Parasite fauna of rodents (Murinae) from El Hierro (Canary Islands, Spain): a multidisciplinary approach

Carlos Feliu1,2*, Mercedes López3, María S. Gómez1, Jordi Torres1,2, Santiago Sánchez1, Jordi Miquel1,2, Néstor Abreu-Acosta4, Juan M. Segovia1, Aarón Martín-Alonso2, Isabel Montoliu1, Mercedes Villa1, Ángela Fernández-Álvarez2, Abdoulaye J.S. Bakhoum1,2, Basilio Valladares3, Jorge Orós5 and Pilar Foronda3

1Laboratory of Parasitology, Faculty of Pharmacy, University of Barcelona, Avda. Diagonal s/n, 08028 Barcelona, Spain; 2Institut de Recerca de la Biodiversitat, Universitat de Barcelona, Barcelona, Spain; 3University Institute of Tropical Diseases and Public Health of the Canary Islands, University of La Laguna, Avda. Astrofísico F. Sánchez s/n, 38203, La Laguna, Tenerife, Canary Islands, Spain; 4Infulab S.L., Mencey Romen 7, 38530, Candelaria, Tenerife, Spain; 5Department of Histology and Pathology, Veterinary Faculty ULPGC, Trasmontaña, s/n, 35416, Arucas (Las Palmas), Canary Islands, Spain;

Abstract
The parasite fauna (protozoa, helminths and insects) of the two most widespread Murinae rodents in El Hierro (Canary Islands, Spain), the black rat (Rattus rattus) and the house mouse (Mus musculus domesticus) was studied. Faunistic, ecological, eco-toxicological data, as well as information on the biology of some nematode parasites of R. rattus are provided. The present work is unprecedented in the Canary Islands, and provides the first data on the parasite biodiversity in Murinae from the archipelago. Concerning to parasitofaunas stands out: a) impoverishment of biodiversity of helminths respect of which have the same hosts in other islands; b) increasing the number of species of Siphonaptera, even compared with flea species that parasitize the same hosts from continental biotopes.

Keywords
Canary Islands, El Hierro, parasites, heavy metals, Mus musculus domesticus, Rattus rattus

Introduction
The role of the black rat (Rattus rattus) and the house mouse (Mus musculus domesticus) for public health has been approached in multiple occasions since they are cosmopolitan species that colonize diverse habitats and trend to be peridomestic (Cameron 1949, Gratz 1994, Meyer et al. 1995, Bat tersby and Webster 2001, Singleton et al. 2003, etc). In isolated ecosystems most of these studies have been target ing at the parasite helminth fauna and the potential role of rodents as reservoirs of parasitic zoonoses (Casanova et al. 1996, Miquel et al. 1996, Waugh et al. 2006, Milazzo et al. 2010).

The present work was carried out in El Hierro (Fig. 1), the most western island of the Canary Archipelago (Spain). Several studies on parasites (protozoan, helminths and arthropods) of R. rattus and M. m. domesticus, the two most widespread rodents on the island, have permitted to provide the first data about the parasite fauna of both murine species in the Canary Islands. Previously, similar multidisciplinary studies had been performed only sporadically. In addition to analyzing the parasite biodiversity, their importance relies on the necessity of information on the degree of infections in nature as well as on their sanitary and epidemiological relevance (Webster and Macdonald 1995). This work also includes data on the biology of some helminth species (Nematoda), and about the presence of heavy metals (Cd, Pb, Hg) in hosts. Heavy metals, similarly to other pollutants, are worldwide distributed into the environment and can cause toxic effects in the biota. Information about these effects in wild mammals is limited despite that it may be relevant to predict environmental risk (Hamers et al. 2006, Sanchez-Chardi et al. 2007). Therefore, biomonitoring pollution through wild animals is useful for the assessment of environmental quality. Nevertheless, few works have been carried out in areas of high ecological interest, which are also subject to other types of anthropogenic chemical stress (Eira et al. 2005). Such is the case of El Hierro designated as biosphere reserve by UNESCO in year 2000.

*Corresponding author: cfeliu@ub.edu
Materials and methods

Samples collection

El Hierro, with an area of 268 km², is located 17°53’–18°09’ W and 27°38’–27°50’ N and belongs to the Canary Archipelago (Northwest of Africa) (Fig. 1). From this island, a total of 226 rodents (53 R. rattus and 173 M. m. domesticus) were captured in 2007–2010 and euthanized. The samples were obtained during all the seasons at different altitudes, between 76–1337 m, mainly in the northern part of the island.

Parasites examination

Faeces were obtained from 37 animals (11 rats and 26 mice), homogenized in vials containing 2% (w/v) of aqueous potassium dichromate (K₂Cr₂O₇), and stored at 4°C. In the laboratory, faecal samples were examined for the presence of parasites using different techniques. A flotation method using modified Sheather’s sugar solution (sp.g.1.3) was carried out in order to look for Eimeria (Sheather 1923). Thirty faecal samples (14 rats and 16 mice) were concentrated using a modification of the Ritchie’s formaldehyde-ether method in sterile conditions (Ritchie 1948). Part of the sediment was fixed with 10% formaldehyde and analysed individually for the presence of Giardia cysts using direct observation with iodine solution (Golvan and Drouhet 1977). Thin smears were made from concentrated faecal samples of nine rats and 26 mice, and screened for Cryptosporidium oocysts by using the modified Ziehl-Nielsen stain (Henriksen and Pohlenz 1981). Protozoan cysts were studied using a Provis AX 70 (Olympus, New York, USA) microscope.

Helminth and arthropods parasites were collected and processed for morphological analysis. All material was preserved in 70% ethanol. Cestodes and acanthocephalans were stained in ferrum-acetocarmine and mounted in Canada balsam. Nematodes were cleared in Amann lactophenol. Fleas were treated with potash prior to be mounted in Canada balsam.

Intermediate hosts

In order to look for the intermediate hosts of the detected helminths, five invertebrate species, 97 Pimelia laevigata costipennis, 150 Hegeter amaroides, 28 Alloxantha ochracea (Coleoptera), 2 Cydnus aterrimus (Hemiptera) and 4 Canari labis maxima (Dermaptera) from the location called Guinea (27°46’29˝N; 17°59’55˝W) were dissected and analyzed.

Heavy metals

Twenty rats from Guinea and 20 mice from Frontera forest site (27°45’00˝N; 17°59’09˝W), were used to analyze levels of metals (Cd, Hg and Pb) in their tissues. Samples of kidneys, liver and muscle were taken using stainless-steel instruments and frozen at –20°C until being processed. Around 100 mg of each sample was mineralized in Teflon vessels with 2 ml HNO₃ (Merck, Suprapur, Darmstadt, Germany) and 1 ml H₂O₂ (Panreac, Barcelona, Spain) overnight in an oven at 90°C. All process was standardized in the Centres Científics i Tecnològics de la Universitat de Barcelona (detection limits and accuracy of results). All concentrations were determined as ng g⁻¹ wet weight.

Fig. 1. Location of El Hierro (Canary Islands, Spain) and the studied places