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Migratory behaviour affects the size of brains in birds

Researchers at Centre for Ecological Research and Forestry Applications (CREAF, a UAB-affiliated centre) shed new light on the evolution of brain size in birds. Scientists have known for some time that migratory birds have smaller brains than their resident relatives. Now a new study looks into the reasons and concludes that the act of migrating leads to a reduced brain size. Authors point to the fact that the causes could be due to a need to reduce energetic, metabolic and cognitive costs. To reach these conclusions, scientists reconstructed the evolutionary history of one of the most numerous orders of birds, the passeriformes, a group which includes swallows, tits and crows.

Understanding brain evolution is something that has interested scientists since the times of Charles Darwin, who considered that the large size of a human brain went hand in hand with the

exceptional cognitive capacities of our species. One of the classic explanations is the cognitive buffer hypothesis, which suggests that a large brain -in comparison to body size- makes learning easier. This protects individuals from changes in the environment, such as those produced by changes in season. In the case of birds however not all species respond to seasonal changes in the same way. Migratory birds avoid these changes by travelling to less inhospitable places when conditions worsen. This is the strategy followed by swallows or cuckoos. Resident bird species stay in the same area throughout the year and face strong environmental fluctuations. Tits and crows belong to this group.

Previous studies showed that both strategies are related to differences in brain size. The problem however is that it is often difficult to discern the causes and consequences of the differences observed. CREAF researchers Daniel Sol and Núria Garcia, together with scientists from Canada and England, offer new research advances in an article published in the March edition of the journal *PLoS One*.

By analysing data from 600 passerine species in regions ranging from tropical to artic, Daniel Sol and colleagues confirm that migratory birds have smaller brains than their resident counterparts. The question now is whether brain size determines lifestyle (migratory or resident) or whether lifestyle determines the size of the brain. According to the cognitive buffer hypothesis, being a resident bird makes it easier for the brain to grow and this for example facilitates acquiring alternative food-finding strategies for the winter months. Nevertheless, the study reveals the complete opposite and points to the fact that being a migratory bird is what makes these birds have smaller brains. Researchers came to this conclusions by reconstructing the evolutionary history of passerine birds and determining the sequence of evolutionary changes which most probably led to the current situation. In the case of this group of birds "the first step was changing from a resident to a migratory life and the second step was a reduction in the size of the brains of migratory birds", Daniel Sol explains. "Therefore", he adds, "differences in brain sizes are not caused by nature's need to provide resident species with larger brains, as suggested in the cognitive buffer hypothesis, but to provide migratory species with smaller brains".

Normally a larger brain offers many advantages. Then why is it that in the case of migratory birds natural selection has favoured smaller brains? The study highlights various explanations, but the general idea focuses on the possibility that a large brain does not necessarily have to be better. According to Daniel Sol, "the brain is an organ that consumes a lot of energy and develops slowly and this can be too costly for migratory species which must travel far and have little time to reproduce". At the same time, the reduction in brain volume could also be caused by a decrease in cognitive functions no longer useful to migratory species. He goes on to say that, "For birds that travel a lot, exploring their surroundings produces more costs than benefits since the information which is useful in one place is not necessarily so in another. It also exposes them to more dangers. For these reasons we believe that for these species, their innate behaviour can be more useful than learned behaviour".

Based on these conclusions, the authors of the research recommend an in-depth analysis of certain areas of the brain such as the pallium and telencephalon, involved in learning and behaviour innovation processes. They believe these areas could be less developed in migratory birds than in resident birds since the cost-benefit balance in these processes does not favour the species.

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References

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