

Bird population declines in northern Europe are explained by thiamine (vitamin B₁) deficiency

Wild birds of several species are dying in large numbers from a paralytic disease with hitherto unknown cause in the Baltic Sea area. A research team at Stockholm University, Sweden, led by Associate Professor Lennart Balk, has demonstrated strong relationships between this disease, breeding failure, and advanced thiamine (vitamin B₁) deficiency in eggs, young, and adults. The results are presented in the article “Wild birds of declining European species are dying from a thiamine deficiency syndrome”, published in the on-line Early Edition of the well-reputed journal Proceedings of the National Academy of Sciences, USA (PNAS).

Thiamine is an essential nutrient for birds and other vertebrates. In the living cell, its phosphorylated form acts as a cofactor for several life sustaining enzymes, which are non-functional if the cofactor is missing. Thiamine is also necessary for the proper functioning of the nerves. Thiamine deficiency was demonstrated in the egg, liver, and brain as reduced thiamine concentrations, and in the liver and brain as reduced activities of the thiamine-dependent enzymes. In the liver and brain, there were also elevated proportions of these enzymes without the thiamine cofactor. Moreover, paralysed individuals were successfully remedied by thiamine treatment. The excess mortality and breeding failure are part of a thiamine deficiency syndrome, which most probably has contributed significantly to declines in many bird populations during the last decades.

The authors' primary aim has been to demonstrate the relationship between the paralytic disease and thiamine deficiency. Also important has been to form an idea about the geographical distribution of the thiamine deficiency syndrome and its distribution among species. Advanced thiamine deficiency was demonstrated in the Baltic Sea area, but incipient thiamine deficiency was found also in Iceland.

The paralytic disease was observed in 78% of the investigated bird species (28 of 36). In some species, such as the herring gull, thiamine deficiency results in a reduction of the number of eggs, whereas in other species, such as the common eider, the females seem to be capable of producing eggs essentially devoid of thiamine. As a result, many herring gulls in the Baltic Sea area do not produce any eggs at all, and the excess mortality among common eider young is immense.

The many observations of advanced thiamine deficiency strongly suggest that also varying degree of moderate thiamine deficiency occurs among the affected species. One effect of moderate thiamine deficiency is altered behaviour. The authors report plenty of observations of reduced aggressiveness and low noise level in herring gull colonies, as well as incomplete nest building in several species. Another effect of moderate thiamine deficiency is immune suppression. The avian influenza is just one example of a disease that may spread more easily among thiamine-deficient birds. Moreover, thiamine deficiency may weaken the blood-brain barrier, which normally protects the brain from many toxic substances.

The occurrence of paralysis among birds has received some attention previously, but has usually been attributed to botulinum poisoning, which is caused by a bacterium. The authors demonstrate that thiamine deficiency is the actual cause. The problem of excess mortality and breeding failure among birds has also received some attention previously, and has routinely been attributed to lack of food, even when reliable information concerning the food supply has been limited. The authors show that thiamine deficiency causes starvation as a consequence of loss of appetite, whereas starvation itself does not result in thiamine deficiency.

The authors stress the urgent need of further investigations focusing on causation. The thiamine deficiency may be induced either by a causative agent(s) acting directly on the affected individual, and/or by insufficient transfer of thiamine between the trophic levels in the food web. Classical persistent organic pollutants are not primarily suspected, since the affected species occupy a wide range of ecological niches and positions in the food web. Last but not least, the authors stress that they are open to the possibility that other wildlife may suffer from thiamine deficiency as well.

More information: Lennart Balk, Department of Applied Environmental Science (ITM), Stockholm University, tel +46-8-6747721, +46-73-6923468, e-mail lennart.balk@itm.su.se.