

ROCKY SHORE ZONATION AT NORTH RUSTICO AND PRIM POINT, PRINCE EDWARD ISLAND¹

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The vertical zonations of organisms on rocky shores are described for two sites. The principal study area, near North Rustico, is in the PEI National Park. The general pattern at this site was: (1) a zone of blue-green algae at the highest level in the intertidal zone; (2) a zone of *Fucus* at mean sea level; (3) a zone of leafy green algae, especially on rocks near sandy beaches; (4) a zone of *Chordaria flagelliformis* at mean lower low water. The subtidal zone was dominated by *Chondrus crispus* and evesiculate *Fucus vesiculosus*, with very little *Laminaria saccharina* except on steel surfaces of a breakwater. Details of four transects and a brief description of the horizontal distribution of algae are included. At the second study site, Prim Point on the south coast of PEI, the zonation pattern is similar except that the zone of *Chordaria* is replaced by a zone of *Chondrus* and *Fucus serratus*. The vegetation and fauna are denser at Prim Point. The results are compared to Stephenson & Stephenson's (1954a, b) study of shores of PEI and Nova Scotia.

Les zonations verticales des organismes sont décrites pour deux sites situés sur des rivages rocheux. Le site principal de l'étude est situé près de North Rustico, dans le parc national de l'Isle-du-Prince-Edouard. A ce site le patron général était: (1) une zone d'algues bleu-vertes située au niveau le plus élevé de la zone intertidale; (2) une zone de *Fucus* au niveau moyen de la mer; (3) une zone d'algues vertes feuilles, située spécialement sur des roches près des plages sablonneuses; (4) une zone de *Chordaria flagelliformis*, au niveau moyen inférieure de la marée basse. La zone subtidale était dominée par *Chondrus crispus* et *Fucus vesiculosus* sans vésicules. *Laminaria saccharina* était très peu représentée dans cette zone sauf sur les surfaces d'acier des jetées. Sont aussi inclus les détails de 4 transects ainsi qu'une brève description de la distribution horizontale des algues. Prim Point, le second site de cette étude, est située sur la côte sud de l'Isle-du-Prince-Edouard. Le patron de zonation à ce site est semblable sauf que la zone de *Chordaria* est remplacée par une zone de *Chondrus* et de *Fucus serratus*. La végétation et la faune sont plus denses à Prim Point. Ces résultats sont comparés aux travaux de Stephenson et Stephenson (1954a, b) sur les rivages de l'Isle-du-Prince-Edouard et de la Nouvelle-Ecosse.

Introduction

The general features of rocky shore intertidal zonation are well known and can be fitted to a universal pattern (Lewis 1954, Stephenson & Stephenson 1972). However, the details at individual locations vary and are of local interest. The rocky shores along the north coast of Prince Edward Island were described by Stephenson & Stephenson (1954a) as among "the most barren and peculiar we have encountered on our travels". The Stephenson's brief visit has been the only work to date on the vertical distribution of intertidal organisms on rocky shores of PEI. Subtidal algal distribution in northeast PEI has recently been studied by Bird et al. (1983). The present study was undertaken for the Dept. Indian Affairs and

¹This work formed part of a BSc Honours Thesis submitted by CSL to Dalhousie University, and a report by LAH and CSL to the Dept. Indian Affairs and Northern Development, Historic Parks Branch, Ottawa (Project No. 05/1-14).

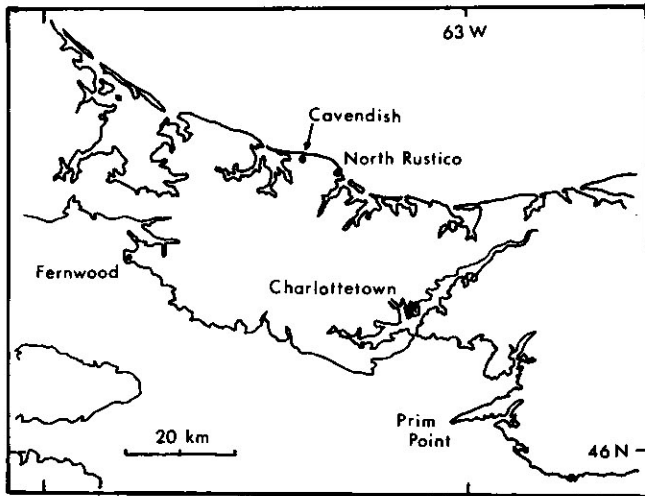


Fig 1. Map of central Prince Edward Island, showing locations of our two study sites at North Rustico and Prim Point, and those of the Stephensons.

Northern Development, National and Historic Parks Branch, to provide more detailed information on intertidal distribution of organisms in the PEI National Park, including observations throughout the year. In addition, we made a briefer comparative study at Prim Point on the south coast of PEI (Fig 1).

The study area in the National Park included the breakwater at the mouth of North Rustico Harbour and the shore for 4 km westward, as far as Doyle's Cove (Fig 2). The substratum, except for two sandy beaches, was rough, friable siltstone, underlain by harder sandstone which forms ledges in the intertidal and subtidal zones. Siltstone in the intertidal zone breaks along bedding planes to form ridges (see Fig 8). Tidal amplitude is 0.70 m (mean tide); tides are semidiurnal, except for a few days each fortnight when they become diurnal with an extended low tide. The shore at Prim Point is also siltstone, but the slope is very much less than at

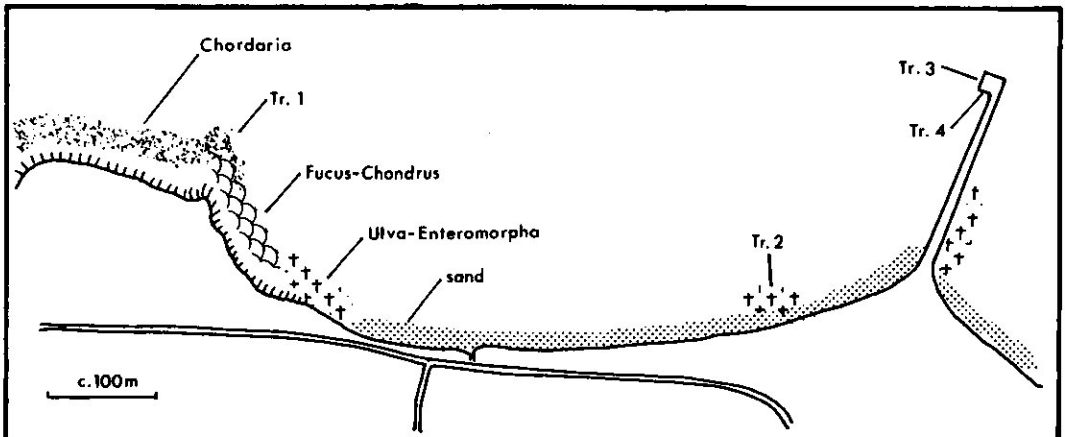


Fig 2. Map of the shore to the west of North Rustico Harbour breakwater, showing diagrammatically the characteristic features of horizontal distribution of major seaweeds, and locations of the four transects.

Rustico and the intertidal area is about 125 m wide. Tides there are semidiurnal with a mean amplitude of 1.83 m. Water temperature at both sites ranges from -1.8°C (freezing) in winter to $22-25^{\circ}\text{C}$ in summer. Salinities range up to 31‰ in winter, decreasing to 26-27‰ in summer.

Methods

The field work was carried out at roughly monthly intervals from July 1970 to June 1971 (at Rustico) and to November 1970 (at Prim Point). Most data were collected 14-29 July 1970, subsequent trips serving to record changes in the flora and fauna and to prepare additional transects. The survey of horizontal distribution at Rustico was carried out in August 1970. Semipermanent steel benchmarks were placed in the rock above each transect and their heights determined with reference to recorded tide levels. The concrete deck of the North Rustico Harbour breakwater also served as a reference level, 3.23 m above zero tide at a Canadian Hydrographic Service scale at the end of the breakwater. Subtidal organisms were studied cursorily with SCUBA, glass-bottomed box and rake collections from a *Chondrus*-harvesting boat. Voucher specimens of the organisms and a large collection of photographs were deposited with the Parks Branch along with our final report. A collection of voucher specimens was also sent to the National Museum of Natural Sciences, Ottawa.

Results

Horizontal Distribution at Rustico

The shore consists of alternate sandy beaches and rocky headlands and can be divided into three floristic regions (Fig 2). Rocks in the sandy areas bore chiefly *Ulva lactuca*² and species of *Enteromorpha*, with some *Chordaria flagelliformis*. At the western ends of the beaches, toward the headlands, there was typically a transition from *Enteromorpha* to *Ulva* to *Scytosiphon lomentaria*. The rocky west side of each bay leading to the promontories had well-developed intertidal belts of *Fucus vesiculosus* and *Chondrus crispus*. Thirdly, the shores from the headlands west to the next bay were dominated by *Chordaria* and a lower belt of Ceramiales (*Ceramium* spp., *Polysiphonia* spp. and some *Rhodomela confervoides*). A high intertidal black zone of blue-green algae was generally distributed along the rocky shore. *Balanus balanoides*, *Mytilus edulis*, *Littorina littorea* and *L. saxatilis* occurred in the regions of *Fucus* (*Mytilus* in the intertidal zone only in crevices).

Vertical distribution at Rustico

















The general pattern of vertical zonation is shown in Fig 3, a composite of various transects. There was a black zone from HHWS³ down to a little below MHHW, passing into a barnacle zone (*Balanus balanoides*). This merged with a zone of *Fucus* which straddled MSL. A zone of *Ulva* and *Enteromorpha* lay between the *Fucus* and the top of a zone of *Chordaria flagelliformis* at MLLW. Below LLWS was an association of *Laminaria saccharina* and *Chondrus crispus*. The details of the transects are as follows (transect locations on Fig 2).





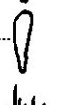
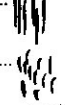







Transect 1. (July) (Fig 4a, 5). Because of the rather gentle slope of the shore, the zones were not sharply defined, but merged into one another. The black zone extended, albeit tenuously, to the limit of wave action, at the foot of the cliff, but was best developed between +0.61 m and +0.79 m, that is a little below MHHW. The upper part of this zone was *Calothrix*, the lower part *Rivularia*. It passed indistinctly into a "brown zone" of *Ralfsia verrucosa*. Although a few stunted plants of *Fucus*

²Authorities for the species names are given in the Appendix.

³HHWS = highest high water of spring tides; MHHW = mean higher high water; MSL = mean sea level; MLLW = mean lower low water; LLWS = lowest low water of spring tides.

List for key symbols:










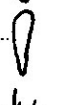



















- Sand 
- Black zone blue-green algae 
- Tube-dwelling diatoms 
- Chondrus crispus* 
- Bonnemaisonia hamifera* tetrasporophytes 
- Crustose corallines 
- Ceramialean algae 
- Furcellaria fastigiata* 
- Devaleraea ramentacea* 
- Ahnfeltia plicata* 
- Corallina officinalis* 
- Sphacelaria* spp. 
- Ectocarpus* spp. 
- Fucus serratus* 
- Ralfsia verrucosa* 
- Chordaria flagelliformis* 

- Laminaria saccharina* 
- Scytosiphon lomentaria* 
- Chorda filum* 
- Chaetomorpha melagonium* 
- Ulva lactuca* 
- Enteromorpha linza* 
- Enteromorpha intestinalis* 
- Urospora* sp. 
- Cladophora sericea* 
- Littorina littorea* 
- Nucella lapilla* 
- Balanus balanoides* 
- Intertidal *Mytilus edulis* 
- Subtidal *Mytilus edulis*
- Acmaea testudinalis*
- Asterias vulgaris*

ERRATUM

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List for key symbols:

Sand		<i>Laminaria saccharina</i>	
Black zone blue-green algae		<i>Scytosiphon lomentaria</i>	
Tube-dwelling diatoms		<i>Chorda filum</i>	
<i>Chondrus crispus</i>		<i>Chaetomorpha melagonium</i>	
<i>Bonnemaisonia hamifera</i> tetrasporophytes		<i>Ulva lactuca</i>	
Crustose corallines		<i>Enteromorpha linza</i>	
Ceramialean algae		<i>Enteromorpha intestinalis</i>	
<i>Furcellaria fastigiata</i>		<i>Urospora</i> sp.	
<i>Devaleraea ramentacea</i>		<i>Cladophora sericea</i>	
<i>Ahnfeltia plicata</i>		<i>Littorina littorea</i>	
<i>Corallina officinalis</i>		<i>Nucella lapilla</i>	
<i>Sphacelaria</i> spp.		<i>Balanus balanoides</i>	
<i>Ectocarpus</i> spp.		Intertidal <i>Mytilus edulis</i>	
<i>Fucus vesiculosus</i>		Subtidal <i>Mytilus edulis</i>	
<i>Fucus serratus</i>		<i>Acmaea testudinalis</i>	
<i>Ralfsia verrucosa</i>		<i>Asterias vulgaris</i>	
<i>Chordaria flagelliformis</i>			

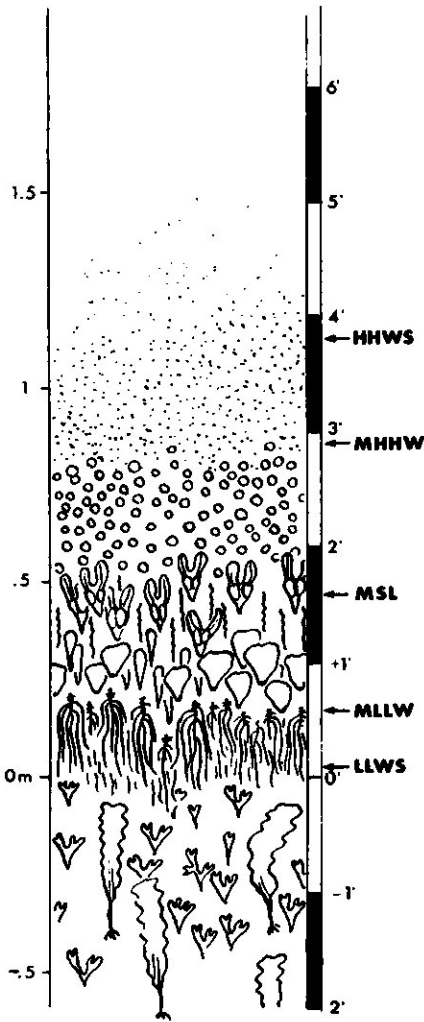


Fig 3. Generalized zonation scheme for North Rustico. (See key to symbols on page 28.)

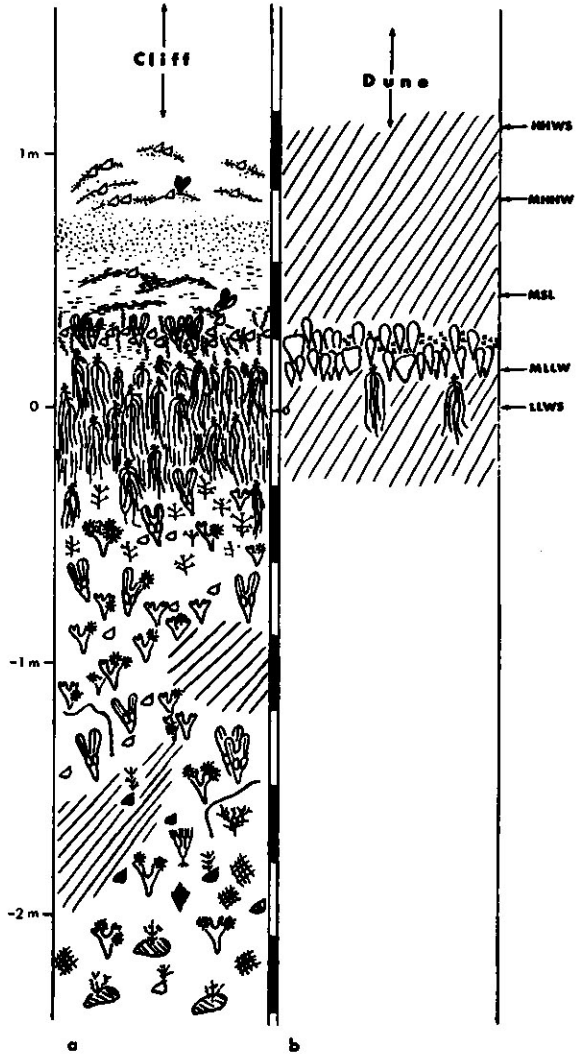


Fig 4. Zonation on Rustico shores. (a) Transect 1, a rocky headland. (b) Transect 2, a rocky outcrop on a sand beach.

vesiculosus occurred in the black zone, this species in the intertidal zone was at its best in a narrow zone between +0.24 m and +0.30 m, in association with *Scytosiphon lomentaria*. *Ralfsia* was also found in this zone. The dense mat of *Chordaria*, heavily epiphytized by *Dictyosiphon foeniculaceus*, straddled low water, from +0.24 m to -0.30 m. There was almost no *Balanus* on this transect, probably as a result of ice scour in winter.

There was a marked drop in the level of the rock under the transect from 0.0 m to -0.9 m. On the vertical face was a mixture of delicate red algae: *Polysiphonia* spp., *Ceramium* spp. and *Rhodomela confervoides*; plus *Chondrus* and *Fucus*. Subtidal



Fig 5. Photograph of the shore at Transect 1.

Fucus was well developed, highly branched, about 0.5 m long, and abundantly fertile, although the wings tended to be severely grazed. The *Chondrus* was heavily epiphytized by the tetrasporophyte phase of *Bonnemaisonia hamifera*, while *Fucus* was epiphytized by *Elachista fucicola*, *Pilayella littoralis* and sometimes *Ectocarpus* sp. The snail *Littorina littorea* was found all along the transect but in the intertidal zone sought shelter on the edges of the ridges (Fig 8) or under *Chordaria*. Below low tide these animals were randomly distributed and were covered by crustose coralline algae, *Corallina officinalis* and *Bonnemaisonia*. *Littorina saxatilis* was not seen on the transect in July or August but appeared in crevices in September. At other places along the shore it was found in pot holes or on *Fucus*. *Mytilus edulis* was common in the subtidal zone and the animals were larger than the intertidal individuals which grew in crevices. Clusters of subtidal mussels provided anchorage for *Fucus*, *Chondrus*, *Desmarestia aculeata*, crustose corallines, and the few *Laminaria*. *Chorda filum* and *Desmarestia* were fairly common from -1.2 m and from -3.0 m, respectively.

Transect 2. (July) (Fig 4b). This transect passed over a rock outcrop from $+0.12$ m to $+0.34$ m in the middle of North Rustico Beach. There were no major animals on the rock. The flora consisted of *Ulva lactuca*, *Enteromorpha linza*, *E. intestinalis* and some *Punctaria latifolia*. Tube-dwelling diatoms (*Navicula delognei* f. *elliptica* and

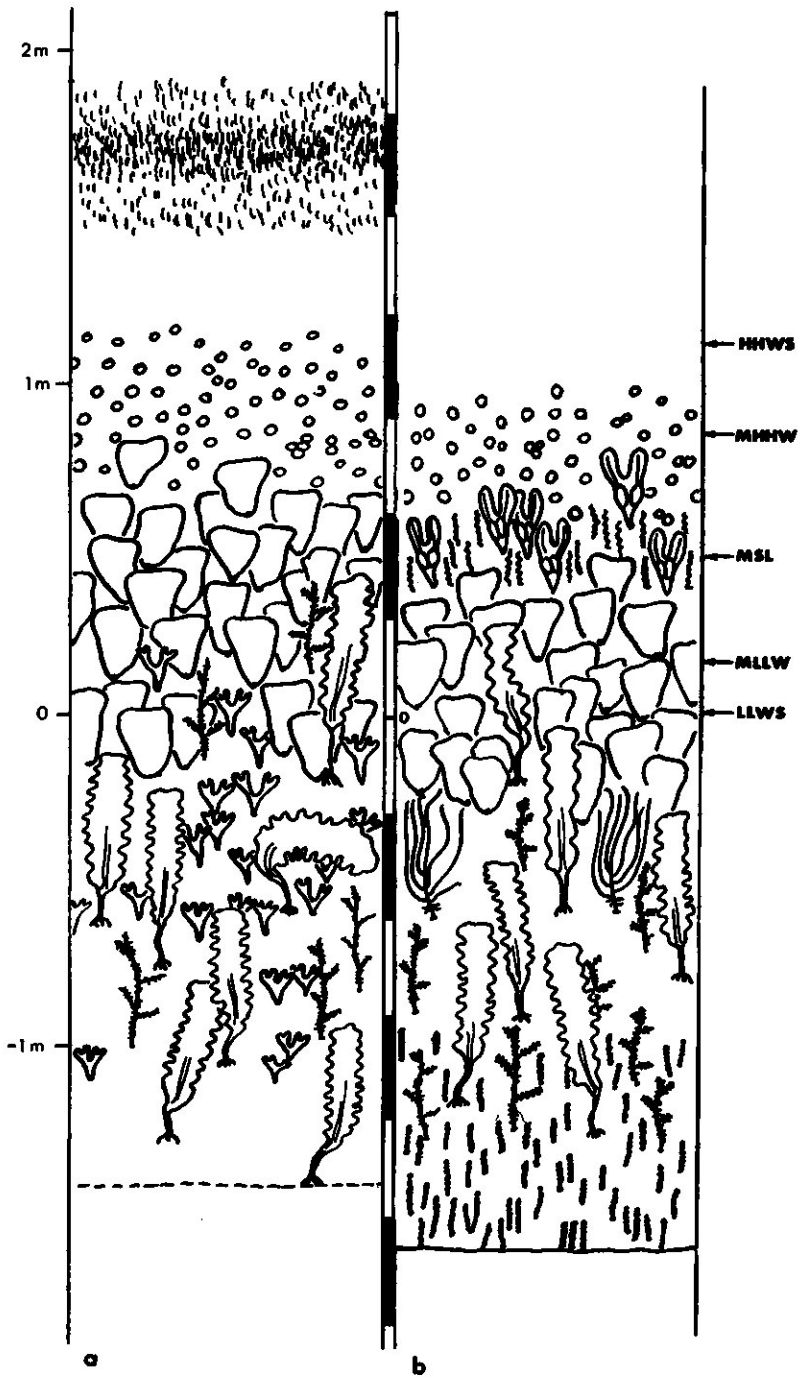


Fig 6. Zonation on Rustico breakwater. (a) Transect 3, west face. Dotted line represents a scour line below which there were no algae. (b) Transect 4, south face. Horizontal line represents the seabed.

Berkeleya rutilans) were found on the higher part of the outcrop. Some *Chordaria* (free of *Dictyosiphon*) grew at the lower edge. The *Ulva-Enteromorpha* association was typical of rocks surrounded by sand, occurring also at the west end of North Rustico Beach and on rocks in Doyle's Cove.

Transects 3 and 4. (November) (Fig 6a, b). These transects were on the west and south faces of the outer end of the breakwater. They differed from each other in two major environmental factors and in their floras. The west face receives less sunlight than the south face and is subject to more splashing by wave action. The zonation on these vertical faces, although not typical of the region, most closely resembled the generalized scheme shown in Fig 2.

The west face (Fig 6a) had a well-developed zone of *Urospora* sp. from above HHWS toward the limit of wave action (+1.46 m to +1.89 m), which was absent from the south face. The south face had a zone of *Fucus* and *Scytosiphon* straddling MSL (+0.40 m to +0.64 m). Both faces had *Laminaria saccharina* (-0.15 m to -1.37 m), *Devaleraea ramentacea* (ca. -0.3 m to -1.2 m) and *Balanus balanoides* (ca. +0.6 m to +1.1 m). The *Balanus* zone and the upper limits of *Ulva* and *Devaleraea* were both slightly higher on the west face. Neither face had a visible black zone.

Seasonal observations at Rustico

By October a marked and widespread zone of *Petalonia fascia* and *Scytosiphon lomentaria* had developed between the black zone and the zone of *Ulva* and *Chordaria-Dictyosiphon* had declined. During the winter the shore was scoured by ice between about +0.3 m and +0.6 m (Fig 7); *Fucus*, *Chondrus* and *Chordaria*, except behind boulders and under overhangs, were reduced to stumps or scraped away entirely (Fig 8, 9). For this reason growth of perennial algae, as well as barnacles, is largely confined to the lee of the siltstone ridges (Fig 8).

The first spring growth was dominated by *Ulothrix flacca*, *Urospora wormskioldii* and species of *Enteromorpha*, with scarce patches of *Bangia atropurpurea*. These were followed by regrowth of *Fucus* and *Chondrus*, and by resettlement of *Chordaria*.

Vertical distribution at Prim Point

The intertidal biota on the south coast of the Island is rather richer, and the zonation is different in a number of respects (Fig 10). The black zone extended to the limit of wave action (ca +3.4 m) but was not well developed above +2.4 m. It reached its best growth between +1.5 m and +2.1 m. Between +2.0 m and +2.7 m, just above HHWS, it was mixed with a small, branching *Enteromorpha* sp. (?*Blidingia minima*) which was fairly well developed but patchy. *Balanus balanoides* extended to the foot of the cliff, +1.5 m, occasionally 0.3 m higher in crevices. Two generations of the animal were evident. The young dominated the open surfaces of the rock and extended a little higher than the older ones which were generally confined to the shelter of the siltstone ridges. The zone of *Balanus* extended from +0.15 m, just above LLWS, to +1.5 m. *Mytilus edulis* grew on open rock from +0.6 m to +1.0 m, and in crevices up to +1.5 m. A zone of *Fucus vesiculosus* lay between MLLW and MSL, from +0.6 m to +1.5 m. In some places along the upper shore the plants were very twisted. *Littorina littorea* was scattered throughout the zone of *F. vesiculosus*, and *L. saxatilis* was found from +1.2 m to about +1.4 m. *Nucella lapilla* extended from about +0.52 m to +0.73 m on open rock and to +0.79 m in hollows.

Cladophora sericea occurred up to +1.13 m on open rock, to +1.29 m in tide pools. It was not observed below +0.52 m, although it probably occurs in the sub-



Fig 7. Rustico shoreline in winter, showing ice foot encrusting the rocks and ice pans floating and beached.

tidal zone. *Chondrus* and *Scytosiphon* were found on open rock below +0.64 m and +0.61 m, respectively, occurring in the shallow tide pools as high as +0.91 m.

Fucus serratus and *Chorda filum* extended from just above MLLW at +0.85 m and were seen down to -0.3 m. *Sphacelaria* sp(p). was encountered from -0.15 m to +0.40 m. *Corallina officinalis* was fairly common below +0.70 m down to unknown depths, and between -0.60 m and -1.2 m there was a zone of *Furcellaria fastigiata* in which limpets (*Acmaea testudinalis*) were also noted. *Mytilus*, encrusted as at Rustico with crustose corallines and providing a holdfast for macrophytes, was found scattered throughout the subtidal region, as were *Ahnfeltia plicata* and the Ceramiales *Ceramium*, *Rhodomela* and *Polysiphonia*. *Palmaria palmata*, *Desmarestia aculeata* and *Laminaria saccharina* were occasionally found in the driftweed but were never seen attached. The starfish *Asterias vulgaris* was common on the edges of the bedding plane ridges, but they were rarely larger than 30 mm in diameter.



Fig 8. Distribution of fucoids and barnacles in the lee in siltstone ridges. Detail (below) ca. 0.75 x life size.



Fig 9. Appearance of rocky shore at Rustico in April, after winter ice scour (contrast with Fig 8).

Discussion

A comparison of the shores at Rustico and Prim Point reveals the following principal distinctions: (1) while both shores are of siltstone, Rustico slopes more steeply and is more exposed to wave and ice action; (2) the intertidal flora and fauna at Rustico are generally impoverished in comparison with those at Prim Point; (3) the zone of *Chordaria-Dictyosiphon* at Rustico was not present at Prim Point, being replaced by *Chondrus* and *Fucus serratus*; (4) *Chondrus* and *Fucus vesiculosus* were displaced into the subtidal zone at Rustico, and *F. serratus* was absent.

The vertical distribution of organisms in the intertidal zone described here is largely as the Stephenson (1954a, b) found it at Rustico and Fernwood. They, however, used *Littorina saxatilis* as a representative zone organism. Their "short orange-brown form of [*Pilayella*] *littoralis* growing directly on rock" was seen on some of the vertical sandstone faces during our study.

Stephenson and Stephenson (1954a) were not favourably impressed by the north coast of PEI, and it is therefore of interest to compare the zonation there with what they found at Peggy's Cove, Nova Scotia, which they considered to represent the fully developed zonation of the Maritime Provinces. The general paucity of the intertidal flora at Rustico and Prim Point is in stark contrast to the dense vegetation at Peggy's Cove. Another significant difference is the absence, at Rustico, of the *Chondrus* subzone: where *Chondrus* occurs in the intertidal zone it scarcely forms a zone. Its place is usually taken by *Chordaria flagelliformis*. The zone of *Chondrus*, although present at Prim Point, is much less dense than at Peggy's Cove, and partly replaced by barnacles.

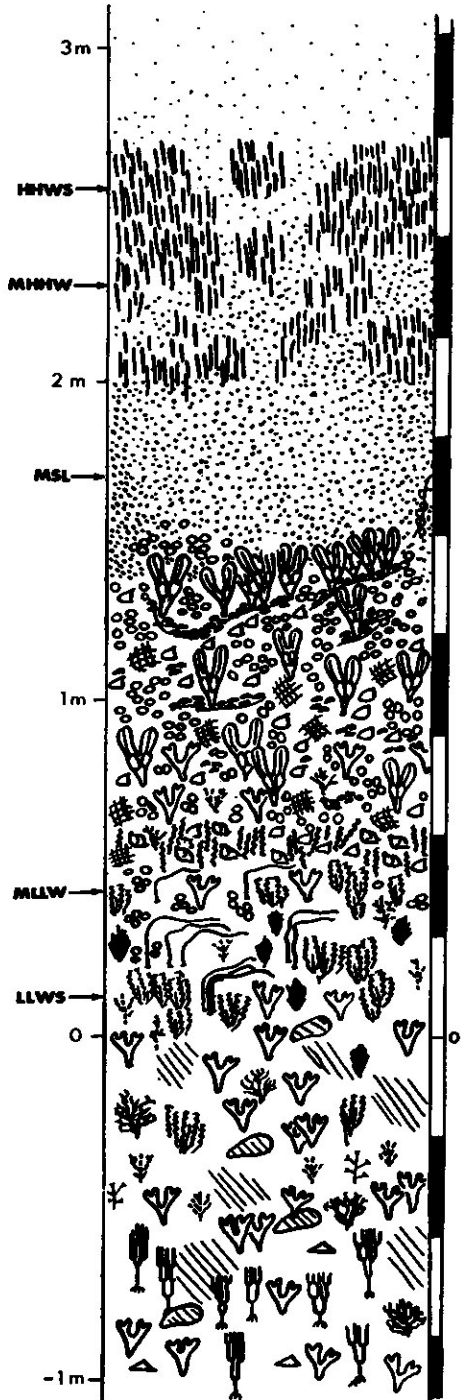


Fig 10. Zonation at Prim Point.

Three factors are probably of importance in the distribution of organisms at Rustico: ice scouring of the shore, leading to impoverishment of the zones of *Fucus* and *Chondrus*, sand scouring near beaches, and absence of competition from *Laminaria* in the shallow sublittoral zone. Sundene (1953) found that ice action in the Oslofjord, Norway, tended to be local and of brief duration—only part of the intertidal population being scoured off, over small horizontal distances. Removal was most often of the fucoids, and these were replaced by faster growing algae such as *Ulothrix*, *Urospora* and *Cladophora*. On the north coast of PEI *Chordaria* may replace *Chondrus* for the same reason. However, Sundene (1953) found that sporelings of *Fucus* often occurred and gradually took over, reestablishing the original zonation pattern if they survived the subsequent winter. This seems not to happen on the north shore of PEI, where, as also noted by Bird et al. (1983), perennial macrophytes are scarce. Wilce (1959, p. 36) gave a graphic first-hand account of the arrival of ice on the shore in Labrador, and said that ice masses there “devastate the algae of the intertidal zone”. In the Rustico area shore ice appears to protect the algae from the more severe grinding of pack ice, which remains off shore. The effects of ice on seaweed populations need closer study.

Rocks in or near the beach are subject to sand scour and even burial. The vegetation in these areas is dominated by ephemeral species. An effect of sand scour was also seen at the foot of Transect 3 (Fig 6a).

The scarcity of *Laminaria*, which again contrasts with Peggy's Cove, seems to be due to a combination of soft substratum and wave exposure. In shallow water, laminarians may be torn off the friable siltstone by storms (see Bird et al. 1983). They do not occur above about -4.6 m at Rustico or about -3.0 m at Prim Point. On the Rustico breakwater, however, which is made of steel at its northern end, *Laminaria* is found up to low water. The absence of *Alaria* is a feature of the region (Bell & MacFarlane 1933a).

The intertidal furoid zone is different among Peggy's Cove, Prim Point and Rustico, becoming progressively more reduced in that order. At Rustico it is extremely depauperate and *Fucus spiralis* is absent. This species was not found by the Stephensons (1954a, b) at Rustico, nor in the sheltered St. Margaret's Bay near Peggy's Cove. *Ascophyllum* does not occur on open rocky shores at Rustico (although it is reported in sheltered bays and inlets along the north coast of PEI by Bell & MacFarlane 1933b). At Prim Point, *F. spiralis* and *F. vesiculosus* are found in the same zones as at Peggy's Cove, but there is also the species characteristic of the Northumberland Strait, *F. serratus*. This is found just below low tide, in the *Chondrus* zone. *Ascophyllum* is very scarce along the Northumberland Strait coast of PEI, although it is more common in very sheltered regions at Caribou, N.S., across the Strait from Prim Point (personal observations).

Our subtidal observations at Rustico were limited but corroborate data from Taylor (1975), showing abundance of *Chondrus* and evesiculate *Fucus vesiculosus*, and scarcity of *Laminaria*.

Although the rocky shores of PEI are “peculiar”, they merit further attention, particularly in winter, when they provide an easily accessible study area for the effects of pack ice and ice foot on intertidal organisms. Furthermore, there were indications of an interesting flora under fast ice, including *Phaeosaccion collinsii*, *Desmotrichum undulatum*, *Rhodophysema georgii*, and a rare foliose diatom *Navicula ulvacea*.

Acknowledgements

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APPENDIX: CHECKLIST OF LITTORAL ORGANISMS AT RUSTICO

(Additional species found only at Prim Point are marked*.)

RHODOPHYTA

Nemaliales

Nemalion helminthoides (Vell. in With.) Batt.

Bonnemaisonia hamifera Hariot

Gigartinales

Furcellaria fastigiata (L.) Lamour.

Gracilaria verrucosa (Huds.) Papenf.

Ahnfeltia plicata (Huds.) Fries

Chondrus crispus Stackh.

**Phyllophora truncata* (Pallas) A. Zin.

Cryptonemiales

Rhodophysema georgii Batt.

Hildenbrandia rubra (Sommerf.) Menegh.

Corallina officinalis L.

crustose corallines

Melobesia Lamour. sp.

Palmariales

Devaleraea ramentacea (L.) Guiry

Palmaria palmata (L.) O. Kuntze

Ceramiales

Ceramium Roth spp.

Spermothamnion repens (Dillw.) Rosenv.

Phycodrys rubens (L.) Batt.

Polysiphonia Grev. spp.

Polysiphonia nigrescens (Huds.) Grev.

Rhodomela confervoides (Huds.) Silva

Rhodomela lycopodioides (L.) C. Ag.

Bangiales

Bangia atropurpurea (Roth) C. Ag.

PHAEOPHYTA**Ectocarpales**

Ectocarpus Lyngb. sp.

Giffordia Batt. sp.

Pilayella littoralis (L.) Kjellm.

Petroderma maculiforme (Woolny) Kuck.

Ralfsia verrucosa (Aresch.) J. Ag.

Elachista fucicola (Vell.) Aresch.

Chordaria flagelliformis (O.F. Müll.) C. Ag.

Sphaerotrichia divaricata (C.A. Ag.) Kylin

Punctaria latifolia Grev.

Dictyosiphon foeniculaceus (Huds.) Grev.

Petalonia fascia (O.F. Müll.) O. Kuntze

Scytosiphon lomentaria (Lyngb.) Link

Desmarestiales

Desmarestia aculeata (L.) Lamour.

Laminariales

Chorda filum (L.) Stackh.

Agarum cribrosum (Mert.) Bory

Laminaria saccharina (L.) Lamour.

Sacchorhiza dermatodea (Pyl.) J. Ag.

Sphacelariales

Sphacelaria Lyngb. sp.

Fucales

Fucus vesiculosus L.

Fucus distichus subsp. *edentatus* (Pyl.) Powell

**Fucus serratus* L.

CHLOROPHYTA**Ulotrichales**

Ulothrix flacca (Dillw.) Thur. in Le Jol.

Urospora wormskioldii (Mert. in Hornem.) Rosenv.

Monostroma grevillei (Thur.) Wittr.

Spongomorpha arcta (Dillw.) Kütz.

Ulvales

Enteromorpha intestinalis (L.) Link.

Enteromorpha linza (L.) J. Ag.

*?*Blidingia minima* (Näg. ex Kütz.) Kylin

Ulva lactuca L.

Cladophorales*Chaetomorpha linum* (O.F. Müll.) Kütz.*Chaetomorpha melagonium* (Web. et Mohr.) Kütz.*Cladophora sericea* (Huds.) Kütz.**CHRYSOPHYTA***Phaeosaccion collinsii* Farl.*Berkeleya rutilans* (Trent.) Cleve*Navicula delognei* van Heurck f. *elliptica* Lobban*Navicula rusticensis* Lobban*Navicula ulvacea* (Berk. ex Kütz.) Cleve**CYANOPHYTA***Rivularia* (Roth) Ag. sp.*Calothrix* Ag. sp.**MOLLUSCA****Gastropoda***Littorina littorea* Linnaeus 1758*Littorina saxatilis* Olivi 1792*Polinices heros* Say 1822**Nucella lapilla* Linnaeus 1758*Acmaea testudinalis* Muller 1776*Crepidula fornicata* Linnaeus 1767**Bivalvia***Mytilus edulis* Linnaeus 1758*Crassostrea virginica* Gmelin 1792*Mya arenaria* Linnaeus 1758**ANNELIDA***Spirorbis borealis* Daudin 1800**ARTHROPODA: Crustacea****Cirripedia***Balanus balanoides* (Linnaeus) 1758**Decapoda***Homarus americanus* Milne-Edwards 1837*Cancer irroratus* Say 1817*Pagurus longicarpus* Say 1817*Pagurus* sp.**Amphipoda***Talorchestia* sp.*Orchestia* sp.**ECHINODERMATA****Echinoidea***Strongylocentrotus droebachiensis* (Muller) 1776**Stelleroidea***Asterias vulgaris* Verrill 1866