

# Vascular plants on Surtsey 1977–1980

By

STURLA FRIDRIKSSON

The Agricultural Research Institute, Keldnaholt,  
110 Reykjavik, Iceland

## INTRODUCTION

The vascular plants of Surtsey have been investigated annually since 1965, when the first plant was observed on the island. Reports on these investigations have been published in the Surtsey Research Progress Reports. The last accounts covered the period 1971-1976 (Fridriksson, 1978). This paper deals with a study of Surtsey's flora of vascular plants during the following four year period 1977-1980.

The methods used in the study during the first two years were the same as described in previous reports. Attempts were made to count, mark and map individual plants and their location was plotted on a chart of the island. The map bore a grid with a coordinate system with quadrats of 100 square m. each, marked numerically and alphabetically. The location of plants and their mapping was done with the aid of an aerial photograph.

In the two latter years the method had to be changed when it came to the study of *Honkenya peploides* which had increased in number to the extent that counting individual plants was not feasible. Instead their frequency was measured by counts in quadrats or on transects.

A description was given of a number of individual plants regarding flowering and seed setting.

Photographs were taken to document appearance of plants and their associations.

## DESCRIPTION OF POPULATION SIZE

Eleven plant species were recorded on Surtsey in the summer of 1977. In addition to the 10 species which grew there in 1976, *Cakile arctica* (syn. *C. edentula* ssp. *islandica*) was once more rediscovered on the island. One plant was also found which may be of the species *Atriplex*

*patula*, but because of its small size it was not possible to confirm the identification. If correctly identified this is the first time the species has been found on Surtsey.

Of the 1132 individuals of vascular plants which were recorded on Surtsey in the autumn of 1976, 489 were found living in the spring of 1977, 473 new plants were found in the summer of 1977, and 962 plants were registered on Surtsey in the autumn of 1977, or 170 fewer than in 1976. This decrease was primarily due to the fact that only 256 seedlings of *Cochlearia officinalis* coll. were recorded in 1977, while in 1976 there were 452 *Cochlearia officinalis* and *Cerastium fontanum* ssp. *scandicum* seedlings. Thus the number of mature *Cochlearia officinalis* and *Cerastium fontanum* plants decreased considerably since 1976. In spite of this the total number of mature plants increased from 680 in 1976 to 706 in 1977, which results from the continual spread of *Honkenya peploides*.

It is probable that a higher number of seedlings would have been found, both of *Cochlearia officinalis*, *Cerastium fontanum* and *Honkenya peploides* had the investigation been carried out later in the summer, but no field observations were made after August 4.

Two plant species flowered for the first time on Surtsey in 1977: *Mertensia maritima* and *Tripleurospermum maritimum*. Both species probably developed seed. Six plant species in all flowered on Surtsey in 1977. In addition to those named above, there were *Cakile arctica*, *Cochlearia officinalis*, *Cerastium fontanum* and *Honkenya peploides* (Fig. 1).

Of the 962 plants that were recorded on Surtsey in the autumn of 1977, 698 plants were found living in the summer of 1978, or 72%. This was

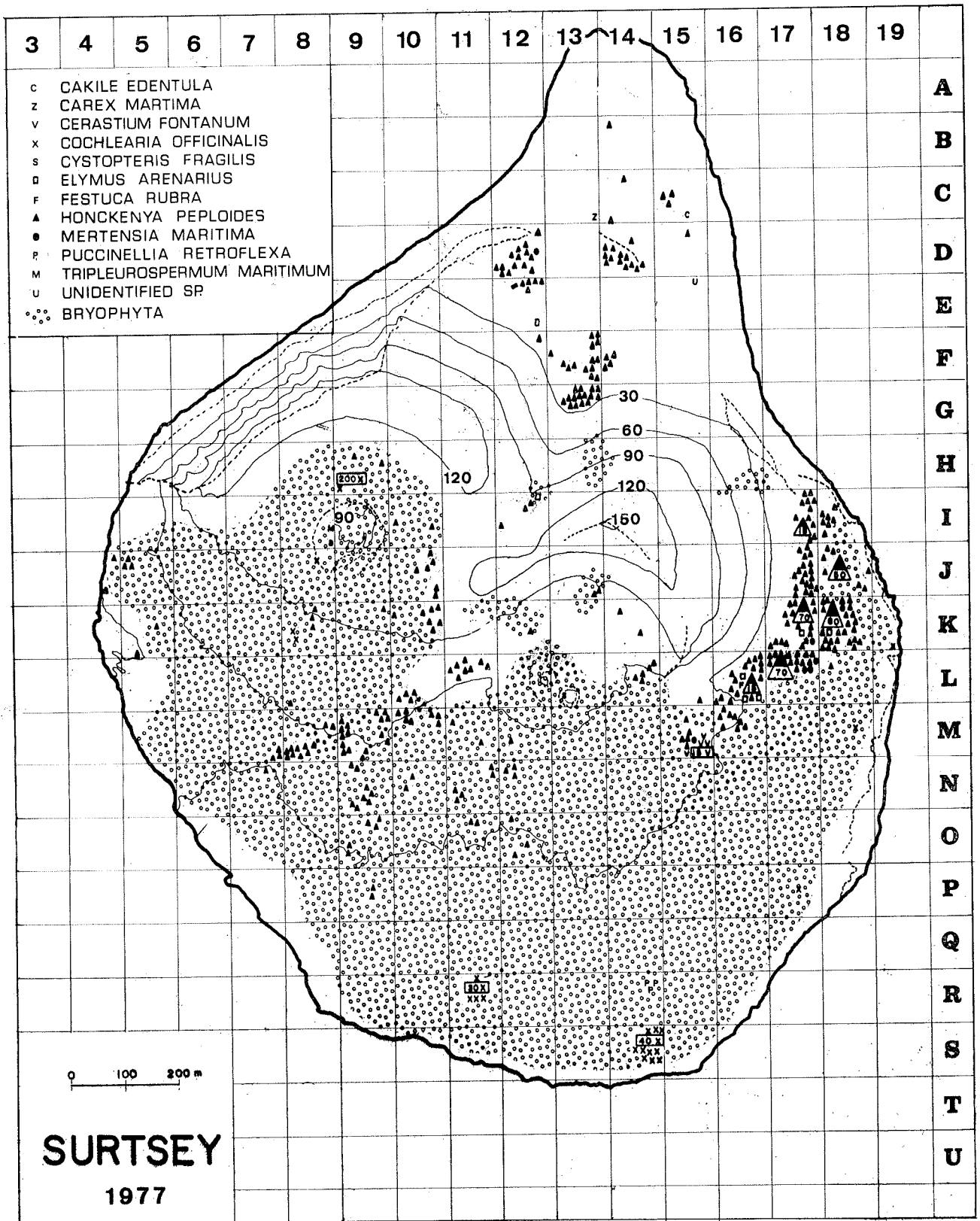


Fig. 1

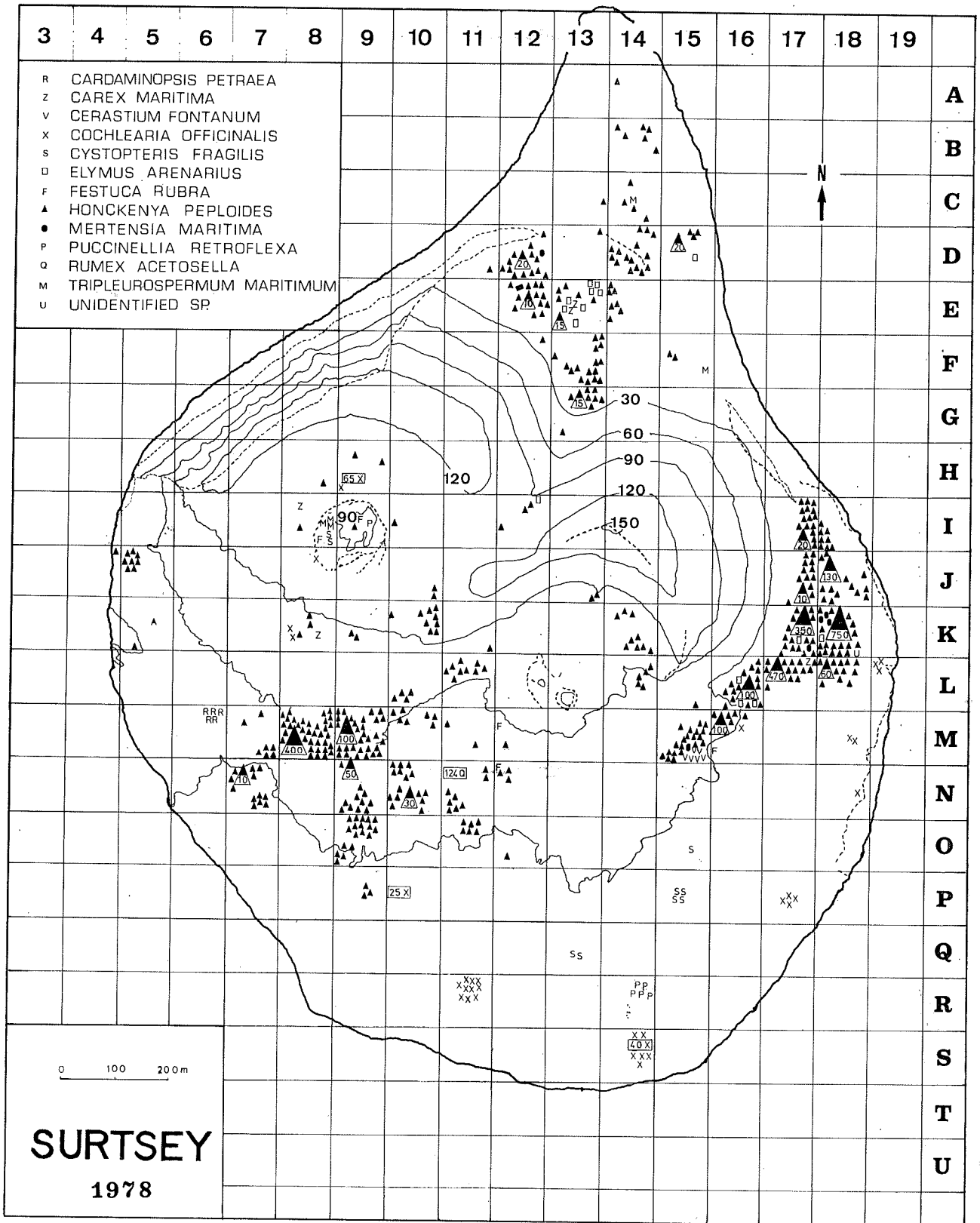
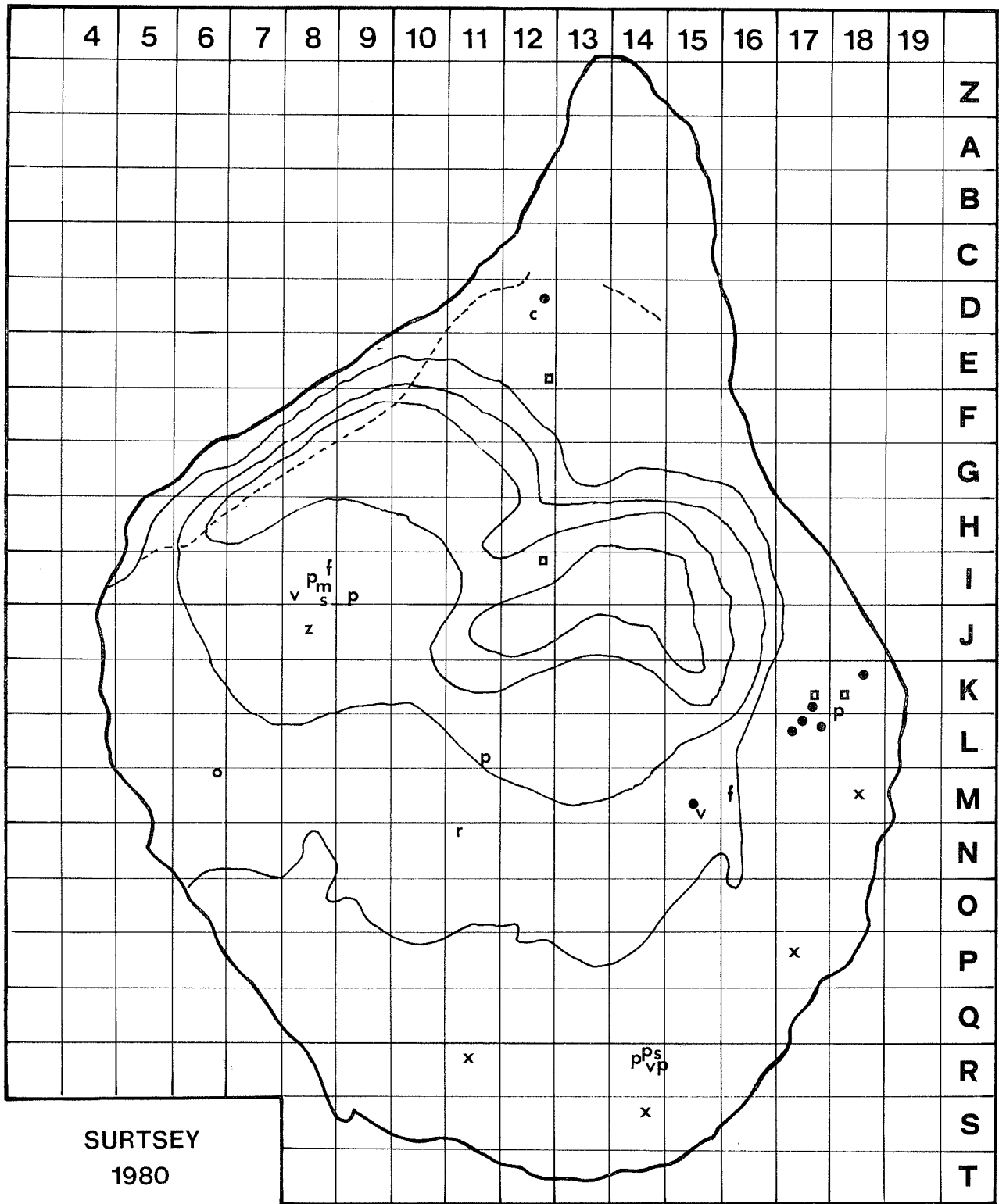


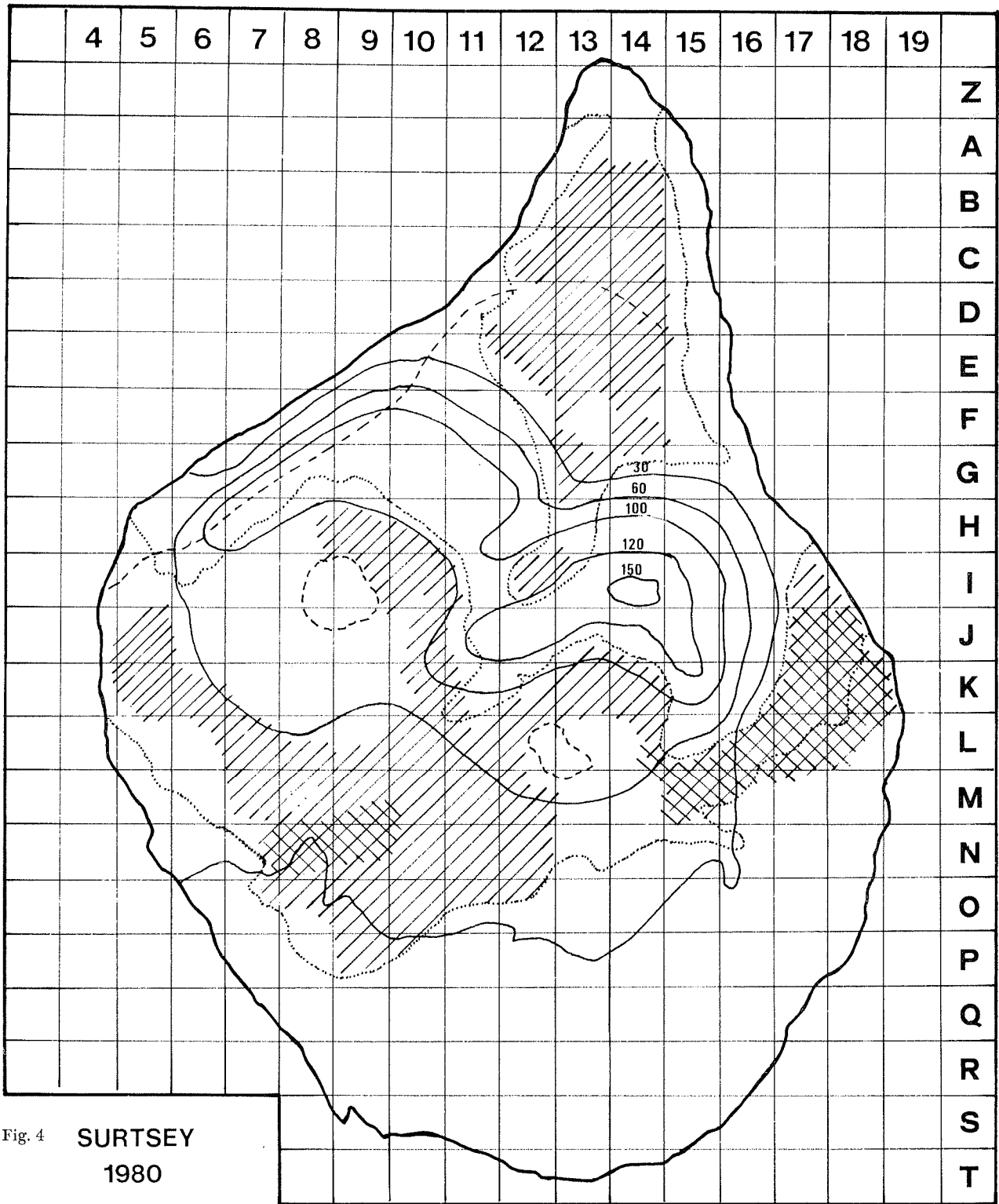
Fig. 2






### DISTRIBUTION OF VASCULAR PLANTS

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>c CAKILE EDENTULA</li> <li>o CARDAMINOPSIS PETRAEA</li> <li>z CAREX MARITIMA</li> <li>v CERASTIUM FONTANUM</li> <li>x COCHLEARIA OFFICINALIS</li> <li>s CYSTOPTERIS FRAGILIS</li> </ul> | <ul style="list-style-type: none"> <li>□ ELYMUS ARENARIUS</li> <li>f FESTUCA RUBRA</li> <li>● MERTENSIA MARITIMA</li> <li>p PUCCINELLIA RETROFLEXA</li> <li>r RUMEX ACETOSELLA</li> <li>m TRIPLEUROSPERMUM MARITIMUM</li> </ul> |
|--|---|

Fig. 3



DISTRIBUTION OF HONCKENYA PEPLOIDES

-  <100 PLANTS PER QUADRAT
-  100-5000 " " "
-  SANDY AREA

the highest percentage of plants that overwintered between years on Surtsey.

In the summer of 1978 the vascular plants began to thrive increasingly well on Surtsey. Two new species were found, *Rumex acetosella* and *Cardaminopsis petraea*, both of which have since borne seed and multiplied on the island. A few well developed individuals of *Festuca rubra* and *Carex maritima* were found, although both species have had difficulties in establishing themselves on Surtsey during the past years. Of the vascular plants on Surtsey in 1978, *Honkenya peploides* had the most marked increase with a total of 2,512 new individuals recorded. Of other species 218 new individuals were found, making the total number of new individuals 2,730 in addition to the 698 plants that overwintered. Thus, a total of 3,428 vascular plants were registered on Surtsey in the autumn of 1978 (Fig. 2). In the two following years, 1979 and 1980, there was a tremendous increase in the number of plants of *Honkenya peploides*, whereas there was no major change in the number of individuals of other species on the island (Fig. 3). The *Honkenya* plants were consequently no longer counted as individual plants, but estimated as having been 24,000 and 50,000 respectively those two years. A special chart was drawn in 1980 to show the distribution of *Honkenya peploides* (Fig. 4).

Thirteen species of vascular plants were recorded on Surtsey in the years 1978-1980: *Cakile arctica*, *Cardaminopsis petraea*, *Carex maritima*, *Cerastium fontanum* ssp. *scandicum*, *Cochlearia officinalis*, *Cystopteris fragilis*, *Elymus arenarius*, *Festuca rubra*, *Honkenya peploides*, *Mertensia maritima*, *Puccinellia retroflexa*, *Rumex acetosella* and *Tripleurospermum maritimum*. These will now be dealt with individually.

## INDIVIDUAL SPECIES

### *Atriplex patula* L.:

A plant was found in quadrat E-15, which is possibly of the species *Atriplex patula*, but the smallness of the plant prevented a firm identification. This plant grew together with some *Honkenya peploides* plants at the high tideline and there is no doubt that the seed from which it grew was carried to Surtsey by sea. *Atriplex patula* is a common shore plant in Iceland and grows on Heimaey.

*Cakile arctica* Pobed. (syn.: *Cakile edentula* (Bigel) Hooker; *Cakile maritima* Scop.)

One specimen of *Cakile arctica* was found on Surtsey in 1977. This plant was numbered 77-94 and was located in quadrat C-15. It consisted of one branch with 5 leaves, and bore 3 flowers on August 2, but no fruit.

In 1978 there was no specimen found of this species. However, in 1979 a new individual had occupied quadrat D-12 at the hightide line. It flowered and had set seed late in July. In 1980 this plant had disappeared but again another *Cakile* plant was found in the same quadrat.

*Cakile arctica*, being an annual, has not managed to find a firm foothold on Surtsey. It is conceivable that meager soil hinders the plant from achieving the level of development necessary to maintain the minimum seed production needed to establish itself firmly.

Most of the *Cakile arctica* plants which have been found on Surtsey have been very puny and seed production has been extremely small. Occasional plants have nevertheless come to maturity and achieved considerable seed production, but not sufficient to ensure the preservation of *Cakile arctica* on the island. The existence of *Cakile arctica* on Surtsey is almost totally dependent on seed from neighbour islands and there are distinct yearly changes in the number of plants on the island.

It would be interesting to investigate during the coming years what connection exists between seed production on Heimaey and the number of plants on Surtsey the following year. The prevailing wind following the fall of seed on Heimaey and on the southern coast of Iceland is also a deciding factor whether seed is dispersed in any quantity to Surtsey.

### *Cardaminopsis petraea* (L.) Hiit.:

In August 1978 five plants of this species were found in quadrat M-6, No. 78-136. They all grew together on a small spot. This species had not been observed on Surtsey before. The largest plant had 2 flowers and 2 fruits and was 7 cm long. The others did not flower and were from 1-4 cm in length. As with *Rumex acetosella*, it is likely that *Cardaminopsis* seed was brought to Surtsey the previous summer, and that a plant grew up and developed seed. This seed was most likely brought by a bird.

In 1979 six plants were found growing on that same spot, two of which were flowering. In 1980 the colony had increased very little.

*Cardaminopsis petraea* is a common plant all over Iceland and thrives well on sand flats. The conditions on Surtsey are probably favorable for

this species and it is likely that it will continue to increase in number and spread and become a permanent settler on the island.

*Carex maritima* Gunn.:

Plant No. 70-72 in quadrat M-11, which in 1976 was disturbed and nearly destroyed by a pair of *Larus marinus* that used it for nesting material, had completely disappeared in 1977. Plant 75-10 in quadrat M-19, which vanished in August 1976, had not grown again and may be counted among the departed.

A new specimen was found on July 29 in quadrat C-13, and it was given the number 77-96. This tiny plant consisted of 1 culm with 3 small leaves. The location of this plant indicates that the seed from which it grew was carried to Surtsey by the sea. This plant was not destined to live long, for it was pulled up by *Rissa tridactyla* on August 2nd and destroyed. Thus birds destroyed all the specimens of *Carex* on Surtsey.

During the summer of 1978 four new plants were found, two of which were well developed and had 28 culms (No. 78-148 in J-8) and 23 culms (No. 78-161 in I-8). Neither, however, had developed flowers. The two remaining plants consisted of 4 and 1 culms. The locations of the larger plants indicates that they have grown from seed carried to the island by birds. The two smaller plants, No. 78-142 and 78-182, grew both by the shore indicating that the seed from which they grew was very likely brought to the island by sea.

In 1979 only two of the plants were alive, the small plant No. 78-182 in quadrat L-17 and the larger plant No. 78-148 in quadrat J-8, which had developed 35 culms and formed a tuft 50x35 cm in area. In 1980 the species was only represented by the large plant in quadrat J-8.

*Cerastium fontanum* Baumg. ssp. *scandicum* H. Gartner:

There was a considerable decrease in the number of *Cerastium fontanum* ssp. *scandicum* plants from 1976 to 1977. In 1976, 38 mature plants were found, but the number was reduced to 19 plants in 1977. They developed on the average five shoots per plant, and during that summer thirteen plants flowered.

Of the 19 plants recorded on Surtsey in 1977, only 6 were found in 1978, five of which flowered. No new plants were found that year.

There were 27 mature plants of this species found on the island the following year. In quadrat R-14 there were 23 plants growing together

on a 2x5 metre large area. All these plants were flowering, some of which had already set seed and had even produced 70 new seedlings that were growing along with the mature plants. Thus there were altogether 97 plants of this species found that year on Surtsey. In 1980 the colony had still increased in quadrat R-14. In quadrat M-15 and I-8 new plants had developed.

The species had managed to survive on the island since it was first observed in 1975. It has readily developed seed, but is not yet well established.

*Cochlearia officinalis* L.:

*Cochlearia officinalis* decreased considerably on Surtsey from 1976 to 1977. Of the 501 plants recorded in 1976, 391 were seedlings. In 1977 only 30 „large“ plants were found, of which two were new, and there were 256 seedlings. The total number of *Cochlearia* plants in autumn 1977 was 286. Only three of these 30 „large“ plants flowered, No. 71-71, 75-66 and 76-172, but near the last-named about 200 seedlings had developed at the beginning of August 1977. Seed had not germinated around the other two plants at that time. *Cochlearia* was found in 8 quadrats in 1977 and in 7 quadrats the previous year. A plant was now found in quadrat K-19, where there was none in 1976.

In 1978 *Cochlearia officinalis* decreased to 160 plants and only 50 seedlings were found. The „large“ plants increased in number from 30 in 1977 to 110 in 1978, and were found in 6 new locations. Only five plants flowered in 1978, and it is likely that all developed seed. Seedlings were observed alongside three plants.

In 1979 there were only 91 specimens of *Cochlearia* counted on the island of which 13 had overwintered, mostly in quadrat R-11. The rest of the plants were seedlings, most of which were found in that same quadrat. In 1980 the species was still found to be occupying four quadrats in the south and southeastern parts of the lava. The majority of the *Cochlearia* plants were, as in previous years, rather undeveloped and it is obvious that conditions are not yet as favourable for the species as on the rocks of the neighbouring islands.

*Cystopteris fragilis* (L.) Bernh.:

In 1977 one plant, No. 72-113 in I-8, survived the winter, but another plant, No. 73-599, disappeared. A new plant was found during the summer of 1977, No. 77-89, which grew in a moss tuft on a vertical lava face in quadrat L-16.

This plant consisted only of 1 frond of about 1 cm in length. Plant No. 72-113 thrived during the year. It had 5 fronds and 2-3 buds at the end of July. The longest frond was about 15 cm. It was unfertile. Plant No. 72-113 survived the following winter but plant No. 77-89 disappeared. Eight additional *Cystopteris* plants were found in 1978, making a total of nine plants recorded. Plant No. 72-113 had grown considerably and had 6 fronds and two buds on July 27. The longest frond was 20 cm in length. For the first time the plant formed spores on 5 fronds. Two of the new plants were found in a small mossy cavity where the species has been observed before, No. 73-113 in Q-13. These may be older plants and, therefore, the previous number was kept. Each plant had two fronds.

A new plant was found in a crevice in the westernmost lava crater in I-8. It had 3 fronds on July 27, the longest being 6 cm. Five tiny plants, with one frond each, were found in two mossy cavities in quadrats O-15 and P-15. In 1979 there were five plants of this species growing on the island and the same number of plants in 1980.

All *Cystopteris fragilis* plants on Surtsey grow in moss tufts, which seem to offer requisite conditions. It is possible that the plants find the necessary moisture in the moss colonies not otherwise obtained on the island.

#### *Elymus arenarius* L.:

Out of ten *Elymus arenarius* plants in 1976, eight survived the winter. No new plants were found in 1977. Plant 74-51 in quadrat K-18 was, as before, the largest *Elymus arenarius* plant on Surtsey, and it increased markedly in size over the summer but did not flower. On August 1, 1977, the plant had 24 culms with 96 leaves; the longest leaves were 50 cm. There were about 160 cm between the most distant stolons. In 1976 this plant had 6 stolons and 28 leaves. Plant 74-55 did also well, having 14 culms and 42 leaves on August 1, 1977, with 55 cm between stolons. In 1976 it had 4 culms and 14 leaves. Plant 74-78, in L-16, has also become large; on August 1, 1977, there were 12 culms and 27 leaves, while in 1976 it had 7 culms and 21 leaves. Other *Elymus arenarius* specimens had 1-5 culms and 3-17 leaves.

Although *Elymus arenarius* plants decreased in number on Surtsey in 1977, it is clear that the conditions there are favourable. The main cause of its scarcity is probably the limit of seed dispersal or lack of germination rather than the

growing conditions on the island. The plants that have achieved a certain development on Surtsey propagated only by stolons and had not flowered.

Of the eight *Elymus arenarius* plants recorded in 1977, six overwintered and eight new plants were observed, making a total of 14 plants recorded in 1978.

All the new plants were located on the northern point of the island and it is, therefore, rather certain that they were dispersed to Surtsey by sea from other islands or from the mainland.

Older plants matured although none of them flowered. The largest plant, No. 74-51, in quadrat K-18, had 65 culms at the end of July 1978 and had increased by 41 stolons in one year. There were about 2 meters between the far ends of the stolons. A pair of *Larus marinus* nested close to the plant, resulting in abundance of droppings and food-leavings. Two young were raised in the nest and they sought shelter in plant No. 74-51.

Other old plants developed 1-15 culms, making them considerably smaller than the two mentioned above. Of the new plants found, eight were growing quite far from the sea, in quadrat E-13.

There were five plants found of the species on Surtsey in 1979 whereas all the new plants from previous years had disappeared. This year the large, well developed plant No. 74-51 in K-18 flowered, bearing eight spikes. The number of culms had increased to 121 and it now occupied an area of 155x290 cm. As in previous years a pair of *Larus marinus* frequently visited the spot and the young used the plant as a shelter. The plant consequently continued to benefit from the birds' droppings. As the plant increased in size, sand started to drift towards it forming a small dune.

Plant No. 74-51 was flowering again in 1980 with over fifty spikes and had still increased in size and more sand had been accumulated towards the developing dune. The spot was also occupied by *Honkenya peploides* plants which together with *Elymus* were forming a sand-dune association. The location of various plants in this dune association was plotted on a chart as shown in Fig. 5.

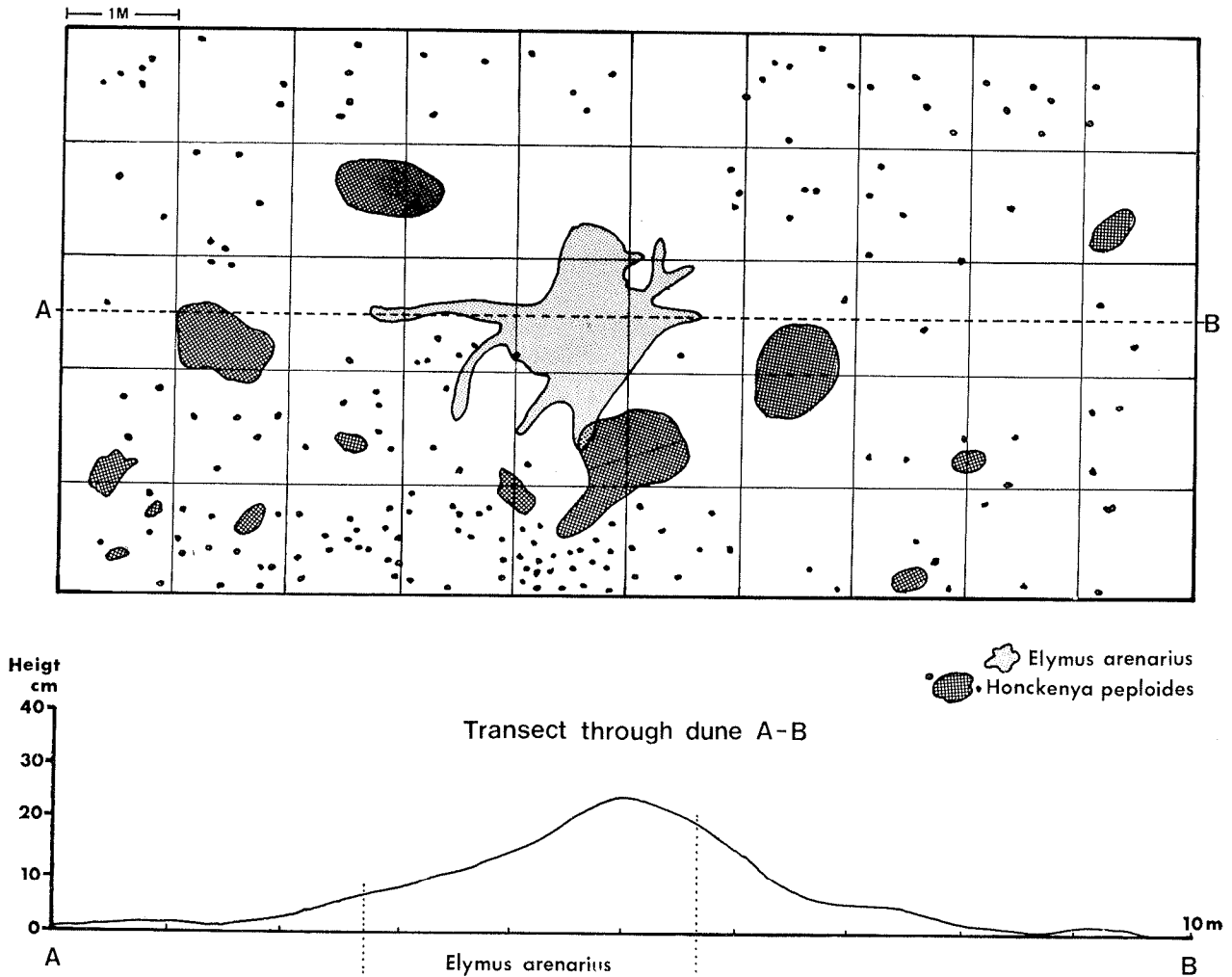
#### *Festuca rubra* L.:

The *Festuca rubra* plant in quadrat, L-12 which a pair of *Larus marinus* used as material for nestbuilding in 1976, did not appear in 1977 and was most likely wiped out. An extremely



Fig. 5

DISTRIBUTION OF PLANTS ON SURTSEY 1980.  
A SECTION OF QUADRAT K-18



small plant of *Festuca rubra* was found in quadrat L-16 and numbered 77-90. This plant had only 1 culm with 2 leaves but it did not survive the following winter. However, in 1978 five plants were found, most of which were well developed. Two of the plants flowered, the first time this species flowered on the island. It is not known whether these plants managed to bear seed in 1978. They were given the following numbers: 78-32 in M-16, which had 45 culms and 4 panicles, and 78-18 in I-9, with 15 culms and 2 panicles. Other plants are No. 78-133 in N-12, 78-160 in M-12, and 78-176 in I-8.

It is interesting to note that so many well developed plants are observed on the island at the same time. Their locations indicate that the seed was brought to the island by birds during the fall 1977.

In 1979 three of these plants were alive. Plant No. 78-32 in quadrat M-16 flowered with 50 panicles and plant No. 78-18 in quadrat I-9 had 11 panicles. The third plant in I-8 did not flow-

er. In 1980 all these plants were alive and flowering.

It is likely that *Festuca rubra* has firmly established itself on Surtsey where it grows on a sandy substrate, sheltered by the lava.

*Honkenya peploides* (L.) Ehrh.:

There was little increase in the number of *Honkenya peploides* plants from 1976 to 1977. Of the 500 plants which grew on Surtsey in 1976 422 were alive in 1974, or 84%. This may be the highest percentage to have survived between years. In all 210 new plants were found in the summer of 1977 and there were thus 632 *Honkenya* plants recorded on Surtsey in the autumn of 1977.

A large number of these plants, or 166, flowered and 108 plants were recorded as bearing fruit. It is probable that this great rise in seed production led to the considerable increase of *Honkenya peploides* plants on Surtsey in the following years. The largest specimens covered

over one square meter. The plants which achieved this size were Nos. 70-37 (95x110 cm), 70-39 (100x120 cm) and 71-43 (90-120 cm).

A breeding pair of *Larus marinus* used plant No. 71-69 as a nesting site and laid 3 eggs there in the spring of 1977. Three young broke through the eggs between June 18-20. At that time the plant was 40x50 cm in size with about 30 flowers. The nest formed approximately a 20x30 cm depression in which growth was badly disturbed (Fig. 6). The abundant droppings of the birds, however, caused a great burst of growth in the plant. By the end of July it had become the largest and most luxuriant plant mat on the island, with a little more than 100 flowers. At the end of the summer the nest basin was again overgrown with shoots. The plant had sixfolded in area from approximately 2,000 square cm (40x50 cm) to approximately 12,000 square cm (100x120 cm) in 6 weeks. Other *Honkenya peploides* plants which had been of similar size and grew under ordinary conditions by and large did not even attain twice their area by the end of July. This indicates the influence which the droppings had on the growth of plant No. 71-69. Many other *Honkenya* plants were in contrast to this injured by *Larus marinus* which bred on Surtsey. The birds tore branches from some of the plants for their nests. Traces of this could be seen on 40 plants.

Of the 632 *Honkenya peploides* plants recorded in 1977, 568 overwintered, or 89%. A very large number of new individuals were found, or 2,512, making a total of 3,080 plants recorded on Surtsey in 1978. This was a tremen-



Fig. 6. A nest of *Larus marinus* in a patch of *Honkenya peploides* plant No. 71-69 in 1977.

dous increase compared to previous years, and can only be attributed to the large seed production by the plants on Surtsey in the fall of 1977. If seed production and the increase in *Honkenya* plants on Surtsey are viewed from the beginning (Table 1) it is found that local seed production begins in 1971 when the first plant matured seed on the island; from then on the number of specimens increased gradually. In 1975 seed bearing plants were 17, in 1976 they were 36, and in 1977 108 plants were recorded maturing seed. Another increase occurs in the fall of 1978 when 190 plants were recorded with matured seed.

Until 1971, when seed production started on Surtsey, the increase of *Honkenya* plants was completely dependent on dispersal of seed to the island. During the summers of 1967 to 1972 few new plants were found compared to what came later. The increase in the number of new plants recorded in 1973 and 1974 may, to some extent, be due to an extensive dispersal as an unusually large number of individuals of the species *Elymus arenarius* and *Mertensia maritima* were also recorded and neither one had begun seed production on the island.

The great increase of *Honkenya* plants on Surtsey is no longer as dependent on seed dispersal from outside as it was early in the island's existence. The species has now achieved a secure foothold on the island and its annual increase derives mainly from local seed production. Seed import to Surtsey, however, is bound to continue and although it has a much lesser effect than before on the increase of *Honkenya* plants, it plays an important role in adding to the gene pool of the plants of that species on the island.

In spite of the large increase in 1978, there was little change in the location of *Honkenya* plants. The increase occurred usually in quadrats where *Honkenya* plants grew already. In 1978 *Honkenya* plants were recorded in only 5 new quadrats.

The largest *Honkenya peploides* plant observed in 1978, No. 70-39, was in quadrat G-13 and measured in area 1.95 square m. Five other plants measured over 1 square m that same year.

The rapid increase in specimens of *Honkenya* on Surtsey continued in 1979. It then became necessary to change the methods of recording the plant's progress. It was no longer feasible to record each individual plant that survived the winter and then plot the additional plants that appeared during the summer. Instead plants were counted in quadrats representing either

low or high densities of *Honkenya* stands. From that the total number of plants was estimated. The individual plants were recorded in three age groups: As seedlings, one year old plants and older plants. In 1979 the total number of plants in the low density quadrats were 350 seedlings, 575 yearlings and 131 old plants, whereas in the high density quadrats the plants numbered approximately 21.000 seedlings, 1.400 yearlings as well as 383 old plants. Thus, the total number of *Honkenya peploides* plants in 1979 were between 23.000 and 24.000 individuals.

It was noteworthy in 1979 that the distribution of the plants had increased from the year before. The drifting sand continues to be blown from the shore into the lava where it fills up the depressions and the plants follow in its wake gradually spreading into new lava territories. Near old and highly fertile plants the number of new seedlings is found to be several hundred per square meter.

In 1980 the number of *Honkenya* plants had still multiplied. This time the spread of the species was recorded and the density per quadrat measured in two magnitude classes, i.e. low density with less than 100 plants per quadrat and high density with 100-5.000 plants per quadrat. The areas occupied with *Honkenya* in 1980 were plotted on a map in these two classes as

shown on the chart (Fig. 4). To facilitate the measurements of plants in the dense area, plants were counted along three fixed transects on the western side of the island, running from the shore up to the old crater, and again through the depression south of the lava crater. In these two sheltered areas there is a great abundance of *Honkenya* plants. The third transect runs up through the lava west of the crater where the plants are more scattered.

*Mertensia maritima* (L) S.F. Gray:

All the six plants of *Mertensia maritima* from 1976 survived the winter. In 1977 two new plants were also found. Two plants flowered in 1977. This had never occurred before. Plant No. 74-53, on quadrat K-18, bore 4 clusters of flowers with 28 blossoms in all. On August 1, 1977, about 10 seeds had dropped, which lay nearby the plant. Plant No. 75-6 flowered as well and bore 4 clusters of flowers, but birds destroyed it during the summer and it did not bear seed.

Six of these eight plants survived the winter and were observed again in 1978 along with 3 new individuals of *Mertensia*. Two new plants were found next to plant No. 74-53, proving that *Mertensia* has managed to propagate on the island, thereby making its expansion less dependent on long distance seed dispersal. In 1978

Table 1  
Total number of plants on Surtsey pr. year, 1965-1980.

Species:	Year:	'65	'66	'67	'68	'69	'70	'71	'72	'73	'74	'75	'76	'77	'78	'79	'80
<i>Cakile arctica</i>	..	23	1	22	..	2	..	..	1	33	3	5	..	1	..	1	1
<i>Elymus arenarius</i>	..	..	4	4	6	5	4	3	..	66	26	12	10	8	14	5	5
<i>Honkenya peploides</i>	..	..	..	24	103	52	63	52	71	548	857	428	500	632	3080	24000	50000
<i>Mertensia maritima</i>	..	..	..	1	4	..	..	..	15	25	44	11	6	8	9	8	7
<i>Cochlearia officinalis</i>	..	..	..	..	4	30	21	98	586	372	863	501	286	160	91	75	75
<i>Stellaria media</i>	..	..	..	..	..	4	2	2	1	..	..	..	..	..	..	..	..
<i>Cystopteris fragilis</i>	..	..	..	..	..	..	3	4	3	3	2	2	2	2	9	5	5
<i>Angelica archangelica</i>	..	..	..	..	..	..	..	2	2	..	..	..	..	..	..	..	..
<i>Carex maritima</i>	..	..	..	..	..	..	..	1	1	1	3	2	1	5	2	1	1
<i>Puccinellia retroflexa</i>	..	..	..	..	..	..	..	2	1	9	8	8	2	6	40	7	7
<i>Tripleurospermum maritimum</i>	..	..	..	..	..	..	..	1	5	2	2	2	1	4	1	1	1
<i>Festuca rubra</i>	..	..	..	..	..	..	..	..	1	1	2	1	1	5	3	3	3
<i>Cerastium fontanum</i>	..	..	..	..	..	..	..	..	..	..	106	99	19	6	97	150	150
<i>Equisetum arvensis</i>	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..
<i>Silene vulgaris</i>	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..
<i>Sagina</i> sp.	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..
<i>Juncus</i> sp.	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..
<i>Atriplex patula</i> (?)	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..
<i>Rumex acetosella</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	124	31	40	40
<i>Cardaminopsis petraea</i>	..	..	..	..	..	..	..	..	..	..	..	..	..	5	6	8	8
Unidentified plants	..	..	..	1	..	..	4	2	1	1	2	1	..	1	..	..	..
Total		23	5	51	114	63	101	85	199	1273	1319	1449	1132	962	3428	24000+	50000+

two plants dropped seed, no. 74-68 and 77-89.

In 1979 eight plants were rediscovered and all but one was found to bear flowers and mature seed. Again in 1980, there were seven plants flowering of this species.

#### *Puccinellia retroflexa* (Curt.) Holmb.:

Out of eight *Puccinellia* plants which were on Surtsey in 1976, only two lived through the winter. No new plant was found in 1977. The two plants were No. 74-89, which had 6 culms and 27 leaves, and No. 76-142, which had 1 culm and 4 leaves. Neither plant flowered in 1977, but both survived the winter. In 1978 four additional plants were recorded, making a total of six plants recorded in August 1978. Plant No. 74-89 had 1 panicle. Two new plants were adjacent to it, but neither flowered. A small non-flowering specimen was found by stake No. 72-90, but no plant was there in 1977.

A new plant was found in the westernmost crater in quadrat I-9. It had 14 culms and 7 panicles on August 1. This is the most well developed *Puccinellia* plant which has been observed on the island. It is likely that its propagation has been due to special conditions in the crater, which appear to be much more favourable than those of the plant's other habitat on Surtsey. In 1979, there were 40 plants growing on the island of which only four were mature and flowering. The remaining 36 were seedlings and young plants. In 1980, however, only seven large plants of this species were found growing on Surtsey.

#### *Rumex acetosella* L.:

In 1978 there were 124 plants of *Rumex acetosella* found in an area of about one square m in quadrat N-11, No. 78-128. This species had not been observed on Surtsey before. Most of the plants were very tiny, with 5-10 leaves, the red colour of the leaves indicating a lack of sufficient phosphate in the soil. Ten plants looked relatively well developed, and three of them flowered.

In 1979 the large plants had increased to 31 and were occupying an area of 1x2 m. The seedlings had not survived the winter. In 1980 the colony was still developing with about 40 plants.

It is likely that *Rumex* seed was brought to Surtsey during the summer or autumn of 1977 and that a plant grew up from it and managed to develop seed the same year. The location indicates that the seed was dispersed to the island by birds. If it was brought by sea, it must have

been blown over a long distance filled with obstacles to reach its location.

The rapid increase of *Rumex acetosella* on Surtsey in its first year indicates that the species can thrive there in the future, propagate and increase its area.

In Iceland *Rumex acetosella* is common on the lowlands, especially near populated areas. It thrives best in a gravelly or sandy soil and should therefore be able to do well on Surtsey.

#### *Tripleurospermum maritimum* (L.) Koch. ssp. *phaeocephalum* (Rupr.) Hämet-Ahti (syn. *Matricaria maritima*):

There were two plants of this species living on Surtsey in 1976. Plant No. 72-40, in quadrat S-14, had vanished in 1977, but the plant No. 76-171 which was found in the westernmost lava crater in 1976, was doing well the following year. It bore about 40 leaves and reached a diameter of about 15 cm. In July that summer it flowered and produced two heads on the same stalk. This was the first time that *Tripleurospermum maritimum* had flowered on Surtsey. Conditions in the lower part of the crater seemed to be promising for the plant where it had some moisture and a good shelter. That old plant was alive in 1978, alongside two tiny seedlings. This was the first time that the species propagated on Surtsey. The motherplant, however, did not flower in 1978 and was not doing well. A new tiny, unflowering plant was also found that summer in quadrat F-15.

In the two following years of 1979 and 1980 only the old plant in the crater survived, but bore no flowers, whereas the young plants had died.

Although *Tripleurospermum maritimum* has managed to propagate on Surtsey, its future does not look very promising. It is obvious from the present state of the plant's development that the conditions on Surtsey are not too well suited for this species and that it may have difficulties in further colonization.

#### UNIDENTIFIED SPECIES

In quadrat K-18 a lone plant was found. It consisted only of 2 cotyledons, and could not be identified. It was assigned number 78-83.

#### SAND DUNE ASSOCIATION

The Surtsey ecosystem has up till now been so immature that only pioneer organisms are present. In 1978, a tendency was observed toward



Fig. 7. A plant of *Elymus arenarius* in flower, and *Honkenya peploides* in the background, together forming a sand dune vegetation.

formation of an association of two species of vascular plants, i.e. *Elymus arenarius* and *Honkenya peploides* in a certain area of the island (Fig. 7). This has developed further throughout the period. Even the *Larus marinus* fledglings have used this area for shelter, so that one would expect an increased growth due to fertilization. This may be the first place for a succession stage beyond the colonization stage to occur on Surtsey. The area was investigated, measured, and mapped (Fig. 5). These two species are also found on the mainland where they form unstable sand dunes and are succeeded by *Festuca rubra* and other grasses. Such ecosystems would be valuable for further study. The sand binding abilities of the two pioneer species are well known and *Elymus arenarius* is used in Iceland in erosion control.

There is an immense struggle for survival for the vascular plants in the island's harsh habitat, where individuals often encounter lack of foothold, nutrition, water and shelter, and have to withstand high winds, droughts, frost, salt spray, floods, sulphuric fumes and sand abrasion, as well as some competition from others. Thus only highly specialized and tolerant species succeed in colonizing the island. Some of these conditions are similar to those faced by individuals of species used in erosion control of the devastated areas on the mainland. Thus, much can be learned about rehabilitation methods from the struggle of these pioneers to survive the conditions on Surtsey.

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