BI432 - PHYCOLOGY

PROJECT REPORT

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QUANTITATIVE AND ECOLOGICAL SURVEY OF GELIDIUM ALGAE IN LAUCALA BAY, SUVA

ABSTRACT : The distribution and ecology of Gelidium spp, is described. Four distinct growth forms occur, 75.6% of which is terete. Total biomass at the site was 31.86 Kg, and the algae seemed obligately associated with Septifer spp.

INTRODUCTION :

The order Gelidiales includes two families : Gelidiaceae and Gelidiellaceae, nine genera, and over a hundred species (Santelices & Stewart, 1984). The important economic species are those of Gelidium and Pterocladia, and the only reliable feature to distinguish these two species is based on the female reproductive structure. However, due to the uniformity of other reproductive structures among the Gelidiales, generic and specific distinctions depend a lot on vegetative and habitat features. Owing to the large variation in vegetative growth forms, the taxonomic identification of these plants is often a difficult task.

In their preliminary checklist of the benthic marine algae of the Fiji Islands, South & Kasahara (1992) state that the only species of Gelidium occurring in Fiji is G. pusillum. For this present study, an algal bed community of predominantly Gelidium pusillum was investigated. These plants were uniquely epizoic on Septifer virgata (Mollusca : Bivalvia), and occur close to the shoreline on marine mudflats opposite the Institute of Marine Resources at Laucala Bay, Suva (see fig.5).

METHODS :

The study site was sampled in August 1991, and three 30m transects were laid in three diverging directions from the shoreline over the beds, so as to give best coverage (see fig. 1). 4cm^2 quadrats were placed every 3m, and all Septifer plus their epizoic algae were collected and placed in labelled plastic vials containing 5% formalin in seawater. A map of the site was also drawn, taking note of the relative distribution of the different species, as well as any relevant topographical features such as tide level, elevation, etc

The samples were taken to the lab, where the plants were scraped off the Septifer and weighed. Once weighed, each sample was examined under a dissecting microscope to count the number of individual plants present, as well as to estimate the percentages of any growth forms present. An estimate was also taken of the average number of plants per single Septifer. Representative

samples of each growth form were mounted in glycerin jelly stained with a small amount of crystal violet (Newroeth, 1971 cited in Mc Cully et al, 1980). Coverslips were sealed with nail varnish, and photomicrographs were taken using an Olympus photomicroscope.

From the data obtained, an estimate was made of the total biomass of Gelidium at the study site.

RESULTS :

Tables 1 and 2 summarize the survey results. The average biomass over the entire site was 159.3 g/m^2. The algae were always obligately associated with Septifer virgata (Mollusca : Bivalvia). The average number of plants per Septifer was about 12, and the mean number of plants per m^2 was 28.6 over the entire site. From Table 1, it can be seen that there is a large standard deviation in all three transects, implying that there is no significant difference between them (fig. 3). Figure 2 shows the relative biomass and plant numbers for the three transects, in graphic form.

The total area of the study site was approximately 864m^2, and Gelidium occupied about 200m^2. Non-encrusted Septifer occupied 60m^2, and the rest of the site was either taken up by barren rock or water pools devoid of either species. The total biomass of Gelidium pusillum over the study site was thus estimated to be about 31.86 Kg.

Four growth forms were identified, namely foliose, terete, pointed and elongate. The terete form was predominant, consisting of 75.6% of the population. The elongate form was the rarest, occurring only in one sample. The various growth forms were heavily intertwined among themselves, suggesting that they were all of the same species.

In many cases, intermediate variations of the growth forms were noticed, supporting the above suggestion.

Plate 1 and figure 4 illustrate the various growth forms. Reproductive structures were only found in the foliose form, and consisted of sporangia (Plate 2e) containing immature tetraspores (Plate 2f).

Plate 2(g,h) illustrates the apical cell region of two growth forms. In the foliose type (Pl. 2h) two distinct apical cells are present, and suggest that the plant will branch in two directions.

Descriptions of the Various Growth Forms :

A. Foliose :

This form is similar to G. pusillum var. pulvinatum (Ag.) Feldmann, described in Feldmann & Hamel (1936). It is characterized by its flattened and broad blades (Plate 1d) and occurred in relatively dry and elevated locations. It is not very common (3.3% of the population) and attaches itself to Septifer virgata via

TABLE 1

SAMPLE	BIOMASS g/m^2	PLANTS/m^2 ($x10^3$)	MEAN BIOMASS g/m^2	MEAN NR ($x10^3$) PLANTS/m^2
T1S1	130	15		
T1S2	250	70		
T1S3	130	17.5		
T1S4	250	60		
T1S5	250	70		
T1S6	0	0		
T1S7	0	0		
T1S8	0	0		
T1S9	250	52.5		
T1S10	0	0		
T1 MEAN			126 ± 111.8	28.5 ± 29.3
T2S1	130	20		
T2S2	0	0		
T2S3	250	42.5		
T2S4	0	0		
T2S5	130	50		
T2S6	0	0		
T2S7	500	100		
T2S8	250	67.5		
T2S9	0	0		
T2S10	500	75		
T2 MEAN			176 ± 186.8	35.5 ± 35.0
T3S1	250	17.5		
T3S2	0	0		
T3S3	500	50		
T3S4	0	0		
T3S5	500	52.5		
T3S6	130	27.5		
T3S7	250	55		
T3S8	0	0		
T3S9	0	0		
T3S10	130	15		
T3 MEAN			176 ± 186.8	21.8 ± 22.0
OVERALL			159.3	28.6

TABLE 2

SAMPLE	% FOLIOSE	% TERETE	%POINTED	%ELONGATE
T1S1	0	100	0	0
T1S2	0	100	0	0
T1S3	0	100	0	0
T1S4	0	100	0	0
T1S5	10	60	30	0
T1S6	0	0	0	0
T1S7	0	0	0	0
T1S8	0	0	0	0
T1S9	0	90	10	0
T1S10	0	0	0	0
T2S1	0	10	90	0
T2S2	0	0	0	0
T2S3	0	100	0	0
T2S4	0	0	0	0
T2S5	0	100	0	0
T2S6	0	0	0	0
T2S7	0	100	0	0
T2S8	0	60	10	30
T2S9	0	0	0	0
T2S10	0	100	0	0
T3S1	0	1	99	0
T3S2	0	0	0	0
T3S3	0	90	10	0
T3S4	0	0	0	0
T3S5	50	50	0	0
T3S6	0	100	0	0
T3S7	0	100	0	0
T3S8	0	0	0	0
T3S9	0	0	0	0
T3S10	0	0	100	0
AVERAGE %	3.3	75.6	19.3	1.7

rhizoidal holdfasts (Fig.4a). Color is dark-red to purple.

B. Terete :

This is the predominant growth form, consisting of 75.6% of the population. Present at nearly all sites, it has a cylindrical body which terminates in a pointed end (Plate 1c). Texture is relatively tough, with short buds of dichotomous branches along the filaments. Color is dark-red.

C. Pointed :

This growth forms consists of 19.3% of the population, and is characterized by its Caulacanthis-like appearance (Plate 1b). However, the latter species does not occur in Fiji (South & Kasahara, 1992) and hence it is merely another variation of g. pusillum. Its color was noticeably lighter than the other growth forms, being of a pale-green hue reminiscent of Eucheuma. Its filaments are terminated by characteristic spine-like "crowns". It occurred fairly isolated from other growth forms, in areas close to the high-water mark.

D. Elongate :

By far the rarest growth form (1.7%), it was found in only one sample. It is characterized by thin, long unbranched filaments arising from a prostrate rhizoidal attachment (Plate 1a). The turf-like plants occur intertwined with the terete and pointed forms, relatively close to the high-water line. Color is dark-red.

DISCUSSION :

a. General :

The distribution of the plants within the site is shown in Figure 1. It is quite striking that the algae only occurred attached to Septifer, and thus follow the distribution pattern of the latter mollusc. However, one can see that the third transect (T3) has large areas of Septifer devoid of Gelidium, and possible implications are examined later. Nevertheless, in all cases it seems that the algae is obligately occurring as an epizoid of Septifer. The reason for this relationship is unclear, but may have to do with the fact that the molluscs provide an ideal substrate for attachment of the algae.

Grazing seemed to be also a factor in the distribution of the algae, and at least three molluscan grazers were identified at the site, mostly near the pools and in moist places. The latter sites had noticeably fewer Gelidium. The species were the neritids Nerita signata, N. planospira and the spirally-coiled Thiarid Clypeomonas spp.

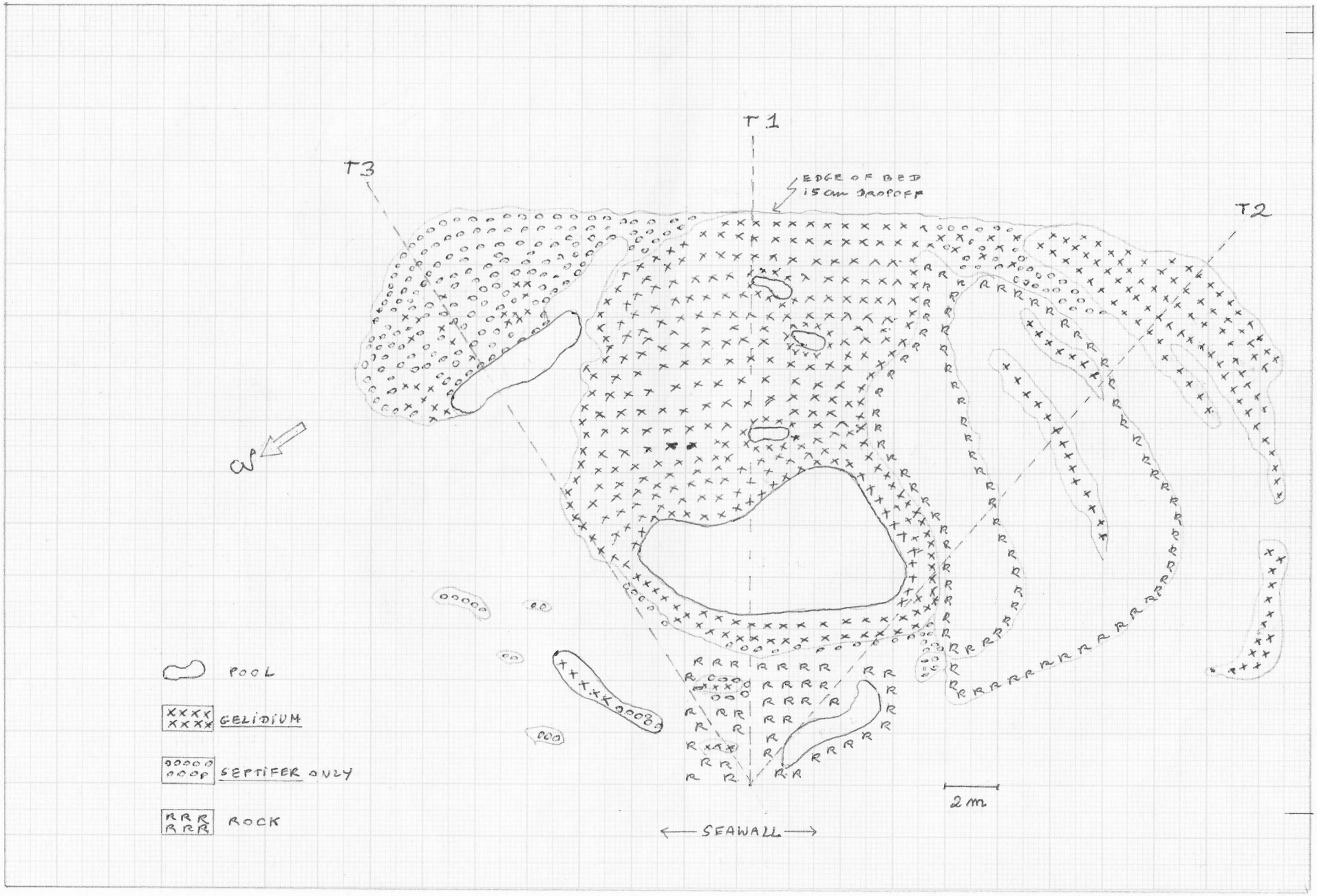


Fig. 1. GENERAL MAP OF STUDY SITE

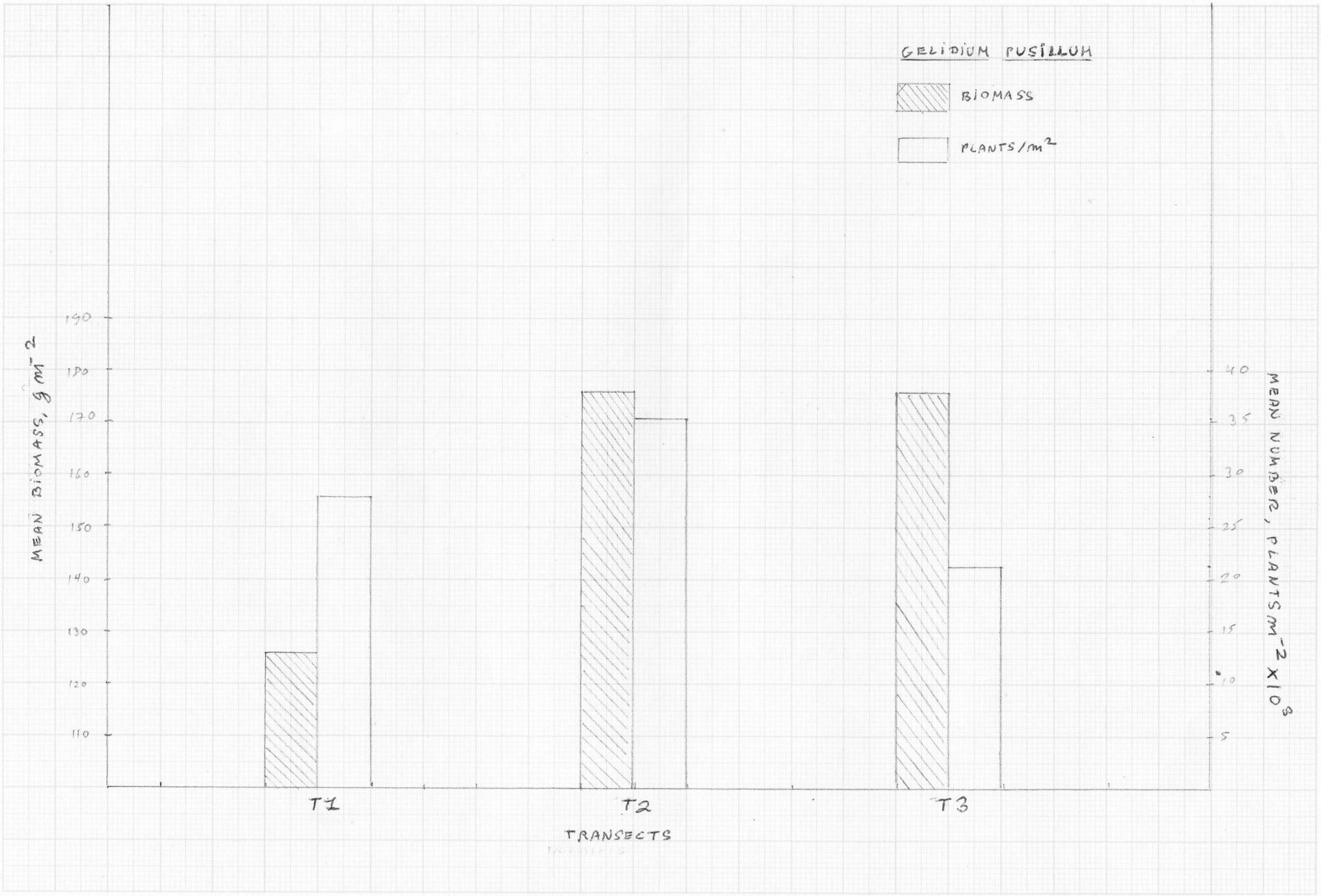


Fig. 2. MEAN BIOMASS & PLANTS m^{-2} FOR THREE TRANSECTS.

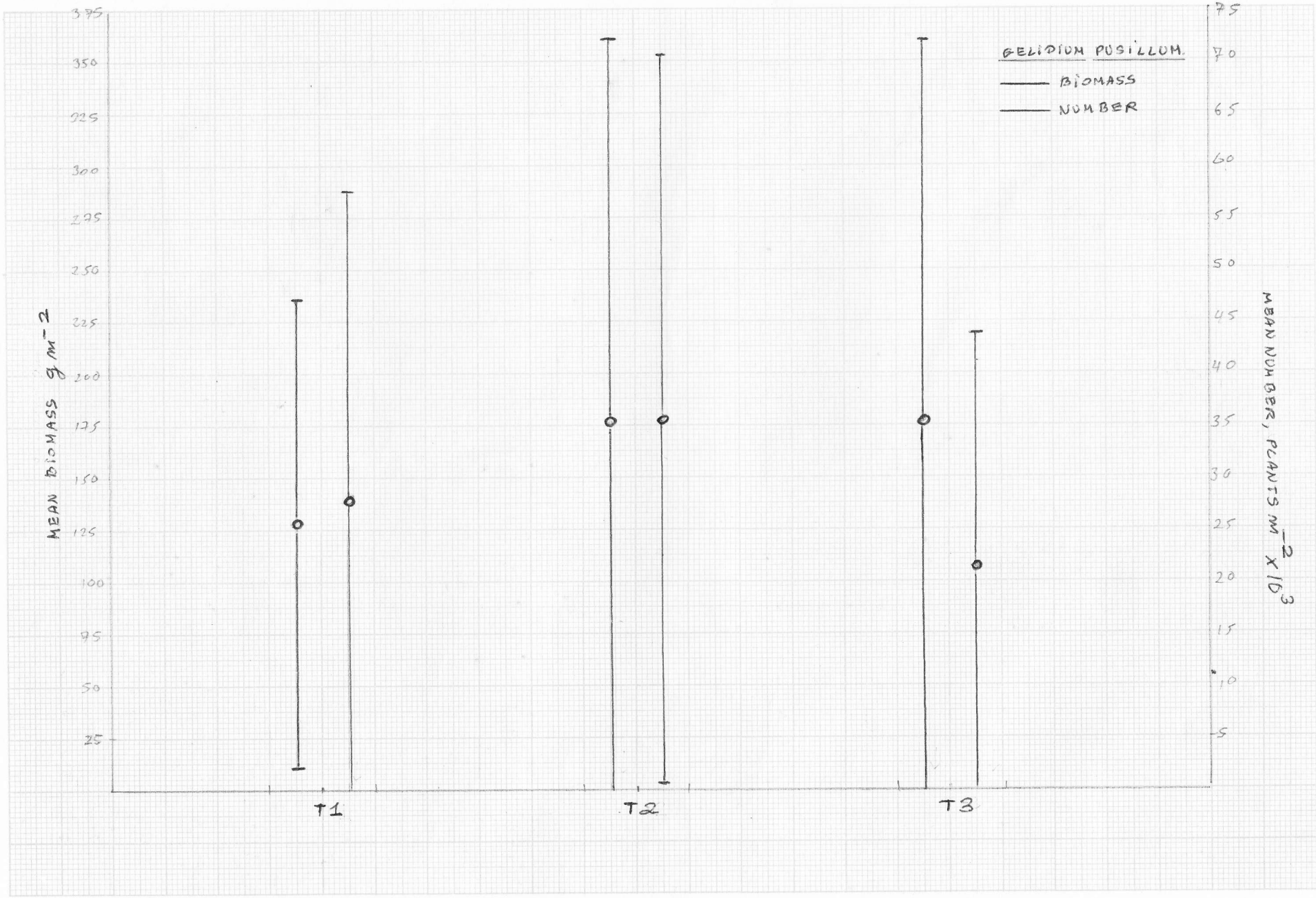


Fig. 3. MEAN BIOMASS & PLANTS m^{-2} WITH STANDARD DEVIATION

Sites which were slightly elevated by about 10-15cm (and hence drier at low tide) had fewer grazers, and more Gelidium. Hence, exposure seems to have an effect on the distribution of the plants, apparently by limiting the number of grazers that occur.

The tidal range at Laucala Bay is about 1.2m, and the beds were totally submerged at all high tides, under about 1m of water (maximum). The area of the third transect which contained non-encrusted Septifer was relatively close to the effluent of a sewer, and raises the question of whether the plants are not tolerant to either lowered salinity or pollutants.

b. Growth Forms :

Santelices & Stewart (1984) offer the following description of Gelidium pusillum :

> "Axes compressed, branching irregular, branches lanceolate or spatulate. Fertile portions on ovoid to rounded branchlets. plants up to 3cm high, main axis up to 2mm broad. 2-3 layers of cortical cells, 4-6µm thick externally. Medullary cells up to 10µm diameter. Rhizoidal filaments abundant in inner medulla. Tetraspores ovoid, 25-35µm arranged without order. Cystocarps round or ovoid, 0.6-0.5mm thick".

From the above, one can be fairly certain that the species in this investigation is indeed G. pusillum.

According to Feldmann & Hamel (1936), Gelidium pusillum (Stackhouse) occurs in spread-out dark-red beds; generally on rocks, piles, and the upper ceiling of caves, relatively high-up on muddy shores worldwide. These authors recognize two variations of G. pusillum occurring in France and North Africa, one of which (var. pulvinatum (Ag.) Feldmann) closely resembles the "foliose" form in this study (Plate 1d; Fig. 4a). Some authors (eg. Kutzing & Furket, cited in Feldmann & Hamel, 1936) consider this a separate species, but Feldmann & Hamel (1936) are of the opinion that because a large number of intermediate forms exist, it is best to consider it a mere variation of G. pusillum.

The noticeable pattern in the distribution of the various growth forms over the site is interesting, though no clear reason for it emerged. Perhaps some growth forms are less susceptible to grazing, such as the relatively "tough" textured terete form. It is pertinent to note that the foliose form was only present in relatively elevated and dry locations.

From a statistical point of view, there is no significant difference in distribution of the plants over the study site, as the large standard deviations overlap extensively (fig. 3). This suggests that a randomly uniform, albeit patchy, distribution pattern exists, akin to the patchy distribution of plankton in

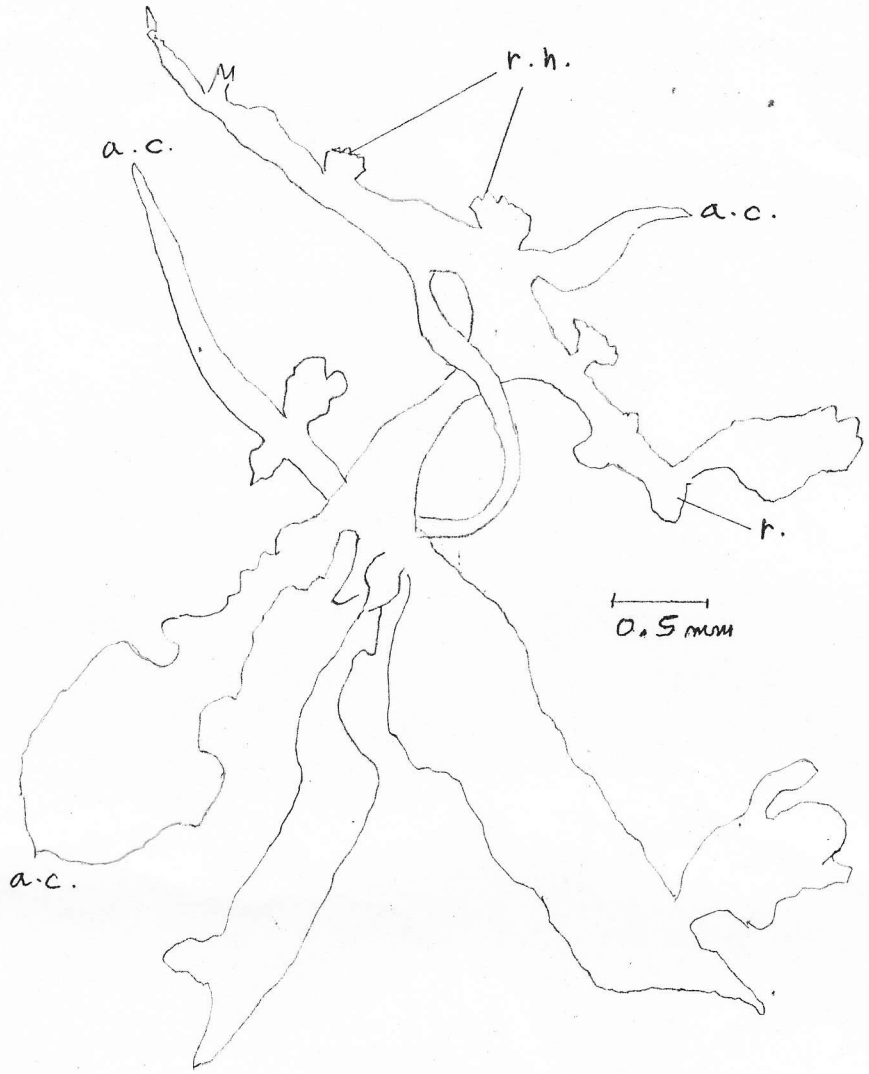


Fig. 4a. GELIDIUM PUSILLUM Var. PULVINATUM (Ag.) FELDMANN. a.c: APICAL CELL. rh: RHIZOIDAL HOLD FASTS. r: RHIZOME.

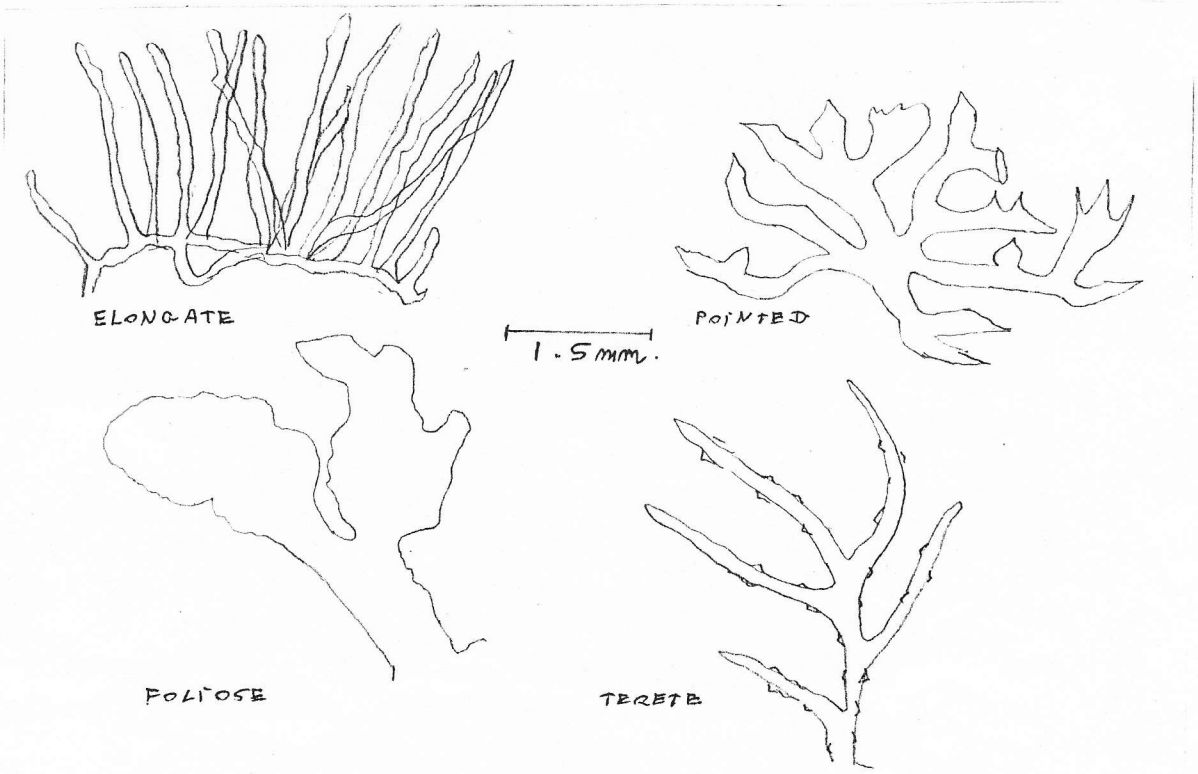


Fig 4b. GELIDIUM PUSILLUM: GROWTH FORMS

a. ELONGATE (x 25)

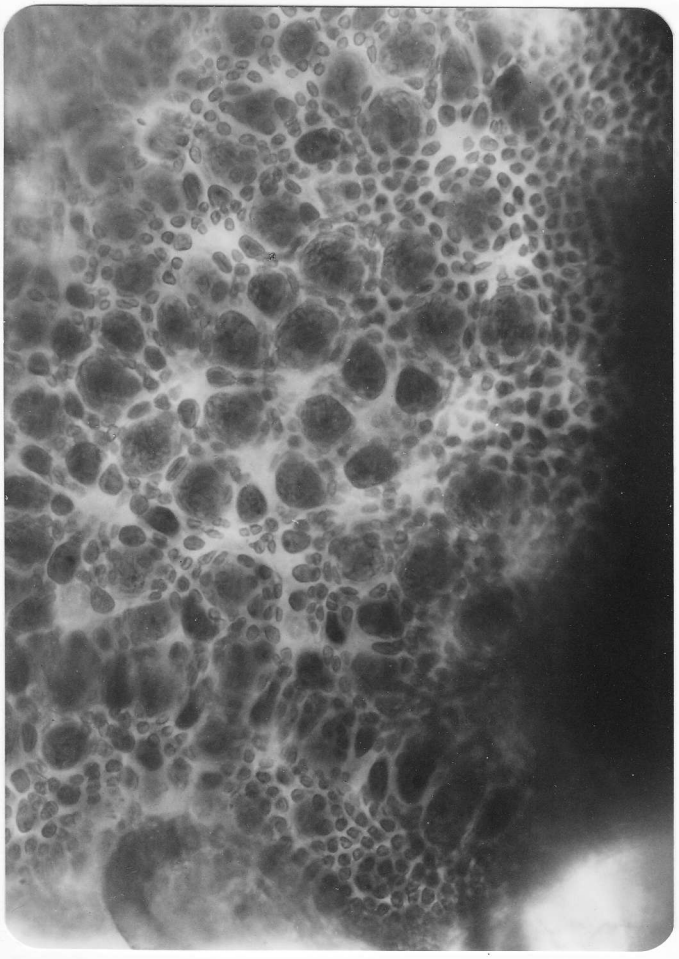
b. POINTED (x 25).

c. TERETE (x 25)

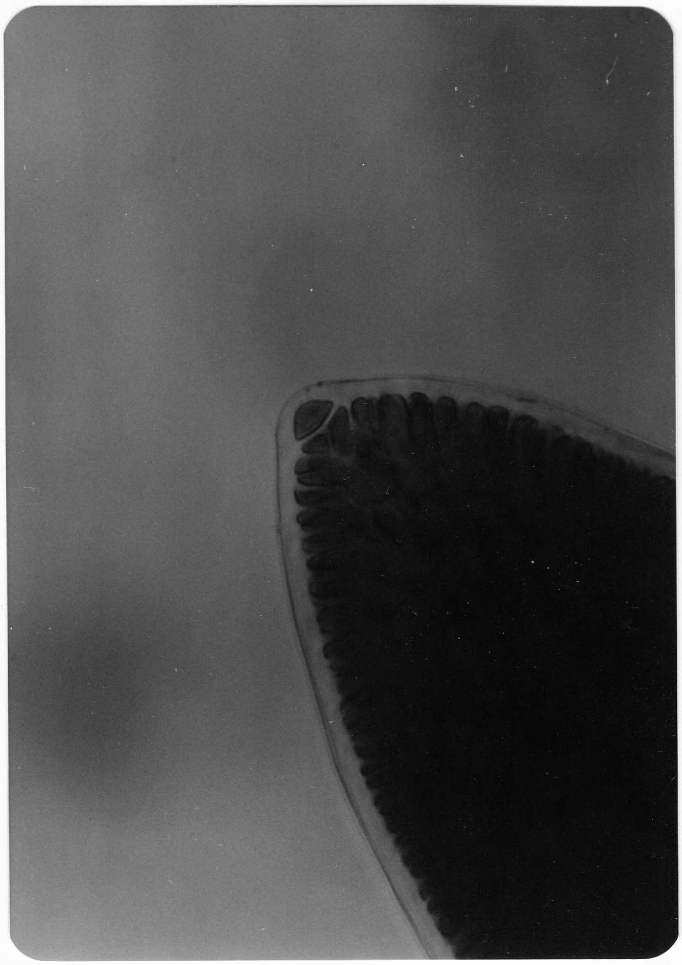
d. FOLIOSE (x 25).

PLATE 1 · GELIDIUM PUSILLUM : GROWTH FORMS

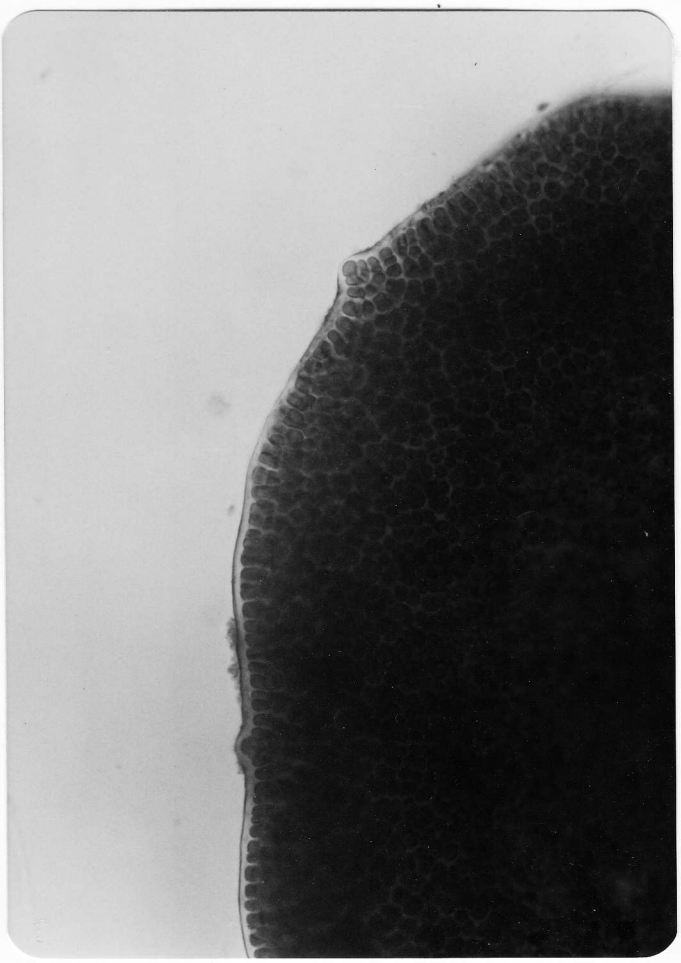
e. SPORANGIUM : FOLIOSE (x 50).



f. IMMATURE TETRASPORES (x 400)



g. APICAL CELL: TERETE (x 400)



h. APICAL CELLS : FOLIOSE (x 200).

PLATE 2. GELIDIUM PUSILLUM : REPRODUCTIVE & APICAL FEATURES

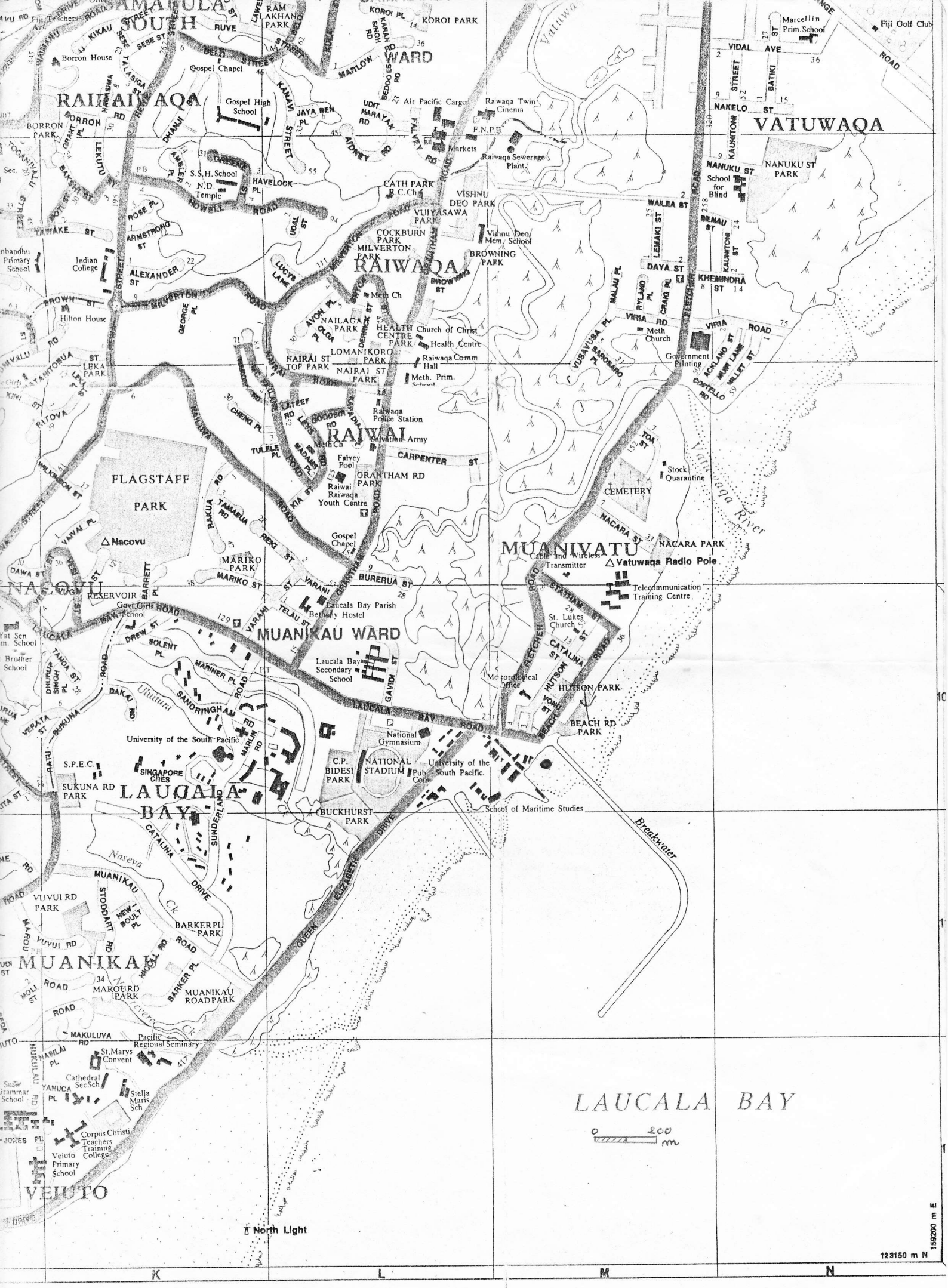


Fig 5. GENERAL MAP OF STUDY AREA. (STUDY SITE : ●)

oceanic waters.

CONCLUSIONS :

From this investigation, it can be appreciated that a number of growth forms of Gelidium pusillum occur at the study site. The algae seems to be always associated with Septifer beds, and its distribution may be affected by grazing pressure and such factors as salinity variations and exposure.

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