# The Marine Algal Communities of Stanmore Bay, New Zealand (Studies in Inter-tidal Zonation 1.)

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## INTRODUCTION

THE MAIN PURPOSE of the present and subsequent studies is to obtain a picture of the algal vegetation on different types of shores in the Auckland province, and to correlate, if possible, the observed zonation with the principal features of the tidal factor. A broad general picture is the aim, and it is not expected that all areas will be studied intensively. Factors other than tidal factors will clearly be involved, but since air exposure (and this includes water loss, exposure to high temperatures, exposure to salinity changes) is a causal factor and is primarily due to tidal phenomena it has been selected for primary investigation. Information is also required as to the number and location of critical levels on the different types of shore, and this is a further aspect that will be investigated.

## GEOLOGY

The present study concerns Stanmore Bay, which lies between Red Beach and Manly on the north coast of the Whangaparoa Peninsula at its proximal end. It is about 25 miles north of Auckland and is just within the Hauraki Gulf (Fig. 1). The sea-water is considerably purer than that on the south side of the peninsula where there is sewage and harbour contamination.

The bay is backed by high cliffs which in the centre terminate in a narrow sand-dune shelf, but which at both ends come down sheer to the sea. The rock is the soft Waitemata sandstone and erosion is progressing continually at the two ends of the bay. At the northern end there is an outcrop of Parnell Grit, which is more resistant to wave action. Here vertical rock faces and dissected platforms are to be found.

On either side of this promontory the soft rock has been worn down to beach level and is continually being covered and uncovered by the beach sand. Because of this the vegetation on this low beach shelf is restricted since sand scour eliminates all but the hardiest plants, especially from mid-tide upwards. Towards low water mark the rock is maintained free of sand and here there is a good covering of vegetation.

The above type of flat shelf is to be found on both sides of the bluff separating Stanmore from the small bay immediately to the northwest, but the latter differs from Stanmore in that there are some big boulders near high water mark. The northwestern end of the small bay terminates in a steep bluff with a wide wave-cut platform and a large cave at the base.

## AREA

The area studied included the flat beach shelf in the centre and northwest of Stanmore Bay, the northwest bluff, and the whole of the small bay to the northwest leading up to Red Beach. The cave in the second bluff did not form a part of this investigation.

## THE FAUNA AND FLORA

On the sea shore, especially on rocky coasts, it is impossible to consider the plants and animals independently. In this particular area the dominant animals have been included but secondary species have been neglected. The communities recognised belong to four

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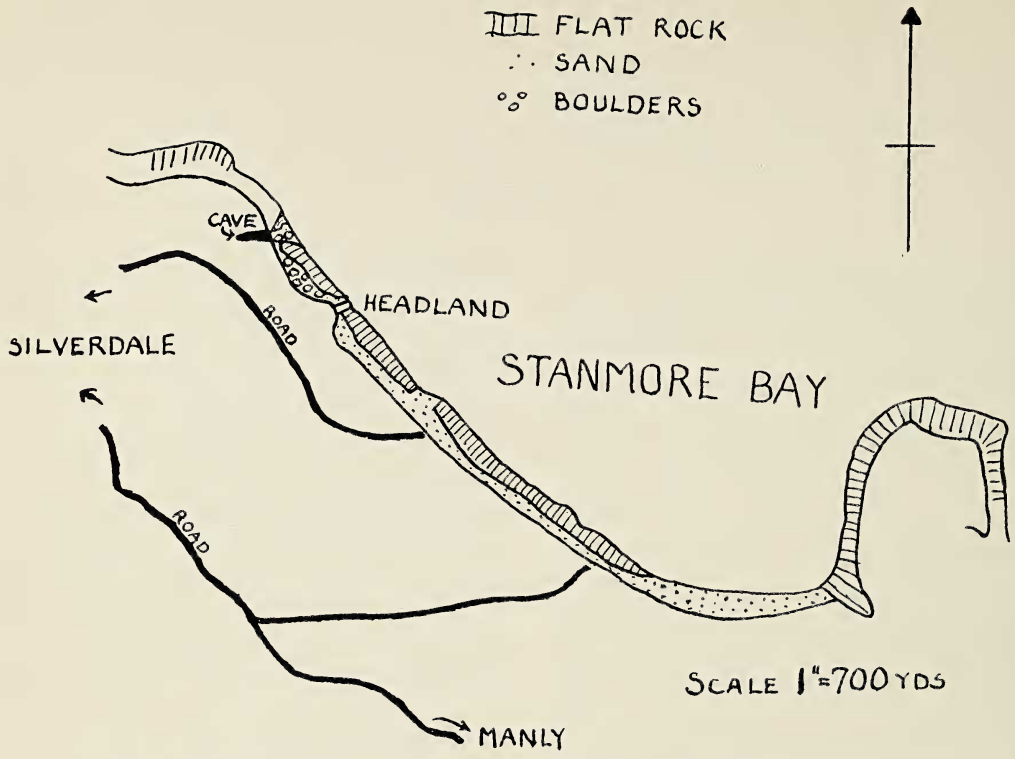


FIG. 1. Sketch map of part of the Wangaparoa Peninsula at the proximal end.

major formations which, as Stephenson (1939) suggests, have a very wide distribution. These four major formations are:

A. Littorina formation of the upper littoral.
B. Barnacle formation of the mid littoral.
C. Mixed algal formation of the lower littoral. This is a new nomenclature but the belt is to be found in many parts of the world. In Stephenson's work it would include part of the lower barnacle zone and part of the sublittoral fringe.
D. Sublittoral brown kelp formation (sublittoral fringe of Stephenson). It seems better to recognise at this level at least two formations, one dominated by large brown seaweeds (kelps) belonging to the Laminariales or Fucales, and one dominated by green, red, and brown algae. The former is to be found in colder waters and the latter in warmer waters where coral will grow.

The following is a description of the various zones as they occur at Stanmore (see Fig. 2).

*Littorina Formation*

1. **Melaraphe–Lichina association**

The dominant species are *Melaraphe oliveri* and *M. cincta,* which are closely allied to *Littorina,* and the maritime lichen *Lichina pygmaea.* The *Lichina* occurs in patches and there is no complete vegetation cover. A number of other species are to be found in the association. *Bostrychia arbuscula* occurs in the lower part of the zone; in the upper part a blackish belt of *Brachytrichia quoyi, Hydrocoleus lyngbyaceus,* and *Entophysalis granulosa* covers the rocks and boulders. Still higher on the boulders *Calothrix scopulorum* and *Entermorpha procera* f. *novae-zelandiae* are to be found. This association is not to

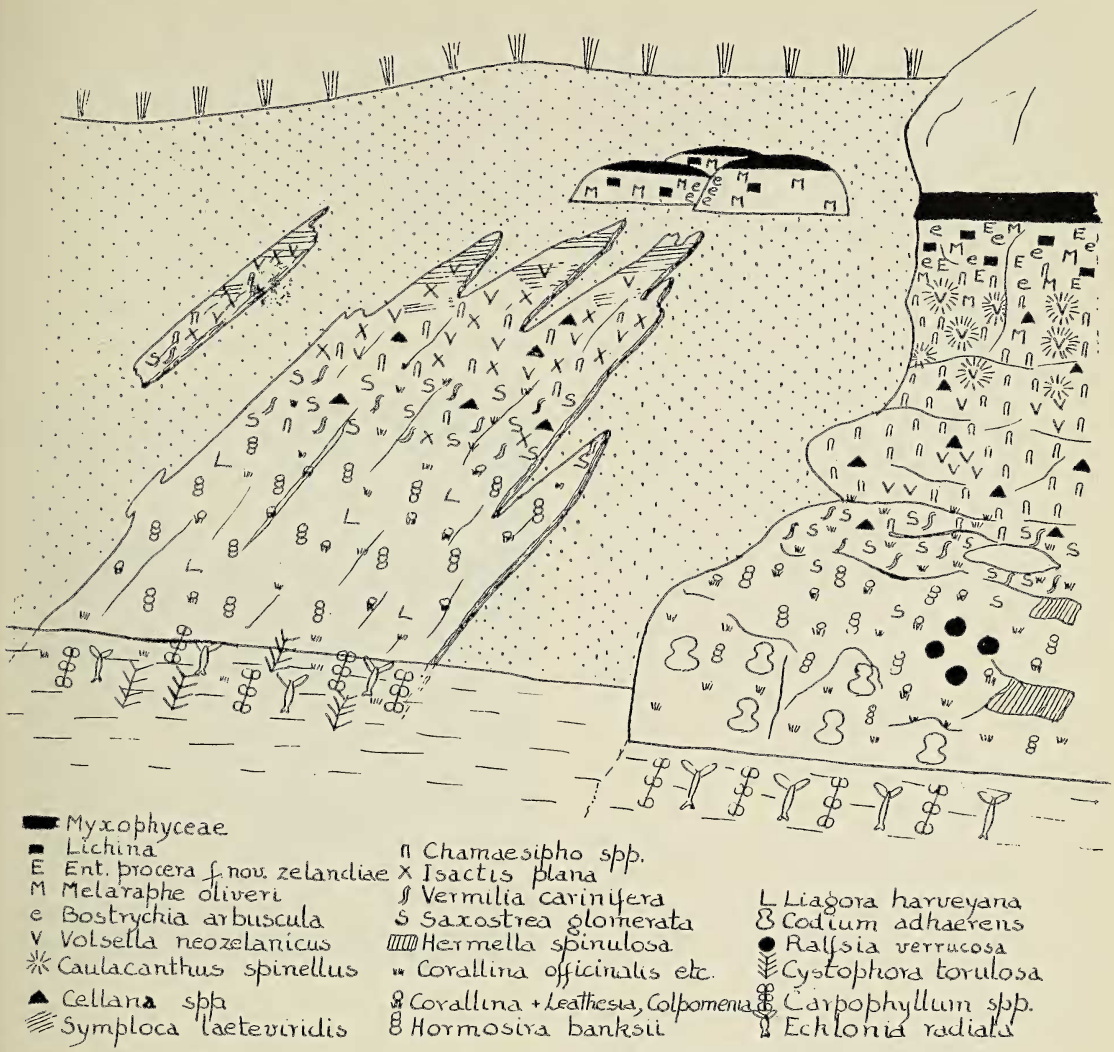


FIG. 2. Diagram of zonation on flat rock (left) and bluffs (right) at Stanmore Bay.

be found on the flat shelf of the beach as the shelf is usually covered by sand at the level at which it would occur. It is therefore restricted to the bluffs and to the large boulders in the small bay. The lower part of the zone is characterised by the presence of the two barnacles, *Chamaesipho brunnea* and *C. columna*, the latter being more abundant than the former.

Where the rock is overhanging, so that there is more shade and presumably less evaporation, one may find *Rhizoclonium tortuosum*, *Enteromorpha salina*, and *Wittrockiella* sp.[2] Here too may be found tufts of *Caulacanthus spinellus* and one or two outliers of *Volsella*, the mussel of the belt immediately below.

*Barnacle Formation*

2. **Chamaesipho–Volsella–(Apophloea) association**

In this area the dominants are *Chamaesipho columna* and *Volsella neozelanicus* but in other places it is evident that the red alga,

[2] This is a new species of an interesting genus. A description will be published separately.

*Apophloea sinclairii,* is normally co-dominant. The red alga is to be found in this belt at Stanmore, but not in abundance. In older areas also there is usually some development of *Chamaesipho brunnea* but the species is not common in this locality. The species of *Chamaesipho* extend rather higher than does the *Volsella.* The associated species vary with the physiography but among the mollusks one may find both species of limpet, *Cellana ornata* and *C. radians.* On the flat beach rock one finds black patches of *Isactis plana, Symploca laeteviridis, Microcoleus tenerrimus, Calothrix scopulorum,* and red patches of what appears to be *Hildenbrandtia* sp. *Corallina* occurs in shallow pools, though if the pools are sandy it is replaced by *Pylaiella (Bachelotia) novae-zelandiae* (Chapman and Ambler, in press). In places the *Isactis* and *Symploca* are sufficiently abundant to form a distinct fasciation: the former does not extend to quite the same height as the *Volsella. Symploca* tends to replace the other alga in this area.

At the bluffs, where there are vertical rock faces, other species are to be found. These include a more frequent appearance of the large barnacle *Elminius plicatus,* the limpets *Cellana ornata* and *C. radians,* and the following algae: *Caulacanthus spinellus, Gelidium pusillum G. caulacantheum, Bostrychia arbuscula, Rhizoclonium hookeri,* and *Polysiphonia rudis.* It is here also that occasional patches of *Apophloea* may be seen.

The *Caulacanthus* is interesting because each colony appears to have started within a group of mussels and to have radiated out from that centre, so that each group of mussels becomes surrounded by a ring of the algal felt.

### 3. Vermilia–Saxostrea association

Both the species *(Vermilia carinifera* and *Saxostrea glomerata)* occupy a well-marked zone. The rock oyster is rather more abundant than the serpulid worm and also extends to a higher level on the shore, so that it overlaps into the association described above. Likewise the *Vermilia* often descends somewhat lower on the shore than the oyster. An alternative treatment would be to separate these animals into two independent communities but in view of the overlap they are here retained as one association. This community is absent from the flat shelf and is only to be found on the more resistant rocks of the bluffs. The associated species are not numerous and include *Chamaesipho columna, Elminius plicatus, Caulacanthus spinellus, Gelidium pusillum, Peyssonelia* sp., *Corallina officinalis* (basal portion only), and *Lyngbya confervoides.*

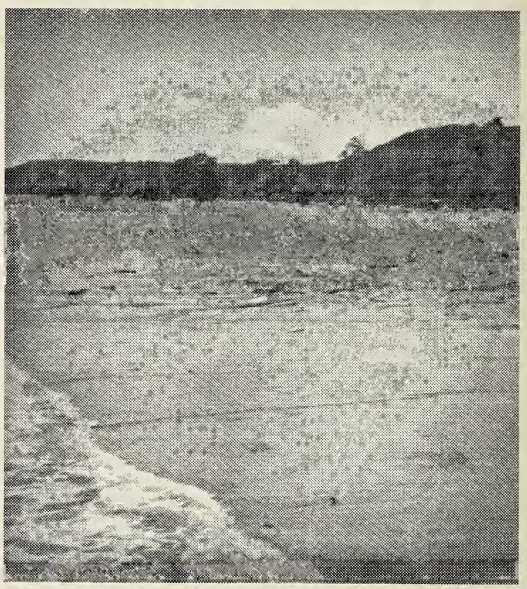

FIG. 3. The flat shelving beach at Stanmore Bay.

At the bluff the lower part of this zone is further characterised by a considerable local development of *Ralfsia verrucosa* and also of the worm *Hermella spinulosa.* Scattered through both the *Chamaesipho–Volsella* and *Vermilia–Saxostrea* associations one may find the mollusks *Lunella smaragda* and *Lepsiella scobina.*

*Lower Littoral Mixed Algal Formation*

4. **Hormosira–Corallina association**

This association is extremely well-marked both on the flat rock shelf and also on the more varied rock faces of the bluffs. *Hormosira, Corallina officinalis,* and *Codium adhaerens* are present at all seasons, but *Leathesia* and *Colpomenia* are mainly to be found in the summer months. *Corallina* extends up beyond the normal limit of this association, but only where there are cracks or shallow depressions that remain moist when the tide is below the upper limit of the association as a whole.

Since this association is near low water mark, conditions are favourable for a number of species and the flora is relatively rich. It also includes the serpulid *Vermilia* and *Hermella spinulosa.* The algal species are as follows:

*Leathesia difformis* (spring and summer) (ab.)
*Colpomenia sinuosa* (spring and summer) (ab.)
*Microdictyon* sp. (see footnote 2, p. 65.) (o.)
*Laurencia thyrsifolia* (f.)
*Laurencia botryoclada* (o.)
*Laurencia pinnatifida* (o.)
*Caulacanthus spinellus* (l.f.)
*Jania* sp. (f.)
*Rhizoclonium tortuosum* (r.)
*Cystophora torulosa* (r.)
*Dictyota dichotoma* (r.)
*Dictyota ocellata* (r.)
*Aphanocladia delicatula* (l. ab.)
*Splachnidium rugosum* (r.)
*Gigartina chapmanii* (o.)
*Liagora harveyana* (f.) (summer only)
*Calothrix pilosa* (l.)

ab. = abundant; f. = frequent; o. = occasional; r. = rare; l. = locally.

*Sublittoral Brown Kelp Formation*

5. **Carpophyllum–Ecklonia association**

This was not studied in any detail but the upper limit of the association was established. The dominant species are *Carpophyllum maschalocarpum, C. plumosum,* and *Ecklonia radiata.*

FRESHWATER SEEPAGE COMMUNITY

There are one or two places where there is a steady trickle of fresh water over the surface of the rocks near high water mark. In such places a characteristic vegetation has developed dominated by *Entermorpha compressa* f. *subsimplex.* A number of species are associated with the dominant and they include *Rhizoclonium hieroglyphicum* (f.), *R. riparium* (f.), *Calothrix scopulorum, Nodularia harveyana, Microcoleus acutissimus,* and *Rivularia polyotis.*[3]

TIDAL PHENOMENA

A temporary tide pole was established at Stanmore and several successive readings of high tides were noted on this pole or on the adjacent vertical rocks. These marks were subsequently levelled with a theodolite and at the same time a series of positions marking the upper and lower limits of the major communities was levelled. The levelled readings of the high tides were then compared with the records from the tide machine in Auckland Harbour, and, after allowance had been made for tides obviously affected by winds, it was found that 5.2 feet on the tide pole corresponded to 8.5 feet on the Auckland Harbour Board datum.

ASSOCIATION LEVELS

When the levels were examined it was found that in the case of the mussel and the *Chamaesipho* species the upper limits on the flat beach rock were lower than those on the vertical faces of the bluff rocks. This eleva-

[3]The author is grateful to Dr. F. Drouet for identification of some of the Myxophyceae.

tion at the bluffs can be accounted for on the basis of splash action. In other words there is a definite splash zone at the bluffs of nearly 1 foot (see Table 1). Other species are apparently not so affected in this way.

One very interesting point that emerged from this survey was that in general there is a far wider range of values for the upper limits of species than for lower limits, and it therefore appears that the lower limits are more rigidly controlled than the upper limits.

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TABLE 1

VERTICAL RANGE OF SPECIES AT STANMORE BAY

| SPECIES | LIMITS | AVERAGE* | HEIGHT DUE TO WAVE ACTION* | RANGE* |
|---|---|---|---|---|
| *Volsella neozelanicus* . . . | upper | 9.49 | 10.19 | 8.2 –11.78 |
| | lower | 6.58 | ..... | 6.34– 6.76 |
| *Chamaesipho* spp. . . . . | upper | 9.39 | 10.24 | 8.2 –11.78 |
| | lower | 6.71 | ..... | 6.66– 6.76 |
| *Saxostrea glomerata* . . . . | upper | 7.44 | ..... | 6.76– 8.13 |
| | lower | 5.56 | ..... | ..... |
| *Vermilia carinifera* . . . . | upper | 6.26 | ..... | 5.39– 7.07 |
| | lower | 5.56 | ..... | ..... |
| *Corallina, Hormosira, Leathesia* | upper | 5.19 | ..... | 4.8 – 6.27 |
| *Elminius plicatus* . . . . . | upper | 8.59 | ..... | ..... |
| *Liagora harveyana* . . . . | upper | 4.29 | ..... | ..... |
| *Codium adhaerens* . . . . | upper | 5.29 | ..... | 5.14– 5.47 |
| *Carpophyllum* spp. . . . . | upper | 2.53 | ..... | 2.24– 2.82 |
| *Cystophora torulosa* . . . . | upper | 4.04 | ..... | ..... |
| *Ecklonia radiata* . . . . . | upper | 2.07 | ..... | 2.24– 2.29 |

*Admiralty datum. All measurements in feet.