Tales of the Flying Earth: The effect of Host Flyways on the Phylogeny of Shorebird Lice (Phthiraptera: Ischnocera)

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Akademisk avhandling för filosofie doktorsexamen i Biologi med inriktning mot systematik och biodiversitet, som kommer att offentligt försvaras fredagen den 27:e april, 2012, klockan 10.00 i Föreläsningssalen, Zoologiska Institutionen, Medicinaregatan 18, 413 90, Göteborg. Examinator: Per Sundberg. Opponent: Vince S. Smith, The Natural History Museum, Cromwell Road, London, SW7 5BD, United Kingdom.

ISBN 978-91-628-8451-2

Dissertation abstract

Daniel Gustafsson (2012). Tales of the Flying Earth: The effect of Host Flyways on the Phylogeny of Shorebird Lice (Phthiraptera: Ischnocera).
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On the wings, bodies, and heads of most birds there are lice. These lice spend their whole lives on their host, with the exception of the few lice that get the opportunity to transfer from one host to another, typically when the hosts come into physical contact with each other. In shorebirds (Charadriiformes), such opportunities are unevenly distributed over the year. The hosts are spread out over vast areas in their Arctic breeding grounds during the Arctic summer, but form dense, multi-species flocks in the tropics and subtropics during the Arctic winter. During autumn and spring, when the hosts migrate between the Arctic to the tropics, they follow more or less well-defined routes, called flyways. In this thesis, the impact of this host migration pattern on the phylogeny of shorebird lice is evaluated. More specifically, two complementary hypotheses of pattern formation in the evolutionary history of shorebird lice, flyway homogenisation and flyway differentiation, are tested by phylogenetic reconstruction of the evolutionary history of two genera of lice (*Lunaceps* and *Carduiceps*) that parasitize the same group of sandpiper (Scolopacidae: Calidrinae) hosts. Flyway homogenisation is founded on the assumption that opportunities for lateral spread of lice between hosts of different species are prevalent in flyways, which will facilitate gene flow between louse populations on different host species, and prevent speciation of lice on host species that use the same stop-over points and wintering grounds. Over evolutionary time, this would cause a pattern of host species migrating along the same flyways having genetically similar or identical louse populations. Flyway differentiation is, conversely, the hypothesis that the division of a widely spread host species into discrete populations that each follow different flyways during migration will work as an isolating mechanism on the lice. If the generation time of the lice is significantly shorter than that of their hosts, this would result in a pattern where the same Holarctic-breeding host species is parasitized by genetically different louse populations in different parts of the world. Extrapolating from data published on other groups of lice, flyway homogenisation is expected to be more pronounced in wing lice (*Lunaceps*) than in body lice (*Carduiceps*) as these are topologically better placed on the host to take advantage of opportunities of lateral transfer to novel host species. Flyway differentiation is expected to be more pronounced in *Carduiceps* than in *Lunaceps*, as wing lice of vagrant hosts migrating along the "wrong" flyway would transfer to novel hosts more easily, and could prevent complete isolation between flyways. While no evidence is found in either genus for flyway differentiation, there is evidence for flyway homogenisation in *Lunaceps*, with three *Lunaceps* species occurring on multiple host species using the same flyways. Surprisingly, most *Carduiceps* collected across the world are genetically almost identical, and thus less isolated on their hosts than are *Lunaceps*. Both *Lunaceps* and *Carduiceps* show some partial evidence of a division between lice on New World hosts and those on Old World hosts. This division in echoed in a larger molecular study on the proposed louse family Rallicolidae, where several species group together according to host biogeography rather than host relationships, thus contradicting the so-called Fahrenholz' rule that states that parasite phylogeny should come to mirror host phylogeny. In the same phylogeny, evidence is presented that the genus *Quadraceps*, widely distributed on most groups of shorebirds, is paraphyletic with regards to most other louse genera on shorebirds, and is in need of further study. Finally, the genus *Lunaceps* is revised morphologically. Six new species and one new subspecies are described, and all old species are re-described and illustrated, several for the first time. Five previously recognised species are placed as synonyms to other species, one species is transferred to the genus *Quadraceps*, one species is resurrected from synonymy, one species is considered a *nomen dubium* and three populations are placed as *incerta sedis*.

Keywords: **Phthiraptera, Lice, Ischnocera, Chewing lice, Charadriiformes, Shorebirds, Scolopacidae, Sandpipers, Flyways, Revision, *Lunaceps*, *Quadraceps*, *Carduiceps***

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