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Nasopharyngeal mites *Halarachne halichoeri* (Allman, 1847) parasitizing the gray seal *Halichoerus grypus* (Fabricius, 1791) in the Baltic Sea with notes on other parasitic Halarachnidae associated with marine mammals

by

Leszek Rolbiecki[1,*],
Joanna N. Izdebska[1],
Konrad Bidziński[2],
Martyna Jankowska-Jarek[2]

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[1]*Department of Invertebrate Zoology and Parasitology, Faculty of Biology, University of Gdańsk, ul. Wita Stwosza 59, 80-308 Gdańsk, Poland*

[2]*Department of Vertebrate Ecology and Zoology, Faculty of Biology, University of Gdańsk, ul. Wita Stwosza 59, 80-308 Gdańsk, Poland*

Abstract

Parasitic arthropods of marine mammals are relatively poorly understood, with the least amount of data on the occurrence of parasitic arthropods in these hosts. Thus far, only seal lice *Echinophthirius horridus* (von Olfers, 1816) have been found in the Baltic seals, while there was no information about the presence of parasitic mites in these mammals. The nasopharyngeal mite *Halarachne halichoeri* (Allman, 1847) has recently been found in the gray seal *Halichoerus grypus* (Fabricius, 1791), representing a new species (and new genus) for the Polish fauna. Sixty three specimens were found in the nasal cavity and the trachea, including 18 females and 45 males. This is also the first documented record of Halarachnidae in seals of the Baltic Sea. A checklist of parasitic Halarachnidae known from marine mammals is also provided.

Key words: parasite, mite, *Halarachne halichoeri*, gray seal, *Halichoerus grypus*, Baltic Sea, marine mammals

* Corresponding author: *l.rolbiecki@biol.ug.edu.pl*

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Introduction

The parasitofauna of marine mammals has been poorly or unevenly studied. There are no comprehensive studies that would cover all ecto-, meso- and endoparasites, as they typically cover only selected groups. Helminths are a relatively well-studied group, while considerably less data are available for parasitic arthropods (e.g. Dail 1988; Marcogliese et al. 1996; Johansen et al. 2010; Pufall et al. 2012; Karpiej et al. 2014; Skrzypczak et al. 2014). Typical parasites of the pinnipeds (Carnivora, Pinnipedia: Odobenidae, Otariidae, Phocidae) are the lice Echinophthiriidae (Insecta, Phthiraptera, Anoplura), skin and tissue mites from the family Demodecidae (Acari, Acariformes, Prostigmata) and endoparasitic mites Halarachnidae (Acari, Parasitiformes, Mesostigmata), although occasionally other arthropods can also be found (Dailey & Nutting 1980; Durden & Musser 1994; Desch et al. 2003; Izdebska & Rolbiecki 2010; Izdebska et al. 2015).

However, since marine mammals are relatively rare in the Baltic and the pinnipeds are represented there by the harbor seal *Phoca vitulina* Linnaeus, 1758, the ringed seal *Pusa hispida* (Schreber, 1775) and the gray seal *Halichoerus grypus* (Fabricius, 1791), the small populations of the seals probably further contribute to the limited knowledge of their parasitofauna. Most of the data relate to the Anisakidae nematodes, whereas the seal louse *Echinophthirius horridus* (von Olfers, 1816) (Kadulski 2001) was the only representative of parasitic arthropods found in the Baltic seals thus far. On the other hand, no reports on the occurrence of parasitic mites, including Halarachnidae and Demodecidae – typical of seals, have been published. In the scientific literature, data on the occurrence of demodecid mites are scarce – only two species have been described: *Demodex zalophi* Dailey et Nutting, 1979, a specific parasite of the California sea lion (Dailey & Nutting 1980), and *D. phocidi* Desch, Dailey et Tuomi, 2003, a specific parasite of the harbor seal (Desch et al. 2003), both known from single observations. Much more information relates to the Halarachnidae mites, which are obligatory parasites of the upper respiratory tract, where they can cause diseases or even lead to death (Van Bree 1972; Dunlap et al. 1976; Kim et al. 1980; Lauckner 1985; Alonso-Farré et al. 2012). Two genera – *Halarachne* and *Orthohalarachne* – are known from the pinnipeds (Table 1). These mites are common parasites of the nasal passages, trachea, bronchi and lungs (Moeller 2004). The genus *Orthohalarachne* is considered to be specific to the eared seals Otariidae and the walrus Odobenidae, while *Halarachne* is believed to be specific to the earless seals Phocidae (Domrow 1962). Most of the data related to Halarachnidae have been collected for the eared seals, thus *O. diminuata* and *O. attenuata* have been the most commonly observed species (Dailey 2001). Initially, more species were described in this genus, but now they are considered to be synonymous with the two above-mentioned taxa (Domrov 1974). Data on the occurrence and parasitism of taxa from the genus *Halarachne* appear to be more fragmentary and scattered. Although seals are their typical hosts, they have also been observed in other aquatic animals – eared seals, walruses or even sea otters and gentoo penguins (Table 1). *Halarachne halichoeri* has a wide geographical distribution within the genus and has so far been found in eight host species, in some earless seal species living in the Baltic Sea. In European waters, this mite has so far only been recorded in the Spanish waters (Atlantic coast), in Great Britain, the Netherlands and recently in Germany (North Sea) (Oudemans 1925; Alonso-Farré et al. 2012; Reckendorf et al. 2016). The objective of the present study was to confirm the occurrence of Halarachnidae representatives in seals from the Baltic Sea.

Material and methods

The study material originated from a dead gray seal (male, 2 m long), found on 6 September 2016 by for WWF-Poland's Blue Patrol when monitoring the beach in Krynica Morska. The most likely cause of the seal's death was its advanced age. A standard parasitological autopsy was conducted, and then selected organs and tissue fragments were collected for further analyses. Considering the purpose of the seal specimen for theriological studies, it was not possible to thoroughly examine the entire respiratory tracts for the presence of mites, thus the nasal cavity and part of the trachea were rinsed with tap water under pressure and the obtained washings were viewed on Petri dishes under a stereoscopic microscope. The collected mites were preserved in 70% ethanol. All mite specimens were measured, and then microscopic preparations (mounted in polyvinyl-lactophenol solution) were made from a portion of the specimens. The parasites have been deposited at the Department of Invertebrate Zoology and Parasitology of the University of Gdańsk, Poland.

Results

The *H. halichoeri* mite has been recently identified in the gray seal. A total of 63 specimens were found,

Table 1

Checklist of mites from the family Halarachnidae associated with marine mammals. (Based on Banks 1899, 1910; Ferris 1925; Oudemans 1925; Doetschman 1944; Popp 1961; Domrow 1962, 1974; Wilson 1970; Dailey & Brownell 1972; Margolis & Dailey 1972; Dunlap et al. 1976; Furman 1977; Furman & Dailey 1980; Kim et al. 1980; Fay & Furman 1982; Webb et al. 1985; Gomez-Puerta & Gonzales-Viera 2015; Alonso-Farré et al. 2012; Felix 2013 and Gastal et al. 2016; data verified with the current systematic status of the species)

Halarachnidae	Host			
	Scientific name	Common name	Class, Order	Family
Halarachne americana Banks, 1899	*Monachus tropicalis* (Gray, 1850)	Caribbean monk seal	Carnivora	Phocidae
Halarachne halichoeri (Allman, 1847) Synonyms: *Halarachne erratica* Fain et Mortelmans, 1959 *Halarachne otariae* Steding, 1923 *Halarachne taita* Eichler, 1958	*Cystophora cristata* (Erxleben, 1777)	hooded seal		
	Enhydra lutris (Linnaeus, 1758)	sea otter		Mustelidae
	Halichoerus grypus (Fabricius, 1791)	gray seal		Phocidae
	Mirounga leonina (Linnaeus, 1758)	southern elephant seal		
	Phoca largha Pallas, 1811	spotted seal		
	Phoca vitulina Linnaeus, 1758	harbor seal		
	Pygoscelis papua (J. R. Forster, 1781)[a]	gentoo penguin	Aves, Sphenisciformes	Spheniscidae
	Zalophus californianus (Lesson, 1828)[b]	California sea lion	Carnivora	Otariidae
Halarachne laysanae Furman et Dailey, 1980	*Monachus schauinslandi* Matschie, 1905	Hawaiian monk seal		Phocidae
Halarachne miroungae Ferris, 1925	*Enhydra lutris* (Linnaeus, 1758)	sea otter		Mustelidae
	Mirounga angustirostris (Gill, 1866)	northern elephant seal		Phocidae
	Mirounga leonina (Linnaeus, 1758)	southern elephant seal		
	Phoca vitulina Linnaeus, 1758	harbor seal		
Orthohalarachne attenuata (Banks, 1910) Synonyms: *Halarachne attenuata* Banks, 1910 *Halarachne otariae* Steding, 1923 *Halarachne reflexa* Tubb, 1937 *Halarachne zalophi* Oudemans, 1916 *Halarachne rosmari* Oudemans, 1916 *Halarachne magellanica* Finnegan, 1934 *Orthohalarachne magellanica* (Finnegan, 1934) *Orthohalarachne reflexa* (Tubb, 1937) *Orthohalarachne rosmari* (Oudemans, 1916) *Orthohalarachne zalophi* (Oudemans, 1916)	*Arctocephalus australis* (Zimmermann, 1783)	South American fur seal		
	Arctocephalus pusillus (Schreber, 1775) (= *Arctocephalus tasmanicus* Scott et Lord, 1926) (= *Arctocephalus doriferus* Wood Jones, 1925)	cape fur seal		
	Arctocephalus tropicalis (J. Gray, 1872)[c] or *Arctocephalus forsteri* (Lesson, 1828)[c] (= *Otaria* (*Arctophora*) *elegans* Peters, 1876) (= ? *Arctocephalus forsteri* (Lesson, 1828))	Subantarctic fur seal or Australasian fur seal		
	Callorhinus ursinus (Linnaeus, 1758)	northern fur seal		
	Eumetopias jubatus (Schreber, 1776)	Steller sea lion		
	Homo sapiens Linnaeus, 1758[a]	man	Primates	Hominidae
	Mirounga angustirostris (Gill, 1866)	northern elephant seal	Carnivora	Phocidae
	Mirounga leonina Linnaeus, 1758[c] (= *Macrorhinus leoninus* (Linnaeus, 1758))	southern elephant seal		
	Neophoca cinerea (Péron, 1816)	Australian sea lion		Otariidae
	Odobenus rosmarus (Linnaeus, 1758)	walrus		Odobenidae
	Otaria flavescens (Shaw, 1800) (= *Otaria byronia* (de Blainville, 1820))	South American sea lion		Otariidae
	Phoca vitulina Linnaeus, 1758	harbor seal		Phocidae
	Zalophus californianus (Lesson, 1828)	California sea lion		Otariidae
	Zalophus wollebaeki Sivertsen, 1953	Galapagos sea lion		
Orthohalarachne diminuata (Doetschman, 1944) Synonyms: *Halarachne diminuata* Doetschman, 1944 *Orthohalarachne chabaudi* Gretillat,1960 *Orthohalarachne letalis* Popp, 1961	*Arctocephalus australis* (Zimmermann, 1783)	South American fur seal		
	Arctocephalus pusillus (Schreber, 1775) (= *Arctocephalus doriferus* Wood Jones, 1925)	cape fur seal		
	Callorhinus ursinus (Linnaeus, 1758)	northern fur seal		
	Eumetopias jubatus (Schreber, 1776)	Steller sea lion		
	Zalophus californianus (Lesson, 1828)	California sea lion		

[a] accidental infection (see the comment in the text)

[b] Newell (1947) believes it was *Halarachne miroungae*

[c] Banks (1910) does not specify the species, he only provides information such as "seal pup". On the other hand, Oudemans (1925) reports that they might represent (*Arctophora*) *elegans* Peters (= ? *Arctocephalus forsteri* (Lesson) or *Macrorhinus leoninus* (L.). However, it follows from Oudemans' notes that there might be three species (*Arctocephalus tropicalis*, *A. forsteri* and *M. leonina*). The original record was used and this certainly applied to "*Arctophoca*" and not "*Arctophora*"

including 18 females and 45 larvae (Fig. 1). They were found in the nasal cavity (17 females, 28 larvae) and the trachea (1 female, 17 larvae).

The larvae of *H. halichoeri* demonstrated a considerable range of variability in the body length (1098–1586) and width (488–756), which is typical of this developmental stage. Similarly, the range of female body length and width was considerable (2391–3367 and 708–1122, respectively). However, it is difficult to refer this to Oudemans' (1925) species redescription, which provides only mean values for two larvae and five female specimens (1320 × 725, 2818 × 927). However, the body of these mites is relatively soft and flexible, thus measurements of the highly sclerotized and rigid element – the dorsal shield – appear to be more significant. In this study, the shields have similar sizes in terms of length (976–1049) and width (464–537), regardless of the female body dimensions (Table 2).

Discussion

The Halarachnididae family consists of approximately 50 species of mammal parasitic mites, of which only two species have been found in Poland – primate-specific *Pneumonyssus simicola* Banks, 1910 and the cattle ear mite *Raillietia auris* (Leidy, 1872) (Piotrowski & Dziecielska 1986; Błaszak 2008). However, many authors believe that *Raillietia* belongs to a separate family, Raillietidae (Dowling & Oconnor 2010). The currently observed species and genus (*H. halichoeri*) are thus new to the Polish fauna. It is also the first documented observation of Halarachnidae in seals from the Baltic Sea. *Halarachne halichoeri* was previously reported from the Baltic Sea by Nehring (1884), based on specimens collected from fragments of a dead gray seal. Based on the published data (subsequently discussed by Oudemans 1925), however, there is no certainty as to the identification of the species, since only one genus and one species of Halarachnidae was known at the time from pinnipeds, described (very briefly) on the basis of specimens originating from the Irish Sea, at Dublin. Thus, the identification performed by Nehring (1884) was based solely on the similarity of the collected specimens to the above description, deviating considerably from the standards of the modern mite taxonomy, and the female drawn by the author differs slightly in terms of the body shape and the dorsal shield from the features typical of the species. At the time, even the classification of *Halarachne* into the order raised concerns (Nehring indicated Ixodida instead of Mesostigmata). An analysis of the original material would confirm that identification, yet it was dispersed due to it being distributed to different authors for further studies.

At present, *H. halichoeri* has been found only in the gray seal, but is likely to be found in other seal species, as was the case in other basins. It is usually associated with Phocidae. Indeed, it was sporadically found in

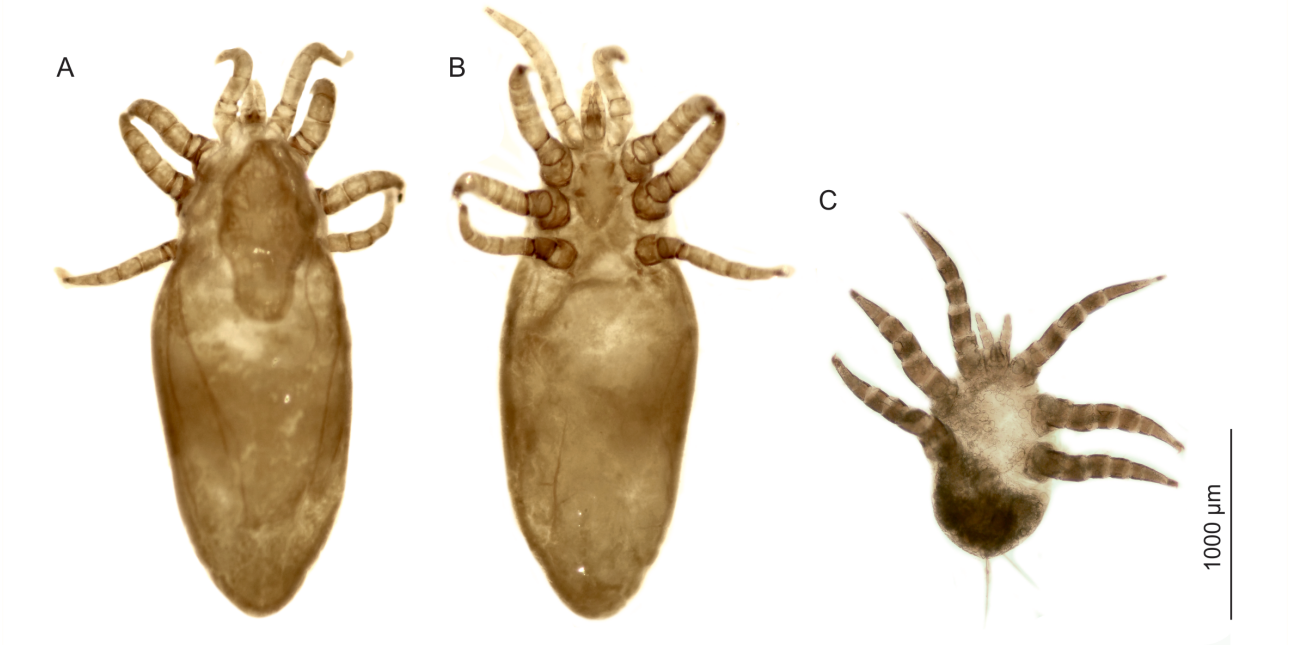

Figure 1

Halarachne halichoeri. A: female (dorsal view), B: female (ventral view), C: larva

Table 2

Body size (means, ranges, SD; micrometers) of *Halarachne halichoeri*

Morphological features	Present study		Oudemans (1925)[a]	
	Larvae (n = 45)	Females (n = 18)	Larvae (n = 2)	Females (n = 5)
Width of opisthosoma	580 (488–756), SD 68	977 (708–1122), SD 106	725	927
Width of podosoma at the level of legs III	560 (439–732), SD 79	–		–
Width of podosoma at the level of legs IV	–	786 (659–952), SD 63	–	891
Length of dorsal shield	–	1023 (976–1049), SD 24	–	–
Width of dorsal shield	–	497 (464–537), SD 21	–	–
Total body length	1299 (1098–1586), SD 128	2996 (2391–3367), SD 223	1320	2818

[a] the author provides only means for selected features

other host species (Table 1), but it was probably an accidental parasite for them, obtained under favorable conditions. What is more, there is a known case of Halarachnidae infestation in humans, where ocular acariasis of *O. attenuata* occurred as a result of staying in a water park near typical hosts – walruses (Webb et al. 1985). However, in the light of current knowledge about Halarachnidae in pinnipeds, it appears that they are oligoxenic parasites with a limited number of hosts, and they further exhibit topical (i.e. they are associated solely with specific tissues and organs of the host – the respiratory tract) as well as probably topographic specificity (i.e. preferring only specific area of the body or an organ) (Izdebska & Rolbiecki 2013). This is indicated by the study conducted on the eared seals, in which coinfestation by two species – *O. attenuata* and *O. diminuata* was observed (e.g. Domrov 1974; Furman 1977; Gastal et al. 2016). It was observed that *O. attenuata* occurs in the upper section of the respiratory tract of these mammals, while *O. diminuata* in the lower section (McFarlane et al. 2009).

However, the parasite-host relationships and the precise mechanism of Halarachnidae parasitism in pinnipeds have not been understood in detail. These mites attach to the mucous membrane of the nasal passage, where they can cause nodular lesions on the turbinates and obstructions. They also occur in the trachea, bronchioles or even in the lungs, affecting the respiration and producing lesions (Lauckner 1985). Transmission between hosts typically occurs through larvae that actively penetrate into the nostrils from other infested portions of the respiratory tract or are transferred during sneezing/puffing. The larvae are capable of thriving in a humid environment, until they penetrate into the nostrils of another host when detecting carbon dioxide in the air exhaled by the host (Furman & Smith 1973). Probably at low levels of infestation, these parasites do not cause any lesions, but they can cause profuse mucus secretion in the upper respiratory tract and from the nose, as well as shortness of breath and coughing (Alonso-Farré et al. 2012). Parasitosis symptoms are probably related to a higher infestation level and they can even cause a pulmonary collapse, edema, excessive mucus secretion related to the presence of mites in the trachea and bronchi (Seawright 1964). In the present study, the infestation intensity was 61 individuals, yet the study method constituted a restriction in this field (mite flushing), which may have impeded the extraction of all individuals anchored in the mucous membranes. Other authors rarely provide full infestation parameters, which prevents the determination of the critical level in the context of inducing lesions. Alonso-Farré (2012) examined 25 juvenile gray seals and reported that 76% of them were infected with *H. halichoeri*. Most of the infected individuals (68.4%) contained only few mites (1–20 individuals), while the remaining individuals (31.6%) contained over 20 specimens of mites. Although all infected seals showed certain symptoms related to the presence of mites (mucus or mucopurulent secretions from the nose, cough, itching and head shaking), the intensification of the symptoms was correlated with the infection intensity.

In conclusion, it is worth noting the similarity of the arthropod parasite fauna in the pinnipeds and other predatory mammals or other mammals associated with the aquatic environment. In this environment, Anoplura, Demodecidae and Halarachnidae are constant elements of the parasitic fauna communities (Izdebska & Rolbiecki 2010; Rolbiecki & Izdebska 2014; Izdebska et al. 2015). Thus, Echinophthiriidae are parasites of pinnipeds and otters (Durden & Musser 1994). Considerable similarity can also be found between Demodecidae known currently from pinnipeds, with species recently described from otter and beaver (Izdebska & Rolbiecki 2014; Izdebska et al. 2016). Also Halarachnidae represent a typical parasitofauna of the pinnipeds and the canines, and likely other predators. It can therefore be predicted that further studies of the arthropod fauna in seals will provide more data on the occurrence of already known parasites, or even discoveries of new species.

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