POPULATIONS, MICROHABITAT PREFERENCE AND EFFECTS OF INFESTATION OF TWO SPECIES OF *Orthohalarachne* (HALARACHNIDAE: ACARINA) IN THE NORTHERN FUR SEAL[1]

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Abstract: All of 116 northern fur seals examined, except black pups (up to 3 months old), had nasal mites, *Orthohalarachne attenuata* and *O. diminuata,* with the mean density of 1,808 mites per subadult male, 435 per adult female, 251 per silver pup, and 21.5 per black pup. Only 63% of black pups examined were infested with both mites. Larvae represented as much as 99% of the total mite population (total samples), and the females of both species of *Orthohalarachne* accounted for more than 90% of the total population of adult mites. The *O. attenuata* adults inhabited the nasopharynx and *O. diminuata* adults were found primarily in the lungs. Larvae of both species occupied the mucus-filled turbinates. The heavy infestation with these mites appeared to result in impairment of respiration in fur seals, and could also cause lesions in the lungs and secondary alveolar emphysems, predispose to more serious diseases, or even kill the host animal.

INTRODUCTION

Northern fur seals *(Callorhinus ursinus)* (Otariidae: Pinnipedia) are infested with two species of the nasal mites, *Orthohalarachne attenuata* (Banks, 1910)[2] and *O. diminuata* (Doetschmann, 1944),[6] in addition to the two ectoparasitic sucking lice, *Antarctophthirus callorhini* and *Proechinophthirus fluctus,* which inhabit skin and fur.[11,12] *Orthohararachne* spp., obligate parasites of the respiratory passages, are known to occur in the two families of Pinnipedia, Otariidae and Odobenidae.[15] In addition to the northern fur seal (type host) *O. attenuata* has also been known from other fur seals *(Arctocephalus doriferus),* sea lions *(Neophoca cinerea, Zalophus californianus),* and the walrus *(Odobenus rosmarus).*[5] *Orthohalarachne diminuata* was described initially from the California sea lion *(Zalophus californianus)* but has been recorded from northern fur seals,[15] other fur seals *(Arctocephalus doriferus)*[5] and the northern sea lion *(Eumetopias jubata).*[15]

Although the larvae,[5] nymphs[8] and adults[15] are now well described, published information on the biology[8] and populations of *Orthohalarachne* is very meager.[7,10]

The impact of arthropod parasites, including the nasal mites, have been considered insignificant in the health and population dynamics of marine mammalian hosts. Dunlap *et al.*[7] first observed some erosion and inflammation of

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the nasal turbinates and nasopharynx associated with species of *Orthohalarachne*. However, they concluded that *O. attenuata* in the northern fur seal was of minor significance since there were no clinical signs of respiratory difficulty and no evidence of occlusion of the respiratory passages. However, the death of two California sea lions was attributed to bronchitis, secondary emphysema and the lung lesions caused by *O. diminuata*.[4] We report the first population study of *Orthohalarachne* including infestation rate, population densities and structure, and microhabitat preference of the two species, *O. attenuata* and *O. diminuata*, in the respiratory passages of northern fur seals. The effects of mite infestation to the host are discussed.

MATERIALS AND METHODS

Although snout samples from 154 seals were examined, this report is based on 116 complete samples of heads and respiratory organs from subadult males (66), adult females (15), and pups (35) because some samples were not complete. Adult male samples were not available for study. Heads, tracheae and lungs were collected and promptly frozen in June and July (1975-1977) during the annual harvest of surplus males (subadults of 3-4 years old) on the St. Paul Island, Pribilof Islands, Alaska. Samples were kept frozen and transported to the The Pennsylvania State University Ectoparasite Laboratory for examination.

Skulls were cut sagittally and brain cases with brains were removed. The turbinates, nasopharynx, tracheae and lungs were then examined for mites. The location and the number of mites were recorded for each seal. Mites were preserved for subsequent identification to species, stage of development and sex, in 80% ethyl alcohol. Mites from each seal were kept separate. Nasal turbinates were initially digested with 1% trypsin solution,[3,12] and dissolved with hot 10% KOH solution. For preliminary histopathology, two samples were fixed in 10% formalin. Sections were stained with hematoxylin-eosin.

Tests of significance were calculated pairwise for population difference by Mann-Whitney U-statistics (non-parametric). For the analysis a program MINITAB II was used in the Computation Center, The Pennsylvania State University.

RESULTS AND DISCUSSION

O. attenuata adults are large mites with a wide range of the body length, 0.9 mm - 5 mm, due to the great elongation of the opisthosoma typical of gravid adults. *O. attenuata* nymphs are about 1.2 mm long and the larvae are 1.0 - 1.3 mm long, much longer than the larvae of *O. diminuata*. The adults of *O. diminuata* are small (0.6 mm - 0.8 mm long), without an elongated opisthosoma, and the nymphs are about 0.7 mm long.[8] *O. diminuata* larvae can be distinguished from *O. attenuata* by their much shorter body length (0.5 - 0.8 mm long).

All 116 seals examined, except black pups (up to 3 months of age, with black coats), were infested with both species of mites. Only 63% of the black pups examined were infested with both mites. The population density of the nasal mites in the respiratory system was unexpectedly high (Table 1). The mean population of *Orthohalarachne* spp. was 1,808 (range 23 to 8,170) per subadult male (3-4 years old), 435 per adult female (12-15 years old), 251 per silver pup (more than 4 months old with silvery coat after the first molt), and 21.5 per black pup. Of 66 subadult males examined, 47% (or 31) had more than 1,000 mites per seal and 30% had more than 2,000. Only 17% of the subadult males had less than 100 mites each.

Difference in mite population density was significant between subadult males and females at 0.0319, adults (males plus

TABLE 1. Population density and structure of *Orthohalarachne* spp. in the respiratory system of *Callorhinus ursinus* on St. Paul Island, Alaska, collected during the summers of 1972-1977. Each value is the average number of individual mites per host ± the standard error.

HOSTS	SAMPLE SIZE	*O. attenuata* LARVAE	*O. attenuata* NYMPHS	*O. attenuata* ADULTS	*O. attenuata* TOTAL	*O. diminuata* LARVAE	*O. diminuata* NYMPHS	*O. diminuata* ADULTS	*O. diminuata* TOTAL	GRAND TOTAL
Subadult ♂	66	555.7 ± 87.0	0	30.1 ± 3.3	585.8 ± 94.8	1,214.8 ± 199.5	0	7.7 ± 1.4	1,222.5 ± 199.9	1,808.2* ± 257.8
Adult ♀ (cow)	15	272.4 ± 86.0	.1	121.7 ± 27.7	394.2 ± 106.5	34.4 ± 9.7	0	6.9 ± 2.5	40.8 ± 11.0	435.1* ± 111.0
Silver Pup	6	126.0 ± 21.1	0	28.8 ± 4.6	166.0 ± 23.7	84.8 ± 11.2	0	0	84.8 ± 11.2	250.8 ± 26.6
Black Pup	29		0	7.1 ± 2.8	7.1 ± 2.8	5.8 ± 3.8	0	8.7 ± 2.3	14.3 ± 5.5	21.5* ± 6.3

*Difference is highly significant.

females) and black pups at 0.0000, and silver pups and black pups at 0.0002. Difference between adults and silver pups was not significant at P≤0.05. This may be attributed to small sample size of silver pups. The significant difference in mite population density between subadult males and adult females may be caused by age, sex (and size) or both. Several possible factors may be enumerated for future consideration: (a) the behavioral characteristics of subadult males, which usually aggregate closely on separate beaches away from rookeries;[16] (b) a higher level of immunity in mature adults due to infestation in the subadult stage[14] and (c) hormonal action.[13]

Mite population density in the silver pups increased more than 10 times from the low level in the black pups. New-born pups were free of mites. It appears that a full reproductive capacity of mites was already reached in the silver pups.

We confirmed the findings of Dunlap *et al.*[7] that the larvae of *O. attenuata* were found on the turbinate mucosa but the adults were found attached to the nasopharyngeal mucosa (Fig. 1, 2). Dunlap *et al.*[7] made no reference to *O. diminuata*. We found that the larvae in the turbinate scrolls and nasal meatuses filled with mucous material represented both *O. attenuata* and *O. diminuata* (Fig. 3). The adult *O. attenuata* occupied the nasopharynx extending to the choanae. Since they attached to the nasopharyngeal mucosa by the mouthparts, only the elongated opisthosoma of the adult was visible on the surface (Fig. 4). *O. diminuata* adults were found primarily in the lungs (bronchi and bronchioles) (Fig. 1). It was assumed that some adults of *O. diminuata* in the turbinates had been newly molted and some adults in the tracheae would have been migrated to the lungs eventually.

During the life cycle, the hexapod larvae of both species are most active, freely motile, and it is the stage when transmission or dispersal could occur among

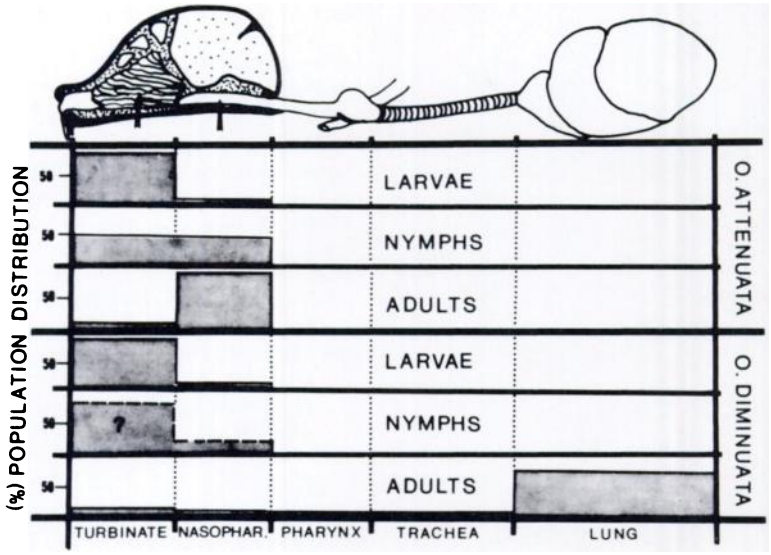

FIGURE 1. Distribution of *Orthohalarachne* mites in the respiratory system of northern fur seal. The shaded area in the nymph of *O. diminuata* is based on inference.

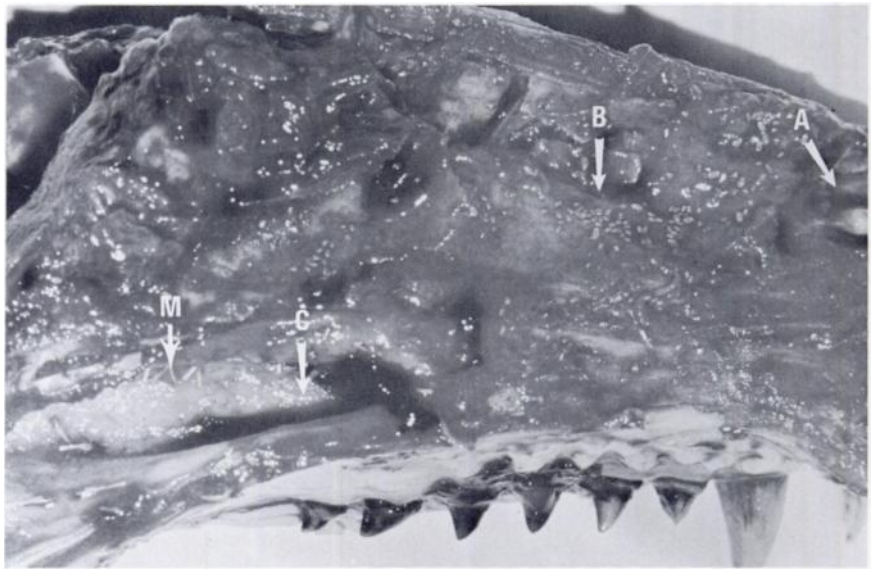

FIGURE 2. Sagittal section of the skull of northern fur seal (subadult male); A-nostril, B-turbinate mucosa with larval mites, C-nasopharynx with adults of *Orthohalarachne attenuata* (M).

FIGURE 3. Larvae of *Orthohalarachne* mites in the turbinate scrolls; A-*O. attenuata*, D-*O. diminuata*.

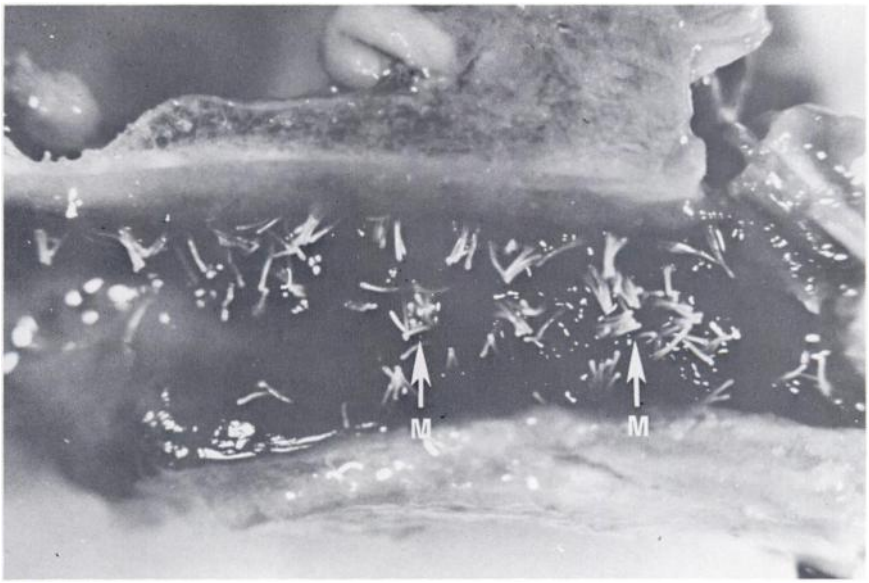

FIGURE 4. Sagittal section of the nasopharynx of subadult male northern fur seal showing heavy infestation of *Orthohalarachne attenuata* adults (M).

hosts. Development of the larvae requires a long period of time and they may survive for longer periods.[9] The octopod protonymphal and deutonymphal instars, which require no food, have a very short duration, usually 16-20 hours each.[9]

Of the total mites collected from 116 samples, *O. attenuata* accounted for 46% and *O. diminuata* represented 54%. In the subadult males the ratio of *O. diminuata* to *O. attenuata* was more than 2 to 1. However, in the adult females and silver pups the density of *O. attenuata* far exceeded *O. diminuata*. The population size of mites on black pups was too small to be meaningful. We are not certain of the cause for this difference.

Among adult mites, females represented about 90% of the total; viz., 92% females for *O. attenuata* and 88% for *O. diminuata*. Of the total mite population the larvae represented as much as 99%. This suggests a high larval mortality during development. Transmission of these mites from host to host is accomplished by hexapod larvae which may be transferred by nose contact[9] or be sneezed from the nostrils of infested animals. *Orthohalarachne* larvae have been found on hairs of the seal skin on several occasions. In the adult seals expiratory dyspnea or prolonged, forced exhalation is commonly observed. It is not uncommon to see mucous material extruded onto the surface of the nose. It appears that this behavior may be related to the heavy infestation of nasal mites in the turbinates. Unlike sucking lice on the seals[12] there is no mass transfer of mites from the nursing cow to new-born pup. New-born pups are free of the mites.

Preliminary histopathological examination based on heavily infested samples from two subadult males showed that the nasal cavities of heavily infested seals had chronic inflammation of the mucous membranes with erosion, hyperplasia and reactive mononuclear and eosinophilic cellular infiltration. In the lung focal edema and congestion, focal fibrosis and pneumonitis were evident and many bronchioles contained edematous fluid and inflammatory cells.

The heavy infestation with *Orthohalarachne* mites appeared to result in impairment of respiration, and probably causes expiratory dyspnea due to the blockage of respiratory passages in fur seals, in contrary to the conclusion of Dunlap *et al.*[7] The heavy mite infestation could also cause lesions in the lungs and secondary alveolar emphysema, predispose to more serious diseases[10] or even kill the host animal.[4] The causes of mortality in fur seal populations are poorly understood because of difficulties in identifying various mortality factors, particularly in the pelagic condition. Hookworms in the fur seal are considered as one of the major causes of mortality in new-born pups. Hookworm larvae occur in the tissues of fur seals of all ages, but adult hookworms occur only in pups.[1,10]

Damage associated with the unexpectedly high level of *Orthohalarachne* infestations must be an important factor affecting the health of northern fur seals particularly in the event that these mites could transmit other pathogens. Thus, the impact of halarachnid mites, as well as that of other internal or external parasites, should be more seriously considered in mortality studies and population analyses of those marine mammals in which they occur.

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