Neotropical Entomology

ISSN: 1519-566X

journal homepage: www.scielo.br/ne

ECOLOGY, BEHAVIOR AND BIONOMICS

# Community Structure of Lice (Insecta: Phthiraptera) from Two Sympatric Gull Species: Kelp Gull (*Larus dominicanus*) and Franklin's Gull (*Larus pipixcan*) in Talcahuano, Chile

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**Keywords**
*Saemundssonia*, *Actornithophilus*, *Austromenopon*, *Quadraceps*, mite

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Edited by Kleber Del Claro – UFU

Received 29 March 2010 and accepted 31 July 2010

**Abstract**

A total of 1,177 lice of four species were collected from 124 kelp gulls (*Larus dominicanus*) and 137 lice of the same four species from 60 Franklin's gulls (*Larus pipixcan*). The louse *Saemundssonia lari* (O Fabricius) (Phthiraptera: Philopteridae) was the most numerous on both gull species, with infestation rates of 4.9 on kelp gulls and 1.8 on Franklin's gulls. The second most abundant louse was *Quadraceps punctatus* (Burmeister), with a high infestation rate but low prevalence on kelp gulls; those parameters were much lower among lice from Franklin's gulls. The composition and community structure of the lice were similar on both host species, but not their infestation rates. In addition, the feather mite *Zachvatkinia larica* Mironov (Acari: Avenzoariidae) is recorded from kelp gulls and Franklin's gulls for the first time, while the gamasid mite *Larinyssus* sp. is recorded from kelp gulls, also for the first time. The population parameters of all species of ectoparasites are discussed.

## Introduction

The kelp gull, *Larus dominicanus*, is a southern circumpolar species distributed over South America, southern Africa, southern Indian Ocean, southern Australia and New Zealand, and some Subantarctic Islands (Martínez & González 2004). The Franklin's gull, *Larus pipixcan*, is resident in North America, from British Columbia in Canada to Minnesota in the United States; it migrates south along the Pacific coast reaching Central and South America, from Ecuador and the Galápagos Islands to the Magellan Straits, with records on both sides of the Beagle Channel (Marin & Couve 2001).

González-Acuña *et al* (2006) recorded four lice species (Phthiraptera: Philopteridae, Menoponidae) from gulls of the genus *Larus* in Chile: *Saemundssonia lari* (Fabricius), *Quadraceps punctatus* (Burmeister) and *Quadraceps ornatus* (Grube) from kelp gulls; *Q. punctatus* from grey gulls (*Larus modestus* Tschudi); and *S. lari* and *Actornithophilus piceus lari* (Packard) from Franklin's gulls. Price *et al* (2003) listed five louse species/subspecies from kelp gulls: *A. piceus lari*, *Austromenopon transversum* (Denny), *Quadraceps ornatus fuscolaminulatus* (Enderlein), *Q. punctatus sublingulatus* Timmermann, and *S. lari*; but four species/subspecies from Franklin's gulls: *A. piceus lari*, *A. transversum*, *Q. punctatus lingulatus* (Waterston) and *S. lari*.

Host-ectoparasite associations provide a natural

ecological system which is unique for the study of community structure (Choe & Kim 1987). A number of paradigms have been formulated to explain those associations and their coevolution (Marshall 1981, Kim 1985). Analysis of frequency distributions and population structures of infesting lice can give an insight into the relationship between the ectoparasite and the host (Fowler & Price 1987). However, very little has been studied concerning relationships at the community level (Choe & Kim 1987). In this study, we compare the community structure of lice from two sympatric gull species in the city of Talcahuano, Chile: the most common resident gull species, *L. dominicanus*, and the only northern hemisphere gull that migrates south to Chile, *L. pipixcan*. Since both gull species have similar biology, and share the same habitats in Chile, we postulate that their louse populations would have similar infestation parameters.

## Material and Methods

This study was carried out in the coastal city of Talcahuano, south-central Chile (36º44'10" S, 73º06'17" W) during winter 2007, summer, autumn and winter 2008, and summer, autumn 2009, with permit Nº 1801 from the Servicio Agrícola y Ganadero (SAG) dated 20 March 2007. Depending of capture methods and the abundance of each gull, a total of 124 kelp gulls were captured with seine nets, and 60 Franklin's gulls were captured with Bal-chatri traps. All kelp gulls were deloused and subsequently euthanized for a microbiological and virological study of their tissues. All Franklin's gulls were anesthetised with *ketamine-xylazine* to extract cloacal and blood samples for a microbiological and virological study, then they were deloused and ringed before being released in the same place of capture.

The lice were removed from the skin and feathers of live hosts and were then preserved in 70% ethanol, and subsequently slide-mounted in Canada balsam following Price *et al* (2003). Louse identifications were achieved with taxonomic keys, descriptions and illustrations in Clay (1949, 1959, 1962), Ward (1955), Emerson & Price (1985), Palma (1995), Price *et al* (2003), and Cicchino *et al* unpubl. Mite identifications were done following Mironov (1989) and Gaud & Atyeo (1996). All of the louse material was deposited in the zoological collection of the Facultad de Ciencias Veterinarias, Universidad de Concepción, Chile.

Ectoparasite populations are conventionally described by two parameters (Marshall 1981): incidence rate or percentage of hosts infested (infestation rate of Kim 1985), and infestation rate or the mean number of ectoparasites per host examined (population rate of Kim 1985). In addition to these two parameters, we added infestation density (mean number of ectoparasites per infested host). These three parameters, together with the total number of ectoparasites collected and the number of host examined, provide a more comprehensive assessment of ectoparasite populations.

## Results

From the 124 kelp gulls examined, a total of 1,177 lice belonging to four species were collected: *S. lari* (n = 609), *Q. punctatus* (n = 504), *A. piceus* (n = 35) and *A. transversum* (n = 29). From the 60 Franklin's gulls, a total of 137 lice belonging to the same four species were collected: *S. lari* (n = 106), *Q. punctatus* (n = 8), *A. piceus* (n = 17), and *A. transversum* (n = 6) (Table 1).

The percentage of hosts infested with *S. lari* was the highest among the four louse species in both host species, and also higher for kelp gulls (63.7%) than in Franklin's gulls (46.7%). Also, percentages of hosts infested with *Q. punctatus* (16.9%) and *A. transversum* (8.1%) were greater among kelp gulls than in Franklin's gulls. However, *A. piceus* infested a greater percentage of Franklin's gulls (15.0%) than kelp gulls (13.7%) (Table 1).

Regarding the developmental stages of the lice collected, there were a greater proportion of adult specimens over nymphs for all louse species on both hosts. The sex ratio was heavily female biased, but there were two unusual instances where males were more abundant than females: *S. lari* (male/female ratio = 1.80) and *Q. punctatus* (male/female ratio = 2.04) from kelp gulls (Table 2).

As many as 86 (69.4%) kelp gulls were infested with lice, of which 54 (43.5%) had only one louse species, with *S. lari* being the most frequent species recorded on 48 birds. Twenty four (19.4%) kelp gulls had two louse species, with the most frequent association being *Q. punctatus* and *S. lari* on 14 birds. Seven (5.7%) kelp gulls were parasitized by three louse species and only one (0.8%) had the full complement of four species. Among Franklin's gulls, 32 (53.3%) birds were louse positive, of which 22 (36.7%) had only one louse species, with *S. lari* also being the most frequent species recorded on 18 of them. Five (8.3%) birds had two louse species, four of them with *A. piceus* and *S. lari*, while other five (8.3%) Franklin's gulls had three louse species, but no bird was found to have the full complement of four species (Table 3).

In addition to the four louse species, the feather mite *Zachvatkinia larica* Mironov (Acari: Avenzoariidae) was recorded from both gull species, and the gamasid mite *Larinyssus* sp. was found but only on kelp gulls (Table 1).

Table 1 Infestation rates, prevalence, and densities of lice and mites on *Larus dominicanus* and *Larus pipixcan* from Talcahuano, Chile.

| Phthiraptera | *L. dominicanus* (n = 124) | | | | *L. pipixcan* (n = 60) | | | |
|---|---|---|---|---|---|---|---|---|
| | Total n° of lice (%) | N° of birds infested (%) | Infestation rates | Infestation density (ranges in brackets) | Total n° of lice (%) | N° of birds infested (%) | Infestation rates | Infestation density (ranges in brackets) |
| *Saemundssonia lari* | 609 (51.7) | 79 (63.7) | 4.9 | 7.7 (1-49) | 106 (77.4) | 28 (46.7) | 1.8 | 3.8 (1-17) |
| *Quadraceps punctatus* | 504 (42.8) | 21 (16.9) | 4.1 | 24.0 (1-352) | 8 (5.8) | 6 (10) | 0.1 | 1.6 (1-3) |
| *Actornithophilus piceus* | 35 (3.0) | 17 (13.7) | 0.3 | 2.1 (1-10) | 17 (12.4) | 9 (15) | 0.3 | 1.9 (1-4) |
| *Austromenopon transversum* | 29 (2.5) | 10 (8.1) | 0.2 | 2.9 (1-15) | 6 (4.4) | 4 (6.7) | 0.1 | 1.5 (1-3) |
| Total | 1177 | 86 (69.4) | 9.5 | 13.6 (1-352) | 137 | 32 (53.3) | 2.3 | 6.5 (1-17) |
| Mite species | Total n° of mites (%) | | | | | | | |
| *Zachvatkinia larica* | 1434 (98.6) | 14 (11.3) | 11.6 | 102.4 (1-552) | 4080 (100) | 26 (43.3) | 68 | 156.9 (2-969) |
| *Larinyssus* sp. | 20 (1.4) | 9 (7.3) | 0.2 | 2.2 (1-6) | 00 | 00 | 00 | 00 |
| Total | 1454 | 23 | 11.7 | 63.2 | 4080 | 26 | 68 | 156.9 |

## Discussion

Although there is a possibility of competition among populations of two or more louse species sharing the same host, it is more likely that resource availability will determine their survival and reproductive success (Marshall 1981, Cicchino & Castro 1998 a,b). However, competitive interactions between louse populations may result in the exclusion of one in favor of the other, or may lead to changes of infestation densities, particularly among species of the family Menoponidae, given their more varied feeding requirements (feathers, feather pith, blood, skin secretions), than among species of Philopteridae, which feed exclusively on feathers and skin debris (Marshall 1981).

Infestation densities were higher in kelp gulls than in Franklin's gulls for all four louse species (Table 1). Those differences may be due to some variables. Firstly, the two gull species are markedly different in size, with kelp gulls almost twice as large as Franklin's gulls in all measurements, and about three times as heavy (Olsen & Larsson 2003). A larger bird has a larger plumage volume and may therefore sustain a greater population of lice. Another variable is that, while kelp gulls are not migratory in Chile, Franklin's gulls are highly migratory arriving in Chile after a long-distance migration from North America (Olsen & Larsson 2003). Louse populations may be reduced by migrant birds preening more frequently than resident

Table 2 Developmental stages of lice from *Larus dominicanus* and *Larus pipixcan* from Talcahuano, Chile.

| Phthiraptera | *L. dominicanus* (n = 124) | | | | | *L. pipixcan* (n = 60) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Adults | | Nymphs | Total | Ratio female/male | Adults | | Nymphs | Total | Ratio female/male |
| | Female | Male | | | | Female | Male | | | |
| *Saemundssonia lari* | 181 | 326 | 102 | 609 | 0.56/1 | 41 | 38 | 27 | 106 | 1.08/1 |
| *Quadraceps punctatus* | 141 | 288 | 75 | 504 | 0.49/1 | 3 | 3 | 2 | 8 | 1/1 |
| *Actornithophilus piceus* | 17 | 11 | 7 | 35 | 1.55/1 | 10 | 3 | 4 | 17 | 3.3/1 |
| *Austromenopon transversum* | 12 | 6 | 11 | 29 | 2/1 | 3 | 3 | - | 6 | 1/1 |
| Total | 351 | 631 | 195 | 1177 | 0.56/1 | 57 | 47 | 33 | 137 | 1.21/1 |

Table 3 Prevalence of Phthiraptera species, individually and associated on *Larus dominicanus* and *Larus pipixcan* from Talcahuano, Chile.

| Phthiraptera | *L. dominicanus* (n = 124) | | *L. pipixcan* (n = 60) | | Total (n = 184) | |
|---|---|---|---|---|---|---|
| | Positive | % | Positive | % | Positive | % |
| *Actornithophilus piceus* | 4 | 3.2 | 1 | 1.7 | 4 | 2.2 |
| *Austromenpon transversum* | 0 | 0.0 | 2 | 3.3 | 2 | 1.1 |
| *Quadraceps punctatus* | 2 | 1.6 | 1 | 1.7 | 3 | 1.6 |
| *Saemundssonia lari* | 48 | 38.7 | 18 | 30 | 66 | 35.9 |
| *A. piceus* & *A. transversum* | 1 | 0.8 | 0 | 0.0 | 1 | 0.5 |
| *A. piceus* & *Q. punctatus* | 0 | 0.0 | 0 | 0.0 | 0 | 0 |
| *A. piceus* & *S. lari* | 6 | 4.8 | 4 | 6.7 | 10 | 5.4 |
| *A. transversum* & *Q. punctatus* | 0 | 0.0 | 0 | 0.0 | 0 | 0 |
| *A. transversum* & *S. lari* | 3 | 2.4 | 0 | 0.0 | 3 | 1.6 |
| *Q. punctatus* & *S. lari* | 14 | 11.3 | 1 | 1.7 | 15 | 8.2 |
| *A. piceus*, *A. transversum* & *Q. punctatus* | 0 | 0.0 | 0 | 0.0 | 0 | 0 |
| *A. piceus*, *A. transversum* & *S. lari* | 3 | 2.4 | 1 | 1.7 | 4 | 2.2 |
| *A. transversum*, *Q. punctatus* & *S. lari* | 2 | 1.6 | 1 | 1.7 | 3 | 1.6 |
| *A. piceus*, *Q. punctatus* & *S. lari* | 2 | 1.6 | 3 | 5.0 | 5 | 2.7 |
| *A. piceus*, *A. transversum*, *Q. punctatus* & *S. lari* | 1 | 0.8 | 0 | 0.0 | 1 | 0.5 |

birds, because the former would need to maintain their plumage in optimum condition for a successful return flight. Preening has been shown to substantially reduce louse populations in birds (Clayton 1991).

The age structure of an ectoparasite population varies with the reproductive cycle of the ectoparasite (Marshall 1981): larger numbers of nymphs over adults would indicate an active reproduction period, while a reduced number or absence of nymphs would indicate a period of lower reproduction, as it can be observed in the four louse species collected during this study (Table 2).

In general, sex ratios in ectoparasites are close to one. However, there are many louse genera where females are far more abundant than males (Marshall 1981). Furthermore, there are two cases with a male/female ratio equal to one (*Q. punctatus* and *A. transversum* from *L. pipixcan*), but these two samples are too small to draw meaningful conclusions. The remaining four male/female ratios are all below one, indicating a greater number of females in the samples (Table 2). Although sampling artifacts may alter expected ratios, female lice tend to be more abundant than males because males live shorter lives and are also more active, hence more likely to leave the host accidentally (Marshall 1981).

Among the 21 kelp gulls that had *Q. punctatus*, one bird had 352 lice of that species, while the remaining 20 gulls had an average of 7.6 lice per bird. That high quantity of *Q. punctatus* is likely to be an indication that the bird was in poor health and could not perform plumage cleaning activities. Ash (1960: 102) reported an estimate of 10,000 individuals of *Austromenopon* on a common gull (*Larus canus*), which was very emaciated and eventually died. Besides poor health, a greater contact between birds due to the gregarious behavior of gulls may lead to an increased horizontal transmission of lice (Geist 1935, Rózsa *et al* 1996). However, most louse populations are smaller because of the control exerted by the host's preening activities (Clayton 1991).

Infestation densities for *Z. larica* on both gull species were very variable and, consequently, infestation ranges very wide. Extreme examples of densities were 552 specimens of *Z. larica* recovered from one kelp gull, and 969 from one Franklin's gull (Table 1). Mironov (1989) described *Z. larica* from several species of *Larus*, and this paper records it from *L. dominicanus* and *L. pipixcan* for the first time. The absence of *Larinyssus* on Franklin's gulls is noteworthy, probably due to the life cycle of the mite, but further research is necessary to explain that absence.

We conclude that the composition and community structure of the lice were similar on both host species of gulls, but not their infestation rates, that were higher in kelp gulls than Franklin's gulls.

## Acknowledgments

We greatly acknowledge project Fondecyt N°1070464 ["Las gaviotas *Larus pipixcan* y *Larus dominicanus* del litoral de la VIII región (Chile) como potenciales vectores

de bacterias, virus y parásitos patógenos para el hombre y los animales]" which funded this study. Also we thank Pesquera Camanchaca Talcahuano and its officers Sergio Valks-Contreras, Teoboldo Navarrete-Cubile and José Cuevas-Díaz, who allowed capture and delousing of gulls in their property. We are indebted to Dr Sandra Briones from Servicio de Salud de Talcahuano, Claudio Parraguéz from Municipalidad de Talcahuano and Giancarlo Garvarino for cooperating in the collecting process. Several students assisted with fieldwork: Karen Ardiles, Roberto Bravo, Sebastián Muñoz, Alejandro Lagos, Jonathan Lara, Nicolás Martín, Carlos Riquelme, and Jordan Torres; we gratefully acknowledge their help. For the identification of the gamasid mites we thank to dr. Hearther Proctor of the university of Alberta and Wayne Knee of the Carleton University.

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