Vet Record CaseReports

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TITLE OF CASE

Plastic ingestion in an emaciated red kite (*Milvus milvus*) in England.

SUMMARY

The red kite (*Milvus milvus*) was successfully reintroduced into England from 1989, though the population continues to face anthropogenic threats. In this report, we describe evidence of plastic ingested in the ventriculus of an adult male red kite which was emaciated. In addition, dried blood was found on the feathers overlying both wings and subcutaneous haemorrhage was identified. Toxicology tests revealed toxic levels (>100 ng/g) of second-generation anticoagulant rodenticides (SGARs), (difenacoum 3.0 ng/g, brodifacoum 734.9 ng/g), in the liver of this red kite. Three possible contributors to mortality were considered: starvation from the ingestion of plastic preventing normal digestion, collision-related trauma and SGAR poisoning. This is the first report of plastic ingestion in a red kite. The case highlights the importance of carrying out post-mortem examinations as part of post-release health surveillance and identifies plastic ingestion as a potential anthropogenic threat facing the red kite population in England.

BACKGROUND

The red kite (*Milvus milvus*) is endemic to the Western Palearctic, with an estimated worldwide population of 20-24,000 breeding pairs (1). The species is listed as 'Near Threatened' by the International Union for Conservation of Nature (IUCN) and is experiencing a 'moderately rapid population decline' in Europe (1). Poisoning is an important threat to this species, through either illegal persecution, indirect poisoning from pesticides or secondary poisoning from consumption of contaminated rodents (1,2).

Red kites were once abundant throughout the UK but were extirpated from England by the nineteenth century due to human persecution (3). Following an assessment by the International Union for Conservation of Nature (IUCN) (4), a total of 326 red kites were introduced in England between 1989 and 2006 (3). The successful reintroduction of the red kite in England has led to rapid population growth, with sample surveys suggesting that over 3,000 breeding pairs currently exist in England, representing more than 10% of the global population (3). Post-release health surveillance is ongoing for red kites in England and Wales, and post-mortem examinations (PME) are undertaken by the Institute of Zoology's Disease Risk Analysis and Health Surveillance project (DRAHS). A number of threats have been identified since their reintroduction, many of which are anthropogenic (5). Previous work has shown that road traffic accidents and poisoning through ingestion of lead pellets and second-generation anticoagulant rodenticides (SGARs) (6,7) may be slowing the recovery of red kites in the UK (3).

Plastic ingestion has not previously been reported in red kites, or in any free-living birds in the UK, but has been described in other raptor species elsewhere, for example, in the California condor (*Gymnogyps californianus*) which resulted in the death of nestlings (8). Reports of vultures ingesting anthropogenic material is widely documented, such as in the turkey vulture (*Cathartes aura)* (9), the Eurasian griffon (*Gyps fulvus)* (10) and the cape vulture (*Gyps coprotheres)* (11). Furthermore, plastic ingestion has been reported in seabirds, particularly among procellariforms

(12–15) where it has been shown to lead to obstruction, starvation and mortality (16). Birds that die from ingestion of plastic often suffer obstruction of the gastrointestinal tract and die of starvation (17). For example, two reports of plastic ingestion in a northern gannet (*Morus bassanus*) and a greater shearwater (*Puffinus gravis*) showed that these birds died as a direct result of plastic ingestion causing obstruction and ulcerations in the gizzard and subsequent starvation (16). Other documented consequences of plastic ingestion include blockage of the intestines and ulceration of the gizzard (18,19), reduction in the functional volume of the gizzard leading to a reduction of digestive capability, and distension of the gizzard leading to a reduction in hunger (20,21).

CASE PRESENTATION

This red kite was found alive on a road in West Totton, Hampshire on the 12 July 2018, approximately 200 meters from power cables. It was taken to a local veterinary practice but died during transportation. The carcass was stored in a -20 °C freezer by the submitter for 12 days before submission and it was then frozen again at -20 °C at the Institute of Zoology, for six months prior to post-mortem examination.

INVESTIGATIONS

The carcass was examined according to a standard avian post-mortem examination protocol (3). A full body ventrodorsal radiograph was taken (42 kV, 0.02 mAs) and no abnormalities were noted.

This adult male red kite was in poor body condition with minimal amounts of subcutaneous fat present. The ventral side of the primary feathers of the right wing were slightly soiled with dried fluid consistent with the appearance of blood. The ventral right wing had a rupture of the skin with associated dried blood staining of the skin and feathers, exposing the bone of the distal humerus and proximal radius and ulna (Figure 1). The ventral left wing had a small amount of dried blood staining and there was dried blood on the skin and feathers of the right side of the caudal ventrum. The left side of the sternum showed sloughing of feathers cranially and subcutaneous haemorrhage mid sternum (12 mm diameter). The right axilla displayed subcutaneous

haemorrhage (9mm diameter) associated with a dry crusty lesion of the skin (2 mm diameter) (Figure 2). The feathers overlying the joint between the femur and tibiotarsus had sloughed off and the skin on the lateral side of the right stifle showed extensive dried sanguineous crusts.

Internally, minimal amounts of fat were present in the caudal coelom and the pectoral muscles were dark in colour and atrophied (Figure 2). The spleen, kidneys and liver were paler in colour than expected and friable. Both lungs were pale in colour with the right lung showing some pale green discolouration on the lateral surface. The gastrointestinal tract was largely empty. The serosal surface of the ventriculus was pale green and the mucosa did not show any lesions; it contained a minimal amount of brown mucoid paste and a piece of irregularly folded white-beige plastic with sharp edges (35x32x1 mm) and brown discolouration in some areas (Figure 3). The mucosa of the small and large intestine was a mottled dark brown to black-pink. The small intestine contained a thin dark brown paste, and the large intestine contained a slightly thicker dark brown paste.

Testing for anticoagulant rodenticides was carried out at the Predatory Bird Monitoring Scheme. Toxicological examination of liver samples detected potentially toxic levels of SGARs in this bird (difenacoum 3.0 ng/g, brodifacoum 734.9 ng/g). Birds that have internal haemorrhage without associated trauma and summed liver SGAR (bromadiolone, difenacoum, flocoumafen and brodifacoum) concentrations of 100 ng/g wet weight or more can be classed as anticoagulant rodenticide poisoning cases (3).

Microbiology was not performed because no gross internal lesions were detected and, because there was a period of days between carcase detection and submission, and the carcase was subsequently frozen, limiting the diagnostic value of bacterial and fungal culture. Histopathological examination was not performed because this test was considered of limited value due to the cellular disruption that occurs during the freeze-thaw process.

DIFFERENTIAL DIAGNOSIS

From these findings, the authors considered three differential diagnoses. Firstly, the largely empty gastrointestinal tract suggests this bird had not eaten in the hours before death, and the poor body condition and minimal quantities of body fat further suggests that this bird had not been feeding well for days to weeks. High levels of SGARs hepatic residues (>100 ng/g) were quantified in this case but it is possible for red kites to live with this level of anticoagulant rodenticide for weeks to months and SGARs levels can be cumulative (3). Although there was no gross evidence of mucosal lesions in the ventriculus, the relatively large size and sharp edges of the ingested piece of plastic may have caused partial obstruction, hindering normal digestion, and leading to possible anorexia, starvation, emaciation, and the death of this bird. Secondly, the finding of the bird on a road, the blood-stained feathers, various other skin injuries and paleness of the heart, liver and spleen is evidence that collision-related injury such as impact with a road vehicle may have been associated with haemorrhage and death. The kite was found 200 metres from a powerline and another possibility is that it had collided with the powerlines. The dried skin ruptures suggest the bird survived the trauma for a short time (hours or days) and thus may have been able to move away from the location where the trauma occurred. Ingestion of second-generation anticoagulant rodenticides may have increased the susceptibility of the bird to haemorrhage following trauma.

TREATMENT

N/A

OUTCOME AND FOLLOW-UP

N/A

DISCUSSION

The purpose of this paper is to describe a case of plastic ingestion in a red kite, which may contribute to morbidity and mortality in this species. While there have been a small number of cases reported of red kites ingesting rubber castration and tail docking rings (22,23), to the best of our knowledge this is the first report of plastic ingestion in a red kite identified at post-mortem examination, and the first report of plastic ingestion by a bird of prey in the UK. The scavenging behaviour of red kites could increase the possibility of accidental plastic ingestion because plastic may be mistaken for bone fragments which these birds seek out and consume (24). Bones are the primary source of calcium for birds of prey. The plastic in this case did resemble a bone fragment due to the pale colour and shape. The plastic object may alternatively have been mixed with food waste and ingested while the bird scavenged. Alternatively, some species may seek out indigestible objects when they have undigested items in the ventriculus to enable them to accumulate a sufficient volume of material to assist with pellet production and ejection (25). A final possible explanation is that when carrion is not available and birds are food-stressed, they may consume any alternative in an attempt to survive (25).

In the UK, red kites mainly feed on carrion including rodents (alive, dead or dying) (26) and often take food from areas close to human settlements (27, 28). This red kite was found close to an area of high human density, and it is probable that the bird accidently ingested plastic when scavenging.

This is the first report of plastic ingestion by a red kite, and by any bird of prey in the UK, identified at post-mortem examination. However, it is possible that similar cases have gone unnoticed due to limited surveillance. There are numerous reports of plastic ingestion, particularly in seabirds

(14,15,29,30)**,** which has been associated with the rapid increase of plastic waste in the environment, which emphasises the need to mitigate this anthropogenic hazard, for example through education and appropriate waste disposal.

LEARNING POINTS/TAKE HOME MESSAGES

1. Here we present the first reported case of plastic ingestion in a red kite, detected at post-mortem examination.
2. This case highlights the importance of carrying out thorough post-mortem examination of wildlife species by veterinary professionals as part of post-release health surveillance.
3. This report identifies plastic ingestion as a potential emerging anthropogenic threat facing the red kite population in the UK.

CONFLICT OF INTEREST STATEMENT

The authors declare they have no conflicts of interest.

ETHICS STATEMENT

No ethical approval required.

FUNDING STATEMENT

No funding was received in this case.

AUTHOR CONTRIBUTION STATEMENT

Georgina Gerard, Sophie M Common and Jenny E Jaffe acquired the data, Georgina Gerard, Sophie M Common, Jenny E Jaffe, Tammy Shadbolt and Anthony W Sainsbury analysed and interpreted the data and Georgina Gerard wrote the paper. All authors have approved the manuscript and agree with its submission.

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FIGURE/VIDEO CAPTIONS

See attachments for Figure 1-3.

- Figure 1. The ventral right wing of red kite XT1129-18 showing a rupture of the skin, exposure of the bone of the distal humerus and proximal radius/ulna.
- Figure 2. The right axilla of red kite XT1129-18 showed subcutaneous haemorrhage (9 mm diameter) associated with a dry crusty lesion of the skin (2 mm diameter). Image also shows the superficial pectoral muscles were dark in colour and atrophied.
- Figure 3. A piece of irregularly folded plastic (35x32x1 mm) found in the ventriculus of red kite XT1129-18.

OWNER'S PERSPECTIVE

N/A

IMAGE QUIZ

A piece of irregularly folded plastic (35x32x1 mm) found in the ventriculus of red kite in England (FIGURE 3).

MULTIPLE CHOICE QUESTION

What is the novel diagnosis discussed in this red kite?

POSSIBLE ANSWERS TO MULTIPLE CHOICE QUESTION

1. SGAR poisoning
2. Infectious disease
3. Starvation from ingestion of plastic
4. Road collision

CORRECT ANSWER

3. Starvation from ingestion of plastic

Three possible contributors to mortality were considered: starvation from the ingestion of plastic preventing normal digestion, collision-related trauma and SGAR poisoning. This is the first report of plastic ingestion in a red kite. The case identifies plastic ingestion as a potential anthropogenic threat facing the red kite population in England.

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