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LICE OF CHILEAN DIURNAL RAPTORS

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ABSTRACT.—We describe species of lice collected from 12 species of Chilean diurnal raptors. Sampled raptors were obtained from wildlife rehabilitation centers and zoos, as carcasses found along highways, and from the avian collection of the National Museum of Natural History. Fourteen species of lice were isolated from all raptor hosts, with genus *Degeeriella* Neumann, 1906 (Philopteridae) and *Colpocephalum* Nitzsch, 1818 (Menoponidae) the most frequently found (60% and 26% of all lice, respectively). *Degeeriella leucopleura* (Nitzsch in Giebel, 1874) from Cinereous Harrier (*Circus cinereus*), *D. carruthi* Emerson, 1953 from American Kestrel (*Falco sparverius*) and *Colpocephalum maculatum* Piaget, 1880 from Southern Caracara (*Caracara plancus*) were the lice most commonly collected. Including data from previous studies, we found that in Chilean Falconiformes (1) *Colpocephalum turbinatum* Denny, 1842 is the louse species associated with the greatest number of raptor species, (2) *Degeeriella fulva* and *Laemobothrion tinnunculi* are characteristic of the genera of *Buteo* and *Falco*, respectively, and (3) the degree of host-specificity is high (76% of all louse species were associated with only one species host). Thus, our results are similar to those observed for other raptor hosts worldwide.

KEY WORDS: *Chile*; *diurnal raptors*; *Falconiformes*; *lice*; *Phthiraptera*.

ESPECIES DE PIOJOS EN AVES RAPACES DIURNAS DE CHILE

RESUMEN.—Describimos las especies de piojos encontradas en 12 especies de rapaces diurnas chilenas. Los especímenes muestreados fueron obtenidos de centros de rescate de fauna silvestre y zoológicos, de aves atropelladas encontradas en carreteras y de colecciones de aves del Museo Nacional de Historia Natural. Catorce especies de piojos fueron aisladas de todas las especies hospederas, siendo los géneros *Degeeriella* Neumann, 1906 (Philopteridae) y *Colpocephalum* Nitzsch, 1818 (Menoponidae) los más frecuentemente encontrados (60% y 26% de todos los piojos, respectivamente). Las especies de piojos más comunes fueron *Degeeriella leucopleura* (Nitzsch in Giebel, 1874), encontrada en *Circus cinereus*, *D. carruthi* Emerson, 1953, encontrada en *Falco sparverius* y *Colpocephalum maculatum* Piaget, 1880, encontrada en *Caracara plancus*. Incluyendo estudios anteriores, encontramos que en los Falconiformes chilenos (1), *Colpocephalum turbinatum* Denny, es la especie de piojo asociada con el mayor número de especies de rapaces, (2) *Degeeriella fulva* (Giebel, 1874) y *Laemobothrion tinnunculi* (Linnaeus, 1758) son característicos de los géneros *Buteo* y *Falco*, respectivamente, y (3) el grado de especificidad de hospedero es alto (76% de todas las especies de piojos estuvieron asociadas sólo a una especie de hospedero). Así, nuestros resultados son similares a los observados para otros hospederos rapaces de otras regiones del mundo.

[Traducción del equipo editorial]

Lice (Phthiraptera) are ectoparasitic insects, living out their entire life cycle on the same mammal or bird host. Under particular conditions, lice may have negative effects on their hosts, such as decreas-

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ing thermoregulatory capacity, reducing nestlings' survival, decreasing body mass (which may negatively affect survival and productivity), influencing sexual selection, or transmitting pathogenic endoparasites (Clayton 1990, Moller 1990, Hunter et al. 1994). Lice often multiply when their hosts are stressed, debilitated, or sick (Morishita et al. 2001, Krone and Cooper 2002) becoming in some cases fatal to birds (Klockenhoff et al. 1973). This may reach major importance in terms of veterinary treatment of infested birds (Cooper 1985, Morishita et al. 2001), or conservation threatened bird and mammal species (e.g., Cooper et al. 1993, Smith and Belthoff 2001). However, because most genera of the Phthiraptera are restricted to particular taxa and because some louse species parasitize only one host species or a number of subspecies (Clayton 1990, Hahn et al. 2000), they can be useful for understanding ecological, coevolutionary, or phylogenetic relationships of the hosts (Marshall 1981, Hafner et al. 1994, Hahn et al. 2000, Clayton and Drown 2001).

Presently there are few data on lice from birds in southern South America (Cicchino and Castro 1998a, 1998b, Valim et al. 2005, Valim and Palma 2007). In Chile, diversity and taxonomy of lice parasitizing non-raptorial birds (González-Acuña et al. 2003a, 2003b, 2004a, 2004b, 2005, 2006a, 2006b) and owls (González-Acuña et al. 2006b) have been only recently documented. Descriptions of lice associated with diurnal raptors in Chile have only been reported for a few species (Price 1964, Mey and González-Acuña 2000, San Martín et al. 2005). Here, we report species of lice collected from a wide array of diurnal raptor hosts and we summarize information from previous studies to provide more complete information on lice associated with Chilean and South American Falconiformes.

METHODS

Between 2001 and 2006, we analyzed a total of 90 birds of 12 diurnal raptor species: Bicolored Hawk (*Accipiter bicolor*, $N = 2$), Red-backed Hawk (*Buteo polyosoma*, $N = 5$), Rufous-tailed Hawk (*Buteo ventralis*, $N = 3$), Cinereous Harrier (*Circus cinereus*, $N = 16$), White-tailed Kite (*Elanus leucurus*, $N = 14$), Black-chested Buzzard-Eagle (*Geranoaetus melanoleucus*, $N = 8$), Harris's Hawk (*Parabuteo unicinctus*, $N = 12$), Aplomado Falcon (*Falco femoralis*, $N = 8$), Peregrine Falcon (*F. peregrinus*, $N = 7$), American Kestrel (*F. sparverius*, $N = 4$), Mountain Caracara (*Phalcoboenus megalopterus*, $N = 2$), and Southern Caracara (*Caracara plancus*, $N = 9$). Lice were obtained from live birds held in the National Zoo in Santiago, Quilpué Zoo in Quilpué, the Wildlife Rescue Center of the Concepción University in Chillán, and the Raptor Rehabilitation Center in Talagante ($N = 12$), from carcasses found along highways in the Ñuble province ($N = 12$), and from the bird collections housed in the National Museum of Natural History in Santiago ($N = 66$).

To remove all louse specimens, each bird or carcass was handled on a clean white surface and the entire plumage was systematically and exhaustively surveyed (Pérez et al. 1996). All visible lice were removed from the host and brought into the laboratory for examination. The collected material was fixed in 70% filtered ethanol solution, and then slide-mounted for identification following the technique of Palma (1978) and Price et al. (2003). This material was deposited in the collection of the Faculty of Veterinary Medicine of the University of Concepción, Chile. Because most of the raptor specimens were obtained from museum and rehabilitation centers, our results probably do not reflect the natural condition, but, nonetheless, are useful in identifying louse species and their host specificity. Because most lice probably were lost from museum material and carcasses found along roads, and the number of host species in most cases was low, no statistical analysis was made. In addition to our work, we review previous studies in order to provide a more complete list of louse species associated with diurnal raptors inhabiting Chile.

RESULTS

We isolated 102 lice of 14 species from the 12 diurnal raptor species we sampled. Three louse species were isolated from Southern Crested Caracara, two each from Bicolored Hawk, Rufous-tailed Hawk, Black-chested Buzzard-Eagle, Harris's Hawk, American Kestrel, and Mountain Caracara, and one each from Red-backed Hawk, Cinereous Harrier, White-tailed Kite, Peregrine Falcon, and Aplomado Falcon (Table 1). Most of the individual lice removed belonged to either the genus *Degeeriella* Neumann 1906 (Philopteridae; 60% of lice) or *Colpocephalum* Nitzsch 1818 (Menoponidae; 26% of lice; Table 1). The most common louse species we collected were *D. leucopleura* (Nitzsch *in* Giebel 1874) from Cinereous Harrier, *D. carruthi* Emerson 1953 from American Kestrel and *C. maculatum* Piaget 1880 from Southern Caracara (Table 1). The remaining ectoparasite species were in low number (Table 1). In

Table 1. Louse species collected during 2001–2006 from specimens of Chilean diurnal raptors taken from museums (M), wildlife rehabilitation centers (Wrc), Zoos (Z), and from road kills (Rk).

Raptor Host Species	Number of Birds Positive (*N*)				Louse Species	Number of Lice				Previously Known Geographic Distribution of Louse Species[a]
	M	Wrc	Rk	Z		Adult Males	Adult Females	Nymphs	Total	
Accipiter bicolor	1				*Degeeriella epustulata*		1		1	A
	1				*Colpocephalum turbinatum*		1		1	NA, E, NZ, Au, Cu, PR, H, Tai, Chi, I, Af, A
Buteo polyosoma	3			2	*Degeeriella fulva*	1	5		6	Tas, NA, E, Af, I, A, C
Buteo ventralis	1				*Colpocephalum turbinatum*	2	6		8	
		1			*Degeeriella fulva*	1	3		4	
Circus cinereus	5				*Degeeriella leucopleura*	2	8		10	
Elanus leucurus	4				*Degeeriella elani*	2	2		4	Thai, A
Geranoaetus melanoleucus	1	2			*Degeeriella fulva*	2	1	1	4	
	1				*Colpocephalum turbinatum*	2	1		3	
Parabuteo unicinctus		3		1	*Craspedorrhynchus* sp.		6		6	
		1		1	*Degeeriella emersoni*	3	1		4	Cu, A
Falco femoralis	1				*Degeeriella rufa*	1			1	E, NA, NZ, I, A
Falco peregrinus				1	*Degeeriella rufa*	1	1		2	
Falco sparverius		3			*Degeeriella carruthi*	14	11		25	NA, Cu, I, Br, A
		1			*Laemobothrion tinnunculi*	1			1	Is, USA, I, S, N, K, Q, Ar, V, Co, PI, V, Af, Af, A
Phalcoboenus megalopterus		1			*Acutifrons megalopterus*		1		1	A
	1	1			*Colpocephalum megalopteri*	1	1		2	NA, A
Caracara plancus	1	1			*Acutifrons connectens*	2	3		5	Br, A
	6				*Colpocephalum maculatum*	12	4		16	USA, Ne, C, Br, Co, A, P, M
	1				*Falcolipeurus josephi*	1			1	Br, USA, A

[a] Data taken from published literature. Previously known geographic distribution of lice: A = Argentina, NA = North America, E = Europe, NZ = New Zealand, Au = Australia, Cu = Cuba, PR = Puerto Rico, H = Hawaii, Thai = Thailand, Chi = China, I = India, Af = Africa, Tas = Tasmania, C = Chile, Is = Israel, Br = Brazil, USA = United States of America, S = Sudan, N = Nicaragua, K= Kenya, Q = Queensland (Australia), Ar = Algeria, V = Vietnam, PI = Philippine Islands, Co = Colombia, Ne = Netherlands, P = Peru, M = Mexico. Data sources: Carriker (1967), Castro and Cicchino (1992), Cicchino and Castro (1998a, 1998b), Clay (1958), Green and Palma (1991), Guimaraes (1943, 1945), Malcomson (1960), Mey and González-Acuña (2000), Nelson and Price (1965), Palma (1973), Pilgrim and Palma (1982), Price (1967), Tandan and Dhanda (1963).

general, more female than male lice were found on raptor hosts, excepting *D. emersoni* Clay 1958 in Harris's Hawk, *D. carruthi* in American Kestrel and *C. maculatum* in Southern Caracara (Table 1).

Considering our data and previous studies, lice of the genera *Colpocephalum* and *Degeeriella* were the most common on Chilean diurnal raptor hosts (88.2% and 70.6% of all raptor species, respectively). However, the degree of host-specificity was high (Table 1); almost 76% ($N = 28$) of all louse species were associated with only a single raptor host species. *D. fulva* (Giebel 1874) and *Laemobothrion tinnunculi* Linnaeus 1758) were characteristic of the genus *Buteo* and *Falco*, respectively. The least host-specific louse species was *Colpocephalum turbinatum*, which parasitized five genera and seven species of raptors. Specimens of *Craspedorrhynchus* Kéler 1938 were collected from Red-backed Hawks and Harris's Hawks (Table 1), but we were unable to identify these to species.

The Phthiraptera *D. epustulata*, *D. leucopleura*, *D. emersoni*, *D. rufa*, *D. carruthi*, *C. turbinatum*, *C. megalopteri*, *L. tinnunculi*, *A. megalopterus*, *A. connectens*, and *F. josephi* represent new reports for Chile. Rufous-tailed Hawk (*B. ventralis*), Black-chested Buzzard-Eagle (*G. melanoleucus*) and Bicolored Hawk (*A. bicolor*) are new hosts for the species *C. turbinatum*; Red-backed Hawk (*B. polyosoma*) and Rufous-tailed Hawk are new hosts for *D. fulva*; Bicolored Hawk for *D. epustulata*, Cinereous Harrier (*C. cinereus*) for *D. leucopleura* and Harris's Hawk (*P. unicinctus*) for *Craspedorrhynchus* sp. are all new host records.

DISCUSSION

Most species of Chilean diurnal raptors were parasitized by *Degeeriella* and *Colpocephalum* lice. Similarly, lice from both genera have been commonly found on North American and European raptors (Malcomson 1960, Price and Beer 1963, Pérez et al. 1996, Price et al. 2003). The high degree of host-specificity we found in Chilean diurnal raptors is in agreement with results observed for many raptor hosts from other regions (Price and Beer 1963, Pérez et al. 1996, Morishita et al. 2001). We found that *D. fulva* and *L. tinnunculi* typically parasitized members of the genus *Buteo* and *Falco*, respectively. Both species of lice have also previously been collected from several species of *Buteo* and *Falco* worldwide, respectively (Nelson and Price 1965, Pfaffenberger and Rosero 1984, Pérez et al. 1996, Morishita et al. 2001, Price et al. 2003). *C. turbinatum*, which parasitized five genuses and seven species of Chilean diurnal raptors, has a large host spectrum including more than 35 species of diurnal raptors (Price et al. 2003). Although *C. turbinatum* was also previously described for the genus *Circus* (Pérez et al. 1996), we did not find it in the sampled specimens of Cinereous Harrier ($N = 19$).

Craspedorrhynchus lice, which we collected from Red-backed Hawks and Harris's Hawks, are specifically associated with accipitrids hosts, but have also been collected from some species of *Buteo* (Morishita et al. 2001, Mey 2001, Price et al. 2003). To the best of our knowledge, our finding of *Craspedorrhynchus* lice in Harris's Hawks represents the first record for this raptor host. Like Morishita et al. (2001) for Ferruginous Hawks (*Buteo regalis*), we were unable to identify specimens of *Craspedorrhynchus* from Harris's Hawks to the species level because male lice were not found. According to Price et al. (1997), the male genitalia are the most reliable means for identifying *Craspedorrhynchus* species.

It is possible that additional species of lice might be found on free-living Chilean raptors. Although our study is preliminary, it is an important step toward initiation of a more comprehensive study of parasite-host relationships.

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