

Shrinking shorebird pays the bill for rapid Arctic warming while wintering in the tropics

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Red knots used to incubate their eggs in the Arctic snow in order to optimally time the hatch date of their chicks relative to the insect food peak. Nowadays, red knots have a hard time keeping pace with the rapidly advancing onset of Arctic summer Credit: © Jan van de Kam

Red knots migrate between their breeding grounds in the Arctic and

their wintering grounds in West Africa. Chicks currently born under rapidly warming conditions attain smaller sizes before migration starts, because they miss the insect peak. If they reach their wintering grounds in the tropics, they are faced with a second disadvantage: their shorter bills cannot reach their favourite shellfish food. This results in an evolutionary force towards smaller-sized birds with large bills.

These findings will be published Friday 13 May 2016 in *Science* by an international team of researchers from the Netherlands (NIOZ and University of Groningen), Australia (Deakin University), France (CNRS), Poland (University of Gdansk), and Russia (Moscow University).

Climate change makes animals smaller

Shrinkage of animal body size has just recently been discovered, but is already considered a universal response to climate change as it is observed across a broad range of animal taxa. Up to now, two competing hypotheses explain the reduction in animal body size. On the one hand, there is the hypothesis that a smaller body is better able to dissipate body heat because of the larger surface to volume ratio. On the other hand, there is the hypothesis that bodies are shrinking because climate change disrupts the ability of a consumer to find enough of the right food at the right time, leading to malnutrition during the juvenile life stage.

Arctic animals shrinking fastest?

As the High Arctic is warming up most rapidly, body shrinkage is expected to be most extreme in this region. However, many organisms breeding in the High Arctic are long-distance migrants, spending the nonbreeding season at much lower latitudes, often as far as the tropics, where the impacts of [climate change](#) are less obvious.



Only long-billed red knots are able to access the deeply burrowed bivalves at their tropical wintering grounds. Shorter-billed birds are forced to make a living of shallowly burrowed seagrass rhizomes Credit: © Jan van de Kam

First author Jan van Gils from NIOZ Royal Netherlands Institute for Sea Research explains: "The red knot (*Calidris canutus canutus*) is one of the world's most northerly breeding birds and a well-known long-distance migrant. It is nesting in northern Taimyr (Russia) and is wintering in tropical coastal ecosystems, notably the Banc d'Arguin, Mauritania (West Africa). Analysis of satellite images has shown that over the past 33 years, snow at the red knot's breeding grounds has progressively melted earlier, at a rate of half a day per year, so that's now more than two weeks. The retreat of the snow marks the start of the insect peak in

the Arctic (Fig. 1); the main food source of the chicks before they leave the Arctic. Juvenile red knots that we caught along the Baltic coast while on their way to West Africa were smaller and had shorter bills after warm Arctic summers".

Shrinking migrants pay the bill in the tropics

Once they have arrived in West Africa, the smallest young birds pay the price of having a short bill: their survival was only half of that of the larger juveniles. Van Gils: "The reason for this bill-length dependent mortality is quite straightforward. Only larger birds with long bill were able to reach the relatively deeply burrowed bivalves at Banc d'Arguin (Fig. 2). Shorter-billed birds were forced to live on seagrass, which is a poor food source for these birds. The poor survival of shrunken first-year birds clearly contributes to the current population decline seen in red knots nowadays".



The red knot as it is now (left) and an (exaggerated) projection how the future red knot might look like (right): smaller, but having maintained its relatively long bill. Credit: © Jan van Gils, NIOZ

Not only body size, but also body shape changes

The high premium on having a long bill, causes red knots also to change body shape (Fig. 3). Nowadays [red knots](#) are smaller, but since the short-billed small birds are selected against, the ones with the highest survival

chances are relatively long-billed.

Van Gils concludes: "Since smaller [birds](#) do worse than larger ones, we reject the hypothesis that body shrinkage is evolutionarily beneficial. Instead, we suggest that a so-called 'trophic mismatch' during chick stage underlies the smaller knot body: due to the rapidly advancing Arctic summer, juvenile knots are now simply born after the rapidly advancing insect peak. We therefore propose that changes in [body size](#) and shape, and the negative population dynamical consequences, will be widespread among other High-Arctic breeding species in the future. This is a very serious ecological effect that requires our immediate attention".

More information: "Body shrinkage due to Arctic warming reduces red knot fitness in tropical wintering range," *Science*, [DOI: 10.1126/science.aad6351](#)

Provided by University of Groningen

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