

The development of the land-arthropod fauna on Surtsey, Iceland, during 1971—1976 with notes on terrestrial Oligochaeta

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INTRODUCTION

In 1973 Lindroth et al. published the results of their terrestrial invertebrate survey on Surtsey and in its adjacent areas. The publication deals with the Surtsey collections from 1964—1970, which consist of 5742 specimens. Only a few species from 1971 and 1972 were included in the discussions.

THE FIELD-WORK 1971—1976

In 1971 the author stayed on the island from June 12 to August 24, and Mr. H. Björnsson from October 10—28. Mr. J. Eldon stayed there from June 6 to August 23, 1972, and from June 24 to August 21, 1973. However only seven collecting days have been noted in 1973. In 1972 (July 4—8) the island was also visited by Dr. C.H. Lindroth, Dr. H. Böldvarsson, Mr. S.H. Richter and Dr. P. Douwes. In 1974—1976 no regular collecting took place on Surtsey. In 1974 and 1976 the island was visited by Dr. H. Böldvarsson and the author on July 30 to August 3 and August 7—12 respectively. No collecting took place in 1975, and because of unfavourable weather during the visit in 1976 the capture was very poor that year, especially regarding the flying insects.

In 1971 no traps were in use as all the available traps had been damaged the previous summer. In 1972 two new screen-traps (see Lindroth et al., 1973, p. 148) were set up in the northern part of the island and kept running from June 8 to August 15. However trap collecting was not continuous, as it was often disturbed by unfavourable weather and other events. On August 20, 1973, insects were unusually common around the hut. Then 409 flies were caught in a water-filled bowl outside the hut.

THE MATERIAL FROM 1971—1976

In this paper unpublished data collected by Dr.

H. Böldvarsson are not included, so all numbers given are data from other collectors.

The material consists of 4064 specimens. Most of the groups have been identified to species. The important group Acari (918 specimens) has only partly been treated by a specialist, but the author has not yet received the results. Most of the Hymenoptera (9 specimens) are still in the hands of a specialist. Diptera Sciaridae and some of the Chironomidae have not been identified.

Dr. Å. Holm, Uppsala, has been very helpful and has identified the Araneae (10 ex.), Dr. S.L. Tuxen, Copenhagen, identified the single Protura found on the island and Mr. K.J. Hedqvist, Stockholm, the single Chalcidoidea (Hymenoptera). Dr. H. Böldvarsson identified the Collembola, and the author is responsible for the identification of the remaining groups.

This material consists of at least 122 species of which 33 are new to Surtsey and one is new to the Icelandic fauna.

ADDITIONS TO THE SURTSEY LIST OF TERRESTRIAL ARTHROPODS.

DIPTERA

Fam. Bibionidae

Biblio nigriventris Hal. 17.VI.72, 1 ex. (J.E.).

Fam. Chironomidae

Cricotopus ? sylvestris Fabr. 3.—5.VII.72, 6 ex.; 1.VII.73, 1 ex. (J.E.).

Diamesa aberrata Lundb. 11.VI.72, 1 ex.; 15.VIII.72, 1 ex. (J.E.).

Fam. Ceratopogonidae

Gen. sp. 3.VIII.74, 1 ex. (E.O.).

Fam. Simuliidae

Eusimulium aureum Fries 31.VII.74, 1 ex. (E.O.).

Fam. Tipulidae

Tipula rufina Meig. 4.VII.72, 1 ex. (J.E.).

Fam. Dolichopodidae

Hydrophorus viridis Meig. 23.X.71, 1 ex. (H.B.).

Fam. Syrphidae

Platycheirus manicatus Meig. 1.VII.72, 1 ex. (J.E.).

P. peltatus Meig. 30.VII.72, one dead ex. in drift on the shore; 4.VII.72, 1 ex.; 5.VII.72, 1 ex. (J.E.).

Syrphus torvus O.-Sack. 19.VI.72, 1 ex. (J.E.).

Fam. Muscidae

Spilogona baltica Ringd. (see Lindroth et al., 1973, p. 51, *Spilogona* sp. A and sp. B) 16.VI.71, 1 ex. (E.O.); 27.VI.72, 1 ex. (J.E.).

HYMENOPTERA

Chalcidoidea

Eupteromalus fucicola Walk. 21.VII.71, 1 ♀ hatched from a pupa of *Coelopa frigida* F. collected in drift on the N shore (E.O.).

COLEOPTERA

Fam. Carabidae

Nebria gyllenhali Schnh. 26.VI.72, 1 ex. dead and badly damaged in drift on the N shore.

LEPIDOPTERA

Fam. Tortricidae

Eana osseana Scop. 30.VII.74, 33 ex. dead in drift on the N shore; 2.VIII.74, 4 ex.; 3.VIII.74, 1 ex. (E.O.).

Fam. Nymphalidae

Vanessa atalanta L. 26.X.71, 1 ex. (H.B.).

Fam. Geometridae

Cidaria (Xanthorhoe) designata Hufn. 23.VI.71, 2 ex. (E.O.).

C. (Epirhoe) alternata Müll. 16.VI.71, 1 ex. (E.O.).

Fam. Noctuidae

Euxoa islandica Staud. 10. VIII.72, 1 ex. (J.E.).

Noctua pronuba L. 27.VII.72, 1 ex.; 25.VI.73, 1 ex. (J.E.).

Peridroma saucia Hübn. 16.VII.71, 1 ex. (E.O.).

Diarsia mendica Fabr. 3.VII.72, 1 ex. (J.E.).

Ceraapteryx graminis L. 30.VII.74, 9 live and 2 dead ex. in drift on the N shore; 1.VIII.74, 1 ex. newly dead in the lava-slope of Surtur II (E.O.).

Phlogophora meticulosa L. 27.X.71, 1 ex. (H.B.).

TRICHOPTERA

Fam. Limnephilidae

Limnephilus elegans Curt. 1971, 1 ex. dead on the NE shore (E.O.).

L. griseus L. 5.VII.72, 1 ex. (J.E.).

HEMIPTERA

Coccinea

Arcorthezia cataphracta Olafs. 1.VIII.74, 9 live and 10 dead ex. in a tuft of grass that was washed ashore (E.O.).

PROTURA

Protentomon thienemanni Strenzke 1. VIII.74, one live ex. in a tuft of grass that was washed ashore (E.O.). New to Iceland.

COLLEMBOLA

Three new species (*Friesea mirabilis* Tullb., *Onychiurus armatus* Tullb. and *Folsomia quadrioculata* Tullb.) will be treated by H. Böldvarsson in a later publication

ARANEAE

Fam. Linyphiidae

Erigone atra Bl. 18.X.71, 1 ♀ (H.B.).

Erigone arctica maritima Kulc. (previously recorded with doubt) 9.VIII.76, 1 ♂ 1 ♀ (E.O.)

E. tirolensis L. 12.VIII.72, 1 ♂ (J.E.).

Islandiana princeps Braend. 29.VII.71, 1 ♀ with an egg cocoon (E.O.).

Of these 33 new species only four can possibly be regarded as permanent settlers on the island, i.e.

the spiders and perhaps the collembole *Onychiurus armatus*. The ten new Diptera, ten Lepidoptera and the two Trichoptera are all casual visitors, and the remaining species were carried to the island in a tuft of grass, that was washed ashore.

EXAMPLES OF HYDROCHOROUS TRANSPORT OF LAND-INVERTEBRATES TO SURTSEY

It was pointed out by Lindroth et al. (1973), that hydrochorous dispersal of land-invertebrates to Surtsey is of great importance. Animals have been carried to the island both by floating objects and simply by floating on the surface of the sea.

Puparia of three species of seashore flies (*Coelopa frigida* Fabr., *Thoracochaeta zosterae* Hal. and *Fucellia fucorum* Fall.) have been found washed ashore and at least the two latter species have hatched afterwards.

On July 21, 1971, six puparia belonging to the above mentioned Diptera species (three, two and one specimens respectively) were collected in drift on the north beach. One of the *C. frigida* puparia hatched a few days later producing the parasitic wasp *Eupteromalus fucicola* Walk. (Chalcidoidea), which in Iceland is only known from the Westman Islands (Lindroth et al., 1973). The host was unknown. Most likely the pupa became infected outside Surtsey, and the inhabiting wasp managed to survive during the hydrochorous transport.

Apparently floating tussocks are going to be of great importance for the establishment of soil fauna on Surtsey. On July 8, 1972, a small tuft of grass (dry weight 52 g) was found washed ashore on the northeast beach. It contained two life specimens of Collembola and ca. 30 specimens of Acari. The origin of the tuft could not be traced. (Lindroth et al., 1973, p. 255). On August 1, 1974, a new floating tussock was washed ashore, this time a large one. It was cylindrical, 90 cm long and 10—20 cm wide. About one half of it (dry weight 884 g) was sampled and isolated in plastic bags. The other half was left on the beach. A few days later the sample was treated in Berlese funnels. Altogether 653 terrestrial invertebrates were extracted through the funnels. Afterwards the dry sample was thoroughly examined, and the search for dead animals resulted in 10 specimens of *Arcorthezia cataphracta*. The invertebrates found in the tussock are listed in table 1.

Various skilled botanists have studied the plant remains in the tussock, but they have not been able to give a definite identification. The tussock could possibly consist of the remains of *Poa* sp.

To trace the origin of the tussock both pollen

analysis and geological studies were performed. The pollen analysis, performed by Miss M. Hallsdóttir, Dept. of Quarternary Geology in Lund, showed a marked predominance of grasses (Gramineae). The results are given in table 2. These results do not give any proof of the origin of the tussock, but undeniably it has got the character of the bird cliffs or the puffin grounds of the Westman Islands, which are often characterized by grasses, *Festuca rubra* and *Poa pratensis*, the composit *Tripleurospermum matitimum* and caryophyllaceous plants like *Stellaria media* (Fridriksson et al., 1972).

Mr. S. Jakobsson at the Natural History Museum in Reykjavík kindly studied grit sampled from the tussock. The grit proved to be quite palagonitized tuff. Phenocrysts of plagioclase and olivine were common, and zeolites were quite common in holes. This type of tuff resembles that of the Westman Islands, especially in the northernmost part of Heimaey (the Heimaklettur area), where the palagonitization of the old tuff is advanced (Jakobsson, 1968). Thus the tussock could originate from that area, but no proof has been obtained.

FURTHER NOTES ON THE LAND-INVERTEBRATE GROUPS FOUND ON SURTSEY

Diptera

At least 114 species of Diptera have been caught on Surtsey, but the actual number might exceed 120, as the identity of some species is still uncertain, especially within the families Chironomidae and Sciaridae.

As could be expected, the different species have been collected on Surtsey in varying quantities. In figure 1 the 114 species of Diptera are divided into ten groups to illustrate this further. The first group includes species, that have been caught only once or twice, the second group species, of which 3—5 specimens have been caught and so on. Of only one species the number caught has exceeded 1000 specimens. In table 3 the nine most common species are listed. In 1964—1976 these nine species made up 80.6% of the total Diptera capture, so the remaining 105 species (plus some unidentified species) totalled only 19.4%. During the period 1964—1970 these same species constituted 83.8% of the total Diptera capture as compared with 76.5% during 1971—1976. Even though these numbers are fairly alike some changes in abundance of individual species are noted. Most notable is the decreasing number of *Heleomyza borealis*

and *H. serrata*. During the very first years of Surtsey's existence the conditions were ideal for saprophagous insects like the *Heleomyza* species since carcasses, that were washed ashore, could lie there for a long time. From 1970 onwards, the beach became a very popular resting place for immature gulls, so all carcasses were quickly devoured. This has no doubt greatly affected the species *H. borealis*, which was previously known to reproduce on the island (Lindroth et al., 1973).

The increase of *Scatophaga stercoraria* in the material is due to the great capture on August 20, 1973, when 381 specimens were caught in a water-filled bowl outside the hut. In 1973 443 Diptera were caught, so *S. stercoraria* makes up 86% of that years capture.

Another biotope, that previously favoured at least two species, i.e. *Chironomus lububris* Zett. and *Scatella tenuicosta* Coll., has also disappeared. These two species had reproduced in the artificial freshwater "pools" erected by Dr. Maguire in 1967. In 1971 his plastic tubs were removed, so no freshwater resources were available on the island after that, except for condensing vapour around the fumaroles. In such places where algal vegetation is usually luxuriant, the *Scatella* species can easily reproduce, but they have been observed in great numbers in identical places in the new lava on Heimaey. However no *Scatella* flies have been caught on Surtsey after 1970.

No new species of Diptera have been proved to have settled permanently on Surtsey after 1970. *Cricotopus variabilis* (Chironomidae) no doubt reproduces regularly in the salt water rock-pools and 21 larvae were collected in 1972. In 1974 many Calliphoridae larvae were observed in a dead kittiwake in the lava slope of Surtur II. However *Cricotopus variabilis* is the only Diptera species suspected to have a permanent population on the island.

Hymenoptera

During 1964—1970 21 specimens of Hymenoptera were collected (Lindroth et al., 1973). They belong to eight species. Ten specimens were collected 1971—1976. One of them has been identified, i.e. *Eupteromalus fucicola* Walk. (Chalcidoidea), that hatched from a pupa of the seashore fly *Coelopa frigida* Fabr., found in drift on the north shore (21. VII.71). The other specimens are at present being treated by a specialist.

Coleoptera

Only four species of Coleoptera have been found alive on Surtsey, 108 specimens altogether.

Additional six species have been found dead in drift on the shore, in some cases only parts of the animal (10 ex.).

The capture of 66 specimens during 1971—1976 gave no new species, except for the drifted and badly damaged *Nebria gyllenhali* Schnh. Three of the old species were rediscovered. *Enicmus minutus* L. is still regularly found inside the hut. Seven new specimens of *Atheta atramentaria* Gyll. have been collected, all caught flying on sunny days. Then *Amara quenseli* Schnh. was rediscovered when a single beetle was found running on the ground in crater Surtur I on August 15, 1972 (leg. J.E.). The specimen was macropterous like the one previously captured. *Otiorrhynchus arcticus* O. Fabr. has not been found after 1969.

Lepidoptera

Altogether 19 species (124 ex.) of Lepidoptera have been found on Surtsey. Nine species (31 ex.) were captured in 1964—1970 (Lindroth et al., 1973). During 1971—1976 ten new species were captured and four of the old species were rediscovered, i.e. *Plutella maculipennis* Curt. (5 ex. in 1972), *P. senilella* Zett. (4 ex. in 1972 and 1 ex. in 1974), *Agrotis ipsilon* Hufn. (1 ex. 25. IX.1976, leg. S. Jakobsson) and *Autographa gamma* L. (22 ex. in 1971). The last species invaded the island on October 19—27, 1971. That event is discussed by Lindroth et al., 1973 (pp. 216—219).

On July 30, 1974, 11 specimens of *Ceraapteryx graminis* L. were found in drift on the north shore. Nine of them were alive but wet and unable to fly. At the same time 33 specimens of *Eana osseana* Scop. were collected in the drift, but all of them were dead. On August 1 yet another specimen of *C. graminis* was found newly dead (soft and undamaged) in the lavaslope of Surtur II. Then on August 2—3 five specimens of *E. osseana* were found alive. These first days of August, 1974, the island was invaded by a variety of flying insects. Only one or two specimens were caught of the remaining 8 new species of Lepidoptera.

Neuroptera

The single Icelandic species, *Boriomyia nervosa* Fabr., was first collected on Surtsey in 1966 (1 ex.) (Lindroth et al., 1973). A second specimen was captured on June 14, 1971.

Trichoptera

The first Trichoptera were found on Surtsey in 1970, when three specimens of *Limnephilus fenestratus* Zett. were captured. The same year a single

L. affinis Curt. was found dead in drift on the shore (Lindroth et al., 1973).

In 1971 a single specimen of *L. elegans* Curt. was found dead on the northeast shore. The specimen was in a good condition. The date of this finding is unfortunately not available at the time of writing. A new species, *L. griseus* L., was caught flying on July 5, 1972.

Hemiptera

Two aphid species had previously been found on Surtsey. Now the coccid species *Arctothezia cataphracta* Olafs. has reached the island, transported by a floating tussock (see above). The species is very common all over Iceland.

Three dead specimens of *Arctocorisa carinata* C.R. Sahlb. were found in drift on the shore in 1969. Still one specimen was found drifted ashore on July 30, 1974.

Protura

Only two species of this order had previously been found in Iceland, both of them being extremely rare. It was therefore surprising when the third species appeared in the tussock, that was washed ashore on Surtsey in 1974 (see above). This species, *Protentomon thienemanni* Strenzke, was previously known from West-Germany (Tuxen, 1964).

Collembola

Lindroth et al. (1973) partly includes the material collected by Dr. H. Bødvarsson in 1972. Eight species were recorded from Surtsey.

The material collected by other collectors during 1971—1976 consists of 691 specimens, belonging to 10—11 species. Three of them had not been recorded, i.e. *Friesea mirabilis* Tullb., *Folsomia quadrioculata* Tullb. and *Onychiurus armatus* Tullb. These species were collected from the floating tussock found in 1974. The last species has also been found on the island on other occasions, under pieces of driftwood. Altogether 243 collemboles were extracted from the above mentioned tussock. They belong to five species (table 1). This group of insects will be treated more thoroughly by Dr. H. Bødvarsson in a later publication.

Araneae

In 1964—1970 11 spiders belonging to five species were found on Surtsey (Lindroth et al., 1973). During 1971—1976 ten specimens were found, giving three new species to the Surtsey list. One species, *Erigone arctica maritima* Kulcz., previously identified with doubt, was rediscovered.

The first spiders were found on Surtsey in 1967, i.e. *Lepthyphantes mengei* Kulcz. (2 ex.) and *Meioneta nigripes* Sim. (2 ex.) (Lindroth et al., 1973). In 1968 and 1969 no spiders were found, but from 1970 onwards spiders have been found every year. In 1976 silky threads produced by spiders were observed all over the lava fields, especially in sheltered and damp holes and caves. Therefore spiders are obviously becoming quite common. Three specimens were found that year, *Erigone arctica maritima*, 1 ♂ and 1 ♀ in a cave on the east part of the island, and *Meioneta nigripes*, 1 ♀ on a big trunk of wood on the boulder beach on the southeast part of the island (leg. S. Nilsson). The latter has become the most frequent species on Surtsey, collected in 1967, 1970, 1971, 1973, 1974 and 1976.

One species has been found with eggs, i.e. *Islandiana princeps* Braend., collected on July 29, 1971, under a piece of driftwood near the airstrip on the northern ness. The egg cocoon was attached to the underside of the wood and was guarded by the mother.

Acari

Acari have been collected in great numbers on Surtsey. The collecting in 1964—1970 gave 1894 specimens and 17 species (Lindroth et al., 1973). In 1971—1976 918 specimens were collected altogether (the collections of Dr. H. Bødvarsson are not included). The material is unfortunately still mostly unidentified due to lack of specialists. However the 398 specimens extracted from the floating tussock have been studied by a specialist, but the results are not yet available.

Oligochaeta

The first representatives of this group of invertebrates were discovered on Surtsey in 1972 when two and nine specimens of Enchytraeidae were found under driftwood on the northern ness on July 7 and 9 respectively. One specimen of the same group was extracted from the floating tussock in 1974, and one was found under driftwood outside the hut on August 10, 1976. No further attempts to identify the species have been made.

FUTURE PLANS

It may be assumed, that good information has been achieved on transport of insects to Surtsey and what species are regularly carried out there and thus are most likely to inhabit the island in the future. As the vegetation on the island is now rapidly progressing, an increase in permanently settled land-invertebrates should be expected in the near future. Thus the most important task for

the future is to follow the development of the biotopes on the island and see how they will be invaded by animals. Active collecting of flying insects will be of minor importance. The island should be visited every second year.

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Table 1. Terrestrial invertebrates found in a tussock, that was washed ashore on Surtsey, 1. VIII.1974.

	No. of specimens
Acari	398
Collembola	
<i>Onychiurus armatus</i> Tullb.	214
<i>Archisotoma besselsi</i> Pack.	18
<i>Friesea mirabilis</i> Tullb.	7
<i>Hypogastrura</i> sp.	3
<i>Folsomia quadrioculata</i> Tullb.	1
Hemiptera	
<i>Arctothezia cataphracta</i> Olafs.	9 (+ 10 dead)
Protura	
<i>Protentomon thienemanni</i> Str.	1
Diptera	
Chironomidae larva	1
Oligochaeta	
Enchytraeidae	1
Total	653 (+ 10)

Table 2. Results of pollen analysis performed on the tussock mentioned in table 1.

	No. of pollen	%
Gramineae	776	92.60
Compositae		
Tubuliflorae	31	3.70
Caryophyllaceae	28	3.34
Chenopodiaceae	1	0.12
<i>Rumex acetosa</i> type	1	0.12
<i>Alnus</i>	1	0.12
Total	838	100.00

Table 3. The most frequent Diptera species on Surtsey

	1964—1970		1971—1976		1964—1976	
	No. of specimens	% of Diptera	No. of specimens	% of Diptera	No. of specimens	% of Diptera
<i>Cricotopus variabilis</i> Staeg.	756	24.2	693	30.8	1449	26.9
<i>Heleomyza borealis</i> Boh.	659	21.1	163	7.3	822	15.3
<i>Scatophaga stercoraria</i> L.	317	10.1	430	19.1	747	13.9
<i>Coelopa frigida</i> F.	425	13.6	176	7.8	601	11.2
<i>Diamesa zernyi</i> Edw./ <i>bohemani</i> Goet.	93	3.0	143	6.4	236	4.4
<i>Heleomyza serrata</i> L.	173	5.5	12	0.5	185	3.4
<i>Copromyza similis</i> Coll.	43	1.4	65	2.9	108	2.0
<i>Scatophaga furcata</i> Say	83	2.7	14	0.6	97	1.8
<i>Fucellia fucorum</i> Fall.	70	2.2	24	1.1	94	1.7
Total	2619	83.8	1720	76.5	4339	80.6

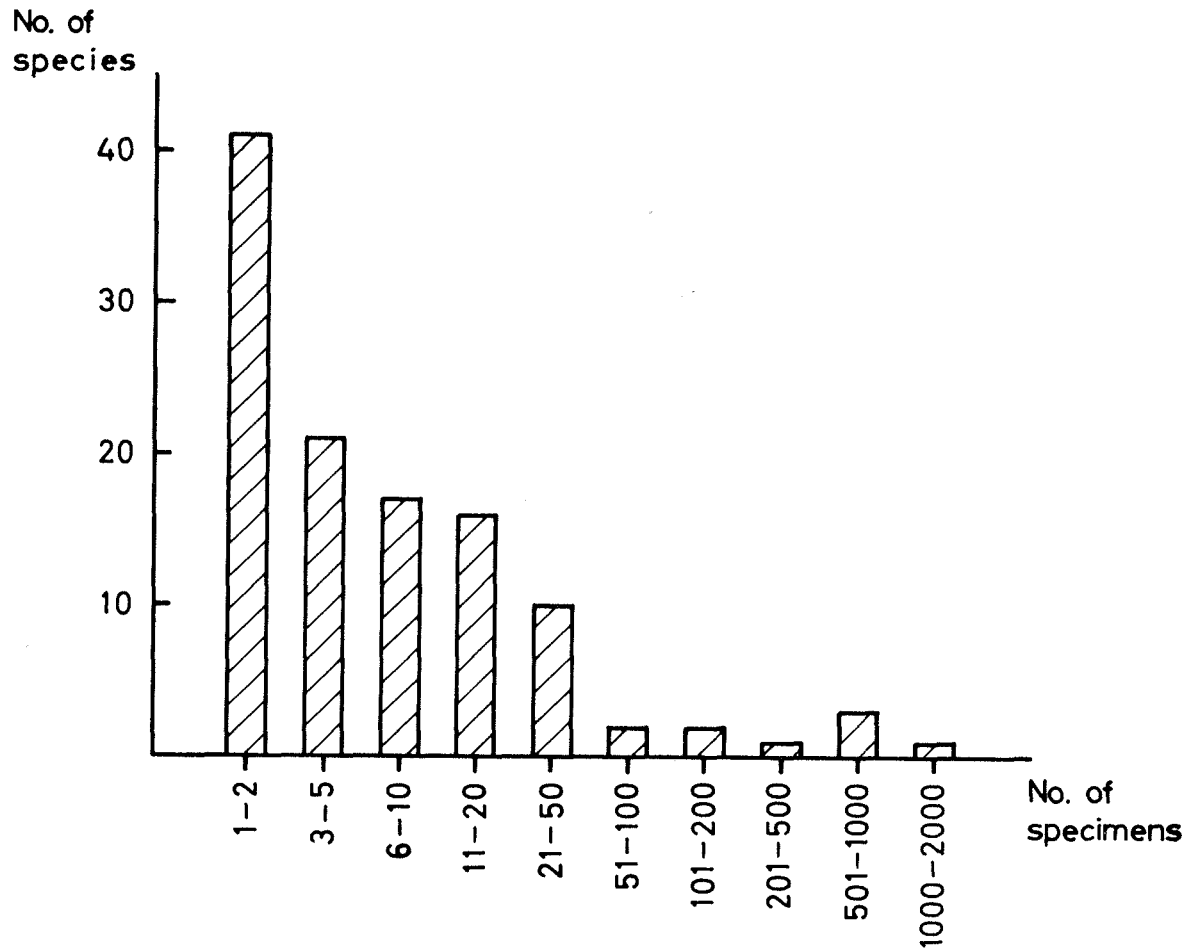


Figure 1. Relation between no. of species and no. of specimens of 114 species of Diptera caught on Surtsey 1964—1976.