Animals 'shape-shifting' in response to climate change

When climate change is addressed in the mainstream media, people frequently wonder, whether humanity can overcome this or suitable technology can fix it. We must acknowledge that animals must also adjust to these changes, albeit on a far shorter time-frame than would have happened during the course of evolution. Increasing temperatures due to climate change will force animals to seek strategies to control their body heat. They are adjusting to environmental changes, with certain warm-blooded animals beginning to 'shape-shift' their bodies in reaction to climatic fluctuations, according to a new study by Deakin University researchers in Australia[1]. Climate change is putting a massive strain on them and although some will survive, many will not. While the alterations are significant, the researchers suggest that more changes are likely to occur sooner than later.

When temperature increases, birds use their beaks to regulate the heat while mammals utilize their ears. Warmer-climate species have traditionally evolved bigger beaks or ears to better dissipate heat. As the temperature rises, these disparities become more obvious. This phenomenon is more noticeable in endotherms. Animals could perish if they are unable to manage their body temperature. Beaks, which are not coated by feathers, are a significant heat exchange point in birds, as are ears, tails and legs for animals if they are not covered by fur. Researchers discovered that the new data support the hypothesis that some warm-blooded animals are changing their bodies. They observed that warm-blooded animals living in colder regions had smaller appendages (such as beaks or legs) than those of the same species living in hotter areas, conforming to 'Allen's rule'. At the same time, body sizes are shrinking because smaller bodies absorb less heat.

The researchers noted that birds, in particular, would experience major alterations as a result of global warming. According to a study, 58% of all bird species obey Allen's rule with respect to the size of their beak, which is utilized to control their body temperature. Some of the most credible evidence of anatomical alterations was seen in birds from Australia and North America. Certain species of Australian parrots have shown a 4–10% rise in the size of their beaks since 1871, which experts ascribe to warming temperatures. Meanwhile, increased beak size and short-term temperature extremes in cold settings were linked in North American dark-eyed juncos, a type of tiny songbird. Researchers noted that wood mice had longer tails and masked shrews had larger tails and limbs. Warm-climate bats were found to have larger wings.

Larger beaks help birds shed extra body heat more effectively, which is a helpful feature as global temperatures increase. It is frequently difficult to pinpoint why a species evolves the way it does. According to the researchers, this pattern is prevalent across a wide range of species and locales, and the common factor is that they are all affected by climate change. While morphological changes suggest that species are adapting to rising temperatures, they may suffer in the coming decades. Shape-shifting does not imply that animals are adapting to climate change and that everything is in order. It simply implies that they are evolving just to stay alive, but we are not aware what the additional ecological repercussions of these changes are, or whether all species are capable of altering and surviving. It is not known if these alterations will have any additional effects on the animals. For example, larger bills may impact how birds feed, which scientists intend to examine in future studies.

According to another study[2] published earlier this year, at least 25% of marine animals may face extinction as climate change, fisheries, by-catch, pollution and maritime development continue to have a negative influence on their existence. A team from the University of Exeter studied the condition of 126 species, including whales, dolphins, seals, sea lions, manatees, dugongs, sea otters and polar bears, and concluded that at least one-quarter of them were endangered.

At this time when Charles Darwin published *On the Origin of Species* in 1859, other scientists were studying how species differed around the world. Carl Bergmann was one among them, and his eponymous rule asserts that larger species would be found in colder habitats among a collection of creatures living throughout a wide range. This is because reducing their surface area to volume ratio reduces heat loss, but in warmer settings the reverse occurs. For example, the biggest penguin species, the emperor penguin, resides in Antarctica, but the smaller Humboldt penguins inhabit in South America. Joel Asaph Allen developed his own rule, which outlines how creatures acclimated to warmer conditions grow larger limbs and other body features to maximize heat dissipation by increasing surface area, e.g. larger ears of African elephants compared to Asian elephants.

With temperatures expected to increase over the next century, the researchers examined whether climate-change adaptations would follow Allen's rule. These adaptations may be favourable in the short to medium term, but if the environment continues to change, animals will be unable to adapt indefinitely. At some point, the trade-off will no longer be favourable, perhaps leading to population reduction and possibly extinction. So, while a larger beak may be advantageous for species seeking to dissipate more heat, if it renders the beak problematic for eating, it may end up being more detrimental to the birds. There are also additional techniques to manage body temperature that do not involve changes in body form, such as using shade and migrating during warmer weather. The researchers also point out that climate may alter other aspects, such as food availability and the water cycle as well as the shape of various bodily parts.

One of the major unresolved concerns about these consequences is whether or not the alterations are permanent. For example, marine iguanas in the Galapagos Islands can shrink and expand their body length by up to 20% when temperatures vary and the amount of food available changes. The researchers also plan to examine shape-shifting in Australian birds for the first time by 3D scanning museum bird specimens over the previous 100 years. This will help determine which birds are altering appendage size as a result of climate change, and why.

1. Ryding, S., Klaassen, M., Tattersall, G. J., Gardner, J. L. and Symonds, M. R. E., *Trends in Ecology and Evolution*, September 2021; doi:10.1016/j.tree.2021.07.006.
2. Nelms, S. E., Alfaro-Shigueto, J., Arnould, J. P. Y., Avila, I. C. and Nash, S. B., *Endangered Species Research*, March 2021; doi:10.3354/esr01115.

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