NOTES ON THE FLEA FAUNA (INSECTA, SIPHONAPTERA) OF THE TERRESTRIAL AZOREAN MAMMALS (1)

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INTRODUCTION

Though the fleas and their mammalian hosts of the Western European countries are now rather well known, the remote Atlantic islands did not give way to many publications on that subject despite the plague epidemics raging there at least till 1949 (Pollitzer, 1954). In fact, until quite recently, the informations about the mammal fauna of the Azorean archipelago remain incomplete and not very precise. Though, the anthropogenic origin of that fauna is established. Only two bat species occur naturally in the Azores. Droqui (1861) and Goodman (1870) mention the presence of the rabbit (Oryctolagus cuniculus),

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d (1) This publication is supported by "Junta Nacional de Investigação Científica e Tecnológicas".
of both the block and the brown rats (Rattus rattus and R. norvegicus), of the house mouse (Mus domesticus) and of two carnivores, the weasel (Mustela nivalis) and the ferret (Mustela putorius furo) whereas ULESTRAND (1961) reports the presence of the hedgehog (Erinaceus europaeus) on São Miguel. However, no very precise locations are noted and the real distribution of all these species throughout the archipelago is never mentioned.

Therefore, it is not surprising that the fleas of this region were poorly studied: only six species are reported from terrestrial mammals of the archipelago. Three others must be added to have a complete view of its flea fauna. ROTHSCILD (1911) quotes a specimen of Ichnopsyllus intermedius (ROTHSCILD, 1898) preserved in the Berlin museum. JORGE (1928) reports the presence of three rodent fleas: Xenopsylla cheopis (ROTHSCILD, 1903), Leptopsylla segnis (SCHÖNHEER, 1816) and Nosopsyllus fasciatus (Bocc D’ANTIC, 1800). The presence of Stenopsylla t. tripectinata (TIRADOCHI, 1902) is first mentioned by JORDAN (1958) and then by ABELE (1973) in São Miguel where some specimens were collected in 1903 by OGLIVIE-GRAIN. In his work on the British fauna, SMIT (1957) simply indicates that the Azores are included in the geographic range of Ichnopsyllus intermedius (ROTHSCILD, 1898), Dasyopsylla g. gallinae (DALE, 1878) and Ceratophyllus (Monopsyllus) s. scutellaris (SCHRANK, 1803). SMIT (1966) also quotes the presence of Spilopsyllus curvicali (DALE, 1878). Unfortunately, no information is given about a precise locality, a host, a collection date or about where the specimens are preserved. These quotations, except the latter, are resumed by ABELE (1973) without any comment. TRAUB et al. (1983) confirm the presence of Dasyopsylla g. gallinae and of Nosopsyllus fasciatus. They also quote the presence of Monopsyllus s. scutellaris as “introduced into the Azores on Bates” (p. 76). Finally, Ceratophyllus gallinae (SCHRANK, 1803) is mentioned from Ponta Delgada (São Miguel) in May 1979 (RIBEIRO & CAPELA, 1985).

During four successive years (1993-1996), field samplings of wild mammals were organised in the late spring or early summer on different islands (fig. 1) and in various habitat types (project JNICT/STRIDE: “The mammals of the Azores as zoonotic reservoirs”). The main objectives of these campaigns were

- the study of the geographical and ecological distributions of the terrestrial wild mammals throughout the archipelago;
- the study of the genetical, physiological and morphological characters of the Azorean mammals;
- the identification of the hosts of some micro-organisms involved in public health problems (Leptospira, Borrelia, Rickettsia and Hantaa virus);
- the comparative study of the parasites (helminths, ticks, fleas and lice) with reference to continental faunas (MATHIAS et al., 1993).

A few domestic animals (cats and dogs) were also searched for fleas.
Material examined

Results obtained allowed to confirm the presence of six flea species of which three (*Ctenocephalides felis*, *C. canis*, and *Nosopsyllus lindoianensis*) were not previously referred. The specimens studied are deposited at the Museu Bocage in Lisbon or preserved in the first author’s collection.

*Ctenocephalides felis felis* (BOUCHER, 1835).

This very common flea has been found on its usual host, the domestic cat (*Felis catus*). Two animals have been examined in Flores bearing respectively 10 males and 31 females (Fazenda das Lajes: 27/05/94) and one male plus five females (Monte Santa Cruz: 07/95). Another cat was found dead in Terceira bearing only one female flea (Angre do Horismo, June ‘93) and a fourth animal examined in July 1995 in Graciosa (Santa Cruz) gave 9 males and 4 females.

One dog (*Canis familiaris*) examined in Graciosa (Santa Cruz, July ‘95) did bear that flea too (1 male and 2 females).

*Ctenocephalides canis* (CURTIS, 1826).

One domestic dog bearing three females of *C. canis* has been examined in Flores (Fazenda das Lajes) the 27th May 1994.

*Spiropterus cuniculi* (DUSZ, 1878).

Except in Terceira, where the fleas were picked up on road killed rabbits, the collects were made on snared (Flores) or shot animals (Faial, Flores, Pico, São Jorge, São Miguel).

This oxiocenous flea has been collected exclusively on its usual host, the rabbit. Its presence seems to be restricted to the central and oriental groups of islands since the rabbit fails in Corvo and doesn’t bear the parasite in Flores (Tab. 1). In Faial (22/06 till 01/07/93), *Spiropterus* has been found in different localities (Cape Verde, Calheira, Capelo, Castelo Branco, Praia do Norte, Pedro Miguel and Ribeira Funda) spread all over the island. On São Jorge (12/07/95) and Pico (13/07/95), the rabbits were sampled exclusively in the central part of the islands: between Norte Grande and Cerrado dos Penedos (S. Jorge) and between S. Roque, Lagoa do Capitão and Lagoa do Caiao (Pico). In Terceira, the flea has been found in four different localities: Caparica (25/06/93 and 10/07/95), the vicinity of Furnas do Enxofre (22/06/93), the crossing of Bagascia (24/06/93 and 31/03/94) and Algar do Carvalho (03/06/94). In São Miguel, the rabbits were shot near Ponta Delgada (14/06/93).

The prevalence of that parasite seems to be the highest in S. Jorge and of the same order of magnitude in Faial and Pico. In Terceira, the lower level could be due to the fact that several rabbits were not freshly killed when examined.

**Table 1. Number of rabbits examined in different islands of Azores and prevalence of their usual flea *Spiropterus cuniculi***

<table>
<thead>
<tr>
<th>Rabbits examined</th>
<th>Rabbits with fleas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flores</td>
<td>23</td>
</tr>
<tr>
<td>Faial</td>
<td>62</td>
</tr>
<tr>
<td>Pico</td>
<td>15</td>
</tr>
<tr>
<td>São Jorge</td>
<td>28</td>
</tr>
<tr>
<td>Terceira</td>
<td>149</td>
</tr>
<tr>
<td>São Miguel</td>
<td>149</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Prev. %</th>
<th>Males</th>
<th>Females</th>
<th>Sex ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flores</td>
<td>0.0</td>
<td>2.0</td>
<td>0.33</td>
</tr>
<tr>
<td>Faial</td>
<td>0.0</td>
<td>2.0</td>
<td>0.33</td>
</tr>
<tr>
<td>Pico</td>
<td>1.0</td>
<td>1.0</td>
<td>1.00</td>
</tr>
<tr>
<td>São Jorge</td>
<td>1.5</td>
<td>1.5</td>
<td>1.00</td>
</tr>
<tr>
<td>Terceira</td>
<td>2.5</td>
<td>2.5</td>
<td>1.00</td>
</tr>
<tr>
<td>São Miguel</td>
<td>6.0</td>
<td>6.0</td>
<td>1.00</td>
</tr>
</tbody>
</table>
### Table II. Number of wild mammals examined in different islands of Azores and fleas collected

<table>
<thead>
<tr>
<th>Island</th>
<th>N. I. londinensis</th>
<th>N. fasciolus</th>
<th>S. tripectinata</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males</td>
<td>Females</td>
<td>Males</td>
</tr>
<tr>
<td>Flores</td>
<td>6</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Graciosa</td>
<td>6</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Pro</td>
<td>8</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>São Jorge</td>
<td>11</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Terceira</td>
<td>23</td>
<td>18</td>
<td>14</td>
</tr>
<tr>
<td>São Miguel</td>
<td>26</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

**Nasonopyllus fasciolus** (Borc d'Antic, 1800).

Twenty-three specimens were collected on three mammal species (Tab. II) and on four islands.

Flores: Monte (Santa Cruz): one male on a black rat (09/07/95); Caldeira (Mosteiro): one male and one female on a black rat (06/07/95) and one female (29/06/96) on another black rat; Lajes (Boca da Baleia) one male and one female on two different black rats (27/06/96) and Fajã Grande (Fonte Frade): one female on a black rat (25/06/96).

Graciosa: Santa Cruz and Canadão do Pinheiro: two females on two different mice (06 and 08/07/95, respectively).

Terceira: São Bartolomeu (20/06/93): two males on a brown rat; Caparica (22/06/93): one female on a black rat; Crossing of Bagacana (10/07/95) one female on a black rat; Lagoa do Negro (centre of the island) on three different black rats: one male plus a female (23/06/93) one female and one male plus three females (10/07/95).

São Miguel: Água do Alto: one male and one female, on two different house mice (25 and 26/05/94); Santana (06/07/95): one female on a mouse.

The observed sex ratio (0.58) is quite the same as what is mentioned by Beaujour (1976) (0.56).

**Nasonopyllus londinensis londinensis** (Rothschild, 1903)

Two male specimens of that species have been found on house mice, the first in São Miguel island (Santana, 06/07/95) and the second in Flores (Monte, Santa Cruz: 25/06/96).

**Stenopopenia tripectinata tripectinata** (Tkaczuch, 1922).

The collected material consists of only one female specimen found on a black rat (São Miguel: Aliprado, 27/05/94) and 35 individuals collected on house mice (Tab. II), either in São Miguel or in Terceira. In São Miguel, one male and one female have been found at Água do Alto (26 and 27/05/94) on two different mice and one more female was found in Santana (06/07/95). In Terceira, the only mouse material was collected at Caparica: 3 males (22/06/93); 2 females on two different mice (02/06/94); 12 males and 10 females (10/07/95) on 3 mice bearing respectively 3 m + 3 f, 1 f and 9 m + 6 f. Another male has been found on an individual trapped near the garbage dump of Angra do Heroísmo (01/06/94) and two animals caught in the neighbourhood of the Gruta do Natal (04/06/94) and along the road bordering the northern edge of the Caldeira de Guimarães Moniz (02/06/94) did bear respectively 3 females and 1 male plus 2 females. All the mice examined in the other islands were negative.
Caparica is a small meadow bordered by dry stone walls with brambles and surrounded by other meadows or by Pittosporum undulatum plantations. The soil is quite moist with a dense cover of Menisca sp. Near Gruta do Natal, the mice were caught at the edge of a wet meadow, with trees, brambles and shrubs thickets. These locations in moist habitats do contrast strongly with the usual habitat of this flea species in the Mediterranean biome (dry open stations, low shrublands) (Beaucournu, 1976).

The observed sex ratio (0.71) doesn’t differ significantly from the value (0.78) mentioned by Beaucournu (1976) on Corsican samples.

OTHER SPECIES

Other wild mammal species live in the Azorean archipelago. We had the opportunity to catch some of them: one weasel in São Mateus (Terceira), one ferret near the crossing of Bagacina (centre of Terceira), others in Flores (Cova da Pedra and Fonte Frade) and sixteen hedgehogs either in São Miguel (12) or in Terceira (4). No flea was collected on these animals. As far as the bats are concerned, we didn’t make any attempt to trap them.

DISCUSSION AND CONCLUSIONS

From a biogeographical point of view, all the mammal-fleas or lice reported so far from the Azores, due to their wide distributional range, don’t give many informations about the possible origin of their host species. C. cons, C. f. felis, N. fasciatus, N. londiniensis are cosmopolitan whereas S. cuniculi and Polypilos spinulosus (Bourreleyer, 1839) are strictly bound to their respective hosts (rabbit and black rat) and have been introduced with them into many countries or remote islands. From that point of view, the probable absence of S. cuniculi from Flores is worth mention. S. t. tripunctata alone indicates that the house mouse was introduced into the archipelago, at least in Terceira and São Miguel, from the Mediterranean basin. Its range is indeed restricted to the countries bordering the Mediterranean sea and to Madeira where it has also been introduced by man with the mouse (Beaucournu & Launay, 1990).

The presence of Ceratophyllus scitillum in the archipelago has to be confirmed because the mention made by Trazu et al., (1983) is not clear enough. Indeed, the common buzzards are native to the archipelago and were therefore not introduced. Nevertheless it is possible that the first buzzards reaching the Azores did bear the flea and that the parasite did adapt to that particular host in insular conditions and is now able to survive on it in the absence of its primary (red squirrel) or secondary (domestic and marten) hosts (Cerna Beaucournu & Launay, 1990).

It is surprising that we didn’t find Arachophilus erinacei since that flea is sometimes plentiful on some continental hedgehogs.

From an epidemiological point of view, we must remember that Nosopsyllus fasciatus and the house, Polypilos spinulosus, may harbour Ricetia torva, the agent of the murine typhus and Jerzina pestis, the agent of the plague (Beaucournu, 1968, 1976).

In conclusion, the Azorean flea fauna seems very poor compared to the continental one, even considering only the host species shared by both geographical entities. The species inhabiting the Azores are very common ones, widespread all over the Palaearctic region (C. gallinae and D. g. gallinae) or even cosmopolitan (C. cons, C. f. felis, N. fasciatus and N. londiniensis). Our observations are therefore not surprising even if further research will probably bring some extra species. Reduction of the species number and selection of the most common and ecologically tolerant species are two characteristics of many insular communities. The fact that Stenoponia was found in moist habitats seems to indicate a niche enlargement which is consistent with the insular syndrome hypothesis.

ACKNOWLEDGEMENTS

This research was mostly funded by JNICT under the programme STRIDE (research project 44792). We are grateful to the «Secretaria Regional da Saúde e Segurança Social» and to the «Secretaria Regional da Agricultura e Pescas» for financial support during 1994 and 1995, respectively. The first author is also grateful to the Belgian Fonds National pour la Recherche Scientifique for supporting a part of his travel expenses.

The authors also wish to express their gratitude to Dr. G. Ferraz de Carvalho for offering the material from Fajal and São Miguel islands (rabbit fleas) and as well to Prof. I. de Matos for his essential cooperation. We are also indebted to Dr. Margarida Colomes-Pereira and to Jean-Pierre Clara for field assistance. In addition, we express our appreciation to the following institutions for their assistance during the field research: University of Azores (Departamento de Biologia, São Miguel island and Departamento de Ciências Agrárias, Terceira island), Direção de Serviços de Sanidade Animal e Higiene Pública Veterinária (Terceira island), and Serviço de Desenvolvimento Agrário of the islands of Flores, Graciosa, São Jorge and Pico.

SUMMARY

During three successive years, field samplings of wild mammals were organized on different Azorean islands and the ectoparasites were collected. Among 340 murid rodents, 31 did bear at least one flea. Nosopsyllus l. londiniensis has been
found on the mouse in São Miguel, Stenopelia t. tripectinata has been discovered in Terceira and in São Miguel, mainly on house mice and on one black rat out of 121. Nosocryptus fascians was present on the mouse an on both the black and the Norway rats. Its presence has been evidenced in four islands: São Miguel, Terceira, Graciosa and Flores. Numerous rabbits were also examined in the visited islands (São Miguel, Terceira, Pico, São Jorge, Faial and Flores) and were found heavily parasitized by their commonest flea, *Spilopsyllus cuniculi*. In Flores, however, that flea seems to be lacking. Though no systematic search has been done on domestic animals, the presence of *Ctenocephalides f. felis* is also reported from Flores, Terceira and Graciosa whereas *C. canis* has been found on a dog in Flores. The flea fauna of the Azorean archipelago is therefore characterized by a few species amongst the most cosmopolitan ones.

RESUMO

Durante três anos consecutivos foram colhidos os ectoparásitos de mamíferos capturados em várias ilhas do Arquipélago dos Açores. Dos 230 roedores murídeos analisados, 26 continham pelo menos uma pulga. Nos 121 indivíduos examinados na Terceira e em S. Miguel foi encontrada *Stenopelia t. tripectinata* em ratinhos-castor (Mus musculus) e numa ratazana-preta (Rattus rattus). *Nosocryptus fascians* foi encontrada em ratinhos-castores em S. Miguel. A presença de *Nosocryptus fascians* foi detectada em quatro ilhas: S. Miguel, Terceira, Graciosa e Flores, no rato-filípede e na ratazana-castanha (R. norvegicus). Por outro lado, os numerosos coelhos (Oryctolagus cuniculus) examinados nas várias ilhas visitadas (S. Miguel, Terceira, Graciosa, S. Jorge) estavam fortemente parasitados pela sua pulga mais comum *Spilopsyllus cuniculi*, com exceção das Flores, onde a espécie parece estar ausente. Embora não tenha sido efectuada uma pesquisa sistemática nos animais domésticos, a presença de *Ctenocephalides f. felis* foi também detectada nas Flores, Terceira e Graciosa enquanto que *C. canis* foi encontrada num cão, nas Flores. A fauna de sifónporos do Arquipélago dos Açores parece assim ser caracterizada por uma reduzida diversidade de espécies, de entre as mais cosmopolitas.

REFERENCES


