

## Lousy big guys: *Lepidophthirus macrorhini* infesting seals from Antarctica

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**Abstract** The present work represents a contribution to the ecology of a little known host parasite association, i.e. sucking lice and Antarctic seals. The information available regarding the health status of Antarctic seals is limited and little is known about the ecology and effect of parasites on these hosts. Particularly, data regarding Antarctic louse infestation are scarce. Therefore, the main goal of this study is to report the results of a survey of the louse infestation of *Lepidophthirus macrorhini* (Anoplura, Echinophthiriidae) on 26 elephant seals (*Mirounga leonina*) and on a Weddell seal (*Leptonychotes weddelli*) from eastern Antarctic Peninsula.

**Keywords** Lice · Echinophthiriidae · 25 de Mayo/King George Island · Elephant seal · Weddell seal

### Introduction

Lice belonging to the family Echinophthiriidae are ectoparasites of pinnipeds and river otters, i.e. they have amphibious hosts, who regularly perform long excursions into the open sea. Consequently, echinophthiriids must be capable of dealing with the challenges of the marine environment. Along the evolutionary time, echinophthiriids have developed unique morphological, behavioural, and ecological adaptations to cope with the amphibious lifestyle of their hosts (Murray 1976; Mehlhorn et al. 2002; Leonardi et al. 2012; Leonardi and Palma 2013; Leonardi and Lazzari 2014). As a consequence, echinophthiriids are one of the few insects adapted to survive at sea (Leidenberger et al. 2007).

Pinnipeds are a group of marine carnivores that include walruses (Odobenidae), sea lions (Otariidae), and seals (Phocidae). One of the main features of pinniped behaviour is their extraordinary diving capacity. While otariids usually dive to about a hundred of metres, true seals have maximum dive depths over a thousand of metres (Stewart 2009; Costa et al. 2010; McIntyre et al. 2010) and can have much of their bodies submerged from several weeks to several months out of the year (Teilmann et al. 1999). Extraordinarily, adult southern elephant seal *Mirounga leonina* has been reported diving at more than 2000 m deep (Costa et al. 2010; McIntyre et al. 2010).

*Lepidophthirus macrorhini* Enderlein (Fig. 1) is a blood-sucking louse known to infest southern elephant seals (Murray and Nicholls 1965; Durden and Musser 1994), and has been reported to carry a type of alphavirus (La Linn et al. 2001). However, at present no studies have described the infestation parameters of this host–parasite association which is needed to evaluate the potential risk of virus transmission. Here we report the presence of *L.*

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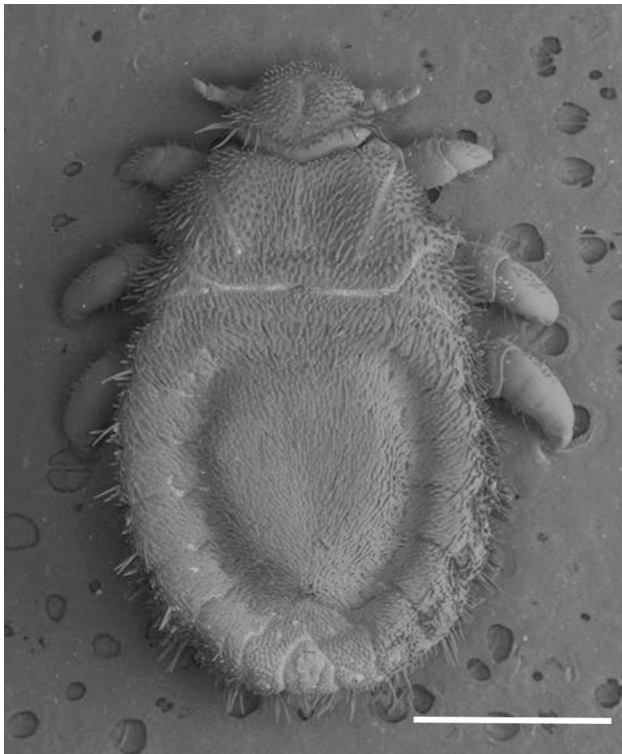
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**Fig. 1** Scanning electron microphotograph of the louse *Lepidophthirus macrorhini* from southern elephant seals (scale bar: 1 mm)

*macrorhini* in elephant seals of different ages at 25 de Mayo/King George Island, South Shetland Islands, Antarctica.

## Methods

During the reproductive season of 2015/2016, 26 southern elephant seals were inspected for lice. The work was conducted in the Antarctic Specially Protected Area ASPA N°132, “Peninsula Potter”, near the Argentinean Scientific Base Dr. Alejandro Carlini, 25 de Mayo/King George Island (62°14'S 58°40'W, Fig. 2).

Lice were collected from the hind flippers of seals (Murray et al. 1965; Thompson et al. 1998; Leonardi et al. 2012) and preserved in 96% ethanol. The hind flippers are the preferred area for lice and the numbers collected there represent a reliable proxy of total burden, while reducing host manipulation time (Thompson et al. 1998; Leonardi 2014).

Infestation parameters were estimated following Rózsa et al. (2000). Prevalence was defined as the frequency of louse occurrence, expressed as a percentage. To set 95% confidence intervals for prevalence, we used Sterne's exact method (Reiczigel 2003). Mean intensity was defined as the mean number of individuals per host in the total sample

of infested hosts, while mean abundance was the mean number of lice in the total host population. We used a bootstrap procedure with 20,000 replications to set 95% confidence intervals of mean intensity and mean abundance (Rózsa et al. 2000). Prevalence was compared between host sexes with Fisher's exact test, mean intensity and mean abundance with a Bootstrap 2-sample *t* test. We estimated the lice sex ratio as  $males/(males + females)$ .

## Results

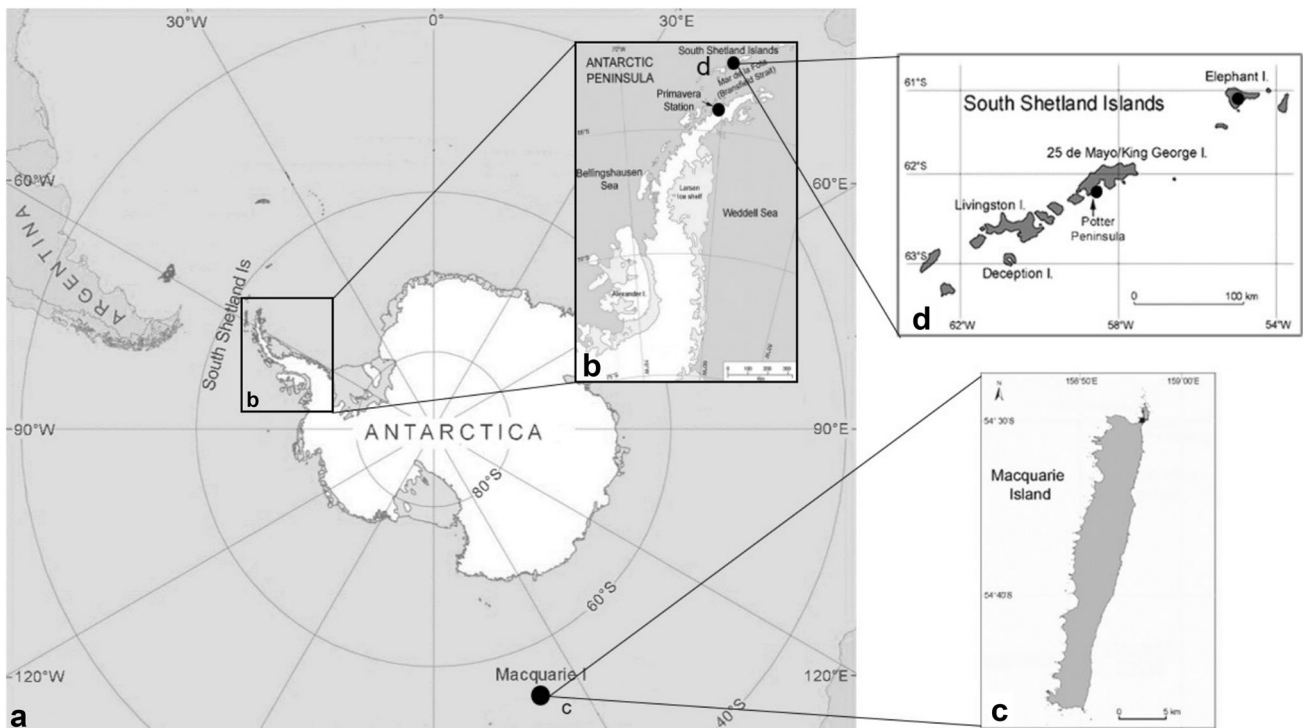
Table 1 compares our results with previous work by Murray and Nicholls (1965) on Macquarie Island, a sub-antarctic island located in the South Pacific Ocean. Lice infested 46.2% of the seals we examined (12 of 26 seals). There was no difference in prevalence between sexes (female 29.4%; male 66.7%; Fisher's exact test,  $p = 0.162$ ). The number of lice found in females ranged from 1 to 32, while in males ranged between 1 to 19 lice. The mean intensity was 9.42 (CI 95% 5.33–16) and mean abundance 4.35 (CI 95% 2.08–8.46). No differences were observed in the mean intensity (12.6 and 11, respectively, Bootstrap 2-sample *t* test,  $t = 0.240$ ,  $p = 0.809$ ) nor in the mean abundance (3.7 for females and 7.33 for males, Bootstrap 2-sample *t* test,  $t = -0.883$ ,  $p = 0.392$ ) between female and male seals. The sex ratio did not differ from 1:1 ( $0.27 \pm 0.27$ , Chi-square test,  $\chi^2 = 2.22$ ,  $p = 0.999$ ).

In addition, we found a female juvenile Weddell seal, *Leptonychotes weddelli*, infested with 5 female *L. macrorhini* at Punta Cierva (64°09'S, 60°57'W) in the northern sector of the Danco Coast (ASPA N°134). This constitutes the first record of *L. macrorhini* infesting other seal hosts and expands the distribution of the species.

## Discussion

Information regarding the health status of Antarctic seals is very limited and little is known about the ecology and effect of parasites on these hosts (Kerry et al. 1999). Here we report new information on a little known host–parasite association, i.e. sucking lice and seals.

Recognizing the special value of Antarctic wildlife and the need to minimize disturbance (Laws 1993; Halliday 1995; Powell and Proulx 2003), we adopted the strategy of Thompson et al. (1998) who sampled lice only in the hind flippers of harbour seals based on previous evidence showing that this was the principal site of infestation. We assumed that the same is valid for elephant seals and this sampling strategy provides a robust estimate of intensity and prevalence.



**Fig. 2** Locations where *Lepidophthirus macrorhini* was reported. **a** General view of Antarctica; **b** Antarctic Peninsula, Base Primavera (present study), **c** Macquarie Island (Murray and Nicholls 1965),

**d** South Shetland Islands, Elephant Island (Becker et al. 2000) and 25 de Mayo/King George Island (present study)

**Table 1** Previous studies and present results on infestation parameters of *Lepidophthirus macrorhini* from southern elephant seal, *Mirounga leonina*

	Murray and Nicholls (1965)			Present work			
	<i>n</i> <sup>a</sup>	Mean intensity	Range	<i>n</i>	Prevalence (%)	Mean intensity	Range
Pups	14	39.14	5–74	3	100	2	1–3
Juveniles	12	34.33	6–150	15	46.7	13.71	3–32
Adult female	6	11.17	2–34	8	25	5.5	2–9

<sup>a</sup>The authors did not detail the total number of examined seals, only the infested ones

*Lepidophthirus macrorhini* is known to infest southern elephant seals from subantarctic islands such as Macquarie Island (Murray and Nicholls 1965). For Antarctica, *L. macrorhini* was reported infesting elephant seals at Elephant Island (Becker et al. 2000) during moulting season. In the present study, we report a southern expansion of *L. macrorhini* (Fig. 2), a first record of *L. macrorhini* infesting southern elephant seals adults during the breeding season, and the first data on host–parasite interaction in the region in 50 years.

Murray and Nicholls (1965) present the first ecological data in echinophthiriids, combining a diverse array of analyses including field counts of lice and in vitro observations, and even analysed confined hosts. These authors only reported the prevalence for pups. They found that 86% of 50 analysed pups were infested by lice and mentioned that “the majority of seals at Macquarie Island” were

infested. Although we only analysed 3 pups, we found lice in all of them. As it was reported for other pinnipeds, the prevalence decreases in older seals (Kim 1985). Prevalence and mean intensity of *L. macrorhini* in adult southern elephant seal from 25 de Mayo/King George Island were lower than those reported by Murray and Nicholls (1965). However, given that our findings are based on a limited number of elephant seals, the results from our analyses should consequently be treated with considerable caution.

Southern elephant seals are widely distributed and there are at least four genetically distinct populations, recognized as follow: the Peninsula Valdés, the Kerguelen population, the Macquarie population and finally the South Georgia population in the South Atlantic Ocean (McMahon et al. 2005) which includes the Peninsula Potter population. The number on land density of breeding females varies greatly among those colonies: 40 females per kilometre of

coastline in Peninsula Potter vs 1100 seals per kilometre in Macquarie Island (Carrick et al. 1962; McMahon et al. 2005). Higher seal density at Macquarie Island can possibly explain the differences in the infestation parameters of *L. macrorhini*.

One of the main features of obligate parasites such as lice is their high level of host specificity (Dick 2007). Particularly, the Anoplura have evolved closely with their mammalian hosts for a long time and, as a consequence, sucking lice show a high level of host specificity with over 60% of the species recorded from a single host species (Kim 1985). Moreover, for Antarctic echinophthiriids each species of louse is restricted to a single seal species (Leonardi et al. 2016). In this context, it was rather surprising that we found a Weddell seal infested by *L. macrorhini* instead of *Antarctophthirus carlinii*, the louse known to be specific to this host (Leonardi and Lazzari 2014). The infested Weddell seal was sampled at Danco Coast, ~250 km south of 25 de Mayo Island. The presence of *L. macrorhini* in another host, the Weddell seal, invites to further study the association of lice and their hosts and their great capacity of adaptability.

The presence of *L. macrorhini* on a Weddell seal may also pose a health risk to the species, as an alphavirus was isolated from individuals of *L. macrorhini* from elephant seals from Macquarie Island (La Linn et al. 2001). This was the first report of a sucking lice implicated in the transmission of this kind of viruses.

Considering that *L. macrorhini* presents a high prevalence in southern elephant seals and that it can infest other hosts, our results will hopefully be relevant to establish the baseline health conditions of this species. Although the presence of a pathogen does not necessarily imply a disease or clinical symptoms (Kerry et al. 1999), high prevalence of this parasite in southern elephant seals and its ability to infest more than one host invite further study of the health risk it may represent. Since Antarctic species live in a speedily changing environment, it is of outstanding importance to monitor their health states.

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