

Suspected road salt poisoning in Bohemian Waxwings *Bombycilla garrulus* (Aves: Passeriformes: Bombycillidae)

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> Abstract

The effect of road salts on wintering birds is a serious but recently underreported environmental threat. With the example of Bohemian Waxwings, *Bombycilla garrulus*, it is discussed that seemingly straightforward explanations, e.g. window collisions, may obscure the primary cause of wrecks. Therefore I argue that birds, particularly those with high daily water intake like the frugivorous waxwings, may consume high concentrations of dissolved road salt with melt water. A review of literature made apparent that salt overdoses lead to aberrant flight behaviour and impaired manoeuvrability, which render them likely to fall victim of road traffic or to collide with windows. It is discussed that undetected road salt poisoning might explain many ambiguous cases of lethal accidents of wintering birds in urban surroundings.

> Kurzfassung

Streusalze stellen eine ernste, aber aktuell selten dokumentierte Gefährdung für überwinternde Vögel dar. Am Beispiel des Seidenschwanzes, *Bombycilla garrulus*, wird diskutiert, dass scheinbar naheliegende Erklärungen für massenhafte Todesfälle, wie zum Beispiel Fensterkollisionen, unter Umständen die tatsächliche Todesursache verschleiern können. Gerade bei Vögeln wie den fruchtfressenden Seidenschwänzen, die täglich große Wassermengen zu sich nehmen, liegt die Vermutung nahe, dass sie hohe Konzentrationen gelösten Streusalzes mit ihrem Trinkwasser aufnehmen. Aus der Literaturdurchsicht wird deutlich, dass Salz-Überdosen bei Vögeln tatsächlich ein gestörtes Flugverhalten und stark beeinträchtigte Manövrierfähigkeit zur Folge haben, was die Wahrscheinlichkeit erhöht, dass sie dem Straßenverkehr zum Opfer fallen oder mit Fensterscheiben kollidieren. Daher wird diskutiert, dass nicht diagnostizierte Fälle von Streusalz-Vergiftungen durchaus manche unklare tödliche Unfälle von überwinternden Vögeln im urbanen Umfeld erklären könnten.

> Key words

Road salt poisoning; salt toxicosis; waxwing; *Bombycilla garrulus*; *Bombycilla cedrorum*.

Introduction

Road salt poisoning is a serious but underreported wintertime threat to European birds. In contrast to many northern countries, where road salt has been recognised as a serious threat to many bird species for years (for example, Environment Canada, 2001; MINEAU & BROWNLEE, 2005), the topic has never been the focus of attention of Central European ornithologists. Moreover, salt toxicity itself has been underestimated as a direct cause of mortality for a long time (MINEAU & BROWNLEE, 2005). Based on an ambiguous case of a

wreck of Bohemian Waxwings *Bombycilla garrulus*, I review road salt ingestion as a hazard of particular importance for waxwings.

The waxwing wreck of 2005

Bohemian Waxwings are typical breeding birds of the boreal forests of the very northern latitudes of Scandinavia and Russia and perform fairly regular and

widespread irruptive winter movements to Central and Western Europe, sometimes even to Southern Europe (GLUTZ VON BLOTZHEIM, 1985; ROSELAAR, 1988; HELLE & PAKKALA, 1997). In the winter of 2004/05 such an exceptional invasion of Bohemian Waxwings took place all over Europe. In the vicinity of Dresden (Saxony, Germany) flocks of more than 600 birds were recorded (ANDREAS KNOLL, unpubl. data).

On 5th and 6th March 2005 about 28 dead or obviously affected Bohemian Waxwings were found in Dresden's city centre. They were discovered on the ground next to a building that is situated directly at a crossing of two major four-lane roads. Some of the birds involved in the incident were alive, yet obviously dazed and unable to fly. Two of them were taken to the local Zoological Garden, where one eventually died whereas the second one recovered after some days. The surviving bird was released, the dead one was sent to the Zoological Museum Dresden. Another two dead waxwings were sent to the Veterinary Institute Saxony.

Firstly, intoxication by nutrition was assumed as a potential cause of the accident. Therefore BARBARA DITSCH (Botanical Garden Dresden) undertook a microscopic examination of the bird's stomach content. However, the examination revealed *Malus* and *Cotoneaster* seeds which are non-toxic or only weakly toxic and are thus not suspected to cause a lethal intoxication. Secondly, the birds were checked for signs of collision (e.g. into windows), which usually cause various fractures of the skull or of the bones of the upper body. While the two birds post mortemmed at the Veterinary Institute did not show any sign of collision injuries, the individual (collection number C 62905) sent to the Zoological Museum did (HEIDEMARIE TÜRK and JENS ZIEGLER, pers. comm.). Because the skeletons turned out to be intact at least in some of the individuals, collision could be excluded as the primary and solely cause of death. That is why I presume that road salt poisoning could have played a role as a third potential cause of the incident.

Effects of road salt on waxwings and other songbirds

During the first week of March 2005, daily temperatures to below -10°C and unusual high precipitation caused a complete snow cover in the Dresden city area. As a consequence of the high amount of road de-icing salt spread, a number of roadside melt water puddles appeared despite the low temperatures. They were the only sources of liquid water available to birds during this period. Since these puddles probably contained high concentrations of dissolved road salt, poisoning by melt water could be a possible explanation for the

primary cause of death of the Bohemian Waxwings found in Dresden. This argumentation receives support by the study of MINEAU & BROWNLEE (2005) who also mention the possibility of an increasing salt ingestion of birds that drink from road salt-contaminated snow melt. Since waxwings are mainly frugivorous, their carbohydrate-rich nutrition (preferably rowanberry *Sorbus aucuparia*) forces them to balance their daily water budget by taking up particularly large quantities of fresh water throughout the day (GLUTZ VON BLOTZHEIM, 1985; MOUNTJOY, 2005). Additionally, due to the low nutrient content of berries they consume large food quantities which in turn requires a frequent substitution for dietary dehydration. Data on the closely related Cedar Waxwing *Bombycilla cedrorum* reveal a daily excretional water loss that is at least twice the amount of total body water (42.0 g, STUDIER *et al.*, 1988). Although there are contradicting results concerning food choice in Cedar Waxwings for water-rich berries (PHERSON, 1987; WITMER, 1996), the water content of fruits, however, cannot balance excretional water loss. Nonetheless, it is known that both Bohemian and Cedar Waxwings eat snow (e.g. GLUTZ VON BLOTZHEIM, 1985; MULHAUSER & ZIMMERMANN, 2005; BREHM & SCHRUMPF, 2006) in the absence of liquid water and therefore it is possible that snow ingestion could counteract the effects of salt toxicosis. Thus waxwings with their extraordinary water consumption seem to be particularly threatened in urban surroundings, where a lot of berry shrubs and trees are to be found. If water with such an enormous concentration of dissolved salt is taken up, it causes a very rapid dehydration that leads to a breakdown of essential body functions. As the physiological shock happens very quickly, no pathological changes in the involved inner organs (digestive tract, liver, brain) are visible (BOLLINGER *et al.*, 2005). This would explain the virtually good condition of the inner organs of the birds found in Dresden. Moreover, it is reasonable to assume that the obvious dazed behaviour of the surviving birds has been a consequence of a preceding salt intoxication. Although window collision could have caused the death of some birds (and the disorientation of the survivors) it also might have been only a secondary effect of salt intoxication.

In contrast to other terrestrial birds known to take up considerable amounts of (road) salt voluntarily (particularly crossbills *Loxia* spp.: MEADE, 1942; DAWSON *et al.*, 1965; BENNETS & HUTTO, 1985), waxwings have not been reported to consume salt actively. Furthermore, ingestion of salt crystals as grit, which is typical of granivorous birds that feed on coarse food items seems to be unnecessary for fruit-eating waxwings. However, similar cases of songbirds that died under comparable circumstances are repeatedly reported in the literature (for instance, MEADE, 1942; TRAINER &

KARSTAD, 1960; BAKER, 1965; OESER, 1977; BAETEN & DEIN, 1996; Environment Canada, 2001). Since most of the incidents refer to birds killed by motor vehicles, it was not always possible to distinguish between ultimate and proximate death causes. In many cases, however, there are observations of aberrant behaviour including dizziness, disorientation and reduced flight distances after the birds consumed road salt or drank from roadside melt water puddles. As shown experimentally, the behavioural alterations mentioned are symptoms of excessive salt consumption (TRAINER & KARSTAD, 1960; BOLLINGER *et al.*, 2005; MINEAU & BROWNLEE, 2005). Such behavioural incapacities render very likely that the birds fall victim of road traffic or collide with windows. Indeed, window collisions represent very common lethal accidents in urban surroundings (e.g. 105 of 119 individuals in Switzerland; see WINKLER, 2006), but a distinction between primary and secondary causes cannot always be made, too.

The only similar symptoms could be signs of alcohol intoxication following ingestion of fermented berries which also has been suspected to have negative effects both on coordination ability and liver condition of waxwings. Indeed, among passerines Bohemian Waxwings have exceptionally large livers of up to about 9.5 % body weight supposed to be necessary for glycogen production and storage as well as for detoxification of fruit toxins or alcohol (PULLIAINEN *et al.*, 1981; ERIKSSON & NUMMI, 1983; GLUTZ VON BLOTZHEIM, 1985). However, Bohemian Waxwings have a considerably high alcohol metabolism rate (900 mg/kg/h) as an adaptation to the increasing alcohol content of their food during mid-winter. Under experimental conditions the birds' blood alcohol never reached levels high enough to impair behaviour or movements (ERIKSSON & NUMMI, 1983). Nonetheless, in some waxwings found dead after window collisions, blood and liver alcohol contents were up to 730 and 989 mg/kg, respectively (FITZGERALD *et al.*, 1990; STEPHEN & WALLEY, 2000). Such doses might lead to affected coordination, at least temporarily. Because no alcohol test was performed in the case described herein, potential side-effects of alcohol have to remain open.

Pathological signs for road salt poisoning

Clinical reference data on salt toxicosis in birds is based entirely on pure sodium chloride or sodium chloride solutions, but there is nothing known about possible harmful effects of additional road salt chemicals. Road salt basically consists of more than 95 % sodium chloride NaCl to which several soluble and insoluble chemicals are added (e.g. calcium chloride CaCl₂ or magnesium chloride MgCl₂, Environment Canada,

2001). Experimental studies in House Sparrows *Passer domesticus* show that solutions with a concentration of 8000 mg sodium chloride per kilogram body weight have a lethal effect, whereas clinical signs are observed at much lower concentrations (BOLLINGER *et al.*, 2005) with a minimum effect level at 266 mg/kg (MINEAU & BROWNLEE, 2005).

Pathological signs indicating salt poisoning are, for instance, reddening and congestion of the brain, visceral gout, fluid accumulation and microscopic pathologic changes in the brain stem and cerebellar areas (for details see TRAINER & KARSTAD, 1960; FRANSON & FRIEND, 2001; METEYER *et al.*, 1997; GORDUS *et al.*, 2002; BOLLINGER *et al.*, 2005). However, a focused search of potential macroscopic alterations in brain and digestive tract of the waxwing taken to the Zoological Museum failed to reveal any visual aberrations. Nonetheless, some of these symptoms are not specific for salt poisoning alone whereas acute salt intoxication can also happen without any pathologic symptoms (BOLLINGER *et al.*, 2005). As a concentration-depending process, a certain amount of dissolved salt may be harmless as long as fresh water is available (BAETEN & DEIN, 1996; BOLLINGER *et al.*, 2005). This might be the reason for the convalescence of one waxwing taken to the Zoological Garden, where enough fresh drinking water was provided.

Conclusions

On grounds of the described circumstances and physiological peculiarities of waxwings I suppose that acute dehydration due to massive intake of road salt-containing melt water could have been the initial cause for the waxwing calamity in Dresden. I am aware that this deductive argumentation is based on just a few birds involved in the incident. But even though the examination results could not resolve unambiguously the initial cause of death, meteorological conditions, massive use of road salt and behavioural deteriorations of waxwings deliver some indications for road salt toxicosis. It would be highly desirable if ornithologists would remind road salt poisoning as a serious threat to wintering birds and if veterinary examinations of dead birds would be performed considering this potential cause.

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