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Ecology

Anoplurans (Insecta: Psocodea: Anoplura) associated with rodents distributed in the neotropical region of Mexico

Anopluros (Insecta: Psocodea: Anoplura) asociados con roedores en la región neotropical de México

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Abstract

From April to December of 2010, we performed a cross sectional study in order to collect and identify the species of anoplurans associated with cricetid and heteromyd rodents from montane forests in 5 localities in Guerrero and Oaxaca, Mexico. We analyzed 147 rodents belonging to 10 cricetid species and 1 heteromyd species. A total of 378 sucking lice were collected (189 ♀, 106 ♂, 83 nymphs), distributed in 6 species (*Fahrenholzia microcephala*, *Hoplopleura emphereia*, *Hoplopleura ferrisi*, *Hoplopleura reithrodontomydis*, *Neohaematopinus neotomae*, *Polyplax auricularis*) and 2 families (Hoplopleuridae and Polyplacidae). Lice specimens were processed for morphological and molecular identification, using the mitochondrial gene cytochrome oxidase subunit I. Infestations were characterized based on the prevalence and mean abundance. Five of the 6 species were confirmed by molecular analysis. The highest levels of infestation were recorded for *H. emphereia* (66.7%; 4.4) on *Megadontomys thomasi*. All localities represent new records for the species studied.

Keywords: Sucking lice; Cythocrome oxidase subunit I; Rodents; Mexico

Resumen

De abril a diciembre de 2010 desarrollamos un estudio con el objetivo de recolectar e identificar anopluros asociados con roedores cricétidos y heterómidos de bosques montañosos en 5 localidades en Guerrero y Oaxaca, México. Analizamos un total de 147 roedores pertenecientes a 10 especies de cricétidos y una especie de heterómido. Se recolectó un total de 378 piojos (189 ♀, 106 ♂, 83 ninfas), distribuidos en 6 especies *(Fahrenholzia microcephala*, *Hoplopleura emphereia*, *Hoplopleura ferrisi*, *Hoplopleura reithrodontomydis*, *Neohaematopinus neotomae*, *Polyplax auricularis)* y 2 familias (Hoplopleuridae y Polyplacidae). Los piojos fueron procesados para su identificación morfológica y molecular, usando el gen mitocondrial citocromo oxidasa subunidad I. Las infestaciones fueron caracterizadas con base en la prevalencia y la abundancia promedio. Cinco de las 6 especies fueron confirmadas molecularmente. Los más altos niveles de infestación fueron alcanzados por *H. emphereia* (66.7%; 4.4) sobre *Megadontomys thomasi*. Todas las localidades representan nuevos registros para las especies estudiadas.

Palabras clave: Piojos; Citocromo oxidasa subunidad I; Roedores; México

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Introduction

Sucking lice are obligate hematophagous ectoparasites of eutherian mammals. Currently, 550 species of Anoplura distributed in 16 families and 49 genera have been recorded worldwide (Durden & Musser, 1994; Light, Smith, Allen, Durden, & Reed, 2010); two-thirds of these arthropods belong to the families Polyplacidae and Hoplopleuridae, both including species parasites of rodents (Durden, 2002). The inventory of Mexican sucking lice is conformed by 44 species distributed in 8 genera (*Antarctophthirus* Enderlein, 1906; *Enderleinellus* Fahrenholz, 1912; *Fahrenholzia* Kellogg and Ferris, 1919; *Hoplopleura* Enderlein, 1904; *Linognathoides* Cummings, 1914; *Linognathus* Enderlein, 1905; *Neohaematopinus* Mjöberg, 1910 and *Polyplax* Enderlein, 1904) and 5 families (Echinophthiriidae, Enderleinellidae, Hoplopleuridae, Linognathidae and Polyplacidae). Forty two of these species (95.5%) have been associated with 61 species of rodents belonging to 4 families (Cricetidae, Heteromyidae, Muridae and Sciuridae), and 21 genera distributed in 28 states of the Mexican Republic (Sánchez-Montes, Guzmán-Cornejo, León-Paniagua, & Rivas, 2013). As part of a project to describe the metazoan fauna associated with cricetid rodents from montane forests of Mexico, we determined the richness and abundance of sucking lice associated with cricetid rodents from forest in the mountains of Guerrero and Oaxaca, Mexico. For this purpose we identified the specimens morphologically and molecularly (using the cytochrome oxidase subunit I [COI] gene) and additionally, we calculated the prevalence and mean abundance for each lice species.

Material and methods

From April to December 2010, hosts were collected under permission FAUT-0170 issued by Semarnat, Mexico from 5 localities, 2 in Guerrero and 3 from Oaxaca, Mexico (Table 1). Rodents were captured using 4 transects of 40 Sherman traps (Romero-Almaraz, Sánchez-Hernández, García-Estrada, & Owen, 2007), and sacrificed in compliance with the guidelines of the American Society of Mammalogy for the Use of Wildlife Mammals in Research (Gannon & Sikes, 2007). Lice were recovered from the external surface of hosts, and were fixed and preserved in vials with 96% ethanol. Likewise, each host was brushed on a sheet of white paper to extract additional lice adhering to the fur, and was posteriorly processed in the laboratory. For morphological determination sucking lice were mounted on slides using the modified techniques of Kim, Pratt, and Stojanovich (1986) and Wirth and Marston (1968). Specimens were identified using the specialized keys of Cook and Beer (1959), Ewing (1935), Kim et al. (1986), Pratt and Lane (1951), Stojanovich and Pratt (1961a, 1961b) and Stojanovich and Pratt (1965). Prevalence and mean abundance were calculated according with (Bush, Lafferty, & Lotz, 1997). Additionally micrographs of specimens were taken using a Photomicroscope Olympus Provis AX70. Sucking lice were deposited in the collection of Laboratorio de Acarología, Facultad de Ciencias (LAFC), Universidad Nacional Autónoma de México.

DNA extraction was performed using the DNeasy Blood & Tissue Kit (QIAGEN Ltd., UK). Amplification of a partial segment of ≈620 of COI was done using primers Jerry 5′-CAACATTTATTTTGATTTTTTGG-3′ and PatII 5′-TCCATTACATATAATCTGCCATATTAG-3′ (Marsico et al., 2010).

The reaction mixture consisted of 2 μl of primers (10 μM, 1 μl each), 0.4 μl (1.25 units) of *Taq* DNA Axygen®, 2.0 μL of 10× Promega reaction buffer, 2 μL of 25 mM $MgCl_2$, 0.8 μL of 10 mM mix dNTPs, 12.3 μL nuclease-free water and 5 ng DNA in a final volume of 19.5 μL. PCR conditions were those used by Marsico et al. (2010). The PCR products were analyzed by electrophoresis on 1.5% agarose gels, using a 100 bp and 1 kb molecular weight marker (nucleic acid markers, Axygen) in 1× TBE buffer.

Purified amplification products were submitted for sequencing to Unidad de Síntesis y Secuenciación de DNA (USSDNA), Instituto de Biotecnología and Laboratorio de Biología Molecular y de la Salud, Instituto de Biología, Universidad Nacional Autónoma de México. Sequences were compared with other sequences of sucking lice available in GenBank using the basic

Table 1
Sampling sites of specimens collected in this study.

State	Locality	Geographic reference	Collection date
Guerrero	Parque Estatal Cerro del Huizteco, Municipality Taxco	18°36′08.17″ N 99°36′30.63″ W 2,499 m	30 July–4 August, 2010
	Puerto del Gallo, Municipality General Heliodoro Castillo	17°28′48.46″ N 100°10′35.79″ W 2,584 m	06–12 December, 2010
Oaxaca	La Yerba Buena, Municipality Santa Catarina Juquila	16°13′59.88″ N 97°16′59.88″ W 1,710 m	30 April–5 May, 2010
	3 km southern Punto Ixtepeji, Municipality Ixtlán de Juárez	17°12′06.37″ N 96°35′28.21″ W 2,537 m	22–25 November, 2010
	km 134.5 Highway 175 Oaxaca-Tuxtepec 21 km north of Guelatao	17°25′10.20″ N 96°29′53.30″ W 2,919 m	22–25 November, 2010