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Source: Journal of Wildlife Diseases, 20(3) : 245-248

Published By: Wildlife Disease Association

URL: https://doi.org/10.7589/0090-3558-20.3.245

Journal of Wildlife Diseases, 20(3), 1984, pp. 245–248

Carpometacarpal Deformity in Giant Canada Geese (*Branta canadensis maxima* Delacour)

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Waterfowl producers have long recognized an anomaly in certain growing birds characterized by a lateral rotation of the distal end of the carpometacarpus (Fig. 1). This has been termed slipped wing (Ministry of Agriculture, 1960, Bull. 70, 10 pp.), angel wing (Francis et al., 1967, Poult. Sci. 46: 768–769), heeled over wing (Acheson, 1954, Modern Goose Keeping, Lockwood, London, 180 pp.), crooked wing (Flieg, 1970, Int. Zoo. Yearb. 10: 95–98), and drooped or dropped wing (Kear, 1973, Int. Zoo. Yearb. 13: 97–100). The multiplicity of reports implies widespread observation of this phenomenon. This abnormality is reported to be more common in males and affects primarily the left or both wings, but rarely the right wing alone (Wright and Dudley, 1948, Harper Adams Utility Poult. J. 33: 30–31). It has been suggested that this deformity is seen only in birds raised in captivity with the following species being documented in one British report (Kear, 1973, op. cit.): giant Canada goose (*Branta canadensis maxima* Delacour), swan goose (*Anser cygnoides* Linnaeus), Hawaiian goose (*B. sandvicensis* Vigors), Andean goose (*Chloephaga melanoptera* Eyton), Magellan goose (*C. picta* Gmelin), blue-winged goose (*Cyanochen* spp.), Egyptian goose (*Alopochen* sp.), Indian spotbill (*Anas poecilorhyncha* Forster), puna teal (*A. versicolor* Vieillot), New Zealand grey duck (*A. superciliosa* Gmelin), African yellow-bill (*A. undulata* Dubas), chestnut-breasted teal (*A. castanea* Eyton), crested duck (*A. specularioides* King), red-crested pochard (*Netta rufina* Tallas), rosybill (*N. peposaca* Vieillot), mountain duck (*Tadorna tadornoides* Linnaeus), and wild-type muscovies (*Cairina moschata* Linnaeus). However, slipped wing has been documented in free-flying populations of *Cereopis* in South Australia, Mute swans (*Cygnus olor* Gmelin) in Switzerland, semi-wild park mallards (*Anas platyrhynchos* Linnaeus) in England, and Canada geese in Sweden (Kear, 1973, op. cit.). We have been unable to locate a reference verifying slipped wing in free populations of North American waterfowl. This report discusses observations of slipped wing in giant Canada geese in Minnesota.

Since 1981, the University of Minnesota has received for examination nine juvenile giant Canada geese from four different bodies of water located in or around the Minneapolis–St. Paul metropolitan area. All birds were unable to fly and easily captured. The birds were in good flesh with no evidence of trauma or systemic disease. The left wing only of all nine birds was rotated in such a manner as to cause mechanical denudation of the vanes of the distal primaries (Fig. 2). Radiographs were taken of the wings of four of the birds; there was no evidence of fractures or nutritional skeletal disease.

One of the geese was necropsied with detailed dissection of the affected wing. There was rotation of the left carpometacarpus which involved both the third and fourth metacarpals. The result was rotational displacement of the distal bone of nearly 90 degrees laterally (Fig. 3). The proximal one-fourth of the bone, includ-

Received for publication 23 January 1984.

FIGURE 1. Giant Canada goose showing lateral rotation of the left distal carpometacarpus.

FIGURE 2. Denudation of the distal primaries of a giant Canada goose affected with slipped wing.

ing the orientation of the proximal metacarpal symphysis, was normal. The rotation began at approximately the junction of the proximal two quarters of the bone and continued steadily towards the distal end. This resulted in the distal half of the fourth metacarpal being on the posterior-lateral aspect of the third metacarpal rather than directly posterior and slightly medial. The distal metacarpal symphysis was on the posterior-lateral aspect, rather than the normal posterior-medial aspect. The articulation of the distal carpometacarpus with the first phalanx of the third digit was normal, but malpositioned. The carpometacarpal rotation dictated that the wing-like process of the phalanx project laterally, rather than caudally. The bones of the affected wing were shorter than those of the contralateral normal wing. The carpometacarpi were 10.3 cm and 10.7 cm and the phalanges were 4.2 cm and 4.5 cm, respectively. This may reflect disuse of the affected wing.

The exact pathogenesis of slipped wing is unknown. Apparently it is caused by rapid growth of the flight feathers whose increase in weight overcomes the muscular stabilization of the carpal joint. Gravity then pulls the wing tip downward and outward. Some workers have speculated that there is a genetic basis for the wing becoming too heavy to be supported (Serfontein, 1943, Farm. S. Afr. 18: 849–856). However, Francis et al. (1967, op. cit.) concluded that if this condition has a genetic basis in Chinese geese, it must be controlled by more than one gene. Wright and Dudley (1948, op. cit.), on the other hand, found no evidence that slipped wing was inherited in domestic ducks.

Nutrition appears to play a significant role. There is some evidence that elevated protein levels are involved. The protein requirement for wild ducklings is no greater than 19% for the first 3 wk (Acheson, 1954, op. cit.). Other studies have shown that domestic ducklings do well on 15–17% total protein (Scott and Heuser, 1951, Poult. Sci. 30: 161–167; National Academy of Science, 1971, Nutrient Requirements of Poultry, Rev. Ed. No. 6.,

FIGURE 3. Dissected carpometacarpals of a giant Canada goose. The left carpometacarpal (top) shows a 90 degree lateral rotational displacement when compared to the normal right (bottom).

Washington, D.C., 26 pp.). In an unpublished study, Canada geese fed diets containing greater than 20% protein developed slipped wing at a much greater rate than those fed lower levels of protein (Westman, pers. comm.). Kear (1973, op. cit.) has noted that the prevalence of slipped wing has increased among waterfowl fed commercial poultry pellets, especially the high protein turkey starter.

It is speculative why the geese in this particular area develop this anomaly. Diet abnormalities in the form of excess protein or other ingredients may be possible, but there is no evidence that a consistently applied program of high protein feeds was given to these geese. Although the genetic component of this phenomenon is equivocal, it is curious that of the Canada geese species only the giant Canada goose appears to develop this condition. The race of giant Canada geese was once thought to be extinct, but isolated flocks were located in the midwestern USA during the 1960's (Hanson, 1965, The Giant Canada Goose, So. Ill. Univ. Press, Carbondale, Illinois, 225 pp.). Since then, several new flocks have been established. Many of these flocks were started with one or two mating pairs with the resultant population being primarily products of inbreeding. It is thought that the population of giant Canada geese residing in Minnesota arose from a few pairs of geese obtained from North Dakota (Westman, pers. comm.).

Another curiosity of this condition is the preponderance of left wing involvement. It is possible that the left wing grows faster than the right, but there is no evidence to support this (Kear, 1973, op. cit.). It is also possible that in embryological development, the left wing is predisposed to differential stresses. The mechanism of such a stress is unknown.

It is doubtful that this wing deformity has a serious impact on populations of

giant Canada geese as the apparent prevalence is quite low. Park managers, though, should be aware of this problem with measures taken to limit artificial feeding and to remove birds with this condition from the breeding population.

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Idiopathic Scoliosis in a Newborn Sea Otter, *Enhydra lutris* (L.)

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An adult female sea otter, captive since November 1976, was kept at the Seattle Aquarium, Seattle, Washington. Age at captivity was estimated at 3–5 yr. The animal's diet in the aquarium consisted of fish, clams and crabs. The animal was housed with four adult otters in a 211,200 liter pool, 4 m deep, separated from the public by glass walls but open to the seawater of Puget Sound via wire fencing. On 20 November 1982, it gave birth to a female infant. This was its first known pregnancy. The infant was not observed to move and was believed to be born dead. The mother carried the infant to a small ledge at the surface of the pool and proceeded to groom it for 30–40 min. The pup then fell into the pool and sank to the bottom, remaining there for about 5 hr, during which time its head was bitten off by one of the otters.

Five hr following the recovery of the carcass, a gross necropsy was performed at the aquarium, the lungs were infused with formalin and the entire animal, minus the head, was submitted to the Comparative Pathology Laboratory at the University of Washington. Tissues were fixed in 10% phosphate-buffered formalin, dehydrated in alcohol, cleared in xylene and embedded in paraffin. Seven-micron sections were stained with hematoxylin and eosin for general observations, Prussian blue for hemosiderin, PAS for mucopolysaccharides, and Brown and Brenn for bacteria (Luna, 1968, Manual of Histologic Staining Methods of the Armed Forces Institute of Pathology, 3rd Ed., McGraw Hill, New York, 258 pp.).

The carcass, without head and thoracic viscera, weighed 530 g. Length of the spine from neck base to rump was 195 mm. No significant gross lesions other than those attributable to the 2 day post-mortem interval were observed in any of the internal organs. When all abdominal viscera were removed, a 50 mm lateral deviation of the spine to the right was observed from the 5th thoracic vertebra to the thoracolumbar junction (Fig. 1). No gross vertebral or rib anomalies were seen. The deviation appeared to have been present for a long period of time and had resulted in considerable deformation in rib alignment. When the carcass was compressed craniocaudally, the deviation became more accentuated.

Histopathologic examination of the heart, aorta, trachea, esophagus, thymus, salivary gland, thyroid and adrenal glands, uterus, ovary and lungs failed to reveal any significant lesions. No structural abnormalities were observed in muscle, connective tissue or nerves. The lungs were congested, and some alveolar spaces were dilated from infusion of fixative. Some of the epithelial cells lining the bronchioles had a slight brownish discoloration consis-

Received for publication 21 December 1983.