Abstractions

FIRST AUTHOR

Many male birds sport brightly coloured feathers and other ornaments in order to woo as many females as possible. By contrast, females, which tend to focus their efforts on raising their brood, are often unarguably drab. This is because females in most avian species are left on their own to raise their young and face little competition for mates. However, in some species males and females live together in family groups that share breeding responsibilities. This means that fewer females get to mate, so they too have to compete. Dustin Rubenstein of Columbia University in New York City and Irby Lovette of the Cornell Laboratory of Ornithology in Ithaca studied 45 species of African starling to examine the evolutionary consequences of such competition (see page 786). Rubenstein tells *Nature* more.

How did you come to this question?

I have been studying African starlings for about 10 years, and one species particularly intensely. In this species, the superb starling, birds live in family groups of 20–30 individuals. I have always wondered what the evolutionary causes are of family living in animals, particularly in creatures such as starlings, where some species live in groups and others do not. About six years ago, we started to build an evolutionary tree of Earth's 117 starling species in an effort to find an answer. We collected data from living species in Kenya, museums and zoos.

How did you use the data?

In 2007, we published a study showing that starling species that live in family groups are more likely to live in environmentally unpredictable habitats. Having family members available to raise young might help to buffer the tough conditions.

What about the current study?

This study addresses a different question: what are the evolutionary consequences of living in a group? We found that female starlings living with relatives are just as ornamented as males. Both have traits such as exaggerated crests and tails, or iridescent patches of blue or green feathers. Thus, for species living in family groups, selection for such traits acts with similar intensities on both genders. In species in which individuals don't live with relatives, selection acts less strongly on females.

Do the findings apply only to birds?

We think they may apply to any species in which individuals live with relatives, including many mammals and insects. I often get asked whether that includes humans, and although it may, I prefer to leave figuring that out to the sociologists. ■

MAKING THE PAPER

Daniel Garcia-Castellanos

A Mediterranean megaflood left its mark on sea-floor rocks.

Rarely do major geological events happen in a 'flash'. But the bulk of a huge flood that provided enough water to fill the Mediterranean Sea more than 5 million years ago may have occurred within less than two years. "That makes it an instantaneous event on geological timescales," says Daniel Garcia-Castellanos, a geophysicist at the Institute for Earth Science Jaume Almera in Barcelona, Spain.

About 5.6 million years ago, the Mediterranean Sea became isolated from the Atlantic Ocean and almost dried up in an event known as the Messinian salinity crisis. Some 270,000 years later, another change — a shift in tectonic plates, alterations in global sea levels or erosion of land (or possibly all three) — reopened the connection between the Mediterranean and the Atlantic at the Gibraltar Strait. The resulting flood, named after its geological timescale the Zanclean, was the largest in Earth's history and has long fascinated geologists. But because little is known about the flood's dynamics, estimates of its duration have been highly variable.

Garcia-Castellanos and his colleagues have successfully modelled the dynamics of the flood using new formulations based on how rivers change landscapes through incision — the water-driven erosion that cuts a path through rock (see page 778). This idea to incorporate incision-based processes stems back to research Garcia-Castellanos did several years ago as a postdoc at the Free University in Amsterdam, where he studied tectonic lakes.

"At peak discharge water poured in at a rate of 100 million cubic metres per second."

Unless an underlying tectonic process keeps them in place, Garcia-Castellanos explains, most lakes 'quickly' disappear — they fill up with sediment, overspill their banks and the water finds a way out, incising along an outlet. "In the models we were running in Amsterdam, this transition was very fast," he says. At around the same time that he was doing his postdoctoral work he started to learn about the Messinian salinity crisis. It struck him that the feedback between water flow and incision should be similar in the Zanclean flood.

By combining a variation of the river-incision model with the proper hydrodynamic equations for the Zanclean flood, Garcia-Castellanos and colleagues predicted that although the initial stages of the flood may have taken thousands of years — with water trickling down a ramp of rock at the strait — 90% of the flood water was transferred to the Mediterranean basin in a period lasting between only a few months and two years. According to the authors' model, at peak discharge water poured in at a rate of 100 million cubic metres per second, cutting down into the bedrock by almost half a metre per day and possibly raising the level of the Mediterranean Sea by more than 10 metres per day.

Garcia-Castellanos was shocked by the numbers that the model produced. "When we got the first predictions, I was very surprised and thought maybe something was wrong with the formulations," he says. To test the model's accuracy, Garcia-Castellanos looked for physical evidence. "If the model was correct, we would expect to find traces of the flood erosion preserved under the sedimentary layers in the strait," he says. In other words, such a tremendous rush of water would have carved a gorge, and its remnants should still be present under the sea floor.

To look for such traces, the team turned to two available data sets gathered by other groups. The first was seismic line data, which can be used to generate maps of a cross-section of the layers of rock under the sea floor. The second was rock cores drilled from the strait area during exploratory work for the Africa–Europe tunnel project, which aims to build a train tunnel connecting Spain and Morocco. Both data sets showed a clear channel running from the Eastern Atlantic to the Western Mediterranean through the strait. Researchers who first detected the channel thought it was the result of erosion caused by a river running through the dried up strait, but there is no evidence for such a river ever existing there. The conclusion that flood waters had shaped the channel makes more sense and is consistent with the team's model.

With the flood's intensity resolved, there is still much to learn about the ramifications of such a drastic event. The flood makes for a "natural laboratory", Garcia-Castellanos says, for discovering how it might have changed oceanic or atmospheric circulations, and so climate, at the time. He also conjectures that the quick disappearance of a land bridge between Europe and Africa affected the migration of mammals, noting that had the connection not disappeared, "hominins might have arrived in Europe much earlier than 1.2 million or so years ago." ■

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