

Survey on the  
Intertidal and Subtidal Algae on Surtsey in 1967

by  
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Previous to the lava flow which started on Surtsey on August 19th 1966, 14 marine algal species had been found growing on the rocky shore (1). This growth exhibited two conspicuous belts in the littoral zone bordering the lava delta, an upper one of green algae, dominated by Urospora penicilliformis, and a lower one of film forming Diatoms, belonging mainly to Navicula mollis. The other species encountered were only occasionally found and then mainly confined to tide pools.

This vegetation was seriously affected by the eruption. On the east coast it was totally destroyed by the lava flow advancing into the sea. Elsewhere, especially on the west coast, it was damaged by the scouring action of sand and sea, but presumably it was not completely wiped out.

In the course of the year 1967 intermittent algological surveys were carried out on Surtsey during a period extending from spring to autumn. The littoral zone was studied by means of direct observations, and the sublittoral zone, down to 20 m depth, was investigated by means of SCUBA-diving techniques.

A. Survey of the intertidal zone

After the 1966 eruption had ceased in 1967 the lava delta of Surtsey was surrounded by two types of coastlines: the old west coast formed in 1964-1965 and the new east coast.

Projecting rocks, boulders, promontories and vertical cliffs characterized the intertidal zone of the old coast, as the new coast consisted mainly of vast beaches of sand, gravel and shingle. On the north-east part of the new shore large rocks broken from the lava front occupied, however, the upper part of the intertidal zone.

Most of the coast was accessible at low tides. However, serious problems of access were encountered along the vertical cliffs on the south-west coast, which could be safely descended in few places only. This applied also to the south-east point where the intertidal zone was too narrow to be explored on foot.

In the first surveys carried out in May and June along the old coast the conspicuous belts of Urospora and Diatoms previously observed were lacking. Only a few tufts of Urospora were found on the rocks, intermingled with sparsely represented Diatoms. This situation markedly changed in the course of the following weeks. In the beginning of August when this coastline was prospected again, Urospora and Diatoms had spread out widely on the rocks, thus forming, once more, the two characteristic belts. Moreover, analyses of field collections made in this survey led, rather surprisingly, to the identification of all the algal species met with on this shore in 1966 prior to the eruption, except Pylaiella littoralis and Enteromorpha species (1). These species, confined to the Urospora-belt or its vicinity, on rocks and in tide pools, played, however, only a subordinated role in the general physiognomy of the algal vegetation. In addition the occurrence of Acrosiphonia albescens Kjellm. on rocks and in rock-pools of the mid-littoral zone of this shore represents a new record for Surtsey. Like other algal invaders so far settled on Surtsey, this species is also found to occur in the Vestmannaeyjar-archipelago, mainly as epiphyte on Gigartina stellata in the lowest part of the eulittoral zone. Another new record of great biological importance is the presence of a single barnacle found in this survey, in a small hole of the rock, in the lower part of the littoral zone.

As to the new shore it was entirely devoid of algal growth, except its rocky north-eastern part where the Urospora-belt was already growing up. Diatoms in branched gelatinous sheaths, belonging to Navicula mollis occurred in rock-pools, but did not form a continuous belt as on the west coast, presumably because of the still intensive scouring action prevailing in the lower part of the shore. Other algal settlers occasionally encountered on the new coast were a few young thalli of Porphyra umbilicalis, Petalonia zosterifolia,

Ectocarpus confervoides and a single tuft of Acrosiphonia albescens species concurrently occurring on the west coast.

During investigations carried out towards the end of the survey in September and October in the same areas as previously studied, no major changes of the marine algal vegetation was noted. In addition to species already met with, two new indigenous species were, however, found. One of these was an immature specimen of Enteromorpha linza (L.) J. Ag., 6 cm high and the other resembles somewhat Enteromorpha compressa (L.) Grev., as described by Bliding (2. p. 132). Both of these species, which grew in rock-pools on the west coast, occur elsewhere in the archipelago. Moreover, it was noted in October, that Codiolum gregorium, sometimes in fruiting conditions, was locally abundant on the west coast, often mixed with decaying filaments of Urospora.

#### B. Survey of the subtidal zone.

Investigations on the submarine algal colonization of Surtsey were carried out on August 15th by means of a transect made by SCUBA-divings, off the western rocky shore of the island. This area was, because of its location on the lee-side of the eruption, the most likely place to offer a rocky bottom favourable for algal settlement.

The position of the transect was determined by taking sextant readings on to accurately fixed points on the shore. Depths were measured both by echo-sounding and with wrist depth-gauges and were corrected to depth below mean lower low water. A deep-to-shallow transect sampling method was employed. Occasionally hydrophone was used by divers to communicate directly with the boat. The survey of the bottom was limited to a maximum depth of 20 meters. This depth was located 90 meters offshore.

The area explored by divers was found to be covered with rocks, 2-4 meters in diameter, and not dissimilar to those found in the intertidal zone. The rocks were surrounded by sand and dust which was easily stirred up by the divers when swimming over the sea bed. At 20 meters depth, where the depth increased abruptly, the rock was covered with asperities.

Sampling was done along the transect towards the shore at various depths, namely 20 m, 17-13 m, 13-6 m and 6-0 m.

At 20 m depth benthic animals, mainly hydrozooids, were dominating on the rocks. Diatoms also occurred at this depth, but no macroscopic algae were found. In the depth range of 17-13 m, the rocks were covered with young plants of Alaria esculenta, only 6-18 cm long spaced approximately at 0.5 intervals. Very young hairy Desmarestia viridis, about 4,5 cm long, grew among the Alaria plants, and one specimen of Giffordia hincksiae with plurilocular sporocysts was brought up from this depth. The presence of Diatoms in gelatinous sheaths on the rock surfaces was also asserted. In the segment of the transect at 13-6 m depth, Alaria was again the dominating species and was accompanied by Desmarestia and Diatoms. The largest specimen of Desmarestia found was 40 cm long and came from the depth of 10 m. The longest Alaria plant observed was 1,10 m long and was found at 6 m depth. This vegetation was immature and without epiphytes. The 6-0 m depth range was very difficult to explore owing to the excessive surge and strong currents prevailing at this depth. The divers succeeded, however, in surveying the bottom at up to 3 m depth. At this depth no vegetation occurred and the rock was clean and did not offer the slippery coating observed at greater depths.

Reconnaissance dives undertaken some 270 m north of the transect revealed, at 10 m depth, the same kind of bottom and an important Alaria-vegetation covering it.

Desmarestia viridis and Giffordia hincksiae are new immigrants on Surtsey. They are obligate sublittoral species which have been found in the archipelago before, either by dredgings or SCUBA-divings. D. viridis has been brought up from 5-25 m depth in various localities off the shores of Heimaey (Eidid, Úrdarviti, Bótin, Ofanleitishamrar), Brandur and Hellisey and G. hincksiae has been found to occur as epiphyte on the stipe of Laminaria hyperborea and Alaria esculenta on 6-18 m depth, in the vicinity of Heimaey and Brandur. As to Alaria esculenta, a very young specimen had already been found in 1966 on the south-east coast of Surtsey (1, p. 49) the day before the shore was submerged in the new lava.

### C. Remarks on the marine algal settlement.

Although seriously affected by the last lava flow on Surtsey, the marine algal settlement has continued and 5 new invading species were detected in 1967 in addition to those previously found and which were all rediscovered with two exceptions. This totalizes 17 species of benthic algae so far identified on Surtsey, Diatoms not included.

The relative paucity of the algal vegetation on the west coast in the beginning of the survey could indicate that the algal growth previously observed was destroyed during the eruption and that repopulation took place later on. This is not necessarily the case. It must be borne in mind that most of the intertidal colonizers, if not all, appear to be annual forms, which pass the wintertime as microscopic plants easily overseen in nature. This might, therefore, have been the situation of the algal growth, when investigations started in the spring. On the other hand, it is obvious that repopulation took place on the north-east coast, where all life was buried under the lava flow. The occurrence on this coast of initial algal populations, similar to that observed before the destruction, is significant and suggests that the algal settlement is the subject of invariable principles. The presence, however, of colonizers, such as Acrosiphonia albescens, which had not been encountered before on Surtsey, seems to indicate that the order of arrival and settlement of certain species might also be accidental.

At present there is no absolute delimitation between the littoral fringe and the eulittoral zone of Surtsey. For this reason it is difficult to appreciate the real extension of the species. This inconvenience will now be surmounted by increasing settlement of barnacles, which have already appeared on the coast. Their occurrence will serve as a precious biological indicator for the establishment of the littoral zonation and the estimation of the degree of exposure of the coast. Their upper limit, in quantity, will eventually mark the boundary between the eulittoral zone and the littoral fringe and this limit will facilitate the study of the variations in the vertical distribution of the benthic algae as their settlement proceeds.

The occurrence of Alaria esculenta as probable pioneer species of the subtidal zone was not surprising, as it had already been met with in 1966. It was unexpected, however, to find Alaria so wide spread, exhibiting a noticeable sublittoral belt, of up to 60-70 meters broad. In adjacent waters this species grows most luxuriantly in the uppermost part of the sublittoral zone extending downwards to 6-10 m depth. In the vicinity of Alsey, divers brought Alaria up from 20 m depth, but this was exceptional. The distributional range of Alaria observed on Surtsey, where it grows at 6-17 m depth, is therefore somewhat exceptional. On the other hand, the largest specimens of Alaria were on Surtsey found at 6 m depth, which appears to be the optimal depth for the growth of this species elsewhere in the archipelago. As to Desmarestia viridis, its vertical distribution on Surtsey coincides fairly well with that observed elsewhere, for example off Eiddid, on Heimaey, where it was found last summer at 6-25 m depth.

Actually the lower limit of the vegetation on Surtsey is located at about 20 m depth. This limit is approximately the same as observed elsewhere in the archipelago, where SCUBA-diving studies have been carried out (Geirfuglasker, Hellisey, Alsey and in different localities at Heimaey). The upper limit of the sublittoral vegetation on Surtsey is, on the other hand, abnormally characterized by a barren belt, which corresponds on adjacent shores to the position of the Laminaria digitata and/or Alaria esculenta belt.

According to the type of life history exhibited by Alaria and Desmarestia, involving an alternation between a large and structurally complex sporophyte and an exceedingly minute gametophyte, it is obligated that these plants grew up from eggs which settled on the bottom of Surtsey. As to the Desmarestia plants it is obvious, because of their juvenile characters, that they grew up during the summer season. It seems likely that the same applies to the Alaria plants despite their presence on Surtsey the year before. The size of these plants compare favourably with the size of the Alaria plants found in Aug. near Heimaey, growing on artificial substrate (aircraft wreck), which had been immersed in the sea, at 6 m depth, for 3 months. This observation shows, moreover, that the growth of Alaria in Icelandic

waters is not restricted to the winter months as seems to be the case, for example, on the Norwegian coast (3).

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#### References

1. Jónsson, S.: Further settlement of marine benthic algae on the rocky shore of Surtsey. Surtsey Res. Progr. Rep. III, p. 46, 1967.
2. Bliding, C.: A critical survey of European taxa in Ulvales. Opera Botanica, 8, 1963.
3. Sundene, O.: The implications of transplant and culture experiments on the growth and distribution of Alaria esculenta. Nytt Mag. Bot. 9, 155, 1962.