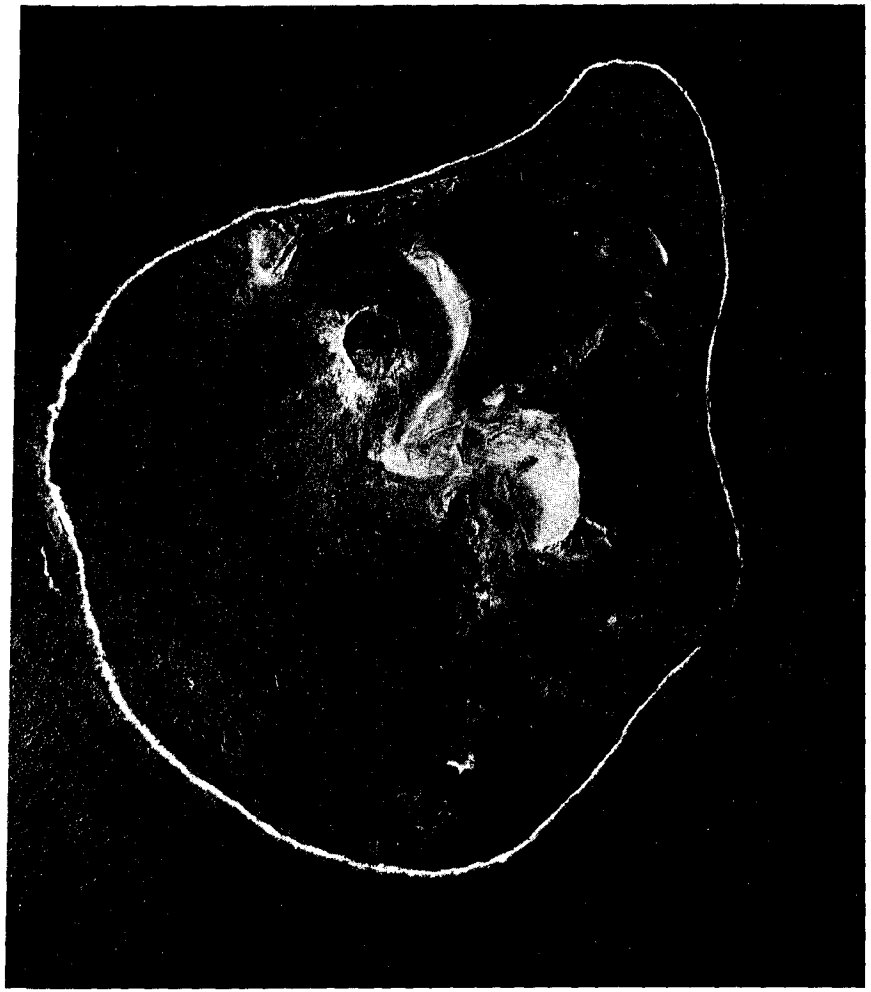

Surtsey. 20.VIII.1969. For correct quarters, see map, fig. 6. The house is on the southern snout of the northernmost tephra hill. (By courtesy of the Surtsey Research Society.)

ENTOMOLOGICA SCANDINAVICA
SUPPLEMENTUM 5

CARL H. LINDROTH, HUGO ANDERSSON,
HÖGNI BÖDVARSSON, SIGURDUR H. RICHTER

# Surtsey, Iceland

## The Development of a New Fauna, 1963—1970
## Terrestrial Invertebrates

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# Contents

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## The Development of a New Fauna, 1963—1970
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By CARL H. LINDROTH, HUGO ANDERSSON, HÖGNI BÖDVARSSON, SIGURDUR H. RICHTER

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*Abstract*

Surtsey was born in November 1963. Plans for a continuous following-up of the immigration and colonization of a terrestrial fauna on the island were organized in May 1965, and the field-work started the same summer. Up to 1970, 158 species of Terrestrial Invertebrates, all Arthropods, have been found alive on Surtsey. With 105 species (66 per cent), the Diptera (Midges and Flies) are strongly dominating, and it is quite certain that most immigrants have arrived through the air, actively or by anemochorous transport. There is a significant correlation between abundance of insects, mostly Diptera, and NW to NE winds during the preceding days, which indicates that the sources of aerial dispersal were usually located in Main Iceland, in a distance of at least 30 km. In the same direction points the fact that several of the Surtsey species are otherwise unknown on the Westman Islands. A few species with higher abundance on the main island, Heimaey, seem, however, to have emanted from there.

Hydrochorous dispersal, on the surface of the sea, has brought most Vascular Plants to Surtsey, one Mite (*Oribotritia faeroensis* Selln.) was stated to have arrived in driftwood, 2 species of Collembola and 5 of Acari were washed ashore in a tuft of grass. Surface sea-currents in the area favour westward transport and the effect of this, from Heimaey to Surtsey, was tested by means of an experiment with released plastic grains. Exposure of a big, peaty grass-tussock growing on the top of Súlnasker (10 km from Surtsey) to saltwater (35‰) revealed that a limited assortment of Coleoptera, Collembola and Acari may survive for at least one week.

Zoochorous dispersal has repeatedly occurred the form of Mites attached to Flies. Anthrop chorous dispersal, fortunately, was less freque than originally expected and seems in particu to have been exploited by Mites.

Long-distance dispersal, presumably from t European Continent, has been performed by certa notorious migrants among the Lepidoptera (b Butterflies and Moths), and by one balloon spider. On one occasion, two species of mo may have arrived from North America.

On the whole, the effect of dispersal to Surt was much above expectation. The opposite can maintained for permanent colonization. Tempor breeding, especially in carcasses, has occur repeatedly, mainly among Flies; but only 3 spe of insects (2 Collembola and 1 Chironomid Mid and at least 1 Mite seem to have managed establish permanent populations. The main rea for the slowness of the process is the lack vegetable food.

The Surtsey investigations will continue, radical changes in the terrestrial fauna cannot expected to be rapid. An ultimate, balanced eco tem will no doubt be of a similar type to that the plateaus of the other Small Westman Isla which were created in the same way as Surt in prehistoric time. It will no doubt take centu before this climax stage is reached on Surtsey

The extent to which the Surtsey case may generalized to cover overseas dispersal and lonization in other parts of the world, is s marized.

# I. Introduction

## "New Islands" in general

That new islands arise is not at all unusual. After a major glaciation an upheaval of land occurs by isostatic movements, and swarms of skerries and islands may appear out of the sea, as in the Baltic area in northwestern Europe. In the tropics, eustatic movements of the sea surface may result in the creation of coral islands.

But these processes are very slow. The age of an island arisen in either of these two ways can hardly be given more accurately than in centuries.

Sudden appearance of an island may ensue from artificial lowering of the water level in a lake; but in the sea only volcanic forces are able to produce a similar result.

Surtsey is, however, not a unique phenomenon. Volcanic islands have risen out of the sea in other regions, but they have either been of quite short duration, for instance near Faial Island among the Azores, or they have been constantly disturbed by repeated eruptions and break-downs through sea erosion, like the Falcon Island in the Tonga group (Zimmerman, 1948:20—21). From the year of its discovery, in 1865, it was repeatedly built up and washed away; at times it was both larger and higher than Surtsey.

The case most worth-while to compare with Surtsey—notably from the biologist's point of view—is the famous one of Krakatau (Krakatoa). The main island of this group, in the Strait of Sunda between Java and Sumatra, was almost destroyed by an explosive volcanic eruption in 1883. The remaining southern third of the island was thought to have been completely sterilized (Dammerman, 1948) and the re-immigration of plants and animals was, though unfortunately a bit late, studied by Dutch biologists. Some doubts have, however, been launched as to whether the sterilization of Krakatau was complete (Backer, 1929)[1] and the case is nowadays not accepted as a standard model of overseas immigration and colonization of biota.

Later on, however, a series of events started among the Krakatau islands, similar to those that created Surtsey (Dammerman, 1948:5—7, 14—16, 57—61). Submarine eruptions were observed at a point located within the limits of the disappeared northern part of Krakatau, 3 km from each of the two satellite islands, Verlaten Island and Lang Island. The crater rose above sea level four times, first in January 1928, and was broken down by erosion three times. The still existing island, called Anak Krakatau IV, appeared on August 11, 1930. Its size (in the 50:ies) was similar to that of Surtsey (diameter about 1 km, height more than 100 m, in January 1973 almost 190 m).

In its later development the new island, though never entirely disappeared, has been more disturbed than Surtsey. In 1939, a heavy tephra eruption destroyed all possible vegetation. The biological investigations of Anak Krakatau, preceding this, were rather sporadic but already after two years (November 1932) fungi as well as Cyanophycean and Chlorophycean algae were stated in soil samples. Several insects, mostly Diptera, and two species of Araneae were observed, all casual visitors with the exception of one species of Collembola found abundantly on the shore. Also all seedlings of plants belonged to litoral species.

Then the war prevented continued observations and the island was not visited by biologists again until 1949 and 1951 (Borssum Waalkes, 1952, 1960). On the latter occasion a rather rich flora, even *Casuarina* trees, had developed; insects were not studied. In October 1952 a new severe eruption took place and,

[1] It is remarkable that Dammerman, in his large Krakatau book of 1948, did not discuss Backer's arguments; the paper of 1929 is not even listed in his bibliography.





when visited less than a month afterwards, the island appeared entirely sterile: "It is not sure of course whether all life was killed on Anak Krakatau although the probability is large" (Borssum Waalkes, 1954). New periods of volcanic activity occurred in 1960—63 (Zen & Hadikusumo, 1964) and in 1972 (Smiths.Inst., 1972). The biological effect of these eruptions seems not to have been reported and probably was not studied. Maps showing the development of Anak Krakatau, 1930—63, were published by Zen (1970).

Worth mentioning are also the careful observations on the influence of heavy volcanic eruptions on the flora of the sub-antarctic Deception Island, situated about 63° S among the South Shetland Islands (Collins, 1969). Since, however, none of these eruptions caused simultaneous destruction of the entire terrestrial flora, and because this is utterly poor, consisting only of mosses, lichens and two species of indigenous vascular plants, the general application of the observations on Deception Island is limited.

In North America an experimental study of island colonization by insects has been carried out with E. O. Wilson as *primus motor* (Simberloff & Wilson, 1970). A number of quite small mangrove islands in the Florida Keys was defaunated by methyl bromide fumigation; the immigration and re-colonization of insects were then studied for two years. This experiment is most interesting but it must be borne in mind, that a situation where the fauna is exterminated and the flora left more or less untouched, is not natural. Actually, as exemplified on Surtsey, the crucial problem governing colonization of terrestrial animals is the availability of organic food produced by plants. Since the dispersal and immigration into a new, sterile area is bound to start simultaneously by both contrahents, producers and consumers, a faunistically empty area with plenty of vegetable food is an artificial situation.

The advantages of Surtsey as an object of biological studies—in comparison with the similar cases just mentioned—are:

(a) the island has remained virtually undisturbed by volcanic forces since shortly (one year and a half) after its birth;

(b) it is rather isolated, the distance from nearest larger land (the island Heimaey) being 18 km;

(c) it is easily available and could ther be visited regularly and during most o summer half of the year;

(d) the flora and fauna of adjacent is and the Icelandic mainland are well kno

(e) sufficient and continuous meteorol and oceanographic data are available;

(f) generous financial support for the work has been provided from different sc and co-operation between the different g of scientists within the project has organized, mainly through the Surtsey arch Society.

## Disposition of the work

This book is a pronounced team-work labour has not only been divided betwee authors but has also been shared, often very great extent, by a large group of nomic specialists accounted for at the of the "Special Part" (p. 21).

Between the four of us the work has divided in the following way. Sections d with Coleoptera, Diptera and Collembola in the "Special" and the "General" Par written by C. H. Lindroth, H. Andersso H. Bödvarsson, respectively. Lindroth i responsible for the "Introduction" an Chapters III A (Surtsey) and III C (Disp except for the Diptera section of the f and the section on "Short range aerial d sal" of the latter chapter, which are w by Andersson. S. H. Richter made the extensive field-work among us, read and cized the entire General Part, but h specific responsibility.

The Special Part has been compiled data produced by the pertinent specialist in many cases, also kindly read the manu and from the literature.

We are well aware that the book may disproportionate, its major part being d to a description of the fauna of the "I land" rather than to Surtsey itself. It however, be regarded as absolutely nec for the understanding of what happen Surtsey to know, as exactly as possibl fauna of the main source areas. Actua is almost as interesting to state what s did *not* succeed in reaching the island as that managed to do so. We also believ the efforts spent on investigating the hint will prove sufficient and indispensable f

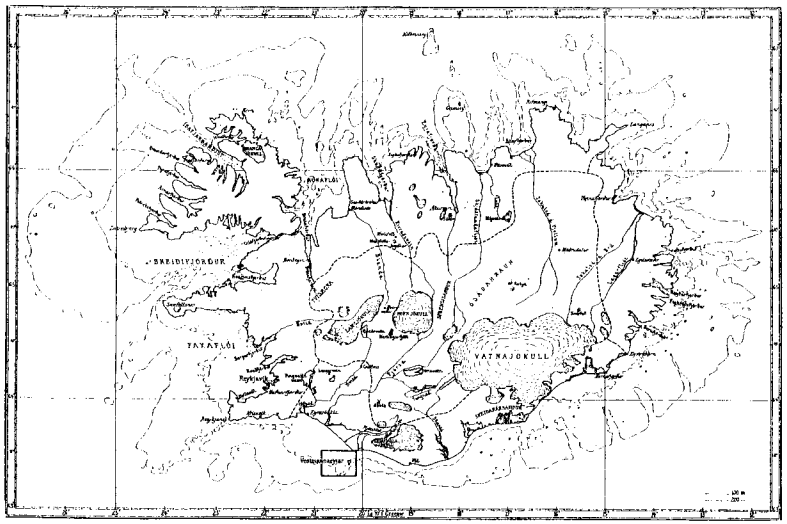


Fig. 1. Iceland. The Westman Islands are within the rectangle.

future zoological work on Surtsey; the fauna of these areas is changing very little and our present knowledge of it will therefore serve as the necessary background for the Surtsey project during decades—or even centuries—to come.

## Field work

Our project was formed in 1965. That year, May 28 and 29, the "Surtsey Biology Conference" was held in Reykjavík, with both Icelandic and invited foreign naturalists participating. Plans for the future biological work were outlined and, within terrestrial biology, this was divided between several groups of scientists. The Icelanders were themselves willing to take care of the investigation of vertebrates (birds) as well as of vascular plants, mosses and lichens. But, since no specialist available in the country, the study of terrestrial invertebrates was entrusted to a Swedish group consisting of three of the present authors (Lindroth, Andersson, Bödvarsson). The following year S. H. Richter was added to the group, in 1970 also a "micro-zoologist", Dr. Birger Pejler from Uppsala, who is publishing his results elsewhere.

Preliminary results of our field work have been included in the "Surtsey Research Progress Reports", I—VI, published by the "Surtsey Research Society" in Reykjavík (1966—72) and covering the years 1965—70.

We soon realized that a proper understanding of what happened on Surtsey required a thorough knowledge of the fauna of the "hinterland", that is, the most closely situated pieces of land, from where the immigrants were most likely to have arrived. These areas are: (a) the other islands in the Westman group, notably the largest among them, Heimaey; (b) the adjacent parts of the mainland of southern Iceland (see map, fig. 8, p. 20). Though considerable collecting had been made in the past, notably on the southern mainland, it soon became apparent that much time had to be devoted in order to obtain a reliable census of the fauna of the "hinterland". So, actually, we made more collecting there than on Surtsey itself.

The periods of field work of our group were:





| | Surtsey | Small Islands | Heimaey | S Mainl |
|---|---|---|---|---|
| 1965 | 24.VII | 21.VII. | 20—29.VII. | — |
| 1966 | 28.VI., 13—18.VIII. | 8—13.VIII. | 13—18.VI. | — |
| 1967 | 24.VI.—11.VIII.<br>20—21.VIII. | 18.VIII. | 16—22.VIII. | 23—30. |
| 1968 | 10—12. & 30.VII.<br>12. & 28—29.VIII. | 28.VI. | — | 22.VI.— |
| 1970 | 5—11.VIII. | — | — | — |

Two skilled entomological collectors outside our group have visited Surtsey during continuous periods and made most valuable contributions:

Hálfdán Björnsson: 12.IV—13.V; 12. & 16.IX.1969.
30.IV—14.V.1970.
Erling Ólafsson: 15.VI—11.IX.1970 (also in 1971).

Several other visitors made occasional collecting on Surtsey. This material has been put at our disposal.

Some records from Surtsey later than 1970, as far as identified by specialists, are listed in Appendix I (p. 272). In part they have also been discussed in the "General Part".

All specimens collected on Surtsey by our group are the property of the Natural History Museum in Reykjavík. Of all species collected on the other Small Westman Islands, at least one specimen has likewise been deposited there. The remaining major part of our collections belong to the museum of the Zoological Institute, University of Lund, Sweden.

*Acknowledgements*

We are greatly indebted to several persons and institutions who not only faciliated our work but actually made it at all possible.

This applies in the first place to the Surtsey Research Society (Surtseyjarfélagid) in Reykjavík, which already in 1965 offered us the opportunity to take over the task of investigating the terrestrial invertebrates of Surtsey, and for several years provided financial support, mainly emanating from the Atomic Energy Commission, U.S.A., and generously offered free transports as well and lodging on the island.

Two persons, above all, have been re for these profitable arrangements, the Pre the Society, Dr. Steingrimur Hermannsson Sturla Fridriksson. We owe them our g gratitude.

In later years most of the expenses c with our field-work was paid through gra the Swedish Natural Science Board.

The Icelandic Coast Guard, on two o put a helicopter at our free disposal, indi for the exploration of the Small Westmar

The firm Rockwool, through its c Malmö, Sweden, provided us, free of cha a supply of specially coloured plastic grain our sea-drift experiment.

Without the aid of a great number of ta specialists, who identified the main par collections, our field-work would have be These persons are enumerated at the hea "Special Part" (p. 21), but we would mention already here the man who to himself the heaviest burden, the late I Sellnick. He worked up the largest of al in species as well as in individuals, the t mites (Acari).

The co-operation with other groups of involved in the Surtsey project has be rewarding and provided indispensable inf for solving our own problems. We woul extend our special thanks for generous hel G. H. Schwabe, Plön, Germany, the algol ecologist, Dr. J. O. Norrman, Uppsala, morphologist, and Dr. J. O. Mattsson, L climatologist.

We wish to express our best thanks to M Lind and Miss Berit Olsson, who made the drawings, including the maps.

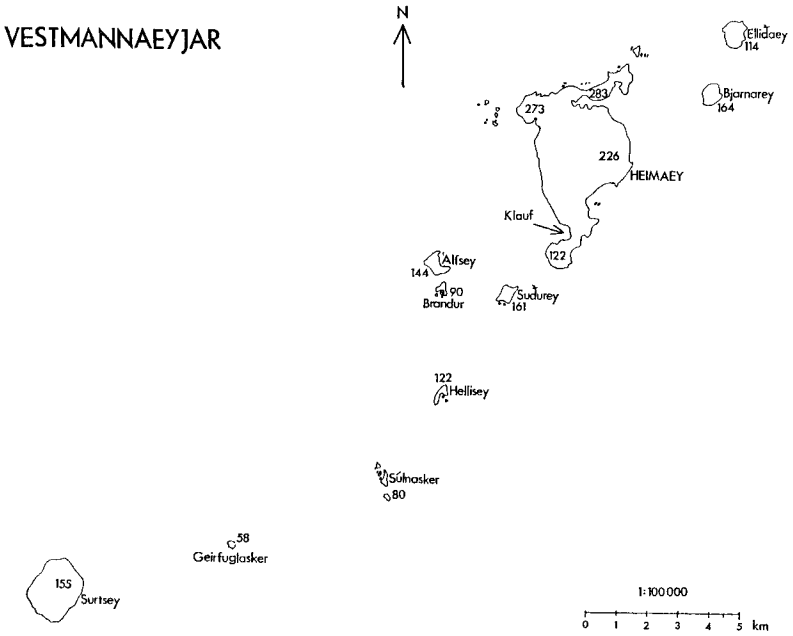


Fig. 2. The Westman Islands. The figures are metres a.s.

## The origin and development of Surtsey

Surtsey is the westernmost and southernmost within the Westman Island group (Vestmannaeyjar) off the southcoast of Iceland (fig. 2). The largest among them is Heimaey (area about 16 km$^2$) with a population of more than 5 000, the dominating fish-harbour of the region. The other islands are much smaller, only Surtsey exceeding 2 km$^2$, and without permanent habitation. They are pronounced bird-cliffs with more or less perpendicular walls, rather high (see map, fig. 2), accessible with difficulty. The distances between Heimaey and each of the small islands, as well as their areas, are given in Table 11.

As far as Surtsey is concerned, the closest island is the tiny and very steep Geirfuglasker, in a distance of almost 5 km; the next group, with Súlnasker, is 10 km and the southernmost part of Heimaey 18 km to the northeast. The distance to the nearest point on the mainland, W of the mouth of river Markarfljót (within "Distr. II"; see map, fig. 8), is 29 km.

The Surtsey eruption was quite unexpected.[1] No volcanic activity had been reported from the entire Westman Island group in historical time. The age of the three largest islands, Heimaey, Bjarnarey and Ellidaey, has been estimated to between 5 and 6 thousand years, except that the northern part of Heimaey, Heimaklettur, is several thousand years older (Jakobsson, 1968). The smaller islands west of Heimaey are probably younger but their exact age could not be dated.

On the other hand, each island within the Westman group has no doubt developed

[1] This condensed account is mainly compiled after Sigurdur Thorarinsson, who followed the fates of Surtsey from the first day of its existence (Surtsey Reports, I—IV, 1965—68).





separately in the same way as Surtsey; in three of them, Bjarnarey, Ellidaey and Brandur, the lava core of the original crater is still traceable above the present sea level. Many additional submarine peaks, apparently of the same nature, have been located west of Heimaey and there is no reason to believe that any of the present islands have at any time been connected (Jakobsson, l.c.). The sea depth on the site of the new island before its appearance was about 130 m.

The Surtsey eruption started visibly early in the morning November 14, 1963. The first part of the tephra cone appearing above sea surface was observed the next morning. The island then grew rapidly and by the end of December had already a diameter exceeding 1 km and a height of 145 m.

The explosive activity of the crater continued, with short interruptions, until the beginning of April, 1964, when the area of the island was slightly more than 1 km$^2$. The persistence of Surtsey, in spite of its size, was at that time by no means granted, the marine abrasion of the soft tephra being most effective. On April 4, however, the eruption suddenly changed its character, as one of the two craters started producing lava, and this activity lasted until the middle of May the following year (1965). About 60 per cent of the island's surface became covered with lava (fig. 4) and its total area had increased to about 2.4 km$^2$. The lava, being less rapidly eroded than the naked tephra, provided some protection to the island.

After the long, continuous lava period had ended, Surtsey has suffered only brief and more local outflows of lava, located within or close to the Older Surtur Crater (Surtur I), or the adjoining shore, in the period 19.VIII.66—5.VI.67. One of these minor eruptions, in January 1967, almost filled the lagoon in the northeast and threatened the field station, but fortunately the lava stopped in a distance of about 120 m from the house.

Two satellite volcanoes forming sep islands appeared after the cease of the eruptions in Surtsey. One, called Syrtli 600 m ENE of the island, lasted from through November, 1965; the other, J about 900 m to the WSW, from en December 1965 through August 1966. B emission of great quantities of drifting te these islands, especially Syrtlingur (fig. were of importance for the biological c tions on Surtsey, as described in a later ch (p. 149).

The area and the outline of Surtsey cha considerably also after the end of the vol activity. This has been due to heavy abra notably during winter storms, and a depos of fragmented material in the N and NE. general form was gradually changed almost circular, through a more rectan and, finally, a pear-shaped form (map, fig The maximum extent of Surtsey was parently in June 1967, with 2.8 km$^2$; at pr (1972) it is about 2.4 km$^2$ (J. O. Norr *in litt.*).

## The development of the terrestrial flor

Investigations on the dispersal of plan Surtsey were started very early by Icel botanists. Already on May 21, 1964, whe island was only half a year old, Eythór Ei son made a thorough search for parts of p washed ashore on the low parts of the c This year fragments of 14 species of vas plants were found. The germination abilit the seeds of two species of grasses found tested without success.

In March and April 1965 other plant ments were collected on the shore, an these seeds of *Archangelica officinalis* *Cakile maritima* (*edentula*).[2] Those of latter species showed good viability, 16 o 24 collected seeds germinating in the la tory.

*Cakile maritima* was also the first vas

[1] This short description of the botanical exploration of Surtsey is compiled from papers by E Einarsson, Sturla Fridriksson, Björn Johnsen, Bergthor Jóhannsson, G. H. Schwabe, Schwabe & B Hördur Kristinsson, and others, in the "Surtsey Research Progress Reports", I—VI (1965—72) Proceedings of "The Surtsey Biology Conference" (1965) and of "The Surtsey Research Confere (1967).

[2] We follow most Icelandic botanists (e.g. in the Progress Reports) in not regarding the N American *Cakile edentula* (Bigel.) Hook. as specifically distinct from *maritima* Scop.

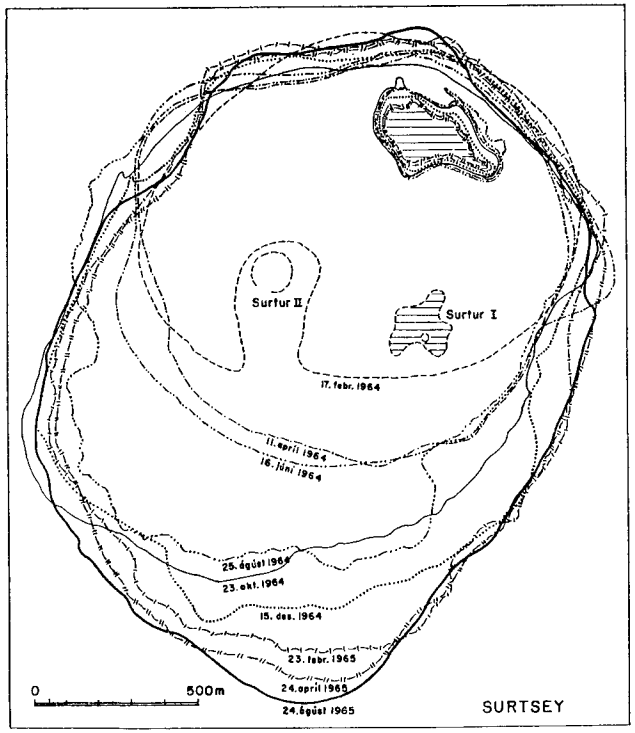


Fig. 3. Growth of Surtsey from February 1964 through August 1965. (From Surtsey Research Progress Report. II. 1966.)

plant growing spontaneously on Surtsey. On June 8, 1965, several small seedlings were found on the beach N of the lagoon in the NE part of the island. They were, however, killed the same summer under ashes carried from the crater of the new island Syrtlingur. *Cakile* started anew next summer and on July 2, 1966, also seedlings of the Lyme Grass (*Elymus arenarius*) were found. In 1967 *Cakile* was observed flowering for the first time and its colonization seemed definite; but the habitat was flooded during severe winter storms and no specimen was observed in 1968. Two plants were rediscovered in 1969, one of which flowering, but the species had again disappeared the following summer.

Meanwhile a few other plants had arrived in 1967: *Honckenya* (or *Minuartia*) *peploides*, from June; *Mertensia maritima*, from August; *Festuca rubra*, from September. In 1969 *Cochlearia officinalis* appeared around the plastic tubs erected by Dr. Maguire, and, in 1970, together with *Cochlearia* in the S of the island, a small stand of *Stellaria media* which produced seeds.

Of the 7 species of vascular plants observed until and including 1970, the *Honckenya* was entirely predominating. This species and a few *Elymus* grew in part on the lava out of reach of the sea and they may be regarded as permanent colonists on the island. Neither had however produced flowers (*Honckenya*, however, in 1971) and both species grow as single small plants without shelter. Any formation of layers of organic debris is prevented by strong winds blowing it away or burying it with sand. Besides *Cakile*, also *Mertensia* and *Festuca* seem to have disappeared again





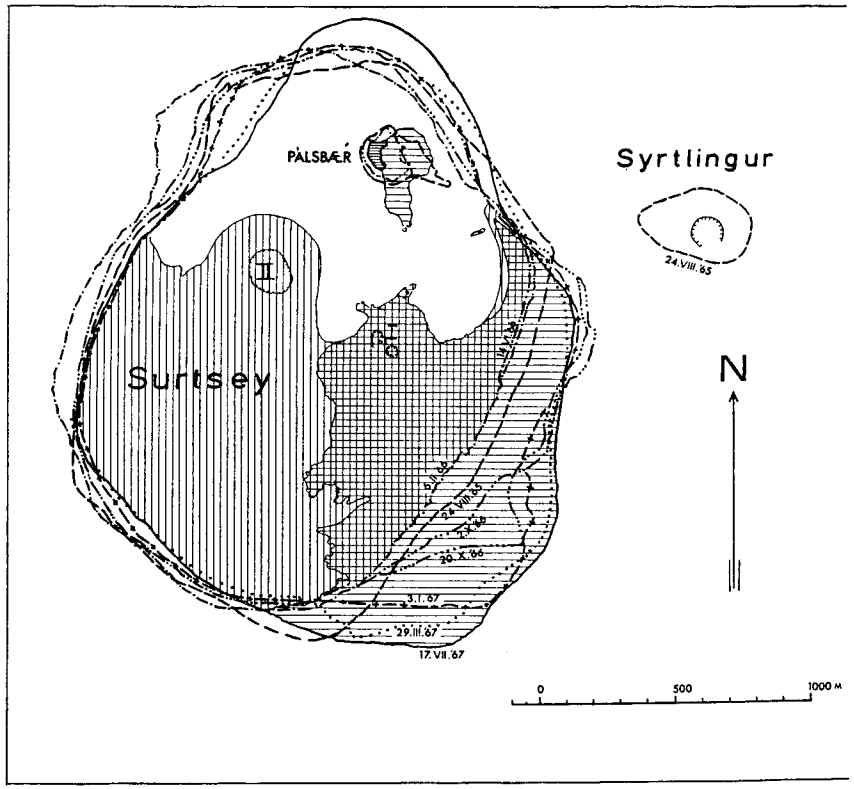


Fig. 4. Surtsey and Syrtlingur at different times. Vertical striation = the 1964/65 lava. Horizontal striation = the 1966/67 lava. (From Surtsey Research Progress Report. IV. 1968.)

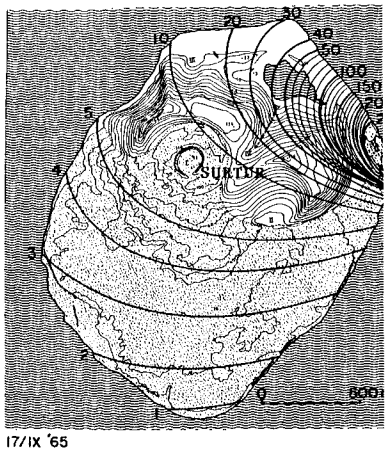


Fig. 5. Distribution of Syrtlingur tephra on Surtsey, September 1965. Thickness in centimetres. (From Surtsey Research Progress Report. III. 1967.)

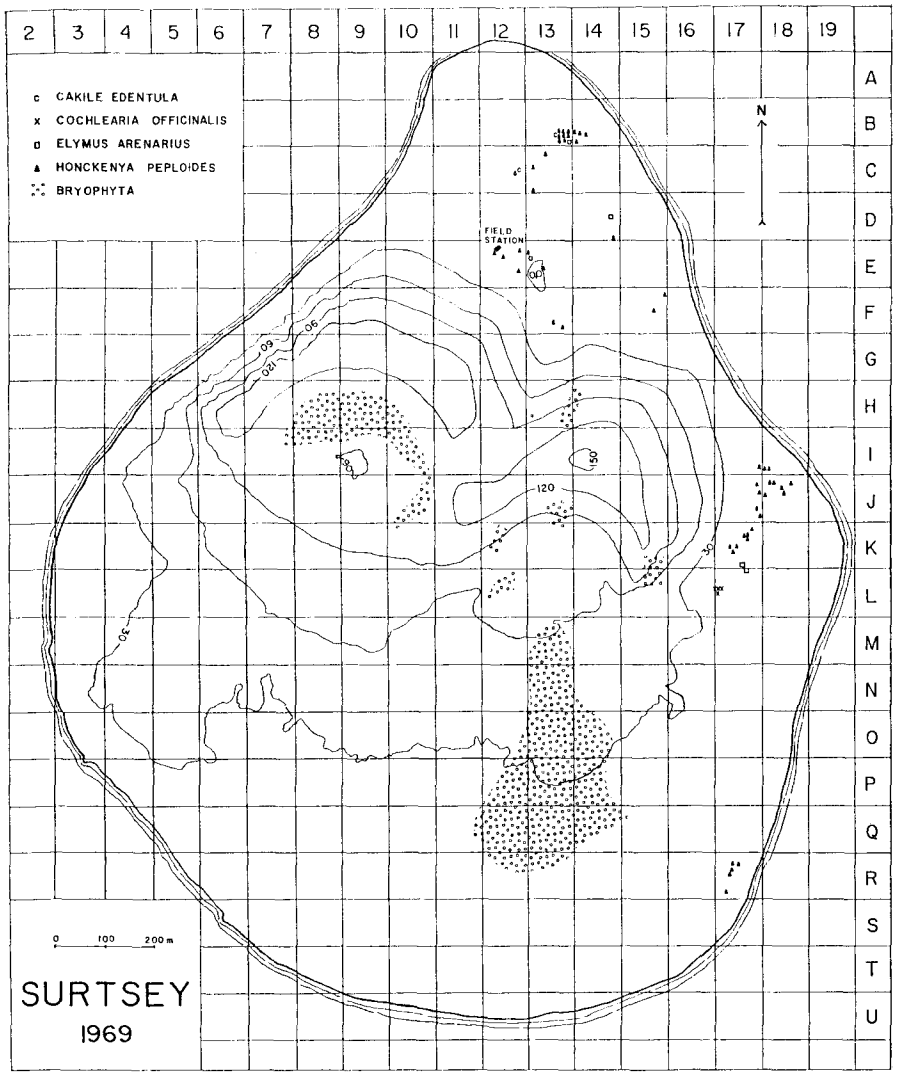


Fig. 6. Distribution of vascular plants and mosses on Surtsey in 1969. (From Surtsey Research Progress Report. VI. 1972.)



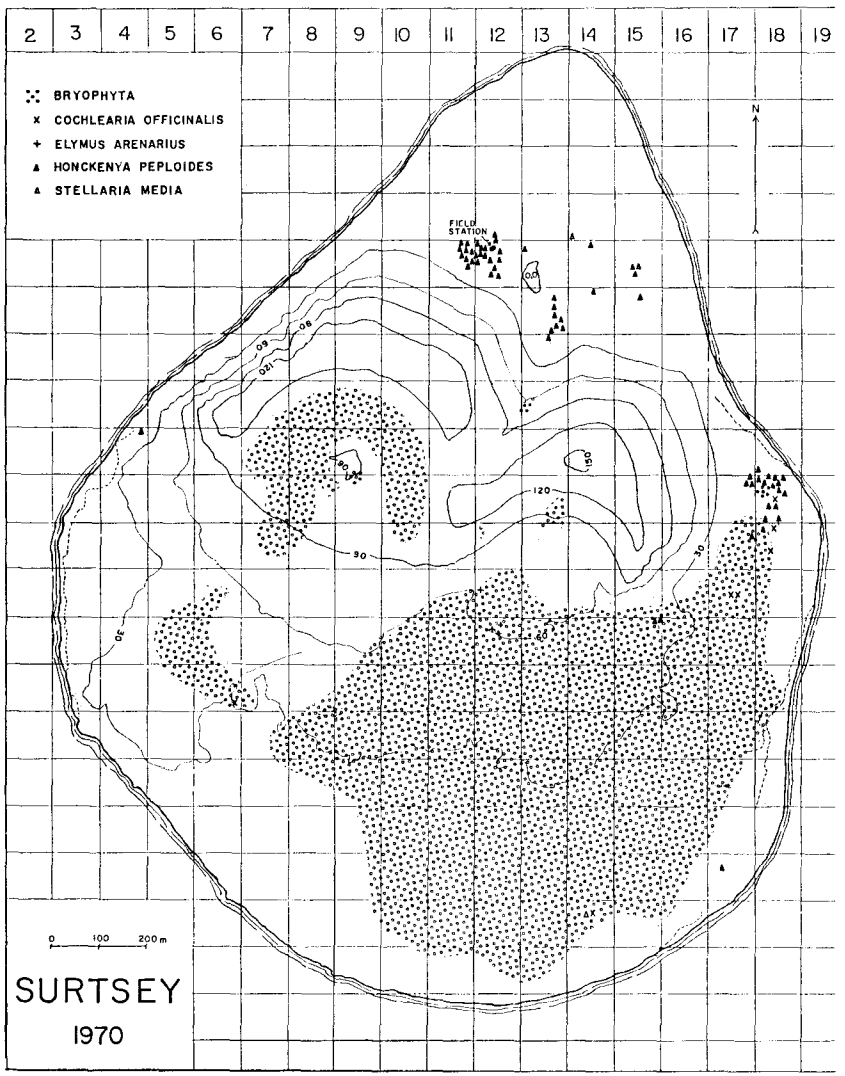


Fig. 7. Distribution of vascular plants and mosses on Surtsey in 1970. (From Surtsey Research Progress Report. VI. 1972.)

from Surtsey. The growing sites of vascular plants in 1969 and 1970 are mapped in figs. 6—7.

The highest number of *individuals* of vascular plants found in one summer (1968) was 114.

The vascular plants have generally arrived by sea-drift, but with two exceptions: *Cochlearia* and *Stellaria* have most likely been transported by birds, probably as endochorous seeds (Fridriksson *et al.*, 1972 b).

The first two species of mosses (*Funaria hygrometrica*, *Bryum argenteum*) were discovered in late summer of 1967 (Jóhannsson, 1968). In 1970 the moss cover had expanded immensely (map, fig. 7) and the number of species had risen to 16. Three of them (*Funaria hygrometrica*, *Ceratodon pu*
*Dicranella crispa*) had developed ripe ca
The richest moss growth was originally
near the main craters of the island, S
and II, where steem is exhalated t

fissures, resulting in condensed freshwater along the rims, which guarantees permanent moisture, binds the ash particles together and prevents them from drifting away with the wind (Behre & Schwabe, 1970). Later, notably between 1969 and 1970, the mosses had spread over most of the lava in the southern half of the island and formation of organic soil on sheltered points is already on its way. The original hypothesis that the two moss species first arrived on Surtsey were the result of anthropochorous transport (Einarsson, 1968:10), in view of the later development of the moss flora, cannot be upheld. There is no doubt that anemochorous dispersal is mainly or alone responsible. In 1972 the number of moss species exceeded 60.

The steam emission habitats in the craters were carefully investigated concerning their algal flora, in 1968 and following years, by G. H. Schwabe, who collected numerous substrate samples from which laboratory cultures were raised. The number of living species stated (Cyanophytes, Flagellatae, Chlorophytes and Diatoms) already in 1968 surpassed 100 (Behre & Schwabe, 1970). Mosses were associated with the algae. Because of the shifting thermal activities in the craters, the favourable habitats there are not very stable (Schwabe & Behre, 1972:88) but they are nevertheless those biotopes on Surtsey, where a permanent surface layer of organic debris is most likely to develop, forming the basis for a soil fauna. The occurrence in steam emission habitats on Surtsey of a sparse microfauna—not treated in this book—consisting of Nematodes, Rotatoria, Ciliata and Rhizopoda, has already been stated (Holmberg & Pejler, 1972; Sohlenius, 1972).

Lichens were not discovered on Surtsey until 1970, when 3 species were observed to grow around the crater Surtur II (Kristinsson, 1972).

It should finally be mentioned that, in 1967, B. Maguire erected artificial bodies of water in plastic tubs placed in the E lava field, for the purpose of studying the immigration of freshwater biota, mainly algae (Maguire, 1970). The rainwater collecting in the tubs was highly attractive to birds and soon became heavily polluted. As this situation must be regarded as an unnatural infestation of the Surtsey biota, the experiment has been discontinued. Larvae of Chironomids (i.a. genus *Chironomus*) and pupae of the fly *Scatella tenuicosta* were found in the tubs (p. 268) but it is not likely that any species of insects has acquired permanent foothold on Surtsey as a consequence of this experiment. That, however, the plant *Cochlearia officinalis* probably has, was mentioned above.



# II. Special Part

## The terrestrial Invertebrates of Surtsey and its "Hinterland"

*Introduction*

Only the macroscopic fauna has been considered: Arthropoda, Mollusca and Vermes (except Enchytraeids and Nematodes). Among aquatic forms, spending at least most of their life in fresh water, only Insects and Gastropods are listed.

We have found it essential to give a full account also of the fauna of the "hinterland" of Surtsey. It is important to know, what species occurring there did *not* succeed to reach the island, and to compare their biological properties with those of species that managed to do so.

Occurrence of species on the Small Westman Islands, situated closer to Surtsey than any other piece of land, has been described separate from that on Heimaey and with more detailed records on dates of capture and abundance.

Only the adjacent parts of Main Iceland are treated, that is, the southern lowland, from Höfdabrekka, Mýrdalur, in the east, to the tip of the Reykjanes Peninsula in the west. This area has been divided into three Districts, I—III (see map, fig. 8).

Of the three Districts, the easternmost (Distr. I; fig. 9) has been most thoroughly investigated and its first rank in most groups, with respect to number of species and specimens captured, is therefore somewhat exaggerated.

Distr. II is the largest. Since no barriers to southward dispersal are present within its limits, we have defined it as consisting of the entire plain W and N of the river Markarfljót, as far north as the region "South Iceland" conventionally reaches (acc. to "Zoology of Iceland").

Distr. III, the southern half of the Reykjanes Peninsula, is quite incompletely investigated, but also the poorest in flora and fa

For ubiquistic or widely distributed sp we have not found it necessary to lis localities on the mainland or on Hein Dates, or at least months, of capture usually given.

Quotations, if considered of interest, given as:

Lth., 1931 (Lindroth, 1931) and Z.o.I. ( logy of Iceland).

Certain further abbreviations are expl in the introduction to the pertinent grou

The absence of reference implies tha material was collected during our own ex tions, 1965—70.

Arrangement of genera and species, w few exceptions accounted for below, fo "Zoology of Iceland". Family names been inserted only in the large insect o and in the Araneae (Spiders); higher taxon units in the Hemiptera and the Acari (M A few foreign, quite accidentally introd species, notably on Heimaey, are omitted

The names of genera and species are ac ing to "Zoology of Iceland", as a rule. S generic names (e.g. among Geometrid M have been treated as subgenera. The aut name of a species is given in abbreviated and without brackets, in spite of the con use of such by many specialists (indic that the specific name was originally giv a different genus). Synonyms are quoted in case they have been used in literature ing with the fauna of Iceland.

Distribution of each species in other of Iceland, as well as "General Distribu (omitted for the Acari), are given in h abbreviated form, especially in poorly k groups which are unsuitable for a zo graphical discussion. In some groups of in e.g. in the Coleoptera, we have follow more detailed division of Iceland (acc. to 1931) than that used in "Zoology of Icel above all by recognizing the concept

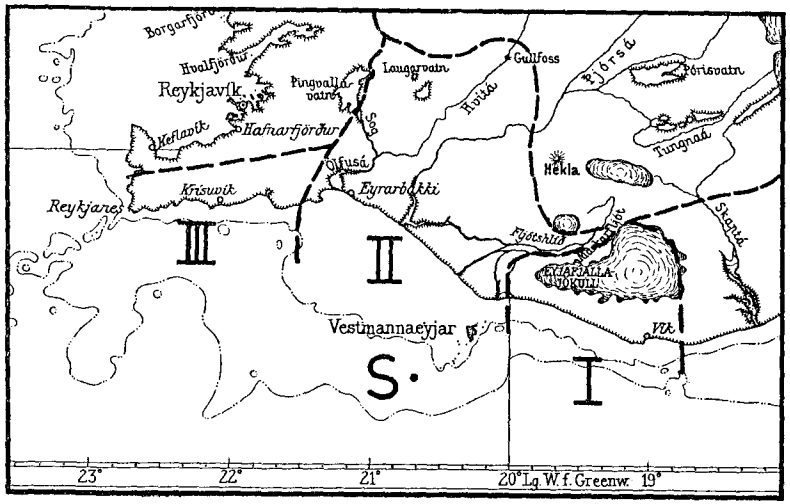


Fig. 8. Surtsey and its "hinterland" in South Iceland, divided into three districts (I—III).

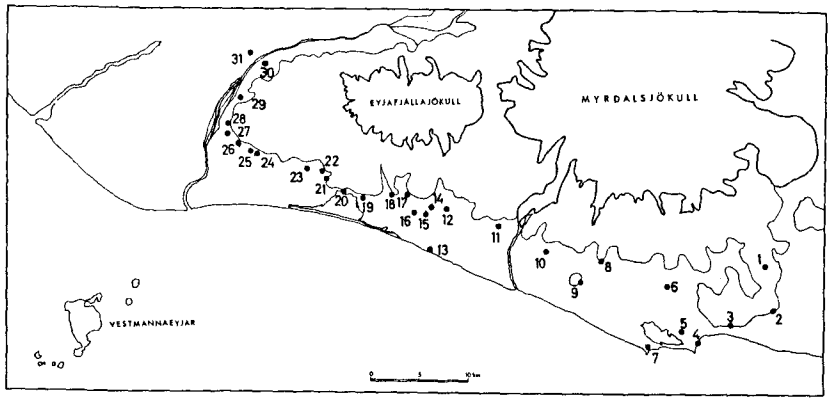


Fig. 9. District I on the mainland (see fig. 8) with collecting localities.

22. Ásólfsskáli
15. Drangshlíd
14. Drangshlídardalur
26. Drífandi
7. Dyrhólaey
11. Eystri Skógar
8. Fell
24. Fit
6. Giljur
2. Höfdabrekka
1. Illagil
18. Lambafell
21. Moldnúpur
25. Paradísarhellir
9. Pétursey
17. Raudafell
5. Reynisfjall
6. Rjómabú
27. Seljaland
28. Seljalandsfoss
16. Skardshlid
12. Skógar
13. Skógasandur
19. Steinar
31. Stóra Dímon
30. Stóra Mörk
29. Stóri Dalur
20. Varmahlíd
4. Vík
3. Víkurhamrar
12. Ytri Skógar
10. Ytri Sólheimar
23. Yzti Skáli





(south-eastern) and SW (south-western) Iceland. The reason is that SE Iceland is an old, particularly interesting faunal centre, whereas SW Iceland, with Reykjavík, is the part of the island most stained by human activities, including introduction of foreign faunal elements, and that these essential characteristics become lost, if the two areas are included into the composite concepts of "S" and "W" Iceland, respectively.

Information on ecology and dynamics, referring, if not otherwise stated, to conditions in Iceland, is presented more fully in sufficiently investigated groups, because these formed the main basis for our conclusions about the dispersal and history of the island faunas.

The specifically Icelandic letters þ, Þ and ð, Ð in the names of places and persons, have been substituted by *th* and *d*.

Indispensable assistance has been rendered by a large number of taxonomic specialists, who identified the material of many animal groups with which the authors were insufficiently acquainted. Our sincere thanks are due to the following persons:

Ackland, D. M., Oxford (Anthomyiidae, in part, Dipt.)
Andersson, Å., Stockholm (Oniscoidea)
Bakkendorf, O., †, Copenhagen (Mymaridae, Hym.)
Brinck-Lindroth, Gunvor, Lund (Siphonaptera)
Cederholm, L., Lund (Thysanoptera)
Clay, Theresa, London (Mallophaga)
Colyer, C. N., †, New Barnet, England (Phoridae, Dipt.)
Dahl, Christine, Lund (Trichoceridae, Dipt.)
Dessart, P., Bruxelles (Proctotrupoidea, in part, Hym.)
Dieckmann, L., Eberswalde, DDR (Curculionidae, in part, Col.)
Douwes, P., Lund (Lepidoptera)
Eady, R. D., London (Braconidae, in part, Hym.)
Eason, E. H., Morcton-in-Marsh, England (Chilopoda, Diplopoda)
Enckell, P. H., Lund (Protura)
Graham, M. W. R. de V., Oxford (Braconidae, in part, Hym.)
Griffiths, G. C. D., Edmonton, Canada (Braconidae, in part, Hym.; Agromyzidae, Dipt.)
Hackman, W., Helsinki (Mycetophilidae, in part; Sphaeroceridae, Dipt.)
Hedqvist, K.-J., Stockholm (Chalcidoi Hym.)
Hinz, R., Einbeck, BRD (Ichneumon part, Hym.)
Hirvenoja, M., Helsinki (Chironom part, Dipt.)
Holm, Å., Uppsala (Araneae)
Horstmann, K., Würzburg, BRD (Ic nidae, in part, Hym.)
Karling, T. G., Stockholm (Turbella
Kauri, H., Bergen (Opiliones, Chelo
Kerrich, G. J., London (Ichneumonida
Lindeberg, B., Helsinki (Chironomidae Dipt.)
Lyneborg, L., Copenhagen (Musci Anthomyidae, in part, Dipt.)
Nilsson, A., Lund (Ixodides, in part)
Nixon, G. E. J., London (Braconidae Hym.)
Nordenberg, C. B., Lund (Ixodides,
Nordström, S., Lund (Lumbricidae,
Nyholm, T., Stockholm (Psocoptera)
Oliver, D. R., Ottawa (Chironomid
Ossiannilsson, F., Uppsala (Hemipte
Overgaard Nielsen, B., Århus, Denn chodidae, Dipt.)
Peterson, B. V., Ottawa (Simuliidae,
Puthz, V., Schlitz, BRD (genus Ste
Quinlan, J., London (Cynipoidea, H
Rundgren, S., Lund (Lumbricidae,
Sellnick, M., †, Grosshansdorf, BR
Starý, P., Praha (Braconidae, in pa
Strand, A., Oslo (Staphylinidae, in
Sundholm, A., †, Karlskrona (Procto Hym.)
Tjeder, B., Lund (Trichoptera, N Tipulidae, Thaumaleidae, Dipt.)
Tuomikoski, R., Helsinki (Sciarida philidae, in part, Dipt.)
Walldén, H. W., Göteborg (Mollus
Wolff, N. L., Copenhagen (Lepid part)

In a few groups of Hymenoptera dae) and Diptera (Ceratopogonida myiidae, Sciaridae) our material w letely or not at all identified. A Chironomidae, only the collections islands were fully studied, by D. R

In the following survey, Hugo A responsible for the Diptera, Carl H for the Coleoptera, Högni Bödvars Apterygota. The remaining groups

compiled by Lindroth and Andersson, the Acari by Lindroth and Bödvarsson, from the literature and from the identifications of our material by the pertinent specialists and, to a limited degree, by ourselves. In many cases, the specialists have kindly read their part of the manuscript.

## A. *Insecta*

### 1. **Diptera**

In 1954, the Diptera part of "Zoology of Iceland" (Nielsen, Ringdahl, Tuxen) recorded 218 species of Diptera satisfactorily proved to be present in Iceland. The whole order was treated except the families Ceratopogonidae and Chironomidae, of which approximately 75 species are known from Iceland. Of all other families we now know 279 species which means an increase of 61 species after 1954. This figure includes a few species mentioned in the literature before 1954 but considered doubtful in Z.o.I.

All Diptera species now known to occur in Iceland, with the exception of the four families Ceratopogonidae, Chironomidae, Sciaridae and Cecidomyiidae, are listed in Table 28.

In this Special Part all the species of Diptera are treated that have been found on Surtsey or in its "hinterland", i.e. the other Westman Islands and the western part of the south coast of the mainland. For several reasons all families have not been studied to the same extent. The family Cecidomyiidae is omitted because no Icelandic material has ever been determined to species and because it has not been possible to find a specialist willing to work up our material; but we consider this a minor drawback only, since swept material under all circumstances cannot be expected to be determined to species. Our extensive material of Sciaridae from the hinterland is still unidentified. If worked up, the picture of the Sciarid fauna of the area would have changed considerably from that given in Z.o.I. The specimens from Surtsey are, however, determined as far as possible. Our knowledge of the Ceratopogonidae and Chironomidae is likewise very incomplete. Of the latter family the material from Surtsey itself has been worked up but only a small part of our large collections from the hinterland. These four families, consequently, are excluded from Table 28 and from most of the following discussions.

The figures of species abundance of Diptera are not always strictly comparable. As many Diptera as possible were pinned during the field work, but lack of time forced us to preserve a considerable part of the collected flies in alcohol. This material was determined and registered as far as possible, but of the Muscidae and Anthomyiidae only approximately one half of the material could be determined. The species of Calliphoridae are likewise more abundant than the figures show, because these shy and fast-flying flies usually escape the net during normal sweeping and no special efforts were made to measure the abundance of the Calliphoridae. Their presence everywhere is well documented by the maps in Z.o.I. (p. 137—140).

There are certain difficulties in field-work on Diptera to obtain a complete and correct picture of species composition and abundance. Among other reasons, an identification of larvae and pupae is in most cases impossible, and the period of adult life is often quite limited. It also varies highly between the species and a complete census of any geographical area involves investigations under most of the summer half-year. Since the activities of the flies, and their availability to the collector, are strongly influenced by weather conditions, and also because standard methods of collecting may be impaired or downright made impossible in stormy weather, by dewfall and rain, collections from different days may be entirely incomparable. This should be borne in mind when evaluating the significance of collecting activities. These difficulties are much less pronounced when dealing with other groups of animals, above all such inhabiting the soil and its surface, for instance Mollusca, Myriapoda and most Coleoptera.

If not otherwise recorded, H. Andersson (abbreviated "And.") is responsible for the identifications of Diptera.

Fam. Anisopodidae

*Sylvicola fenestralis* Scop. (*Anisopus f.*)

Mainland only known from Reykjavík.

Heimaey. 16.VI.66, 4 ex.

**Surtsey.** 1.VII.70, 1 ex., in the hut (E. Ólafsson).

General Distribution. Europe, in Sweden N to Norrbotten; N. America. — Brit. Isl.

Ecology. Imagines often found indoors. — Larva phyto-saprophagous.

Fam. Trichoceridae (det. Ch. Dahl)

*Trichocera maculipennis* Meig.

Mainland. Distr. I: Víkurhamrar; Rjómabú; Dyrhólaey; Skógar; 24.VI, 1 ex.; 27—29.VII, 6 ex.; 1 loc. (Z.o.I.); II: 2 loc.:s (Z.o.I.). — Found all over Iceland, except in the central highland.

Heimaey. 3 loc.:s, 16.VI—17.VIII, 40 ex.

**Surtsey.** 27.VI.70, 1 ex. (E. Ólafsson).

General Distribution. Holarctic, in Sweden N to Lule Lappmark (Dahl, 1957, 1966). — Brit. Isl., Faroes.

Ecology. On the mainland collected in canyons and on steep cliffs with rich vegetation (*Archangelica*, &c.). On Heimaey also in stables and other farm buildings. In Iceland active all the year round (Z.o.I.). — Larva coprophagous (Dahl, 1966) or phyto-saprophagous.

*Trichocera hiemalis* De G.

Mainland. Distr. I: Drangshlídardalur, 30.VI.68, 1 ex. — The only mainland loc.

Heimaey. 6 loc.:s, 16.VI—16.VIII, 12 ex. (And., 1967).

Small Islands. Ellidaey, 21.VII.65, 2 ex.

General Distribution. Holarctic, in Sweden N to Torne Lappmark (Dahl, 1966). — Brit. Isl., Faroes.

Ecology. On cliffs, around farmyards and on ruderal places. — Larva phyto-saprophagous. — In southern Sweden the adults are found in the cold part of the year, from October to April, in northern Sweden from September to May (Dahl, 1966). In Iceland apparently present also in summer.

Fam. Thaumaleidae (det. B. Tjeder)

*Thaumalea verralli* Edw.

Mainland. Distr. I: 12 loc.:s, 24.VI—30.VIII, 124 imagines, 18 larvae; II: 1 loc. (Z.o.I.). — NW, E, SE, S & W Iceland.

General Distribution. W and C Europe. — Brit. Isl., Faroes.

Ecology. The larva develops on stones in small streams or on rocks soaked by seeping water. The adults hide on rocks and in the vegetation or are swarming near the breeding places.

Fam. Bibionidae

*Dilophus femoratus* Meig.

Mainland. Distr. I: 13 loc.:s, 23.VI—1.VII, 692 ex.; II: Vomúlastadir, Réttasandur, 1.VII.68, 41 ex.; 2 loc:s (Z.o.I.) — Common and abundant all over Iceland except in the central highland.

Heimaey. 14 loc.:s, 13—17.VI, 753 ex.; 28.VII, 3 ex.

Small Islands. Ellidaey, 28.VI.68, 2 ex. — Bjarnarey, 28.VI.68, 33 ex. — Sudurey, 6 ex.

**Surtsey.** 12.VII.67, 1 ex.; 13.VII.67, 2 VIII.67, 3 ex. (dead).

General Distribution. Europe den N to Torne Lappmark; N Africa; N Brit. Isl., Faroes.

Ecology. Common on most localiti cially on meadows, heaths and agricultu Imagines gather in flowers, such as *Ra Taraxacum* &c. — The larva feeds on debris in the field layer.

*Bibio nigriventris* Hal.

Mainland. Distr. I: Skógar, 27.VI. Drangshlídardalur, 30.VI.68, 1 ex.; Lamb VI.68, 1 ex.; Ásólfsskáli, 25.VI.68, 18 loc.:s (Z.o.I.). — Restricted to E, SE, S land. Map: Z.o.I. (p. 14).

Heimaey. 10 loc.:s, 13—17.VI, 40

General Distribution. Euro Sweden. — Brit. Isl., Faroes.

Ecology. On meadows and heaths. on flowers, predominantly in June. phyto-saprophagous in the field layer.

Fam. Scatopsidae

*Scatopse notata* L.

Mainland. Distr. I: 7 loc.:s, 23.VI 18 ex.; 3 loc.:s (Z.o.I.); II: Von Réttasandur, 1.VII.68, 1 ex.; 2 loc.:s ( Found all over Iceland, except in the cer land, usually not abundant.

Heimaey. 14 loc.:s, 13.VI—17.VII

Small Islands. Bjarnarey, 11. ex.; 28.VI.68, 49 ex. — Sudurey, 28.VI. — Álfsey, 9.VIII.66, 2 ex.; 28.VI.68, 1

**Surtsey.** 15.VIII.66, 1 ex. — 10.VIII. 16.VIII.70, 1 ex. (E. Ólafsson).

General Distribution. Cos In Europe to N Scandinavia. — Brit. Is Greenland.

Ecology. Occurs synanthropicly a cliffs. Imagines on flowers. — Larva sa on carcasses, excrements, in birds nests

Fam. Cecidomyiidae

Due to the difficulties to determin specimens of this family no attempts made to work up the material collec Westman Islands and South Iceland. N Cecidomyiid has been determined to s

and Stóra Mörk; II: several loc.:s. — Most parts of Iceland, also in the central highland.

General Distribution. Palaearctic, most of Europe, to N Norway. — Brit. Isl., Shetl., Faroes.

Ecology. Larva in stagnant waters.

*Limnephilus fenestratus* Zett.

Mainland. I: Vík and Seljaland (Lth., 1931); II: Ölfusárbrú (Z.o.I.). — All parts of Iceland, also in the central highland; most abundant in the N.

**Surtsey.** 11.VII., 13.VII., 4.VIII.70, 3 living ♂ (Erling Ólafsson).

General Distribution. Circumpolar and northern (not in C Europe or on the Brit. Isl.). — Greenl.

Ecology. In bogs with *Carex* and *Eriophorum*.

*Limnephilus affinis* Curt.

Mainland. I: Several loc.:s in the W part, from Raudafell to Stóra Mörk; II: several loc.:s. — Local but known from most parts of Iceland.

(**Surtsey.**) Found dead in the tidal zone in the NE, 27.VI.70, ♀ (Erling Ólafsson).

General Distribution. W-Palaearctic, to N Norway. — Brit. Isl., Shetl., Faroes.

Ecology. The larva in ponds and lakes.

*Apatidea zonella* Zett. (*arctica* McL., *Apatania z.*)

Mainland. I: Raudafell 26.VI.68, ♂, 9 ♀; Seljaland (incl. Fit and Drífandi) 24.VIII.67, ♂, 6 ♀ (also Lth., 1931); II: several loc.:s. — Locally abundant in all parts of Iceland, also in the central highland.

General Distribution. Palaearctic with northern distribution (not in C Europe or the Brit. Isl.). — Faroes, Greenl.

Ecology. The larva in large streams with cold water, but not in pure melt-water from glaciers.

Dynamics. The species is normally parthenogenetic and therefore easily spread. Besides the two males from Distr. I (above), only 1 ♂ is known from Iceland (Ellidavatn, SW; Lth., 1931).

## 7. **Neuroptera** (det. Bo Tjeder)

Only one species is indigenous in Iceland.

*Chrysopa carnea* Steph.

Not found on the mainland.

Heimaey. 2 ex. taken in Herjólfsdalur, X.65 (Frídrik Jesson; Mus. Westm. Isl.).

General Distribution. Holarctic, in Europe to C Scandinavia. — Brit. Isl.

Ecology. As in other species of the family, the larva feeds on different species of Aphids.

Dynamics. The find on Heimaey is no doubt a result of unintentional introduction.

*Boriomyia nervosa* F. (*betulina* Ström)

Mainland. II: Thórsmörk (Lth., 1931); Thrastaskógur and Laugardalur (Z.o.I.). — In most parts of Iceland but very local.

Heimaey. 5 almost full-grown larvae in gardens on birches attacked by Aphids, 28.VIII.67.

**Surtsey.** In the NE part, 28.VI.66, ♂.

General Distribution. Palaearctic, in Europe to N Scandinavia. — Brit. Isl., Faroes, Greenl.

Ecology. In Iceland almost entirely confined to stands of birch and therefore absent from wide areas, e.g. in the south.

Dynamics. The adult is a slow flyer but apparently it may be carried away by wind currents.

## 8. **Hemiptera** (det. F. Ossiannilsson)

The distribution outside Iceland and the ecological demands of species in this order are sufficiently known, and useful for biogeographical discussions, only in the Heteroptera and the Auchenorrhyncha (leaf-hoppers); for these a somewhat more detailed information is given. For the remaning Homoptera, above all the dominating group of Aphidina (plant-lice), because of the quite incomplete knowledge of species distribution, we found it suitable to restrict ourselves to a very condensed treatment.

We are deeply indebted to Dr. Ossiannilsson, who devoted so much time to the identification of our material, especially of the rich collection of the difficult Aphidina. He also read the Hemiptera part of the manuscript.

The sequence of genera and species follows "Zoology of Iceland", except for the Aphidina, which are treated according to Ossiannilsson, 1969. His name is here abbreviated as "Oss.".

### Heteroptera

*Arctocorisa carinata* C. R. Sahlberg

Mainland. Distr. II: 2 loc.:s (Z.o.I.). — All parts of Iceland (map: Z.o.I.) but more scarce in the S.

Heimaey. In a spring 8.IX.26 (Lth., 1931); in artificial pond at Kirkjubaer, repeatedly, 1965, 1967.





(**Surtsey.**) 3 dead specimens in drift on the NE shore 28.IV., 10.V.69 (Hálfdán Björnsson).

General Distribution. N and mountains of C Europe (maps in Lundblad, 1925, and Poisson, 1927). — Brit. Isl., Shetl., Faroes.

Ecology. In different kinds of vegetated stagnant waters.

Dynamics. Probably constantly macropterous and flying.

*Salda littoralis* L.

Mainland. I: Several loc.:s; II: several loc.:s; III: 1 loc. — All parts of Iceland, often abundant.

Heimaey. 21.VI.67, 1 larva.

General Distribution. Circumpolar, in Europe to Norway. — Brit. Isl., Shetl., Faroes.

Ecology. At the margin of fresh water and the seashore.

Dynamics. Icelandic specimens are probably always brachypterous and unable to fly.

*Lyctocoris campestris* F.

Not found on the mainland.

Heimaey. Kirkjubaer, in a hay-barn, 28.VII.65, 16.VI.66, abundant. — This is the only Icelandic record.

General Distribution. West-Palaearctic, introduced in N. America and in the S Hemisphere. — Brit. Isl.

Ecology. Also on the Continent mainly indoors or under other synanthropic conditions.

Dynamics. Macropterous and no doubt always able to fly. To a great extent spread by human activities.

*Teratocoris saundersi* Dgl. & Scott, sensu lato.

Mainland. II: Ölfusárbrú, brachypterous (Lth., 1931). — Scattered loc.:s in the E two-thirds of Iceland.

Heimaey. Kirkjubaer 27.VII.65, macropterous ♂, brachypterous ♀.

Small Islands. Sudurey 28.VI.68, larva.

General Distribution. In its widest sense, the species has a circumpolar distribution, but Dr. Ossiannilsson informs us that the status of the Nearctic *herbaticus* Uhler, to which the Icelandic population has been referred (Lth., 1965:137), is not yet clear. — The true *saundersi* in Europe N to N Norway. — Brit. Isl.

Ecology. On rather moist meadows with rich vegetation; not limited to coastal areas in Iceland.

Dynamics. The species shows wing-dimorphism, as on the European continent, but, in Iceland, most specimens are brachypterous.

*Pachytomella parallela* Meyer-Dür

Only 1 ex. found, at Akureyri in the N, mainland.

Heimaey. Swept on a somewhat wet i near Herjólfsdalur, 23.VII.65, 3 ♂.

General Distribution. The sp otherwise restricted to S, C & W Europe, Germany (lacking in Scandinavia). — B (incl. Scotland).

Dynamics. Icelandic specimens, al are macropterous but the ♀ is constantly ypterous in Europe.

*Myrmedobia exilis* Fall. (*tenella* Zett.)

On the mainland found on scattered l the E half of Iceland, but not in Distr.:s

Heimaey. Swept from a somewh meadow near Herjólfsdalur, 26.VII.65, ♂

General Distribution. Europe Siberia. In Scandinavia to Swed. Lapl. — I

Ecology. On open meadow ground. Continent often among moss, usually in fc

Dynamics. The species exhibits wing-dimorphism, the ♂ being fully wing ♀ virtually apterous.

*Acalypta nigrina* Fall.

Mainland. I: Drangshlíd 29.VI.68, 5 A few loc.:s in NW, N & SE Iceland.

General Distribution. Euro Norway N to 70° N. — Brit. Isl.

Ecology. Among moss and grass in dry meadow slopes.

Dynamics. The species is wing-din the macropterous form rare everywhere i found in Iceland.

*Nysius groenlandicus* Zett.

Mainland. I: Vík and Pétursey (Lth. II: Fljótshlíd (Z.o.I.). — Otherwise scatter in NW, N, SE & S Iceland.

General Distribution (incor known). Probably circumpolar; in Europ Fennoscandia. Lacking in C Europe and Brit. Isl. — Greenland.

Ecology. On dry places with inc vegetation.

Dynamics. The wings are always f probably functioning.

### Auchenorrhyncha

*Jasargus pseudocellaris* Flor (*Deltocephalu guendus* Fall.)

Mainland. I: Varmahlíd 22.VI.29

1931) — not found in 1967—68 —; no doubt also in II (see Z.o.I.). — All main parts of Iceland.

General Distribution. Palaearctic, in Europe to N Sweden. — Brit. Isl., Faroes.

Ecology. In moderatly moist meadows.

Dynamics. Macropterous and probably flying.

*Cicadula quadrinotata* F.

Mainland. I: Drífandafoss, Seljaland; Stóra Dímon; 24.VIII.67, 8 ♂, 5 ♀. — Only scattered loc.:s in distant parts of Iceland (Oss., Ent. Tidskr. 1947:128; Ent. Medd. 25 1948:250).

Heimaey. Near Herjólfsdalur 26.VII.65, ♂.

General Distribution. Palaearctic, in Europe to N Scandinavia. — Brit. Isl., Faroes.

Ecology. Swept in meadows and bogs.

Dynamics. Macropterous and observed flying (Oss., *in litt.*).

*Macrosteles laevis* Rib. (*Cicadula sexnotata* auctt. p. p.)

Mainland. I: Common everywhere; also in II and III. — All parts of Iceland (map in Tuxen, 1944:156).

Heimaey. Abundant everywhere.

Small Islands. Sudurey 28.VI.68, 2 larvae.

General Distribution. Palaearctic, in Europe to N Scandinavia; Alaska. — Brit. Isl., Faroes.

Ecology. On grassland and in meadows of varying moisture. It feeds on grasses.

Dynamics. Macropterous and observed flying (Oss., *in litt.*).

*Javesella pellucida* F. *(Liburnia & Calligypona p.)*

Mainland. I: Widely distributed and often abundant, from Skógar to Seljaland, VI.68; II: Vomúlastadir, Réttasandur 1.VII.68, 2 ex.; Thórsmörk and Fljótshlíd (Lth., 1931). — Otherwise only in the SE: Skaftafell and Hornafjördur.

Heimaey. Many loc.:s and often abundant, VI.66, 298 ex.

Small Islands. Bjarnarey 28.VI.68, 10 brachypterous ♂, 5 brach. and 1 macropterous ♀. — Sudurey 28.VI.68, 3 ♂, 1 ♀, brach.; 1 ♂, 3 ♀, macr.

General Distribution. Circumpolar, in Europe to northernmost Scandinavia. — Brit. Isl.

Ecology. In moderately moist meadows. Feeds on grasses. It is a pronounced spring species.

Dynamics. The species shows asexual wing dimorphism and only macropterous individuals are able to fly. It is interesting that in Distr. I on the mainland almost exclusively the brachypterous form (57 of 60 exx.) has been found, but in Distr. II as well as on the Westman Islands, the macropterous form, though in minority, occurs regularly (on Heimaey 14 %). In SE Iceland, 6 macr. and 13 brach. exx. were found.

Aphidina

Records on "Dynamics" are not given because, with the exception of *Acyrthosiphon pelargonii*, all species have been found both in wingless and winged forms.

*Euceraphis punctipennis* Zett. (*betulae* auctt.)

Mainland. I: Skógar, abundant; II: 3 loc.:s (Z.o.I.). — Most parts of Iceland.

Heimaey. Abundant on birch in gardens.

**Surtsey.** 11.VII.68, 1 ex.

General Distribution. Palaearctic, in Europe to northernmost Scandinavia. — Brit. Isl., Faroes (Heie, 1972).

Ecology. The food-plant is tree-formed birch; on the Continent also *Betula nana.*

*Betulaphis brevipilosa* Börn.

On the mainland recorded only from SE Hornafjördur. No doubt more widely distributed but not kept apart from the following species in Z.o.I. (1955).

Heimaey. On birch in the village, 22.VIII.67, 1 apt.

General Distribution. Europe, N to Swed. Lapl.

Ecology. On tree-formed *Betula*; on the Continent also on *Betula nana.*

*Betulaphis quadrituberculata* Klt. (*Subcallipterus minimus* v. d. G.)

Mainland. I: Skógar and Stóra Dímon, VIII.67. — No doubt widely distributed in Iceland though partly confused with the preceding.

Heimaey. On birch in the village, 22.VIII.67, abundant (al., apt., juv.).

General Distribution. Europe; in Scandinavia mainly in the north. — Brit. Isl.

Ecology. On tree-formed *Betula.*

*Trichocallis cyperi* Walk. *arctica* H. R. L. (*Thripsaphis c. a.*)

Mainland. I: Many loc.:s, abundant; II: 2 loc.:s. — Almost entire Iceland (map, Z.o.I.).

Heimaey. Near Herjólfsdalur in wet meadow, very abundant.





General Distribution. The species occurs in Europe, N to northernmost Scandinavia, also Brit. Isl. Sbsp. *arctica* is otherwise known from Greenland only.

Ecology. On several species of *Carex.*

*Allaphis thripsoides* H. R. L. (*Thripsaphis & Trichocallis t.*)

Mainland. I: 5 loc.:s, rather abundant. — Otherwise in N, SE, SW and W Iceland (Z.o.I.; Prior & Stroyan, 1960).

Heimaey. Near Herjólfsdalur 26.VII.65, 1 apt.

General Distribution. Europe, N to C Sweden. — Brit. Isl.

Ecology. On *Carex.*

*Schizaphis graminum* Rond. *gigjai* Stroyan

Mainland. I: Dyrhólaey, in dry cultivated grassland, 28.VIII.67, ♂ ♀; II: Geysir (type loc.). — Otherwise known from SE Iceland.

General Distribution. The species is almost cosmopolitan; sbsp. *gigjai* not known outside Iceland.

Ecology. On unidentified grasses. The typical form polyphagous on many different kinds of grasses.

*Schizaphis rufula* Walk. (*geijskesi* H. R. L.) *priori* Stroyan

Mainland. I: Skógasandur, seashore, on *Elymus*, 29.VIII.67, rather abundant. — Described from SW Iceland.

Heimaey. Klauf, seashore, on *Elymus*, repeatedly and abundant.

General Distribution. The species in Europe, N to C Sweden, and Brit. Isl.; sbsp. *priori* known only from Iceland.

Ecology. Also the nominate sbsp. from the Continent feeds on *Elymus.*

*Aphis atuberculata* H. R. L.

Mainland. I: Stóra Dímon, dry meadow slope, 24.VIII.67, 7 ex. (al., apt., ♂). — Previously known only from the type loc. in N Iceland (Z.o.I.).

Heimaey. 3 loc.:s on rather dry meadow ground, 20—23.VII.65, 7 ex. (al., apt.).

General Distribution. Not known from outside Iceland.

Ecology. Food-plant unknown.

*Brachycaudus helichrysi* Klt.

Mainland. I: Víkurhamrar, on *Archangelica.* 27.VIII.67, 17 ex. (al., apt., juv.). — Otherwise from Reykjavík.

Heimaey. Near Herjólfsdalur, in a VII.65, 1 al.

**Surtsey.** Crater "Surtur I", in one of D guire's plastic tubs, 12.VIII.67, 1 al. Apr found dead; infiltrated by mycelia of a sapr fungus, probably *Cladosporium herbarum* ( Björling).

General Distribution. Almost politan, in Europe to N Sweden. — Brit.

Ecology. Mainly on Compositean on the Continent usually with *Prunus* as p host.

Dynamics. The species was trapp ships at sea in the S Pacific area (Yoshir Gressitt, 1964).

*Thuleaphis ? acaudata* H. R. L.

Mainland. II: Grímsnes VIII.58, on *(Rhodiola) roseum* (Prior & Stroyan, 19 This is the only Icelandic record.

General Distribution. Describe Greenland, later discovered in Wales (P Stroyan, l.c.).

Ecology. In Wales occuring on th host.

*Coloradoa rufomaculata* Wils.

Mainland. II: Fagrihvammur, Öl greenhouse on *Chrysanthemum* (Z.o.I.). only Icelandic record.

General Distribution. Cosmo introduced in Iceland.

Ecology. On cultivated *Chrysanthem*

*Ericaphis latifrons* Börn.

Mainland. II: Ölfus (Z.o.I.). — Als SW & W Iceland.

General Distribution. Europ parently boreo-alpine, to N Scandinavia. ( the Brit. Isl.).

Ecology. In Iceland on *Vaccinium sum* (Z.o.I.) and *Calluna* (Prior & Stroyan in Scandinavia on *Empetrum* and probably subspecifically different (Oss., 1951:453).

*Cavariella aegopodii* Scop.

Mainland. I: Mýrdalur (Z.o.I.); Eyst gar VIII.67, 2 apt., 1 juv., 29.VI.68, 1 al.; on *Archangelica* 29.VIII.67, 1 apt.; II: Von dir, Réttasandur, swept from *Salix*, 1.VII.6 — Otherwise known from N, SE & W Icel

Heimaey. On *Salix herbacea*, 23 3 apt.

General Distribution. Palaeai