

## Flea species (Insecta, Siphonaptera) from the Faroe Islands

JENS-KJELD JENSEN & EYÐFINN MAGNUSSEN

Jensen, J.-K. & Magnussen, E. 2017. Flea species (Insecta, Siphonaptera) from the Faroe Islands. *Norwegian Journal of Entomology* 64, 22–27.

The current investigation specifies the occurrence of four flea species living in the Faroe Islands: *Ceratophyllus garei* (Rothschild, 1902), *Dasysyllus gallinulae gallinulae* (Dale, 1878), *Leptopsylla segnis* (Schönherr, 1811) and *Ctenophthalmus nobilis* (Rothschild, 1902). One of these species, *C. garei*, has never been reported in the Faroe Islands before. In addition, the flea species that have been reported in the Faroe Islands during the years 1929 to 2016 are listed. In total eleven species have been found. However, one of them, *Pulex irritans* (Linnaeus, 1758), has probably disappeared again.

Key words: Fleas, Siphonaptera, new species, Faroe Islands, occurrence.

Jens-Kjeld Jensen, Í Geilini 37, FO-270 Nólsoy, Faroe Islands. E-mail: jkjensen@post.olivant.fo

Eyðfinn Magnussen, University of the Faroe Islands, Faculty of Science and Technology. Nóatún 3, FO-100 Tórshavn, Faroe Islands. E-mail: eydfinnm@setur.fo

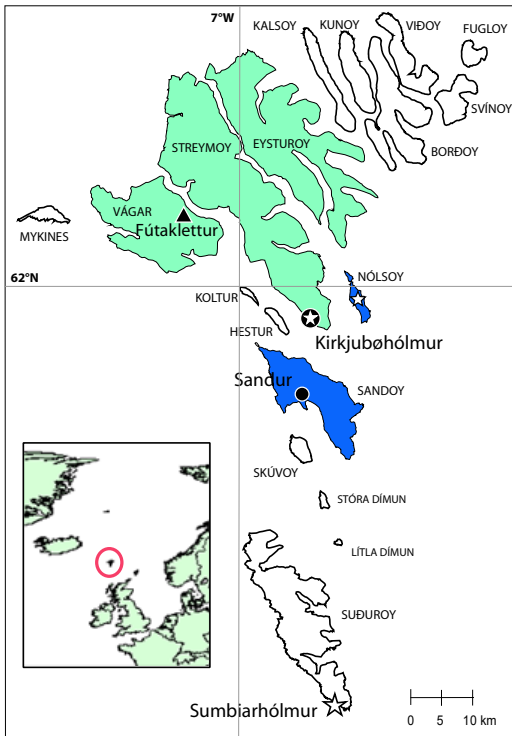
### Introduction

Fleas (Insecta, Siphonaptera) are small, mostly 2–3 mm long, wingless, laterally flattened and highly specialized insects with holometabolous metamorphosis (Brinck-Lindroth & Smit 2007). According to Bitam *et al.* (2010), 2,574 species are described, belonging to 16 families and 238 genera. As adults, both males and females are obligate hematophagous ectoparasites of mammals and birds, therefore, the diversity of fleas in an area is highly dependent on the number of mammals and birds living in the area, but is normally reduced in isolated areas.

The Faroe Islands are an archipelago located in the middle between Scotland, Iceland and Norway, consisting of 18 islands with rocks and islets (Figure 1). Originally, there were no native terrestrial mammals in the Faroe Islands. However, over time, three mammalian species were introduced by humans. The house mouse (*Mus musculus* Linnaeus, 1758) is supposed to have come to the islands during the Viking age,

about a thousand years ago (late 8th century to the mid-11th century) (Jones *et al.* 2011). The brown rat (*Rattus norvegicus* Berkenhout, 1769) arrived in 1768 (Jensen & Magnussen, 2015) and the mountain hare (*Lepus timidus*, Linnaeus, 1758) was introduced for hunting in 1855 from southern Norway (Bloch & Fuglø 1999). The Faroe Islands are characterised by its rich birdlife, and 312 bird species are known from the Faroe Islands by 2015 (Jensen & Sørensen 2015), of which at least 50 breed regularly (Sørensen & Block 1990).

The first investigation of fleas in the Faroe Islands was conducted by Henriksen (1929), who reported two flea species; human-flea (*Pulex irritans* Linnaeus, 1758) and bird-flea (*Ceratophyllus gallinae* Schrank, 1803). Conceivably, this was probably just a cursory investigation because in the description the author wrote, “*The flea-fauna of the Faroes must doubtless include more species than are known till now*”. More than seventy years later Trolle & Jensen (2001) ascertained this statement. They reported nine species of fleas, of which four were



**FIGURE 1.** Locations where eider (\*), brown rats (▲) and house mice (●) were collected for the investigation of fleas. The green colour indicates the islands where *Ctenophthalmus nobilis* (Rothschild, 1898) has been reported. The blue colour indicates the islands where *Leptopsylla segnis* (Schönherr, 1811) has been reported. The star with circle (★) shows the location where *Ceratophyllus garei* (Rothschild, 1902) was found, which is the first record of this species on the Faroe Islands. Names written by capital letters are names for the corresponding islands. The map in the lower left corner shows the location of the Faroe Islands in the North Atlantic (in red circle).

characterised as ‘mammal species’ and the others as ‘bird species’. Seven of these had never been reported for the Faroe Islands before.

The best-known flea species on Faroese animals is probably the ‘hen flea’ (*Ceratophyllus gallinae gallinae*), also known as the ‘European chicken flea’, and in the Faroe Islands as ‘starling flea’. This species is very common on Faroese birds (Trolle & Jensen 2001) and has been well known in the Faroe Islands ever since the first fleas were collected on the islands by Henriksen

back in 1929 (Henriksen 1929). Since 1996, Jens-Kjeld Jensen, the first author of this paper, has continually collected and identified fleas in the Faroe Islands when he ringed birds or searched for fleas in nests of birds.

The aim of the present paper is to give an overview of all flea species recorded in the Faroe Islands, from 1929 to the present.

## Material and methods

Ectoparasitic fleas were collected from three stationary animal species living in the Faroe Islands, including one bird species (eiders (*Somateria mollissima* Linnaeus, 1758)) and two mammal species (house mouse (*Mus musculus*) and the brown rat (*Rattus norvegicus*)).

The eider fleas were collected from eider nests just after the young had left. The entire nests were placed in a polystyrene bag and later on a Tullgren funnel (also known as a Berlese funnel) to extract living larvae and adult fleas inhabiting in the nests. In some cases, the nests were stored in the polystyrene bags where potential larvae had possibilities to develop to adult fleas. In these cases, each of the bags was regularly checked for adult fleas. Nests from eiders were collected from three locations: Nólsoy in August 2013 and 2014 (n=6 & 6, respectively), Sumbiarhólmur, 18 August 2015 (n=9) and on Kirkjubøholmur, 16 August 2014 (n=11) (Figures 1 and 2).

Eight recently dead house mice were collected in the village of Sandur on 21 July 2005 and two recently dead brown rats were collected at Fútaklettur on 20 January 2016 (Figure 1). The collected mice and rats were individually frozen in plastic bags immediately after they were collected. Before examination, they were thawed and each creature was then gently washed with lukewarm soapy water in a plastic bucket and carefully cleaned in running water. The water was filtered with a sieve, having mesh size of 300 µm. Subsequently, the collected fleas were sorted out under a dissecting microscope. To avoid contamination between specimens, each rat was treated separately and the bucket was cleaned carefully before investigation of the next rat.



**FIGURE 2.** The flea species *Ceratophyllus garei* (Rothschild, 1902) was found for the first time in the Faroe Islands in an eiders nest on the islet ‘Kirkjubøholmur’, which is located about 250 m outside the village ‘Kirkjubøur’ on Streymoy. In 2011, 120 pairs of eider bred on this islet.

All the collected fleas were preserved in 70% alcohol. For our convenience, the fleas were separately slide-mounted, following the technique described by Palma (1978). The identification follows Brinck-Lindroth & Smit (2007) and Smit (1954, 1957). For the details, see Jensen & Olsen (2003). Voucher specimens of the flea species, found in the present investigation, are deposit in the collections of the Natural History Museum (Tórshavn, Faroe Islands). Specimens are also available from the first author of this paper, Jens-Kjeld Jensen, Nólsoy, Faroe Islands. Voucher specimens of all flea species, recorded in the Faroe Island during the last 20 years are also available at the same places.

## Results

**Eider:** Two flea species were found in the 11 eider nest collected in Kirkjubøholmur (Figure 2): *Ceratophyllus garei* Rothschild, 1902 and

*Dasypsyllus gallinulae gallinulae* Dale, 1878.

The finding of *C. garei* included 9♂♂ and 7♀♀ and is the first record of this species in the Faroe Islands. Only one specimen, a female, was found of *D. g. gallinulae*. This is the first observation of this flea species, living on eider bird in the Faroe Islands; however, it has been reported earlier on other bird species in the Faroe Islands.

No fleas were found in the 15 eider nests investigated in the two other locations, at Nólsoy and Sumbiarhólmur.

**House Mice:** Among the eight mice specimens investigated, one was infected by a flea species, *Leptopsylla segnis* Schönherr, 1811, 2♂♂ and 2♀♀. This is the first record of this flea species on the island of Sandoy.

**Brown rat:** One of the two rats investigated was infected with a single female specimen of the flea species *Ctenophthalmus nobilis* Rothschild, 1898 (Figure 3). This is the first record of this flea species on the island of Vágar.



**FIGURE 3.** The flea species *Ctenophthalmus nobilis* (Rothschild, 1898) is now found on three Faroese islands, including Eysturoy, Streymoy and Vágar.

## Discussion

The current investigation observes four species of fleas, *Ceratophyllus garei*, *Dasypsyllus gallinulae gallinulae*, *Leptopsylla segnis* and *Ctenophthalmus nobilis*, living in the Faroe Islands. The first two species were found in a single eider nest, while the others were found on a house mouse and on a brown rat, respectively.

*C. garei*, also known as ‘duck flea’ (Forbes 2015), is a Holarctic species and is common in East and Central Asia, Northern continental Europe (including British Isles), Iceland, Greenland and in the North America, north to Alaska. It lives mainly as a parasite on a variety of bird species that nest on or near the ground often in damp sites, such as species of Anseriformes, Charadriiformes and Galliformes, but are also found in nests of *Sturnus*, *Turdus*, *Passer* and others species (Brinck-Lindroth & Smit 2007). The present record of *C. garei* is the first in the Faroe Islands, which is surprising because it occurs

in the neighbouring countries. For example, it is common in eider nests in Iceland (Forbes 2015) and is also registered in Shetland (Johnston 1999).

It is quite common that not all species are reported in a geographic area due to the lack of efforts on searching for the specific species. However, this seems not to be the reason why *C. garei* has not been reported earlier in the Faroe Islands. Since 1996, the first author of this paper has ringed thousands of birds. While doing this, both birds and nests were regularly checked for fleas, but *C. garei* was never found. Besides being rare, it can provisionally be stated that there is only one distinct population of *C. garei* in the Faroe Islands, living in eider nests on the islet ‘Kirkjubøholmur’ (Figure 2). This statement is based on the fact that the eider nests, collected from the two other locations, ‘Nólsoy’ and ‘Sumbiarholmur’, in the present investigation had no fleas, which is consistent with a similar investigation from the two locations in 1997 (Trolle & Jensen 2001). Moreover, the occurrence

of *C. garei* seems also to be low, because only 16 specimens were found and all in the same eider nest. Based on the facts that *C. garei* was only recorded at one location during the years 1997, 2013, 2014 and 2015, and occurred in one out of 42 eider nests investigated, we conclude that *Ceratophyllus garei* is rare in the Faroe Islands.

The other flea species found in the eider nest at 'Kirkjubøholmur' was *Dasypsyllus gallinulae gallinulae*. This species is very common in most parts of Europe where it is known from many different host species, especially of the order Passeriformes, but strays on small mammals have also been reported (Brinck-Lindroth & Smit 2007). *D. gallinulae gallinulae* is the second most common flea species of Faroese birds, only exceeded by the 'starling flea' (*Ceratophyllus gallinae gallinae*) (Trolle & Jensen 2001). Moreover, this species has also been reported on a Faroese mammal where a single specimen was found on a house mouse (*Mus musculus*) (Trolle & Jensen 2001).

Only one flea species, *Leptopsylla segnis*, was found on the house mice investigated. This species has a cosmopolitan distribution, mainly living on house mice (*Mus musculus*), although this flea occurs rather often on *Apodemus* and *Rattus* and other small mammals (Brinck-Lindroth & Smit 2007). In the Faroe Islands, this species has earlier only been recorded on the island of 'Nólsoy', where it was found on house mice (Trolle & Jensen 2001). Thus, our finding of this species on the island 'Sandoy' is the second Faroese island where this flea species has been recorded.

On the two brown rats investigated, only one flea species, *Ctenophthalmus nobilis*, was found. This species has previously been reported on brown rats on the Faroe Islands, where it was found together with another flea species *Nosopsyllus fasciatus* (Bosc d'Antic, 1800) (Jensen & Magnussen 2015). They found 30 specimens of *C. nobilis*, 9♂♂ and 21♀♀, occurring on 18 % of the rats investigated. Between 1 and 14 individual were found on each rat. However, they did not find *C. nobilis* on the four rats investigated from the island 'Vágur'. Thus, the present investigation is the first finding of this species on the island 'Vágur' and the second reporting of *C. nobilis*

in the Faroe Islands. However, *C. nobilis* has a peculiar geographic distribution. It is concentrated in Western Europe, being a common parasite on small mammals in Great Britain, France, Spain and Switzerland (Lopez & Soledad 2013), but are absent in Scandinavia (Brinck-Lindroth & Smit 2007) and do not live on pets and hedgehogs in Germany (Visser *et al.* 2001). Thus, our finding of *C. nobilis* in the Faroe Islands is both the most westerly and northerly finding of this species in Europe (Jensen & Magnussen 2015).

According to the work by Smit (1957), *C. nobilis* can be divided into two subspecies: '*C.n.vulgaris*' and '*C. n. nobilis*', of which only the males can be separated to subspecies based on morphological differences on the lower lobe of the fixed process of the clasper (Smit 1957). Thus, these two subspecies are a bit speculative and of doubtful value. In any case, we found both 'morphs' in the Faroe Islands.

In an overview of the flea fauna on the Faroe Islands, Trolle & Jensen (2001) described nine species, of which seven were new for the Faroe Islands at that time. Jensen & Magnussen (2015) added one more species and with the finding of *Ceratophyllus garei* in the present investigation, the total number of flea species recorded in the Faroe Islands has reached to 11 (Table 1). It is well known that the species richness in an ecosystem heavily depends on how isolated the ecosystem is (e.g. Smith & Smith 2012). Although remote from other countries, about 300 km northwest of Scotland, 600 km from Norway and 430 km from Iceland, it is in fact unknown how isolated the Faroe Islands really are from the surrounding areas. Birds migrate regularly back and forth to the islands, and it must be expected that new individuals of rats and mice are regularly introduced by cargo and other human activities. Thus, we expect that the number of flea species living in the Faroe Islands also will increase in the future.

**Acknowledgments.** We are grateful to Solfin Kjørbo for his assistance collecting eider nests from the islet Sumbiarhólmur and to Martin Simonsen for collecting rats at Fútaklettur on the island of Vágur.

**TABLE 1.** Flea species (Siphonaptera), reported in the Faroe Islands during the years 1928 to 2016. †, this species probably has disappeared from the Faroe Islands.

| Species                                                     | First reporting in the Faroe Islands |
|-------------------------------------------------------------|--------------------------------------|
| <i>Ctenophthalmus nobilis</i> (Rothschild, 1898)            | Jensen & Magnussen (2015)            |
| <i>Ceratophyllus gallinae gallinae</i> (Schrank, 1803)      | Henriksen (1929)                     |
| <i>Ceratophyllus vagabundus insularis</i> (Rothschild 1906) | Trolle & Jensen (2001)               |
| <i>Ceratophyllus columbae</i> (Gervais, 1844)               | Trolle & Jensen (2001)               |
| <i>Ceratophyllus garei</i> (Rothschild, 1902)               | Present investigation                |
| <i>Nosopsyllus fasciatus</i> (Bosc, 1800)                   | Trolle & Jensen (2001)               |
| <i>Dasypsyllus gallinulae gallinulae</i> (Dale, 1878)       | Trolle & Jensen (2001)               |
| <i>Leptopsylla segnis</i> (Schönherr, 1811)                 | Trolle & Jensen (2001)               |
| † <i>Pulex irritans</i> (Linnaeus, 1758)                    | Henriksen (1929)                     |
| <i>Ctenocephalides felis felis</i> (Bouché, 1835)           | Trolle & Jensen (2001)               |
| <i>Ornithopsylla laetitiae</i> (Rothschild, 1908)           | Trolle & Jensen (2001)               |

## References

- Bitam, I., Dittmar, K., Parola, P., Whiting, M.F. & Raoult, D. 2010. Fleas and flea-borne diseases. *International Journal of Infectious Diseases* 14, 667–676.
- Bloch, D. & Fuglø, E. 1999. *Villini Súgdjór í Útnorðri*. Føroya Skúlabókagrunnur. Tórshavn. 216 pp.
- Brinck-Lindroth, G. and F.G.A.M. Smit 2007. The fleas (Siphonaptera) of Fennoscandia and Denmark. *Fauna Entomologica Scandinavica* 41. Brill. Leiden-Boston. 185 pp.
- Forbes, V. 2015. Duck fleas as evidence for eiderdown production on archaeological sites. *Journal of Archaeological Science* 61, 105–111.
- Henriksen, K.L. 1929. Siphonaptera. In: Jensen, A.S., Lundbeck, W., Mortensen, T. & Spärck, R. (Eds.). *The Zoology of the Faroes*, 2(1) 41, 2–3.
- Jensen, J.K. & Olsen, B. 2003. A comparison of two methods for collecting feather lice from dead birds. *Atlantic Seabirds* 5(3), 119–126.
- Jensen, J.K. & Magnussen, E. 2015. Occurrence of fleas (Siphonaptera) and lice (Phthiraptera) on Brown rats (*Rattus norvegicus*) on the Faroe Islands. *Norwegian Journal of Entomology* 62, 154–159.
- Jensen, J.K. & Sørensen, S. 2015. *Birds of the Faroe Islands – facts and numbers*. í Støplum. Tórshavn. 363 pp.
- Johnston, J.L., 1999. A Naturalist's Shetland. *Poyser Natural History Series*. 520 pp.
- Jones, E.P., Jensen, J.K., Magnussen, E., Gregersen, N., Hansen, H.S. & Searle, J.B. 2011. A molecular characterization of the charismatic Faroe house mouse. *Biological Journal of the Linnean Society* 102 (3), 471–482.
- Lopez, G. & Soledad, M. 2013. Fauna Europaea: Ctenophthalmidae. Fauna Europaea version 2.6. <http://www.fauna-eu.org>. version 2.6 (last update 29 August 2013).
- Palma, R.L., 1978. Slide-mounting of Lice: a Detailed Description of the Canada Balsam technique. *The New Zealand Entomologist* 6 (4), 432–436.
- Smit, F.G.A.M. 1954. Lopper. *Danmarks Fauna* 60, 1–125
- Smit, F.G.A.M. 1957. *Handbooks for the identification of British fleas*. Royal Entomological Society of London, London. 94 pp
- Smith, T.M. & Smith, R.L. 2012. *Elements of Ecology*. Benjamin Cummings. Boston. 704 pp.
- Sørensen, S. & Bloch, D. 1990. *Fugle i Nordatlanten - en felthåndbog*. Gad. København. 277 pp.
- Trolle, L. & Jensen, J.K. 2001. The Fleas (Siphonaptera) of the Faroe Islands. *Fróðskaparrit* 48, 135–144.
- Visser, M., Rehbein, S. & Wiedemann, C. 2001. Species of flea (Siphonaptera) infesting pets and hedgehogs in Germany. *Journal of Veterinary Medicine Series B-Infectious Diseases and Veterinary Public Health* 48, 197–202.

Received: 11 May 2017

Accepted: 23 May 2017