Exceptions prove rule of tropical importance in biodiversity

November 7 2007

Even a group of shellfish that appear to violate the overarching pattern of global biodiversity actually follows the same biological rules as other marine organisms, confirming a general theory for the spread of life on Earth. The University of Chicago's David Jablonski and his colleagues present this finding this week in the advanced online edition of the *Proceedings of the National Academy of Sciences*.

"There's more of everything in the tropics. More genetic diversity, more diversity in form, more diversity of species," said David Jablonski, the William R. Kenan Jr. Professor in Geophysical Sciences at Chicago.

Biologists call this the "latitudinal diversity gradient." They have known about this phenomenon for more than a century, "but there's remarkably little agreement on how it's formed," Jablonski said.

Scientists have offered dozens of different theories to explain the evolutionary underpinnings of the tropics' rich biodiversity. In their Proceedings article, Jablonski, the University of Chicago's Andrew Krug and the University of California, Berkeley's James Valentine present findings that highlight the importance of the tropics in maintaining the entire planet's biodiversity.

Scientists had debated for three decades whether the tropics were a cradle of diversity, where new species originate, or a museum of diversity, where old species persist. Last year Jablonski, Valentine and Kaustuv Roy of the University of California, San Diego, potentially resolved the debate by showing that the tropics is both a cradle and a museum of biodiversity.

But there is a problem nagging at all research on the latitudinal diversity gradient. "So many variables correlate with latitude" - temperature, environmental stability and many other features of the oceans - "that it is tough to separate cause and effect," said Krug, a Research Associate in Geophysical Sciences at Chicago. To do exactly that, the team sifted through a database consisting of 4,600 species of bivalves that occurred in more than 200 locations worldwide.

The research focused on bivalves because of their rich fossil record. "They're known from the shallowest intertidal zone to the deepest of the deep sea," Jablonski said of the bivalves, a group that includes clams, scallops and oysters. "They're known in every latitude, from the north polar ocean to the Antarctic."

The vast majority of bivalve groups show the standard pattern: a peak of diversity in the tropics, tailing off into less diversity in the higher latitudes. "We found one major group that didn't do that. We call that a contrarian group," Jablonski said. That group, called the Anomalodesmata and dubbed the Anomalos by the Chicago-Berkeley team, displayed a striking diversity pattern. Contrary to virtually all other marine life, Anomalo diversity peaked in the mid-latitudes of both hemispheres, but dipped in the tropics.

"We knew we had to take a closer look at these guys," Jablonski said. "We had to see how they fit into the bigger picture, how they got into this strange state. They could've shown a whole new evolutionary dynamic." But they didn't, which actually excited the scientists even more.
"We found out that they do follow the same rules, that they are an exception that proves the rule," Jablonski said. "This was really exciting:

science is always about the search for rules, generalizations that can explain nature in new ways." Krug agreed: "The results of the research were a bit surprising, as general rules governing natural systems can be hard to come by."

The origin of new Anomalo lineages was concentrated in the temperate zones, coinciding with their peak diversity. The coincidence between peak diversity and prolific evolution was seen in that group's relatives, too, and because both fell in the tropics, a normal diversity resulted.

"You could imagine a situation in which all their evolutionary action was still in the tropics, but they just had so much extinction there that by default their diversity peak was in the temperate zone," Jablonski said. "But if you know where the diversity peak is, you can predict where evolution is the most prolific."

"Thanks to the fossil record, we can show that their weird diversity pattern is because of a failure to diversify in the tropics and not because of supercharged evolution in the temperate zones. Our rule came through with flying colors."

These results show how important the tropics are for life on Earth: "The tropics are the engine of biodiversity. As the tropics are undermined or deteriorate for a whole variety of reasons, that actually undercuts evolutionary production on a global scale," Jablonski said.

Source: University of Chicago