Genetic variation is a necessity

April 28 2015, by Linda Koffmar

The Earth is constantly changing. For new species to be able to adapt and cope with the changes, there must be sufficient genetic diversity, or genetic variation, in the population. But what type of diversity is required and how large must the population be to survive? Jacob Höglund and his research group are investigating these important issues at the Evolutionary Biology Centre.

We have known for some time that genetic variation is an absolute necessity in order for species to be able to thrive. Jacob Höglund, professor in animal conservation behaviour, likens genetic diversity to a box of screws in the garage.

'If the box only contains one type of screw, we can only use them for a certain type of job. However, if we have collected a lot of different screws, we are better equipped to solve all possible types of problem we may encounter.'

If a species lacks the opportunity to adapt itself to new conditions, it will die out.

In all populations, genetic drift occurs constantly—species gradually lose genetic variation. The drift varies in strength depending on how large the population is. For example, genetic variation disappears more quickly in wolves, where there are not many individuals, than in herring, where there are very many individuals.

Genetic variation can be measured in a number of different ways. Large

parts of the genome in different animal species are very similar—others are different. One of the challenges for researchers is identifying which genes are important for a species to keep up with evolution.

Jacob Höglund and his research group are primarily focusing on MHC genes, which are a type of immune defence gene. The animals they have chosen to study are different species of birds, amphibians and fish. The practical work takes place both out in the field and in the lab, where new techniques within gene research give the field new impetus.

One of the group's current studies relates to investigating whether the dreaded fungal disease Batrachochytrium, which has caused mass mortality of amphibians in other parts of the world, has gained a foothold among Swedish frogs and toads and how sensitive they are to the disease. Are there populations in different parts of the country which are immune?

Of course one might ask what difference it makes if a species of frog dies out? Surely we have worse problems to deal with?

The answer to the question will probably be different depending on which researcher is asked. Someone with another research interest would perhaps answer differently, but when we ask Jacob Höglund, whose research field is evolutionary conservation genetics, he says:

'When a species disappears it has no immediate effect on the ecosystem. For as long as the Earth has existed, the number of species and the biologically diversity present have gradually increased. But we know that there have been five occurrences of mass extinctions. We have associated these with catastrophes caused by major volcanic eruptions or collisions with large comets, like when the dinosaurs died out. After this, the biological diversity has gradually built up again. Now we're facing a sixth mass extinction', says Jacob Höglund.

The Earth is currently losing biological diversity at an ever increasing rate, and according to Jacob Höglund it is clear that this is the result of human activity. By studying mammal fossils, the speed at which species 'normally' die out has been established. In the 1900s and probably for the 2000s, the average figure for extinctions of species lies around 1000 times higher than for background extinctions.

'We are probably overestimating biological diversity today because many species are in the process of dying out', says Jacob Höglund.

In several places in the world, animal populations live isolated from other populations of the same species. They receive no injection of new fresh genes, but gradually lose genetic variation. The population becomes increasingly unable to resist environmental changes and other challenges.

'We must begin to apply knowledge and calculate figures for the size of populations that are required to retain our animal species. We want to avoid emergency conservation—expensive efforts to save species at the last minute.'

Jacob Höglund says that we must try to understand how we can co-exist with other organisms. Just having people on Earth is not sufficient.

'Ultimately it's about our own possibility of survival. If we deplete the environment and destroy the conditions for existence on the planet, everything else is unimportant.'

Provided by Uppsala University

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