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tified as serovar *balcanica* occur commonly in possums in Victoria (Durfee and Presidente, 1977, Aust. Vet. J. 53: 508; Durfee and Presidente, 1979, Aust. J. Exp. Biol. Med. Sci. 57: 191–201) and in New South Wales (Milner et al., 1981, J. Wildl. Dis. 17: 197–202). The two serovars, *hardjo* and *balcanica*, cannot be differentiated by conventional agglutination tests and possums infected with serovar *balcanica* develop microagglutination antibody that reacts with *hardjo* antigen (Durfee and Presidente, 1979, Aust. J. Exp. Biol. Med. Sci. 57: 231–240). We tested serum samples for antibodies to serovars *hardjo*, *pomona*, *copenhageni* and *tarrasovi*. Antibodies were not detected to any of the serovars tested.

It is apparent that the brushtail possum may be a host for certain nematode parasites of ruminants. Although detection of specific antibody indicated exposure to two microbiological agents, both occurred at a low prevalence and *T. vulpecula* is therefore unlikely to be an important host or reservoir for these infectious diseases. Helminth specimens have been deposited in the Australian Helminth Collection housed in the South Australian Museum (S.A.M.) (Accession Nos. 14954–14957) and arthropod specimens have been lodged with the Australian National Insect Collection in Canberra and in the S.A.M. Animals were collected with the permission of the South Australian National Parks and Wildlife Service (permit number S01937).

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Feather Loss of Unknown Etiology in a Gull Colony in Newfoundland, Canada

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Since 1966 13,082 herring gull (*Larus argentatus*) and 626 great black-backed gull (*L. marinus*) chicks have been handled and banded during a variety of studies in the Witless Bay Sea Bird Sanctuary, Newfoundland, Canada (e.g., Threlfall, 1968, Can. J. Zool. 46: 1119–1126; Haycock and Threlfall, 1975, Auk 92: 678–697; Threlfall, 1978, Bird-Banding 49: 116–124). During this period no epizootics were observed, and only one mass die-off of chicks occurred, apparently due to adverse environmental conditions (Threlfall et al., 1974, Auk 91: 846–849).

The northernmost island in the seabird sanctuary is Gull Island (47°16′N, 52°46′W) which is the breeding site for more than one million seabirds of eight species (Nettleship, 1980, A Guide to the Major Seabird Colonies of Eastern Canada, Canadian Wildlife Service, Ottawa, Ontario, 133 pp.). In 1984 during a study of the breeding biology of the great black-backed gull on this island 113 nests were found

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with zero to three eggs. The mean clutch size (calculated using only nests with eggs) was 2.5. Of 251 eggs laid 178 (71%) hatched, with 106 (60%) of the chicks fledging. The major food item of this species on Gull Island was fish (Threlfall, 1968, Can. Field. Nat. 82: 176–180).

In late July and early August 1984 13 chicks of approximately fledging age lost all their contour and flight feathers during a 2.5- to 3-day period, except for the outermost four to six primary feathers. Nine chicks were located in eight territories at the interface between monospecific colonies of great black-backed and herring gulls while four others were distributed in a mixed colony of the above two species. The affected birds formed more than 7% of the total number (13/178) of great black-backed gull chicks hatched on the island in 1984. Furthermore 11 herring gull chicks showing similar signs were found in both types of colonies slightly later in the breeding season, but their progress was not followed.

In this study only gross examinations were made, including efforts to demonstrate the presence of mites (Acarina) and biting lice (Mallophaga) using standard techniques (Eveleigh and Threlfall, 1976, Can. J. Zool. 54: 1694–1711; Krantz, 1978, A Manual of Acarology, 2nd Ed., Oregon State Univ. Book Stores Inc., Corvallis, Oregon, 509 pp.). A number of small scab or crust covered lesions (usually <5 mm diameter) were seen where feathers had been lost. Material used to attempt to demonstrate the presence of mites was taken from these regions, and from the bases of feathers that had dropped out or were pulled out. Fresh feathers for examination were obtained from other affected birds. The feathers were easy to remove from their follicles. A small amount of blood was present in the base of the shaft of each feather.

The feathers were lost in a similar order in all affected birds except one which did not shed the neck feathers. The loss of feathers started on the nape and hindneck, but not on the crown or auricular regions where the feathers were never shed. Feather loss then occurred in the following sequence: mantle, back, rump, upper and undertail coverts, rectrices. Scapulars, axillaries, upper- and underwing coverts were then shed simultaneously followed by secondary and primary feathers. Feathers covering the remaining underparts finally were lost in the following order: throat, foreneck, breast, belly and flank, vent, thighs. Only 2.5–3 days were required to complete the sequence of feather loss which left the chicks covered in down, but still possessing crown, forehead, auricular and four to six primary feathers (Fig. 1). Feather loss appeared to be symmetrical and similar to the normal pattern of molt in Laridae. Primary feathers dropped off beginning with number ten at the wrist joint, proceeding outwards; secondaries were shed in random groups of two or three while rectrices appeared to be lost from the center outwards. Not all birds of the same age were found at the same stage of denudation: the onset of feather loss occurred either 42–48 days after hatching, just before the first flight, or after this period at the age of 55 days or more (mean fledging age $\pm$ SD = 48.6 $\pm$ 4.7 days; Roy, 1985, The breeding biology and behaviour of great black-backed gulls (*Larus marinus* L.) in Newfoundland, M.S. Thesis, Memorial University, St. John's, Newfoundland, 105 pp.).

The pattern of feather replacement was not as well defined, but flight feathers and those covering the upperparts grew back first. Feather replacement usually occurred approximately 10 days after the onset of feather loss, but in one case regrowth occurred as early as 4 days after this time; the chick lost all its feathers between days 46 and 48 and was already regrowing the remiges, rectrices and

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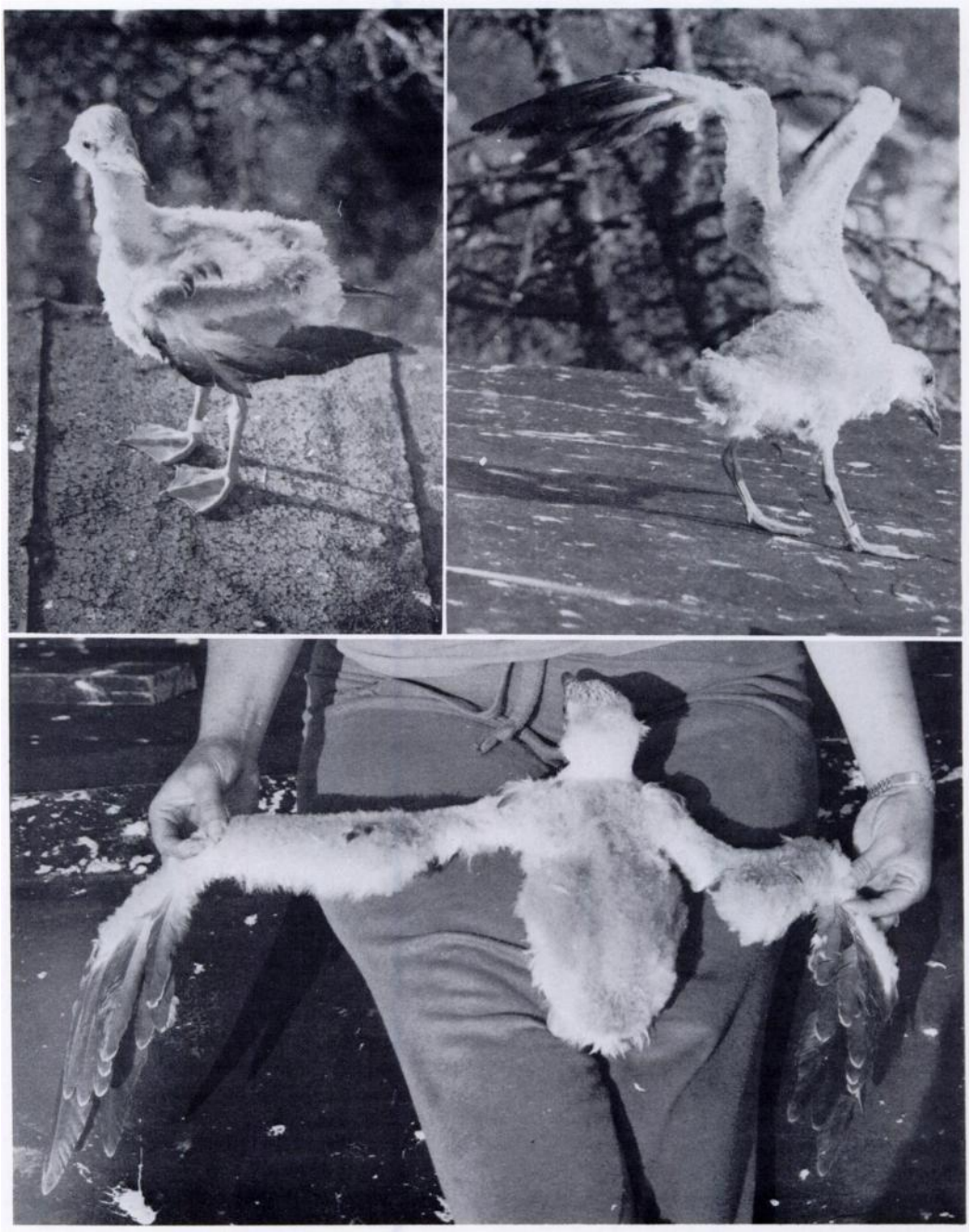


FIGURE 1. Various views of a great black-backed gull chick that lost all its feathers, except for the outermost primaries, crown and auricular feathers, just prior to fledging.

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mantle feathers by day 49. On day 56 the flight feathers varied from 2 to 6 cm in length. The onset and rate of feather replacement among birds that were affected only after fledging was not observed. However, some birds as old as 67 days were still losing feathers. While no definitive statement can be made about survival and fledging success of these individuals it is believed that all the affected birds did fledge, albeit later than their congeners, as no dead birds were found in the areas inhabited by the featherless chicks, or elsewhere on the island.

Feather loss and abnormalities are common in birds but the etiology of many conditions is poorly or not understood. Viral infections, ectoparasitism, nutritional deficiencies and toxicities are known or suspected causes of some of these conditions (e.g., Robel, 1977, Poult. Sci. 56: 1968–1971; Tajima et al., 1977, Avian Dis. 21: 77–89; Wyatt et al., 1975, Poult. Sci. 54: 1042–1045). Reticuloendotheliosis virus and a papovavirus cause feather abnormalities and feather loss in chickens and psittacines, respectively, and it is most probable that a 20-nm icosahedral virus is the cause of French molt (psittacine beak and feather disease) (Pass and Perry, 1984, Aust. Vet. J. 61: 69–74; Pass and Perry, 1985, Aust. Vet. Pract. 15: 55–60). These viral infections produce characteristic lesions in the feather epidermis. As histological studies were not performed on gull feathers/skin it is not known whether changes similar to these viral infections were present. It should be noted that the parents and siblings of affected birds did not show this condition, suggesting that it was not readily transmissible even if it was caused by a virus.

The areas in which the present birds were observed have populations of the tick *Ixodes* (*Ceratixodes*) *uriae* White, 1852 (Eveleigh and Threlfall, 1974, Acarologia 16: 621–635) that obtain their blood meals from the seabirds as well as serving as hosts to a number of viruses (Main et al., 1973, J. Med. Ent. 10: 229–235; Main et al., 1976, J. Wildl. Dis. 12: 182–194).

Taylor (1967, Br. Poult. Sci. 8: 315) has shown that young chicks and turkey poults develop a condition resembling French molt when their diet lacks certain nutrients. It seems unlikely that a nutritional deficiency was the cause of the present feather loss as one would expect all the chicks in a given brood to be affected the same way rather than just one showing a deficiency syndrome, since all are fed the same diet. Despite the efforts to demonstrate the presence of mites the euthanized bird proved to be ectoparasite free. Furthermore, the fresh feathers from other affected birds were also parasite free. Once again if the feather loss was caused by mites, one could reasonably expect all the siblings in a brood and those of adjacent territories to become infested, rather than have the irregular occurrence of the condition throughout the whole gull colony. Environmental factors such as temperature and availability of food were similar to those noted in other years and were not thought to have contributed to the condition. Taylor (1982, French molt, *In* Diseases of Cage and Aviary Birds, M. L. Petrak (ed.), Lea and Febiger, Philadelphia, Pennsylvania, pp. 361–367) noted that many diseases are multifactorial in origin, with several factors contributing in varying degrees to a given condition. The condition reported in this work is of unknown etiology, but may be multifactorial in origin.

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