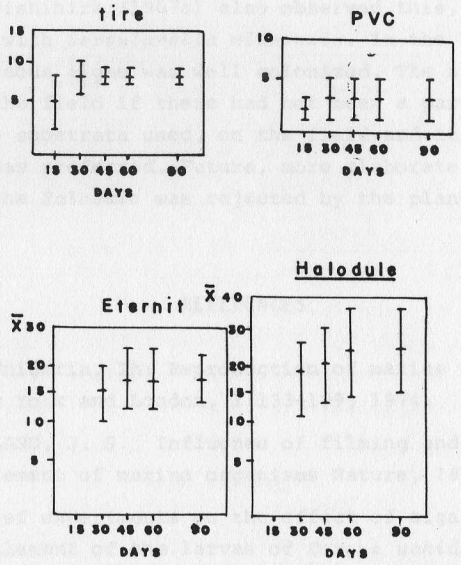

Fig. 2 Average number of colonies per substratum during the second period of observation.

Period: March-April-May 1977

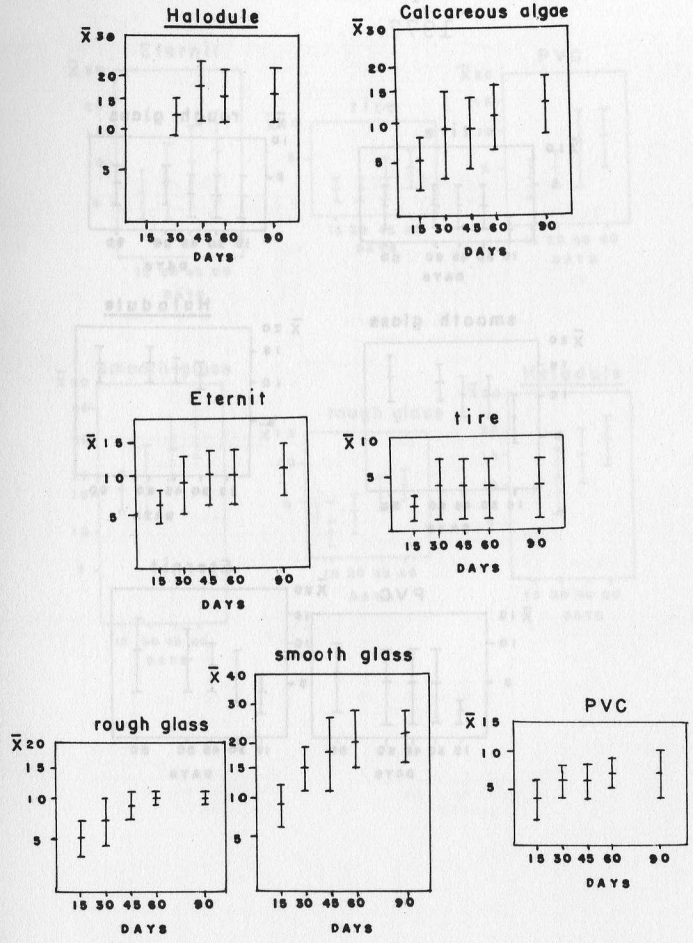

Fig. 3 Average number of colonies per substratum during the third period of observation.

Period: September-October-November 1977

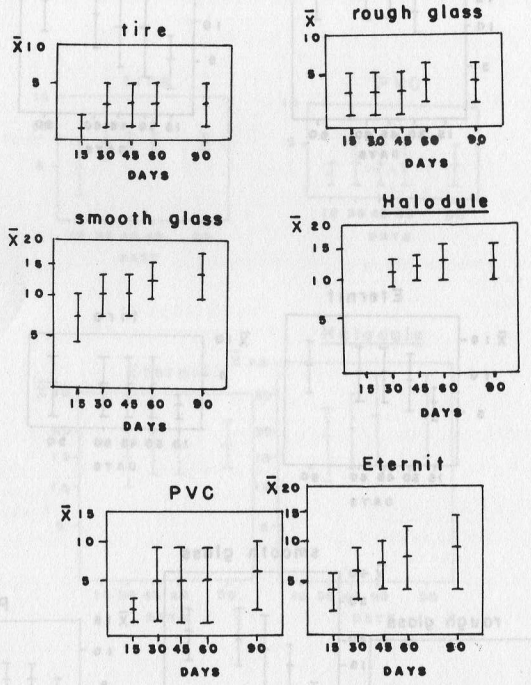

Fig. 4 Average number of colonies per substratum during the fourth period of observation.

Period: December-1977 January-February 1978.

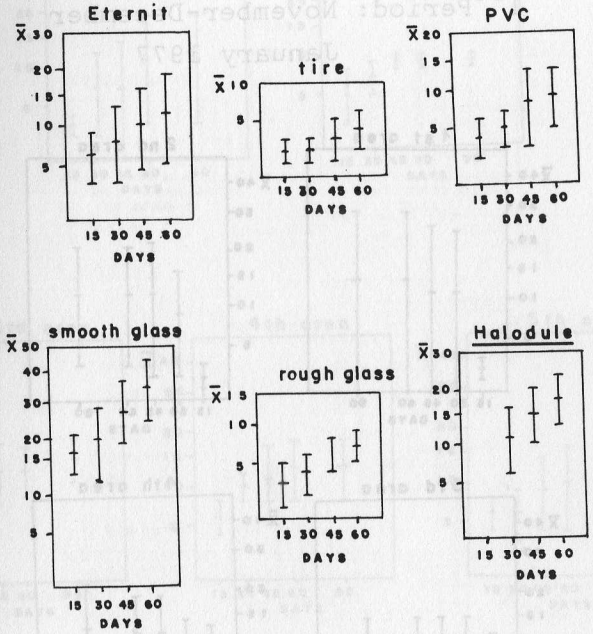

Fig. 5 Average number of colonies in each subarea during the first observation period.

1st Period: November-December 1976
January 1977

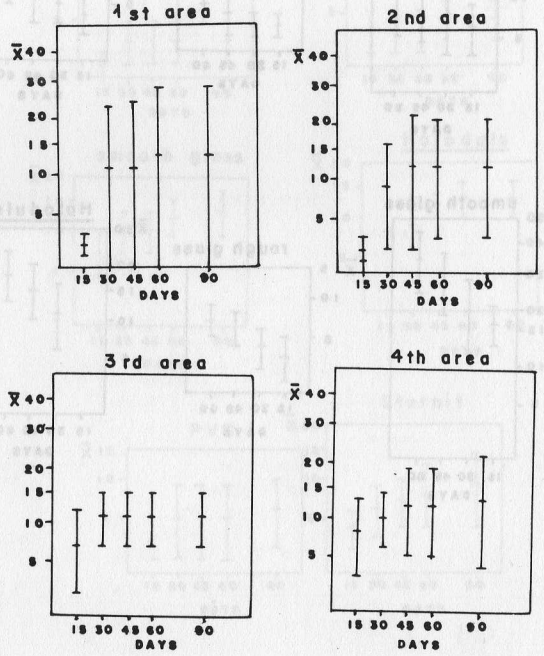

Fig. 6 Average number of colonies in each subarea during the second observation period.

2nd Period: March-April-May 1977

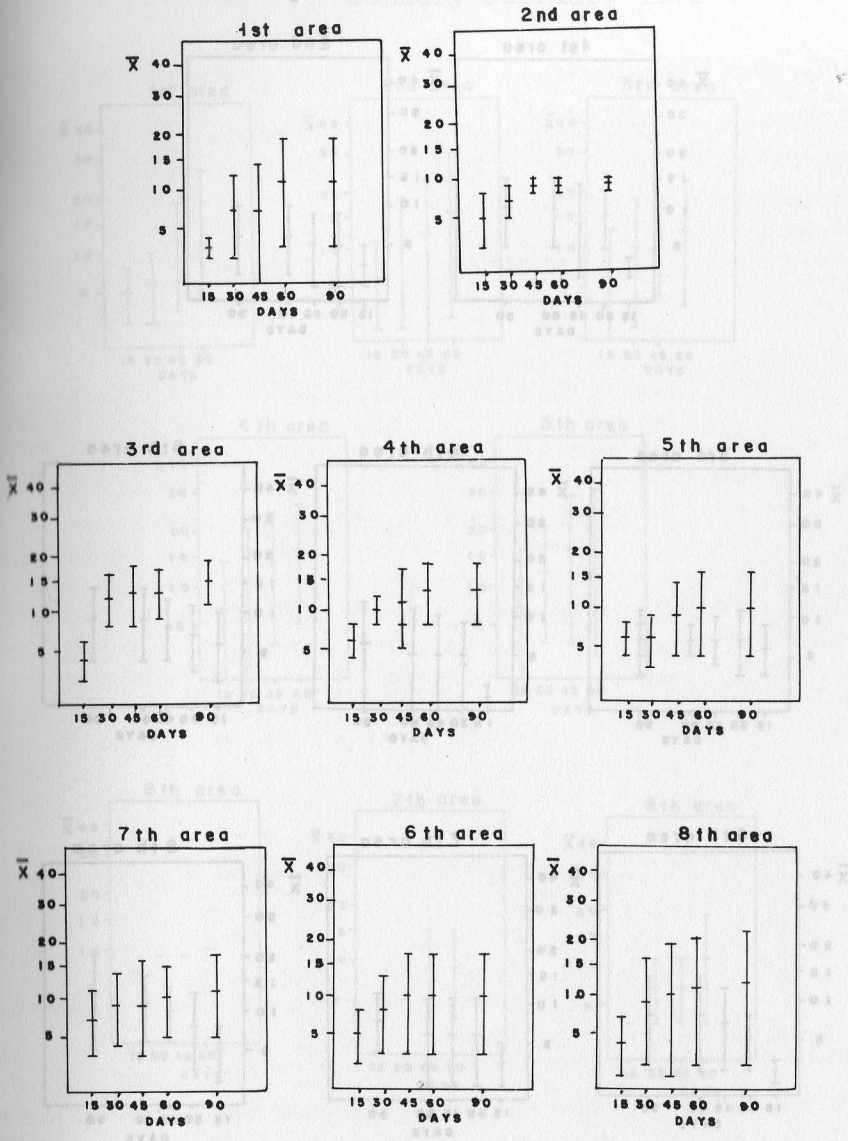

Fig. 7 Average number of colonies in each subarea during the third observation period.

3rd Period: September-October- November 1977

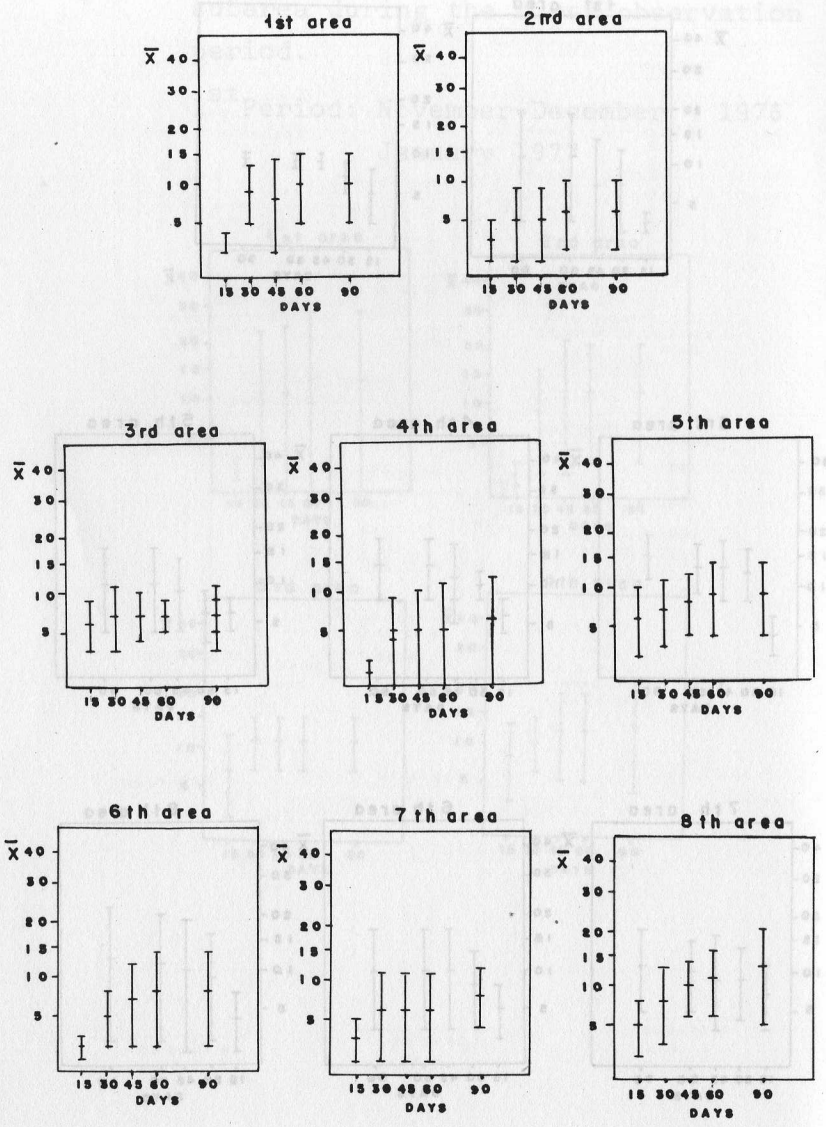

Fig. 8 Average number of colonies in each subarea during the fourth observation period.

4th Period: December 1977
January-February 1978