Dawn of a crocodilian dynasty

THE MISSING LINK in the evolution of crocodilians has finally been unearthed near the outback town of Isisford, central-western Queensland. A 20 cm long fossilised skull weighing no more than a coffee cup, discovered in April 2005, was the last piece of a thrilling puzzle that my colleagues and I have been piecing together since the mid-1990s, when grazier Ian Duncan found the fossilised skeletons of two small crocodilians in a dried-up creekbed on the outskirts of town.

Meticulous lab work has revealed a 1.1 m adult crocodilian aged between 98 and 95 million years old. Compared to living crocodiles, the Isisford croc may be small in size, but its significance is huge. It's the world's first modern crocodilian, and its appearance in outback Queensland means we can now pinpoint Australia as the place where the evolution of today's crocs may have begun.

Crocodilians have a fossil heritage dating back over 200 million years. Fossil evidence shows they've passed through several phases of evolution since then. We've known for a long time that modern crocs had their origins in the 'Age of Dinosaurs', during the Cretaceous period (142–65 million years ago), but what the first ones looked like, and when and where they originated, was unclear.

The earliest crocodilians, such as the cat-sized *Orthosuchus strombergi* (A, below), had internal nostrils at the front of the mouth, and vertebrae (seen from the side) that were concave at both ends – a design that in combination with their bony armour allowed the spine only limited movement. These characteristics suggest they were land-bound animals that only ate small prey. Later crocodilians or 'mesosuchians', such as the marine *Pelagosaurus typus* (B), had a long narrow snout and internal nostrils at the back of the palate, which indicates they fed underwater on fish and other small, fast-moving marine animals.

Modern crocodilians, such as the 'saltie' Indo-Pacific crocodile, *Crocodylus porosus* (D), have internal nostrils even further back in the palate, and the bones surrounding them are sutured together to form a broad plate. This structural reinforcement means modern crocs can prey on much larger animals than their predecessors, and can use the 'death roll' during feeding. The loosely fitting ball-and-socket joints formed between their vertebrae (concave at one end and convex at the other) enable them to grow very large without losing the ability to walk and swim efficiently.

The Isisford crocodilian (C) neatly fills the gap between the mesosuchians like *Pelagosaurus* and the modern crocs we know today. Its palatal plate has only just begun to form, and the vertebrae are developing the loosely fitting ball-and-socket joints of today's crocodilians. Its design suggests it was one of the first crocs to employ the 'death roll', and it would have been as comfortable walking on land as it was swimming.

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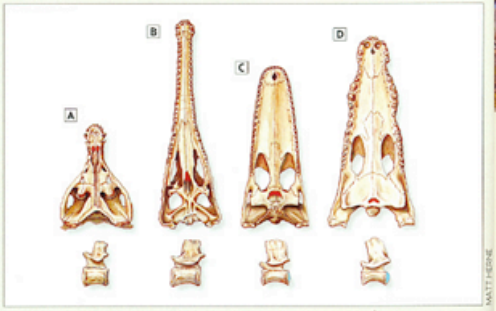

MATT HERNE

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STEVE SALISBURY

Steve Salisbury (far left) pieces together the fossil puzzle (above) that brings the world of the Isisford crocodilian (left) to life.

If every fossil tells a story, the Isisford crocodilian is like a missing volume in the evolution library. It tells us that all the world's living crocodilians, including the fearsome Indo-Pacific crocodile of Australia's north, began as diminutive animals that lived in the shadows of giant sauropods in central-western Queensland 98–95 million years ago.

Within 20–30 million years of the appearance of the Isisford crocodilian in Australia, its descendants would make it through the extinction event that wiped out around 75 per cent of all species existing 65 million years ago, and quickly come to rule the water's edge as the explosive semi-aquatic ambush predator that we know so well today.

STEVE SALISBURY

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