Abstractions

FIRST AUTHOR

Amphibians emerged from Earth's waters around 360 million years ago, evolving into terrestrial vertebrates — first reptiles, then birds and mammals. Since that time, land vertebrates have returned to the sea many times. Aquatic amniotes today — whales, manatees and sea snakes — bear live young whose sex is determined by chromosomes, or genotype, rather than by temperature, as for many egg-laying reptiles. Work by Chris Organ, an evolutionary biologist at Harvard University, and his colleagues, now suggests that Mesozoic marine reptiles also relied on genotypic sex determination (see page 389). Organ tells *Nature* more about the significance of these findings.

Was there evidence for genotypic sex determination in ancient marine reptiles?

No. The evolution of genotypic sex determination was poorly understood in extinct species, primarily because genetic and genomic characters don't fossilize.

What made this study possible?

First, recent palaeontological discoveries have revealed that mosasaurs and sauropterygians gave live birth — something that was already known in ichthyosaurs. Second, with Mark Pagel and Andrew Meade at the University of Reading, UK, we developed computational tools to make evolutionarily informed predictions about extinct species. Then, in collaboration with Daniel Janes at Harvard, we were able to think about the evolution of sex determination in new, interdisciplinary ways.

How did you apply these methods?

In the 1990s, Mark built a general framework to model correlated evolution among traits, each of which occur in two states, such as presence or absence. We extended this framework to predict the state of a character that did not fossilize in extinct species based on the rates at which the characters evolve in relation to one another, the state of the correlate that did fossilize and where the extinct species sit on the evolutionary tree.

What did you find?

We found that the evolution of live birth is dependent on the prior evolution of chromosomal sex determination and that extinct marine reptiles probably used chromosomes to determine the sex of their offspring. It's a nice demonstration of how characters change in concert with one another and of how the evolution of genomic characters can affect the success of species in different environments. It also shows that the fossil record continues to have a central role for understanding how traits evolve — even for traits that don't fossilize. ■

MAKING THE PAPER

Astrid Kiendler-Scharr

Isoprene is the missing link for atmospheric aerosols.

The intoxicatingly fresh aroma of pine forests is the result of organic compounds called terpenes that are released into the atmosphere by coniferous trees. Terpenes belong to a large group of volatile organic compounds (VOCs) thought to have a key role in modulating local climate. As VOCs waft into the atmosphere, they react with hydroxyl radicals (OH) and ozone (O_3), contributing to the formation of aerosol particles. These aerosols serve as nuclei for water droplets to form into clouds, which ultimately have a cooling effect on the climate.

Researchers have long been puzzled by a mismatch between the amounts of organic aerosols measured in the atmosphere and those predicted to be there by models of plant emissions and subsequent reactions. To get to the bottom of this apparent incongruity, Astrid Kiendler-Scharr, an atmospheric chemist who recently established her lab at the Jülich Research Centre in Germany, teamed up with a Jülich colleague, physicist Jürgen Wildt, to demonstrate that an abundant VOC called isoprene may provide the missing link.

Wildt had developed specialized 'plant chambers' to study the types of emissions given off by plants. He, Kiendler-Scharr and their colleagues spent two years refining their experimental design of these chambers so that they could isolate VOC emissions and the aerosols produced as VOCs mingle with OH and O_3 in the atmosphere.

Their system includes a pair of chambers with volumes of 1.1 and 1.3 cubic metres. The first chamber houses a small mixed stand of different saplings. VOCs emitted by plants in this chamber are transferred to the second chamber and there combined with O_3 and OH. The researchers then apply a suite of analytical chemistry instruments to determine the exact size and number of aerosols formed.

In an earlier study, Kiendler-Scharr's team experimented with spruce and pine, which emit a class of terpenes known as monoterpenes. In that experiment, they were able to accurately predict how much aerosol should form based on the plants' VOC emissions.

For the current study (see page 381), they added to the plant chamber an oak sapling, which emits a different VOC called isoprene. This molecule accounts for a third of global VOC emissions from both natural sources such as vegetation and anthropogenic emissions such as traffic. When they first observed that the addition of an isoprene emitter to their experimental plant chamber led to fewer aerosol particles forming, they did not trust their results. "We went through the details of our experimental set-up for a week to figure out what mistake we were making," says Kiendler-Scharr.

The team found that isoprene scavenges OH radicals and suppresses the formation of new aerosols. In the atmosphere, fewer aerosols would lead to less cloud formation and less of a cooling effect on climate. Thus, isoprene emissions could lead to increased global-warming trends, says Kiendler-Scharr.

She hopes that further collaborative efforts within her institute will make it possible to study atmospheric simulations over a period of two to three days in much larger chambers.

It is estimated that 10,000–100,000 different VOCs exist in the atmosphere, resulting in thousands of oxidation products. The lingering question, says Kiendler-Scharr, is how these complex mixtures of molecules interact during oxidation. ■

FROM THE BLOGOSPHERE

Peer review is under scrutiny in a survey by the British non-profit science lobby Sense About Science, according to *Nature*'s senior news reporter Geoff Brumfiel, writing for The Great Beyond blog (http://tinyurl.com/mozdbv). Brumfiel succinctly sums up the survey's findings: "Peer review is hardly perfect, but nobody's got a better idea." The poll of 4,000 peer reviewers revealed a few surprises — only 9% of scientists canvassed were dissatisfied with the current peer-review system, and most think that more secrecy could improve the process.

Only 20% of respondents supported the idea of 'open peer review' in which reviewer names are revealed, whereas a "whopping 76% of researchers" cast a vote in favour of 'double-blind' peer review, in which the names of both authors and reviewers are hidden from each other. A significant percentage, 41%, responded that getting paid would make them more keen to review papers.

For junior researchers who would like to get involved in peer reviewing, the Peer-to-Peer blog has some tips on how to be noticed by editors (see http://tinyurl.com/ner3s8). ■

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