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Clinical examination and necropsy findings of a mountain hawk-eagle (*Nisaetus nipalensis*) that died during rehabilitation

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ABSTRACT. We examined the clinical signs and necropsy findings of a mountain hawk-eagle (*Nisaetus nipalensis*) that died during rehabilitation. The bird was rescued and treated for open fracture of the right forearm. During rehabilitation, the bird could not stand up or fly. Part of the right secondary and left and right primary feathers were removed during rehabilitation; additional fracture was found in the right tibiotarsus and treated. However, the bird died 92 days after rescue and necropsy was performed. Severe hepatic lipidosis and capture myopathy were confirmed by histopathological examinations. These lesions may be associated with the cause of death of this animal. Accumulation of information is expected to contribute to the improvement of effective rehabilitation techniques for raptors.

KEYWORDS: capture myopathy, mountain hawk-eagle, *Nisaetus nipalensis,* rehabilitation

One of the purposes of wild bird rehabilitation is to return the birds to the wild [21] and appropriate rehabilitation methods have contributed to successful reintegration into the wild. Appropriate rehabilitation methods vary by species and type of injury or disease [8]. It is important to note any behaviors and clinical signs of individuals during rehabilitation for return to the wild [3]. The International Wildlife Rehabilitation Council and the National Wildlife Rehabilitation Association [11] has published guidelines on appropriate rehabilitation methods. Some researchers have devised appropriate species-specific rehabilitation methods for rare species, such as the chuditch (*Dasyurus geoffroii*) [16], and common species, such as vervet monkeys (*Chlorocebus pygerythrus*) [7].

Bird carcasses could contribute to improving rehabilitation methods by elucidating the association between the clinical signs during rehabilitation and necropsy findings [15, 20].

Here we report the pathological findings of a mountain hawk-eagle (*Nisaetus nipalensis*) that had died during rehabilitation and discuss its association with clinical management during rehabilitation.

The mountain hawk-eagle was rescued on April 25, 2021, in Nagahama City, Shiga Prefecture (35.5°N, 136.1°E). When the bird was rescued, the right wing was entangled in a net trap. The bird was held in the trap for 4 days. Once released from the net, three lacerations and one open fracture were found in the right-wing forearm, which were treated by a veterinarian. Before treatment, blood was sampled and the serum lead (Pb) levels were measured. The bird was emaciated (body condition score 2/5) when it was rescued [18]. Throat swabs were collected and tested for influenza A virus (ESPLINE Influenza A & B-N; Fujirebio Corp., Tokyo, Japan). After treatment, all right primary feathers were taped. The bird was unable to stand completely for 4 days after being rescued and was managed in a small box that provided a quiet, dark environment. Thereafter, the bird was managed on a perch in a cage (length: 3.0 m, width: 2.2 m, depth: 2.2 m) with a leash attached to the bird's tarsus. During this period, it was confirmed that the bird was hitting the wall with its wings once every few days. From day 14 to 22 post rescue, the right first to eighth primary feathers and first to second secondary feathers were removed. Additionally, on day 16, the first and second left primary feathers and the third to ninth left primary feathers were removed; from day 49 to 62, the first to fifth secondary feathers were removed. Eighty-five days after rescue, a right tibiotarsus fracture was confirmed by X-ray examination and was treated by pinning. Then, itraconazole (Nichi-Iko Pharmaceutical Co., Ltd., Toyama, Japan) 25 mg BID for 10 days, fluoroquinolone antibacterial agent (Victas® S, Sumitomo Pharma

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Animal Health, Tokyo, Japan) 10 mg SID for 12 days, NSAID (Onsior, Elanco Animal Health, Tokyo, Japan) 5 mg SID for 12 days, cimetidine (Tagamet, Sumitomo Pharma Animal Health) 25 mg BID for 12 days were administered. The bird was managed using a hammock until the bone joined, only at night. On day 90, it was found that the pin was not inserted correctly, and the operation was reperformed. The bird died 92 days post rescue. No postoperative complications was noted besides that the bird was anorexic for 1 week before it's death. Vitamin supplements (Nekton-S, NEKTON GmbH, Dammfeld, Germany) were added to the diet on the second day in an attempt. During rehabilitation, the bird was fed a quail (Coturnix japonica) with its wings, internal organs, and head removed. If the bird did not eat, it was force-fed occasionally according to the body mass that should be maintained.

A necropsy was performed, and the internal organs were collected and fixed in 10% neutral buffered formalin for histopathological examination. Blood Pb level was 0.045 ppm, and the influenza A virus test was negative. In the blood test, a thick buffy coat was observed in the blood sample (blood biochemistry test results are shown in Supplementary Table 1 [22]). From the appearance, the bird was young and had no trauma (Fig. 1), and no abnormal findings were observed except for the right and left feathers and right tibiotarsus. The necropsy revealed considerable fat storage (Fig. 2), dilation of the renal vena cava and portal vein, enlarged liver (Fig. 3), and focal discoloration of the left and right pectoral muscles (major axis of 10 mm, minor axis of 5 mm; and major axis of 50 mm, minor axis of 20 mm, respectively; Figs. 4, 5).

Histologically, localized granuloma in the kidney, diffuse fatty degeneration of hepatocytes, and granulomas with nematode-like foreign substances were observed in the left lobe of the liver, proventriculus, and ventriculus. Skeletal muscle degeneration and necrosis accompanied by calcification and macrophage infiltration were observed in the left and right focal discoloration of the pectoralis muscles (Fig. 6). The forearm muscles (ulnometacarpalis ventralis and flexor carpi ulnaris) were atrophied. No abnormalities were observed in other organs.

The histopathological findings suggested severe hepatic lipidosis and capture myopathy. Excessive fat storage during rehabilitation is likely to be associated with hepatic lipidosis. Capture myopathy is caused by excessive muscle movement, especially when wild animals are captured or detained, and results in increased lactic acid level. Therefore, hepatic dysfunction due to hepatic lipidosis and acidosis may be associated with the death of this animal. Release of myoglobin from damaged muscle tissue may cause acute kidney failure and myoglobinuria, however myoglobin casts or renal tubular degeneration were not observed in the present case [2, 5].

In the present case, it is likely that capture myopathy occurred several times. Initial manifestation of astasia may be due to capture myopathy which occurred when the bird was rescued. Besides capture myopathy, astasia can be caused by various etiologies: infectious diseases such as antipestifer infection [13] and Marek's disease [10, 12]; nutritional deficiency such as vitamin E deficiency [1]. Based on the necropsy findings and nutritional management during rehabilitation, such infectious diseases and vitamin E deficiency were unlikely in this case. Next, the skeletal muscle lesions that were observed at the time of necropsy were likely to have occurred a few days before the animal died, because there was little regenerative change and inflammatory cell infiltration. After surgical treatment of the right tibiotarsus fracture, the bird was rehabilitated in a hammock, which may be associated with further damage of the skeletal muscle.

In the present case, feather loss may have been caused by muscle atrophy in the forearm owing to myopathy. As the forearm muscles are located close to the wing shaft [9], it is possible that atrophy of these muscles made it easier for them to be pulled out by external forces such as wing banging against the wall during rehabilitation.

In Japan, 90% of the wildlife rescued are avian species [19]. However, rehabilitation information of rare species is limited, and

Fig. 1. Ventral side of mountain hawk eagle which was rescued April, 25, 2021 in Shiga Prefecture.

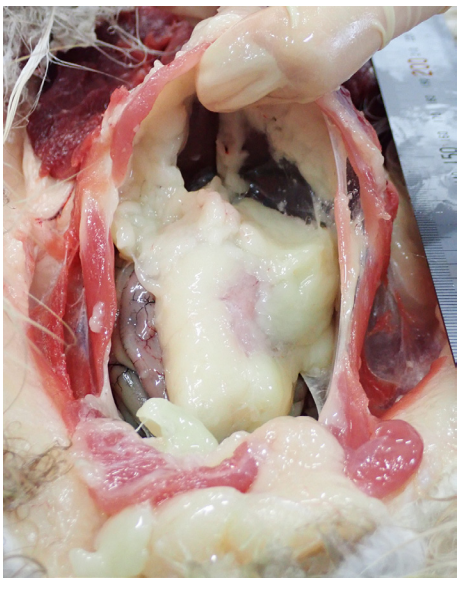

Fig. 2. Fat storage found in the body cavity.

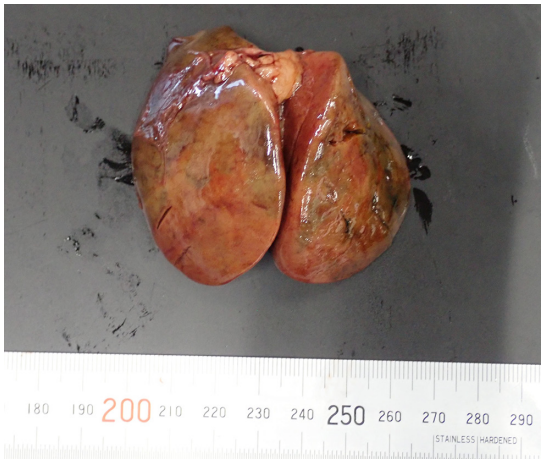

Fig. 3. Cranial aspect of enlarged liver.

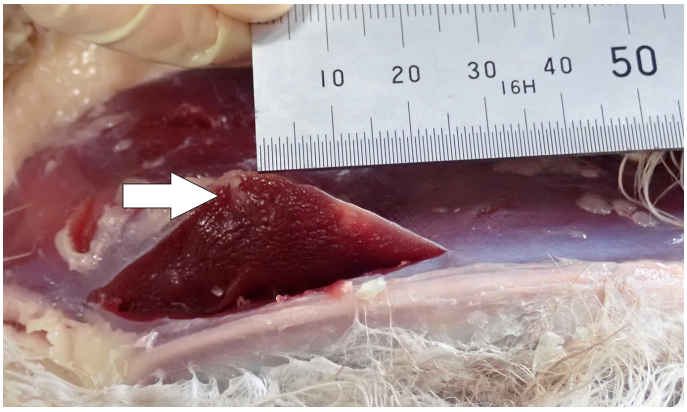

Fig. 4. Focal discoloration (white arrow) of the left pectoral muscle.

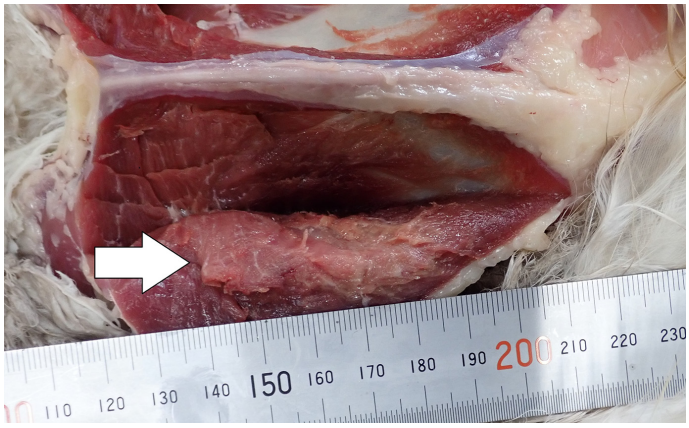

Fig. 5. Focal discoloration (white arrow) of the right pectoral muscle.

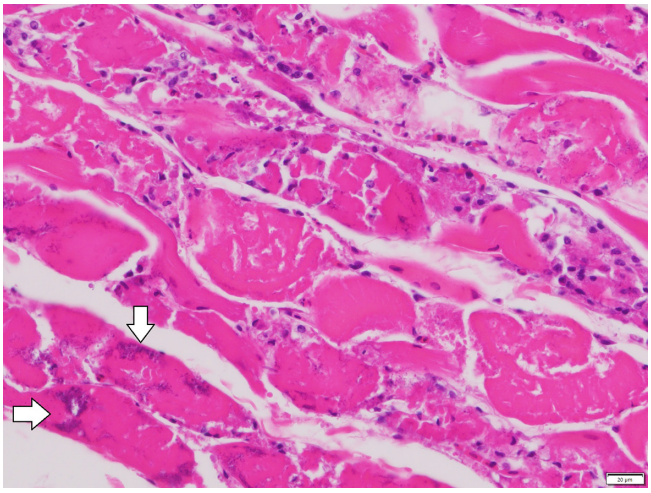

Fig. 6. Degeneration and necrosis of skeletal muscle fibers accompanied by macrophage infiltration and calcification (white arrows).

details of individual cases are often not disclosed. Management techniques differ among raptor species [6], and energy requirements differ with age and sex within the same species [4, 14, 17]. Thus, it is important to report any incidence during wildlife rehabilitation and accumulate information of raptor management.

POTENTIAL CONFLICTS OF INTEREST. The authors have nothing to disclose.

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REFERENCES

1. Armstrong W, Featherston W, Rogler J. 1973. Influence of methionine and other dietary additions on the performance of chicks fed bird resistant sorghum grain diets. *Poult Sci* **52**: 1592–1599. [CrossRef]
2. Breed D, Meyer LCR, Steyl JCA, Goddard A, Burroughs R, Kohn TA. 2019. Conserving wildlife in a changing world: understanding capture myopathy-a malignant outcome of stress during capture and translocation. *Conserv Physiol* **7**: coz027. [Medline] [CrossRef]
3. Cope HR, McArthur C, Dickman CR, Newsome TM, Gray R, Herbert CA. 2022. A systematic review of factors affecting wildlife survival during rehabilitation and release. *PLoS One* **17**: e0265514. [Medline] [CrossRef]
4. Dierenfeld ES, Alcom HL, Jacobsen KL. 2002. Nutrient composition of whole vertebrate prey (excluding fish) fed in zoos. National Agricultural Library Z7994.Z65. http://www.nal.usda.gov/awic/zoo/WholePreyFinal02May29.pdf [accessed on May 10, 2022].
5. Fogo AB, Lusco MA, Najafian B, Alpers CE. 2016. AJKD atlas of renal pathology. *Am J Kidney Dis* **67**: e31–e32. [Medline] [CrossRef]

6. Greene DM, Engelmann M, Steck TR. 2004. An assessment of cage flight as an exercise method for raptors. *J Raptor Res* **38**: 125–132.
7. Guy AJ, Curnoe D. 2013. Guidelines for the rehabilitation and release of vervet monkeys. *Primate Conserv* **2013**: 55–63. [CrossRef]
8. Hall E. 2005. Release Considerations for rehabilitated wildlife. pp. 1–12. National Wildlife Rehabilitation Conference, Surfers Paradise, Queensland.
9. Hieronymus TL. 2016. Flight feather attachment in rock pigeons (*Columba livia*): covert feathers and smooth muscle coordinate a morphing wing. *J Anat* **229**: 631–656. [Medline] [CrossRef]
10. Hirayama T, Ushiyama K, Osa Y, Asakawa M. 2014. An overview of infectious diseases recorded from wild birds in Japan. *Bird Research* **10**: V1–V13 (in Japanese).
11. International Wildlife Rehabilitation Council and National Wildlife Rehabilitators Association. 2021. Standards in Wildlife Rehabilitation, International Wildlife Rehabilitation Council, Eugene.
12. Katzen S, Matsuda K, Reid BL. 1969. Amelioration of Marek's disease by *Mycoplasma gallisepticum*. *Poult Sci* **48**: 1504–1506. [Medline] [CrossRef]
13. Leavitt S, Ayroud M. 1997. Riemerella anatipestifer infection of domestic ducklings. *Can Vet J* **38**: 113. [Medline]
14. Melin T. 2020. Dietary Preferences of Golden Eagles (*Aquila chrysaetos*) in Sweden: a Camera Trap Approach. Epsilon Archive for Student Projects, Swedish University of Agricultural Sciences, Uppsala.
15. Obón E, Molina R. 2010. Wildlife Forensics as Tool for Raptor Conservation. Falco. *The Newsletter of the Middle East Falco Research Group* **13**: 13–15.
16. Orell P, Morris K. 1994. Chuditch recovery plan. Wildlife Management Program No. 54. Department of Environment and Conservation, Government of Western Australia.
17. Panter CT, Amar A. 2021. Sex and age differences in the diet of the Eurasian Sparrowhawk (*Accipiter nisus*) using web-sourced photographs: exploring the feasibility of a new citizen science approach. *Ibis* **163**: 928–947. [CrossRef]
18. Reid C. 2008. Exploration avoidance and an anthropogenic toxin (lead Pb) in a wild parrot (Kea: *Nestor notabilis*). A thesis submitted to the Victoria University of Wellington in partial fulfilment of the requirements for the degree of Master of Science in Ecology and Biodiversity, Victoria University of Wellington, Wellington.
19. Suda O, Okubo T, Kanesaka H, Baba K, Ikeya H, Shibata S, Nakatsu S, Takashima K, Nakamura A, Niizuma I, Morita T. 2009. Bird's ecology and prognosis as seen from a chart summary. *WRV News Letter* **71**: 3–8 (in Japanese).
20. Viner TC, Hamlin BC, McClure PJ, Yates BC. 2016. Integrating the forensic sciences in wildlife case investigations. *Vet Pathol* **53**: 1103–1106. [Medline] [CrossRef]
21. Wimberger K, Downs C, Boyes R. 2010. A survey of wildlife rehabilitation in South Africa: is there a need for improved management? *Anim Welf* **19**: 481–499.
22. Yamazaki T. 2005. Hematology and blood chemistry values of the Japanese Mountain Hawk Eagle *Spizaetus nipalensis orientalis*. Asian Raptor Research & Conservation Network. The 4th Symposium on Asian Raptors. ARRCN, Malaysian Nature Society, Taiping.