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Unilateral corneal opacity as a result of GPS tracking in in a European Northern Bald Ibis (*Geronticus eremita*) population released in the context of a LIFE+ reintroduction project

In the course of a LIFE+ project, a migratory Northern Bald Ibis (NBI) population is reintroduced in Europe (Fritz et al., 2019; www.waldrapp.eu). Since 2014, all birds are equipped with standard GPS transmitters. Remote monitoring is an essential element of the reintroduction due to the large-scale movement patterns of the released birds.

At first, all birds were equipped with battery-powered devices attached to their lower back via leg-loop harnesses. Since 2016, we successively switched to solar-powered devices which are usually attached to the sun-exposed upper back area via wing-loop harnesses.

In 2016, we observed a first case of unilateral corneal opacity (UCO) in one individual. From 2017, further cases were detected; up to 2018, a total of 25 birds was affected by UCO with varying degrees of intensity, including blindness. So far, all involved experts were unfamiliar with the symptoms. However, we found a striking correlation in 2017: Only birds carrying a solar-powered GPS transmitter that was attached via wing-loop harness were affected by a UCO. In 2017, this corresponded to 70% of the released birds carrying this transmitter type! Furthermore, not a single bird with a GPS transmitter attached to the lower back showed UCO symptoms.



Fig.1: UCO with varying degrees of intensity, from slight opacity till loss of eye light.

Since we recognized this connection in 2017, we have changed the attachment of the devices from the wing-loop to the leg-loop position in affected individuals. It turned out that the opacities quickly disappeared, if the organ was not yet irreversibly damaged by the progressing opacity and a resulting inflammation. Successively, the attachment was also changed in all other birds.



Fig.2: NBIs sleeping with the heads turned on their backs and one eye close to the GPS device fixed in the wing-loop position.

NBIs sleep with their heads turned on their backs, meaning that – in the case of devices mounted on the upper back position – one eye is in close contact to the GPS device during sleep. This is not the case when devices are attached via leg-loop harness. A causal explanation for the UCO is a persistent, slight mechanical irritation of the eyeball when the head is in the sleeping position. For various reasons, however, we consider a

second explanatory approach to be more plausible. In the used standard GPS transmitters, the GPS positions are transmitted via GSM, which leads to a regular emission of electromagnetic radiation. This type of radiation is known to lead to a warming of the surrounding tissue. Since the cornea is considered a temperature-sensitive tissue, a repeated warming could cause a progressive clouding of the cornea.

To our knowledge, UCO has not yet been observed in other NBI populations or other species. However, it seems unlikely that this is a species or population specific effect. The early stages of UCO are barely discernible at a distance, and if the opacity has progressed further, it may lead to the death of the individual without the causal mortality cause being recognized. The measures implemented in our reintroduction project, especially (re)capturing individuals for management reasons, allow an early detection of UCO cases.

UCOs do not seem to be the only impairment resulting from the attachment of GPS transmitters on the upper backs of the birds. Observations made during the flights with NBIs indicate that devices mounted via wing-loop harness cause turbulences and separate boundary layers along the posterior body of the birds, thereby causing considerable aerodynamic costs. In order to quantify these deleterious effects, various transmitter housing types and mounting methods are currently being tested with NBIs in a specially designed wind tunnel.

Our findings suggest that further research on the immediate effects is urgently needed in the fast-growing area of animal tracking. Adhering to the 5% rule on transmitter weight certainly does not suffice (Kay et al. 2019; Pennycuick et al. 2012). **Regarding UCO, we urge everybody to pay special attention to these symptoms. We are very grateful for any indications of possible further cases and for contributions to the clarification of the causal relationship!**

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Literature

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