Only some like it hot: How birds from different populations react to infections

March 31 2010

North American song sparrow with transmitter for measuring temperature. Image: Kamiel Spoelstra

With the help of new radiotelemetry technology, researchers from the University of Princeton and the Max Planck Institute for Ornithology in Radolfzell have now succeeded, for the first time, in studying fever in a vertebrate species living in the wild, the North American song sparrow.

The immune system is the most important system at the disposal of an organism for defending itself against pathogens. All organisms have an immune system; however, thus far, it was unclear as to why species and populations within a given species display significant variations in their immune reactions. Up to now it was not possible to study this phenomenon in animals living in the wild. With the help of new radiotelemetry technology, researchers from the University of Princeton

and the Max Planck Institute for Ornithology in Radolfzell have now succeeded, for the first time, in studying fever in a vertebrate species living in the wild, the North American song sparrow (*Melospiza melodia*). (*Functional Ecology*, March 31, 2010)

As anyone who has suffered from a cold or flu knows, a high temperature is an unpleasant but important side effect of the body's immune reaction when fighting off pathogens. Laboratory studies, in which the immune responses of animals could be observed in detail, have shown that these responses display significant variations. Why doesn't every organism defend its body at the maximum possible level of intensity? New immunological theories presume that immune responses are "costly", that is they compete with other energy-consuming processes such as partner selection, territorial behaviour and reproduction. Each individual has limited resources and must, therefore, enter into compromises, so-called trade-offs. This could explain why different species with different living conditions also display variations in their immune responses.

Laboratory tests can only simulate the conditions that prevail in nature to a very limited extent. In captivity, animals have unlimited access to food, enjoy pleasant climatic conditions and are not vulnerable to predators. These conveniences can result in the absence of any need to compromise when it comes to the distribution of their energy reserves.

Jim Adelman, a doctoral student at the University of Princeton, and a staff working with Michaela Hau and Martin Wikelski at the Max Planck Institute for Ornithology in Radolfzell have now succeeded in measuring fever and illness-related behavioural changes in various populations of a North American bird species living in the wild, the song sparrow (*Melospiza melodia*). For the tests, individual sparrows were caught in South California and in the northern state of Washington. To stimulate the immune response in a standardised way, both groups were

administered a small dose of bacterial cell walls which causes fever for a limited period of around one day. A control group was left untreated. Following the administration of the injection, a small transmitter weighing approximately 0.5 grams was attached to the birds' backs and transmitted data on both their temperatures and activities over a 20-hour period.

Interestingly enough, the "injected" sparrows showed barely any increase in temperature during the day. However, during the night when, based on their natural biorhythms, birds reduce their metabolism and their temperatures by three to four degrees, clear differences emerged between the two populations: the Californian sparrows recorded a body temperature of over two degrees Celsius higher than the animals in the untreated control group of this population. As opposed to this, the temperatures of the more northern population increased by at most one degree and only during the first half of the night.

The song sparrows from Washington only have a very short breeding season of around 100 days. For this reason, they probably have to invest all of their resources in reproduction; the investment of time and energy in the immune response could reduce their breeding success. In contrast, due to their longer breeding period of 150 days, the sparrows in sunny California have greater scope for compensation and can give priority to the immune reaction.

"These results prove to us that limitations in the resources at the disposal of the organism and environmental conditions play a significant role in the strength of the immune response and, therefore, the capacity to fight infectious diseases," says Jim Adelman. "With this study, we were also able to show that populations of the same species living in the wild display different immune reactions." The study also represents an advance in terms of the possibilities available to scientists to study the processes and effects of the immune system under natural environmental

conditions with the help of radio telemetry.

More information: James S. Adelman, Sergio Córdoba-Córdoba, Kamiel Spoelstra, Martin Wikelski, Michaela Hau, Radiotelemetry reveals variation in fever and sickness behaviours with latitude in a free-living passerine, *Functional Ecology*, published on March 31st 2010. DOI:10.111/j.1365-2435.2010.01702.x

Provided by Max-Planck-Gesellschaft