

Abstract

Understanding the present situation of lead contamination causing immunosuppression in endangered birds and elucidating the relationship with avian influenza outbreak

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Several toxic effects of exposure to lead are reported in human and wildlife. Immunosuppression is thought to be one of lead toxicities and there are concerns about mass mortality in wildlife due to infectious diseases linked to immunosuppression caused by lead exposure. In Hokkaido, Japan, lead poisoning was confirmed in raptors caused by the ingestion of lead bullets from remaining deer hunting carcasses in 1997. As a result, restrictions on lead bullets were introduced in all areas of Hokkaido in 2000. However, lead bullets are not regulated in Honshu Island, except in major wintering areas, although it has been reported that some birds, such as golden eagles, have been exposed to lead in Honshu Island. Therefore, the objectives of this study were to understand the current situation involving lead contamination and to elucidate the direct (lead poisoning) and indirect risks (changes in susceptibility to highly pathogenic avian influenza virus [HPAIV]) of lead exposure in raptors in Honshu and areas to the south. This study consists of three subthemes. Subtheme 1 is the integration of the results of sub-themes 2 and 3, described below, to identify areas where lead poisoning and low levels of lead contamination are likely to affect raptor populations, and to prioritize these areas for the control of lead bullet use. In subtheme 2, we administered lead bullets to captive ducks and raptors to determine toxicological differences between the two species. Additionally, differences between the lead kinetics in the two species was observed using LA-ICP-MS. Gene expression profiling of lead-exposed birds and experimental infection with HPAIV alongside lead exposure suggested that lead exposure may cause immunosuppression. Furthermore, a method to identify the origin of lead (rifle bullets, shotgun shells, and fishing weights) using multi-element and isotopic analyses was developed. In subtheme 3, the organs and blood of live or dead raptors were collected to measure the concentration of lead in order to understand the current situation of lead exposure of wild raptors outside of Hokkaido.

As a result, it was found that the peregrine falcon (*Falco peregrinus*), northern goshawk (*Accipiter gentilis*), mountain hawk-eagle (*Nisaetus nipalensis*), and several other raptor species had been exposed to lead. Based on behavioral observations using GPS telemetry and measurements of lead concentrations in potential raptor prey, it was determined that game animals, such as deer, wild boar, and waterfowl are likely sources of lead contamination in raptors. Therefore, it was suggested that risk assessment of lead exposure in raptors could be conducted using hunting statistics.