

## *Ectoparasites of Antarctic Seals and Birds*

M. D. MURRAY

*Division of Animal Health, C. S. I. R. O., McMaster Laboratory,  
Glebe, N. S. W., Australia*

**Abstract:** The arthropod fauna decreases from the Subantarctic to the Antarctic, and many of the known species are ectoparasites of seals and birds. These comprise ticks, fleas, feather mites, respiratory mites and lice, both Mallophaga and Anoplura.

Fleas and ticks are represented by species confined to the various Subantarctic islands south of South America or New Zealand, and by circumpolar species. One species of flea is probably circumpolar on Antarctica where it is found in the nests of silver grey fulmars and snow petrels. Most of the ecological studies have been confined to the fleas and ticks which infest penguins. Penguins can be heavily infested with the flea *Parapsyllus magellanicus heardi* and the tick *Ixodes uriae* on Macquarie Island. The severity of the infestations of each species of penguin is largely determined by their breeding and moulting behaviour.

Most of the birds possess more than one species of louse, and penguins are no exception. The feathers of penguins trap an air blanket around the bird when it is swimming, so their lice can multiply whether the penguin is on land or in the sea. Consequently the ecology of penguin lice is probably not unlike that of other bird lice. The lice of seals differ greatly from other mammalian lice, and the lice of the elephant and weddell seal have been shown to multiply only when the seals are ashore. These lice are confined to the tail and flippers of the seal, parts of the body which are associated with thermoregulation. The fluctuations in blood supply and skin temperature of these regions afford more opportunities for the lice to breed when the seal is ashore, and to feed when the seal is at sea.

### 1. Introduction

Modern transport has enabled many scientists to visit the Subantarctic and Antarctic during the summer months, and the benefit of such visits by specialists may be seen in all branches of biology. It has enabled many collections of terrestrial arthropods to be made in recent years, and the principal features of this fauna have been summarised by GRESSITT (1965). The number of genera and species of terrestrial arthropods declines sharply from the Subantarctic to the Antarctic where the majority of the known species are ectoparasites of seals and birds. Ectoparasites comprise a significant proportion of the arthropod fauna of these regions, and in this paper will be given a review of the present knowledge of their biology.

Fleas, lice, mites and ticks are the ectoparasitic types which have been found. Some only visit the host to obtain a blood meal as do fleas and ticks, others live permanently on their hosts. Only the former are exposed to the rigours of the Subantarctic and Antarctic climate but the biology of some of the latter, notably

the lice of seals, has been influenced greatly by the adaptations of their hosts to survive in these regions.

## 2. Fleas

According to DUNNET (1964), the fleas have evolved from stock parasitising mammals and birds in Australia and South America. Some species from each region have become circumpolar in their distribution whereas the distribution of others is restricted, and there is evidence of speciation of several of the species throughout their ranges. The Pygiopsyllidae is a predominantly Australian family although it is represented in Africa and South America. It is represented in the Subantarctic by the genus *Notiopsylla*, of which *N. kerguelensis* Taschenberg is circumpolar whereas *N. enciari* Smit is found on Subantarctic islands in the New Zealand sub-region. The family Rhopalopsyllidae has South American affinities, and is represented by the genus *Parapsyllus*. *P. magellanicus heardi* de Meillon is circumpolar and found on a wide range of hosts which includes penguins; *P. magellanicus* Jordan is found on the Falkland Islands. *P. longicornis* Enderlein is circumpolar with evidence of speciation throughout the region whereas *P. cardinis* Dunnet has only been found on Macquarie I. but there may be speciation of this type throughout the islands of the New Zealand sub-region.

The one flea, *Glaciopsyllus antarcticus* Smit and Dunnet, which is found on Antarctica, is a member of the Ceratophyllidae. It was first found in the nests of the silver-grey fulmar *Fulmarus glacialisoides* (Smith) on Ardery Island, Wilkes 66° 15'S, 110°32'E and in nest material of the snow petrel *Pagodroma nivea* (Forster) from Magnetic Island, Davis 68°34'S, 77°57'E. It is likely that the distribution of *G. antarcticus* is circumpolar as a suitable study area has now been located on the Masson Range near Mawson 67°36' S, 62°52' E, where numerous larvae and adults were found in the nests of snow petrels. It has been recommended that this area be declared a nature reserve to protect the flea, and must surely constitute the first attempt to conserve a member of this order.

Two species of fleas have been introduced comparatively recently into the area. Man has taken *Pulex irritans* L., and *Nosopsyllus fasciatus* Bosc was introduced with its rat hosts, *Rattus norvegicus* Berkenhout and *Rattus rattus* (L.) which are now found on some of the Subantarctic islands.

*P. magellanicus heardi* is widespread and is a common flea of penguins. On Macquarie I. it is found on the rockhopper penguin, *Eudyptes chrysochome* (Forster), and the following summary of their life history is based on the findings of MURRAY and VESTJENS (1967).

Adults may be seen in numbers on the brood patch of penguins, and leave readily when the bird is disturbed. Eggs are laid soon after penguins have returned to nest, and the larvae live and overwinter in the nest where the life cycle is completed within the year. Infestations of penguins are heaviest amongst those which nest in caves or under overhanging rocks, situations sheltered from the rain which is abundant and daily on Macquarie I. Larval and adult *P. magellanicus heardi* drown in water so sodden nests are, unsuitable for survival. The

rockhopper penguin is the only penguin which makes a nest in caves and under rocks on Macquarie I., and consequently is the only penguin infested with fleas. The other species of fleas *P. cardinis*, *N. kerguelensis* and *N. enciari* are found in the burrows of petrels where the nests are sheltered from the weather. It appears that these species also overwinter in the larval stage.

### 3. Ticks

All of the ticks found in the Subantarctic and Antarctic are members of the genus *Ixodes*, and like the fleas some are circumpolar whereas others are restricted in their distribution with evidence of speciation. The commonest species, *Ixodes uriae* White, has a circumpolar distribution on Subantarctic islands, and has been found on the Antarctic Peninsula (GRESSITT, 1965). It is found on a wide range of hosts, all of which are sea birds. In addition, it is found on sea birds in New Zealand and Australia, and has a circumpolar distribution in the Arctic. *I. pterodromae* Arthur is also circumpolar, and is found in the nests of prions and diving petrels. *I. kerguelensis* André and Colas-Belcour has been found on prions and petrels on the Isles de Kerguelen 49°S, 70°E and Heard I. 53°10'S, 73°35'E, and *I. diomedae* Arthur on the yellow-nosed albatross *Diomedea chlororhynchus* Gmelin on Nightingale I. 37°24'S, 12°30'W, Tristan da Cunha. The taxonomy of the other species of the *I. auritulus* Neumann and *I. percavatus* Neumann groups has caused difficulty, and there may be several species involved (ARTHUR, 1960). There is a great need for more collections to be made so that the present unsatisfactory situation may be resolved.

*I. uriae* is abundant on Macquarie I., and heavy infestations of chicks of the royal penguin *Eudyptes chrysolophus schlegeli* Finsch are common (MURRAY, 1964). It is a three-host tick, and the larvae and nymphs drop to the ground to moult. Females lay their eggs in the base of the tussock, *Poa foliosa*, which surrounds the royal penguin colonies or on the rock stacks within the colony area. Oviposition and egg development do not take place in flooded habitats, and for this reason ticks do not breed on the normally wet floor of the colony area (MURRAY and VESTJENS, 1967). Where a colony is on a well-drained hillside, ticks may be found under the stones on the floor of the colony area.

The rockhopper penguin is also commonly infested but not with the same severity as are royal penguins. Occasionally an infested king penguin, *Aptenodytes patagonica* Miller is found but an infested gentoo penguin *Pygoscelis papua* (Forster), has not been found. The different severity with which the four penguin species that breed on Macquarie I. are infested, is related apparently to their breeding and moulting behaviour (MURRAY and VESTJENS, 1967).

Royal penguins nest in large colonies, the locations of which are constant from year to year. The floor of the colony area is devoid of vegetation but it is surrounded with tussock, and rock stacks may be present within the colony. An intensive study of the royal penguin by CARRICK (unpublished data) has shown that no birds are ashore during winter. The adults come ashore to nest in late September and return to the previous nest site. The males and females spend

alternate periods of 18 days ashore during incubation of the egg and the male remains with the chick until it is 3–4 weeks old and vacates the nest to enter a creche. The chick goes to sea by early February. The adults, after a period of feeding at sea, return to moult at the nest site, and eventually depart by April. Immature birds visit the colony site throughout the summer. Thus, penguins are present in numbers in the colonies for 6–7 months, and throughout this period many birds are ashore at the nest site for several days enabling a tick to engorge and drop off. The density of penguins near to regions which favour tick survival appears to be important as *I. uriae* is an active tick, and apparently searches for a host rather than waits passively until one passes. Under such favourable conditions the life cycle of *I. uriae* could be completed within 2 years.

The colony of king penguins on Macquarie I. is extensive and compact like those of royal penguins, and penguins are present throughout the year. High densities occur only during the breeding season as many birds moult elsewhere on the island. However the colony is situated mainly on the beach so there is only restricted contact with the tussock survival area of *I. uriae*.

Rockhopper penguins come ashore to nest in October, return to their previous nest site, make a nest, rear a chick, go to sea for a month and then return to moult at the nest site before going to sea again in March (WARHAM, 1963). Birds are present at the nest site for about 5 months of the year. Their nests are fairly well made, and are scattered throughout the tussock, under overhanging rocks and in caves. The density of penguins never reaches that of the royal penguin, which probably explains why, although ticks are common, they are never found in the same numbers as encountered on a rock stack in a royal penguin colony.

The gentoo penguin also nests in the tussock but the site of the colony often changes 50–100 yards each year on Macquarie I. (Purchase—personal communication), and the nest sites within the colony are the most widely scattered of the penguins. The chicks are active and leave the colony area to chase their parent for food, even to the edge of the ocean, rather than wait in creches in the colony area as do royal, king and rockhopper penguins. Gentoo penguins moult on the beach not in the colony area. Thus, the location of their colony is not permanent, the nests within the colony are well dispersed, and less time is spent in the colony. These factors apparently prevent the establishment of *I. uriae*.

#### 4. Mites

Nasal mites have been found in seals, and it is likely that several species will be found in Subantarctic and Antarctic birds because elsewhere these mites have been found to be widespread in birds. Similarly many species of feather mites of birds may be found, but at present only a few specimens have been collected.

#### 5. Lice

Mallophaga, biting lice, have been found on most of the birds examined, and it is not uncommon to find more than one species on a host. Their forms are

varied but it is unlikely that their biology differs markedly from related species found elsewhere. Penguins are infested, and lice have been found on all the Subantarctic and Antarctic species except the gentoo penguin and the chinstrap penguin, *Pygoscelis antarctica* (Forster). Penguin lice of the genus *Austrogoniodes* are not unlike other types of bird lice, and their biology appears to be basically similar. Penguins maintain an air blanket within their feathers and maintain a warm skin temperature when in water, so it appears that their lice can continue to breed whether the bird is on land or in the sea (MURRAY, 1964, unpublished data).

Anoplura, sucking lice, are found on the seals, and two genera are represented. Both of these genera are restricted to seals and show many modifications, most conspicuous of which is the body covering of thick, flattened setae that are sometimes modified to scales. Species of the genus *Antarctophthirus* are found on the Hooker sealion *Phocarctos hookeri* (Gray), the Ross seal *Omnatophoca rossi* Gray, the leopard seal *Hydrurga leptonyx* (Blainville), the crabeater seal *Lobodon carcinophagus* (Hombrom and Jacquinet), and the Weddell seal *Leptonychotes weddelli* Lesson. *Lepidophthirus macrorhini* Enderlein is the sole representative of the genus, and is found on the southern elephant seal, *Mirounga leonina* (L.). The biology of two of these species have been studied (MURRAY and NICHOLLS, 1965; MURRAY, SMITH and SOUCEK, 1965), and provide an interesting comparison.

*L. macrorhini* is found principally on the hind flippers of elephant seals, and adult lice are transferred from the elephant seal cow to the pup soon after it is born in the spring. Eggs are attached to the base of the hair, and hatch in 5–10 days. The nymphs develop and within *c.* 12 days another generation of adults are present. The whole life cycle takes *c.* 3 weeks, and, as females lay 6–9 eggs daily, *L. macrorhini* has a great potential rate of reproduction. However, multiplication can only proceed at temperatures over 25°C, and females only oviposit on a flipper in air. Consequently, louse multiplication ceases when the pup goes to sea because the skin temperature of the seal drops below 25°C, and water permeates through the hair to the skin surface. A few lice survive 6 weeks without a blood meal at sea temperature but seals go to sea for 3–4 months. Lice must feed weekly if sufficient are to survive until the seal returns to land. Lice on a seal in water will feed, and those on flippers, where heat dissipation with an associated vasodilation occurs more frequently, have more opportunities to feed and more survive. Thus, when the seal comes ashore in winter the density of lice is greatest on the hind flippers. Reproduction commences, particularly on the hind flippers where the skin temperature is >25°C more frequently than elsewhere on the body, and another generation of lice is produced. Elephant seals are gregarious and spend much time ashore lying together in groups with the result that lice are disseminated throughout the seal population. The seal returns to sea and comes ashore again in the summer to moult. The elephant seal sheds both stratum corneum and hair at the moult, and many eggs of *L. macrorhini* are lost. The nymphs and adults however spend much of their lives in a burrow in the stratum corneum, and many survive the moult because only

the roof of the burrow is removed. This annual cycle of events is repeated, and as the elephant seal matures it comes ashore to breed in early spring and to moult in the autumn, staying ashore 3–4 weeks on each occasion and spending the rest of the year at sea. With increasing age the moulting behaviour of the elephant seal changes, and adult females moult in mud wallows rather than on the beach. *L. macrorhini* does not breed on a seal in a mud wallow so there are fewer lice in the population to survive the next period at sea. Thus, there are fewer to repopulate the flipper when the seal returns to land, and the number of lice commences to decline. *L. macrorhini* lives in a habitat which alternates abruptly from terrestrial to aquatic or from warm to cold. Its biology has evolved to utilize any opportunity to multiply rapidly when the elephant seal is ashore and to feed when the elephant seal is at sea.

*Antarctophthirus ogmorhini* Enderlein spread solely from the Weddell seal cow to the pup, and most pups are infested by 6 weeks of age. Like the elephant seal, it is the yearlings and immature seals which are the most heavily infested. *A. ogmorhini* can breed at 5–15°C, and eggs can develop and hatch at 0–4°C. It is found in greatest densities on the flippers, tail and rump of the Weddell seal, regions known to be involved with thermoregulation, and the more variable skin temperatures of these regions favour both multiplication when the seal is on land and feeding when the seal is at sea. The life cycle may be completed in 3–4 weeks, and the louse has the reproductive potential to increase its numbers rapidly whenever the opportunity arises. Such opportunities only arise when the seal is ashore. The life history of this louse appears to be as follows. Pups are infested from the mothers, and the lice multiply rapidly until the pup learns how to swim and spends more time at sea. Pups, immature seals and some adults apparently leave the immediate shores of Antarctica during the winter for pack ice regions where ice is less solid and where they probably haul out of the sea onto the ice regularly throughout the winter. On these seals the lice numbers are maintained or may gradually increase. As seals reach maturity more remain close to the coast of Antarctica throughout the winter, in regions of thick and fast ice where breathing holes are maintained by sawing their teeth, and as a result of spending less time out of the sea the size of their louse populations declines. Larger louse populations are maintained on Weddell seal cows than bulls because the cows spend more time out of the sea due to pupping and tending their young.

Both *L. macrorhini* on the elephant seal and *A. ogmorhini* on the Weddell seal are opportunists. But whereas *L. macrorhini* may breed rapidly for 3–4 weeks twice a year and its metabolism is adapted to survive relatively long periods without food, *A. ogmorhini* may breed for a few hours only, often daily in the summer, and is not adapted to survive long periods without food. However, the temperature range for breeding of *A. ogmorhini* is 5–15°C, so it is truly an Antarctic louse. When their hosts are at sea the metabolic rates of both of these species of lice are minimal, and it appears that sufficient oxygen is obtained by transfusion through their cuticles as neither possesses any visible modifications of their respiratory systems.

## 6. The Future

The difficulties taxonomists have encountered with the inadequate material from the Subantarctic and Antarctic clearly indicates that there is still a great need for general collections of ectoparasites to be made, and particularly for adequate series of the known species to be obtained. The extent of speciation of certain fleas and ticks throughout the Subantarctic islands cannot be assessed until these series have been collected, and it may well be possible to test experimentally the conclusions of the systematists. A sound understanding of the systematics of the fauna is a requisite for future ecological studies. The basic requirements for biological research are now available at many of the stations in the region, and these can easily be augmented with facilities and equipment for more refined techniques so more detailed physiological studies of the adaptations of the fauna to their environments may be contemplated. An attractive feature is the suitability of some of the ectoparasitic fauna for intensive study, and already it has been found profitable to study fundamental problems of ectoparasite-host relationship in the Subantarctic and Antarctic.

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