WHY IS GLASS DANGEROUS FOR BIRDS

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Abstract
Thanks to technological advances, glass is now used more extensively in the construction industry. Large glazed surfaces are being incorporated into the building envelopes of structures such as recreational facilities and private vacation homes. Glass is also used for noise barriers, bus shelters, and bike racks, as well as for auxiliary structures such as balcony railings. Virtually all glass surfaces can be dangerous to birds; it depends greatly on their surface treatment and, above all, their location. Glass also reflects its immediate surroundings, including trees, thereby creating a fictional environment that birds attempt to enter. The aim of this article is to provide a basic introduction to the issue of bird collisions with glass surfaces. The article will focus on identifying the locations and structures where collisions most frequently occur. Subsequently, options for prevention or additional measures will be presented.

Key words: bird collisions with glass surfaces, glass surface planning, glass reflectivity, transparency.

Introduction

Nature is home to birds. Birds in the wild face a wide range of dangers. Some are natural, while others are caused by humans. Often, it is a combination of several factors at once. Humans frequently destroy the natural habitats that are so vital to birds; they also endanger birds through traffic and by constructing large glass surfaces, not only on buildings.

In many ways, birds see better and more clearly than humans. Their vision is among the most highly developed in the animal kingdom. Many birds have eyes on the sides of their heads, allowing them to see almost all around (up to nearly 360°), giving them a wide field of vision.

Most diurnal birds have tetrachromatic vision. In addition to the three types of cones found in humans, they possess a fourth receptor sensitive to ultraviolet light. This allows them to distinguish color combinations that do not exist for humans and to perceive a much broader spectrum of hues. In connection with sensitivity to UV radiation, it is important to note that many objects in nature that play an important role in birds' lives (e.g., insects, fruits, feathers, or eggs) reflect this radiation. (Šulc, 2014) As a result, the world is far more colorful to them than it is to us, and they perceive color patterns and markings in their feathers that remain hidden from us.

We also know that, for example, the hunting of birds of prey is primarily guided by visual acuity. They can spot prey from a great distance. Although birds have excellent vision, glass surfaces are invisible to them. The reflection of their natural surroundings in large windows is confusing to birds, causing them to injure themselves as they attempt to fly through the glass. Smaller songbirds, such as titmice, finches, blackbirds, thrushes, swallows, and sparrows, as well as some larger bird species, such as woodpeckers and doves, are particularly at risk from glass surfaces. Why do birds collide with glass if they have such good eyesight? First and foremost, it is important to realize that birds move significantly faster on average than mammals. Even small songbirds the size of a tit fly at a minimum speed of 30 km/h when flying short distances, and pigeons, for example, commonly fly at speeds of around 70 km/h.

Material and methods

The most common cause of bird collisions with glass is its transparency. Birds do not perceive glass as an obstacle. They see the sky, trees, or other attractive features in nature through it, try to fly toward them, and collide. Furthermore, the risk of collision increases with the size of the glass surface and its transparency. However, clear (transparent) glass can act as a mirror at certain angles of light incidence; in such situations, clear glass can behave as a reflective surface (Viktora, L., Dolejský, V. 2015).

Reflective glazing is generally considered the most dangerous. In addition to their aesthetic function, their reflective coating also serves a thermoregulatory purpose—it reflects solar radiation and most of the heat energy, preventing a sharp rise in indoor temperature during sunny weather. They are often used for the exterior cladding of entire buildings or parts thereof, and south-facing windows also frequently feature a reflective coating. At the same time, they faithfully reflect their surroundings,

thereby creating a fictional environment that birds attempt to penetrate. For example, mirrored trees appear as a distant target, and birds then collide with the glazing at full speed. These collisions are very often fatal. (Viktora, L., Dolejský, V. 2015)
It doesn't always have to be buildings. Reflective surfaces in the landscape have the same effect.
So which specific locations are dangerous?
First, noise barriers (see Fig. 1) or windbreaks made of transparent materials—such as glass—are most commonly found along major roads and railway lines. These barriers are also frequently installed on bridges that span natural obstacles such as river valleys, bodies of water, or similar areas. It is precisely these areas that serve as natural corridors for birds.

Glass and related materials are becoming increasingly popular building materials in construction. Demand for glass is growing as processing technologies improve its physical properties. For example, the use of glass for cladding entire buildings or parts of them (large glass surfaces, entrance portals, atria, connecting passages, etc.) is very popular, especially where greenery is incorporated. Sometimes it is precisely the architect's intention to reflect the interesting immediate surroundings on the facade (see Fig. 2) or even on a building such as a mountain cable car station or a mountain hotel. Views into the interiors of buildings or through the entire structure may be designed. The danger also increases in confined spaces (e.g., a glass wall between two large buildings).

Fig. 1: Noise and wind barriers along roads
Fig. 2: Mirroring trees is aesthetically pleasing, but not at all suitable for birds

Small structures in open landscapes, such as bus, train, or public transit stops, may also consist solely of clear or reflective glass panels mounted on metal frames. Similarly, clear panels are used to enclose playgrounds (see Fig. 3), certain sports facilities, seating areas in restaurant gardens, and even animal enclosures in zoos. There are, therefore, many places that offer views of the surrounding area, but they also pose a danger to birds. Glass railings on balconies or green roofs with vegetation planted behind them can also become hazardous areas.

Results
If transparent surfaces in exposed areas cannot be avoided, it is essential to reduce their transparency. The most effective method is to use semi-transparent materials or materials with a pattern covering the entire surface. It has been shown that silhouettes of birds of prey do not serve the intended purpose. Stickers featuring bird silhouettes are not a sufficient protective measure to make the infill visible (see Fig. 4).
To effectively prevent bird collisions, transparent surfaces must be modified so that they are visible to birds. While reduced transparency may limit our view, it will prevent further bird collisions. There are two options to choose from: patterns covering the entire surface (such as stripes or dots), see Fig. 5, or alternative materials, such as matte, light-transmitting materials like patterned, textured, or frosted glass. Glass manufacturers offer a wide range of standard patterns.

Fig. 3: Glass screens at the playground prevent flying objects from passing through

Fig. 4: It is found that silhouettes of predators do not have the desired effect

Fig. 5: Transparent glass at stops can be made visible with stickers according to recommendations

Clear outlines and high-contrast lines are the most effective patterns. Tests have shown that red and orange patterns are significantly more effective than the same patterns in shades of blue, green, or yellow. Vertical lines perform slightly better than horizontal lines. Markings placed on exterior surfaces are even more effective, as they break up reflections. It is generally recommended to use proven patterns, as even small changes in the pattern can result in significant changes in effectiveness. Rules for additional printing—linear patterns:

- Lines must always be at least 3 mm thick with a maximum spacing of 25 mm (horizontal lines) or 5 mm thick with a maximum spacing of 100 mm (vertical lines).
- Dotted patterns should cover at least 15% of the surface area. Coverage may be reduced to 4% only if the diameter of the dots exceeds 30 mm. Dots should have a diameter of at least 5 mm. The dotted pattern should contrast sharply with the background; otherwise, the lines must be thicker.

(Schmid et al., 2021)

Guidelines for the design of bird collision protection elements for new noise barriers (TP 104, 2024)

- Use panels with integrated vertical or horizontal black lines, typically 2 mm wide with a spacing of 30 mm;
- Alternatively, the following may be used: • panels with sandblasted stripes 20–30 mm wide, spaced at a maximum of 100 mm for vertical stripes and a maximum of 50 mm for horizontal stripes

- integrated wire mesh with 20 × 20 mm mesh openings,
- Screen-printed black lines, typically 2 mm wide with a spacing of 30 mm;
- As a supplementary measure to the above, subtle color shading of transparent fill areas may be used.

Semi-transparent glass surfaces, walls, and blocks are building elements that pose no danger to birds. Depending on the material used, sufficient natural light can be achieved.
Adjustable and fixed shading elements on the exterior of a building's glazed surfaces serve not only to protect against overheating. Depending on their type and method of installation, they can also help reduce the risk of bird collisions. For example, double-pane windows with integrated vertical blinds allow diffused light into the interior while simultaneously increasing bird safety. Horizontal blinds also help make the glass more visible to birds (see Fig. 6).

Fig. 6: External shading elements provide sufficient protection for birds

Additionally, colored surfaces with low reflectivity and rich colors can be safe for birds.
To reduce the risk associated with reflectivity, it is recommended to install glass with an external reflectance coefficient of 15% or lower (Schmid et al., 2021).

Conclusion

Glass surfaces can be very dangerous for birds. Collisions occur due to the transparency and reflectivity of the glass. If it is not possible to modify the glass so that it is not invisible to birds, the immediate surroundings of a building with glass surfaces must be modified so that they are not attractive to birds. This primarily means planting trees and shrubs at a distance of approximately 30 meters from the facade, avoiding the placement of bird feeders, and refraining from designing water features. Trees should only be placed in front of non-reflective parts of buildings. This must be addressed during the design phase to avoid the need for additional measures later. A simple measure can be applying additional window decals or installing blinds. Previous window decals featuring silhouettes of birds of prey on bus stops and noise barriers are being replaced with more effective decals in the form of stripes or dots of recommended dimensions.

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Souhrn

Prosklené plochy pro ptáky mohou být velice nebezpečné. Dochází ke kolizím v důsledku průhlednosti a odrazivosti. Jestliže nemáme možnost sklo upravit tak, aby nebylo pro ptáky neviditelné, je třeba prostředí v nejbližším okolí budovy s prosklenými plochami upravit tak, aby nebylo pro ptáky atraktivní. Znamená to zejména vysazovat stromy a keře ve velké vzdálenosti od fasády, neumisťovat krmítka pro ptáky nebo ani nenavrhovat vodní plochy. Stromy mohou být jen před neodrazivými částmi budov.

To je třeba řešit již v projektu, aby nebylo nutné provádět dodatečná opatření. Jednoduchým opatřením pak mohou být dodatečné polepy skel nebo instalace žaluzií. Dřívější polepy skel siluetami dravců na zastávkách a protihlukových clonách se nahrazují účinnějšími polepy ve formě pruhů nebo teček doporučených rozměrů.

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