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# BIRD INJURIES, CAUSE OF DEATH, AND RECUPERATION FROM COLLISIONS WITH WINDOWS

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Abstract.—Three hundred fatalities and 31 survivors were studied to determine the types of injury, cause of death, and recuperation from collisions between birds and windows. The consequences of collisions depend on the momentum with which birds hit glass panes. The effects of window strikes for birds ranged from no visible damage to fractured bones and superficial and internal bleeding. Skeletal fractures were rare. Every fatality sustained intracranial hemorrhaging which suggests that the cause of death was ruptured blood vessels and brain damage resulting from the impact. Survivors also sustained extensive intracranial hemorrhaging, and one individual exhibited increased paralysis over time. Other survivors appear unharmed immediately after the strike or recuperate for varying periods of time before recovering completely. To increase the chance of initial recovery, place stunned or unconscious survivors in a protected enclosure isolated from excessive stimulation; keep the enclosure warm and provide food and water.

**HERIDAS, CAUSAS DE MUERTE Y RESTABLECIMIENTO DE AVES QUE CHOCAN CON VENTANAS**

Sinopsis.—Trecientas fatalidades y 31 sobrevivientes, fueron estudiados para determinar el tipo de daño, causa de muerte y restablecimiento de aves que chocan con el cristal de ventanas. Las consecuencias de estas colisiones dependen del momentum del pájaro al instante del choque. El efecto de los choques varió desde ningún daño visible hasta huesos fracturados y sangramiento superficial o interno. Las fracturas fueron ráras. Las aves muertas presentaron hemorragia intracraneal, lo que sugiere que la causa del deceso fue el resultado de la ruptura de vasos sanguineos y del daño cerebral a causa del impacto. Los sobrevivientes también mostraron hemorragias intracraneales, y un individuo exhibió una parálisis que progresó con el pasar del tiempo. Otras aves que no murieron, parecieron no sufrir daño de inmediato, otras se recuperaron totalmente a lo largo de diferentes periodos de tiempo. Para aumentar la probabilidad de que un ave se recupere, debe colocarse el pajaro en un lugar aislado. El lugar debe mantenerse cálido y se debe proveer al ave con alimento y agua.

Window strikes have fatal or debilitating consequences for birds (Klem 1979; Klem, in press). Previous accounts of bird injuries resulting from window collisions are based on single specimens or unreported sample sizes. The injuries and cause of death are described generally as head injuries (Keil 1964), and more specifically as skull, neck, or wing fractures (Townsend 1931, Dunbar 1949, Valum 1968, Diederich 1977) or internal hemorrhaging (Dawson and Dalby 1973). The most thorough account is a note by Blain (1948); using an X-ray and necropsy he reported a female pheasant (*Phasianus colchicus*) that sustained a basal fracture of the skull with massive hemorrhaging into the brain. A better understanding of the range of consequences resulting from window strikes may aid persons attempting to rehabilitate survivors. In this study I use a large sample to

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describe the different types of collision injuries, the cause of death if the strike was fatal, and the recuperation and subsequent consequences for survivors.

Three hundred window-killed specimens were collected at commercial and private buildings in southern Illinois. Each fatality received a complete superficial examination followed by removal of the skin and recording of all visible injuries to the head and neck. Four specimens were x-rayed: a Yellow-billed Cuckoo (*Coccyzus americanus*), Black-and-White Warbler (*Mniotilta varia*), Ovenbird (*Seiurus aurocapillus*), and Dark-eyed Junco (*Junco hyemalis*). The Ovenbird was x-rayed to better illustrate the skull fractures it sustained; the other three specimens were x-rayed to determine if they had sustained fractures not evident from a detailed superficial examination. All specimens were placed in the Department of Zoology bird collection at Southern Illinois University at Carbondale (now cataloged in the Natural History Museum, Department of Biology, Muhlenberg College). Notes on possible cause of death indicated by the posture of the victim were recorded at most collision sites.

If the bird survived and flew off, the time required to recuperate and the behavior during this period were recorded. Recuperation period is defined as the elapsed time from impact to unassisted departure from the collision site or the appearance of normal activity.

The consequences of window strikes vary greatly for individual birds. Some are killed instantly. Others are knocked unconscious or stunned and later succumb to their injuries or scavengers, or they recover enough to fly off weakly, but seemingly unharmed. Still others appear startled, but unaffected and fly off immediately after impact.

External and internal injuries were sustained by window-killed birds. The most obvious external injuries were broken bills. Evidence of internal injury was indicated by blood and fluid leaking from the mouth and nostrils. Internal examination revealed that every window fatality sustained some intracranial hemorrhaging (Fig. 1). X-rays showed no cervical and only one obvious skull fracture (Fig. 2). Internal injuries sustained by birds that survived window strikes were determined from two specimens that were sacrificed after appearing alert, active, and completely recovered 2 and 4 h after the collision. Both birds sustained severe intracranial hemorrhaging (Fig. 3).

Window strike survivors exhibited different periods of recuperation. Of 28 survivors at one house, 12 (42.9%) flew off after a known period, 8 (28.9%) flew off immediately after impact, 7 (25.0%) were discovered stunned but were gone a short, but unknown time later, and 1 (3.6%) was discovered stunned, but gone 50 min later. Documented recuperation times for specific species were (min): 480 for Virginia Rail (*Rallus limicola*, $n = 1$), 15–28 for Yellow-billed Cuckoo ($n = 2$), 15–140 for American Robin (*Turdus migratorius*, $n = 5$), 20 for Tennessee Warbler (*Vermivora peregrina*, $n = 1$), 375 for Nashville Warbler (*Vermivora ruficapilla*, $n = 1$), 5–75 for Dark-eyed Junco ($n = 8$), and 65 for White-crowned Sparrow (*Zonotrichia leucophrys*, $n = 1$). After impact, the rail remained uncon-

FIGURE 1. Differential extent of intracranial hemorrhaging (darkened or shaded areas of skull) in four window-killed White-crowned Sparrows (*Zonotrichia leucophrys*).

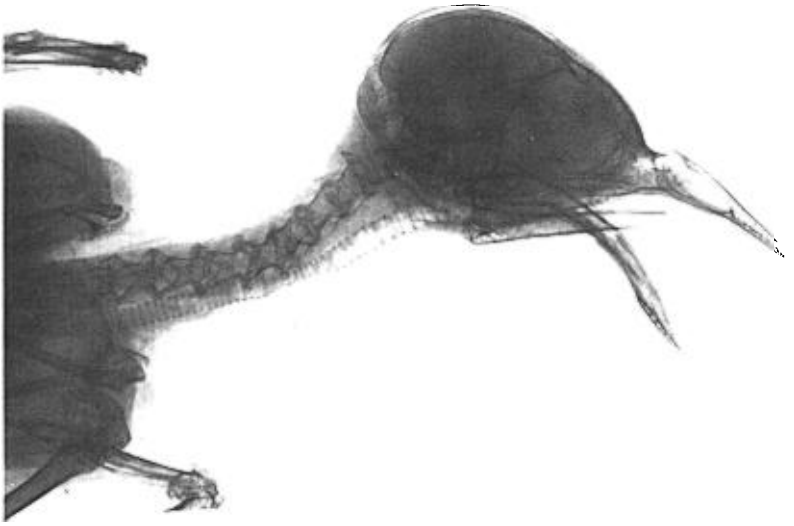

FIGURE 2. X-ray showing fracture of maxilla and mandible of window-killed Ovenbird (*Seiurus aurocapillus*).

FIGURE 3. Extent of intracranial hemorrhaging (darkened or shaded areas of skull) in Yellow-breasted Chat (*Icteria virens*, left) and White-throated Sparrow (*Zonotrichia albicollis*, right) that appeared to initially survive and recover from a window strike.

scious for at least 8 h, was held in captivity for approximately 12 h thereafter, and recovered enough to appear alert, normally active, and fly off seemingly unharmed after release.

Treatment of an Evening Grosbeak (*Coccothraustes vespertinus*) revealed the potential after effects of collisions. After hitting a window the bird was placed in a cage for care and observation. It exhibited increasing paralysis over a 3 wk period, and when it could no longer move about and feed it was sacrificed. A massive blood clot was found in the brain, and the clot is suspected of causing its progressive paralysis. In contrast, M. T. Butler (pers. comm.) provided evidence that some birds can recover and survive for extended periods. He documented an after-hatching-year Indigo Bunting (*Passerina cyanea*) that was banded (No. 7249888) on 13 May 1975 after stunning itself against a window in Halton Co., Ontario. Almost to the day, the same bird struck the same window and killed itself one year later on 15 May 1976.

The behavior of birds that initially survived the effects of impact was generally similar. If knocked unconscious, they remained motionless, usually lying on their side and seemingly breathing slowly and regularly. After regaining consciousness or if only stunned initially, they sat upright with their body resting on their legs and feet and appeared to be breathing deeply by slowly opening and closing their mouth. At this point, they either stopped moving their mouth, breathing appeared faint, eyes slowly closed, and they slumped and fell over dead; or heavy breathing and

mouth movements became less frequent and exaggerated and eventually stopped, they appeared to be breathing without stress, and after a period that varied with each bird, they raised up on their legs and flew weakly, but directly to the ground or a nearby perch within cover.

I found no evidence to support the common suspicion that birds die of a broken neck from striking windows. No specimens were found to have any form of cervical fracture, and it is likely that neck injury is frequently assumed due to the natural flexibility of the avian cervical region, especially in freshly killed specimens.

Regarding treatment, to increase the chance of initial recovery, place survivors in a protected enclosure isolated from excessive external stimulation. Keep the enclosure warm and provide the bird with food and water.

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## LITERATURE CITED

BLAIN, A. W. 1948. On the accidental death of wild birds. Jack-Pine Warbler 26:59–60.

DAWSON, G. A., AND P. L. DALBY. 1973. A goshawk-thermopane encounter. Jack-Pine Warbler 51:128.

DIEDERICH, J. 1977. Vogelverluste an Glasfläechen des Athenäeums in Luxemburg. Regulus 12:137–139.

DUNBAR, R. J. 1949. Birds colliding with windows. Migrant 20:12–15.

KEIL, W. 1964. Der Gläserne Tod. Gefährdung der Vogelwelt durch Glaswände. Vogel-Kosmos 1:184–186.

KLEM, D., JR. 1979. Biology of collisions between birds and windows. Ph.D. dissertation Carbondale, Southern Illinois Univ.

———. In press. Bird-window collisions. Wilson Bull.

TOWNSEND, C. W. 1931. Tragedies among Yellow-billed Cuckoos. Auk 48:602.

VALUM, B. 1968. Fugledød mot glassvergger. Sterna 8:15–20.

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