THE SCIENCE OF EVERYTHING
COSMOS

20 August 2020 / Nick Carne

NatureWatch: New ideas on strength, speed, size

Spiders, fish, sharks and Australia's iconic ‘tiger’.

A slingshot spider ready to launch its cone-shaped web at a flying insect. Credit: Lawrence E Reeves

Not all in nature is at it seems or, at least, as we might have thought. Four new studies have interesting findings on how things survive and evolve.

A spider that’s clever and fast

Peru’s slingshot spider (genus Theridiosomatid), like its cousins, has the rather intimidating habit of launching an entire web to catch prey. Now researchers from the Georgia Institute of Technology, US, have put some hard numbers around that impressive feat.

Writing in the journal *Current Biology*, they say the spider stores enough energy to accelerate 100 times faster than a cheetah, producing velocities of four metres per second and subjecting themselves to forces of approximately 130 Gs – more than 10 times what fighter pilots can withstand without blacking out.

"If you compare this natural silk spring to carbon nanotubes or other human-made materials in terms of power density or energy density, it is orders of magnitude more powerful."

When it senses a a fly or mosquito within range, the spider launches the web and itself . If successful, it quickly wraps its meal in silk. If it misses, it simply pulls the tension line to reset the web for the next opportunity.

Given how much energy would be required in the "ready" position, Bhamla and colleague Symone Alexander suspect the spider must be able to lock its muscles like a latch

Tiger sharks and the yo-yo dive

Tiger sharks (*Galeocerdo cuvier*) also have a reputation as fast and fierce predators, but new Australian research suggests they actually prefer life in the slow lane.

When a team from the University of Western Australia (UWA), the Australian Institute of Marine Science (AIMS) and Murdoch University used camera tags to follow 21 sharks at Ningaloo Reef for a day or two, they discovered they spent most of the time swimming slowly in a yo-yo fashion between the surface and the bottom.

A tiger shark descends to the seabed on the sandflats of Ningaloo Reef. Credit: Alex Kydd

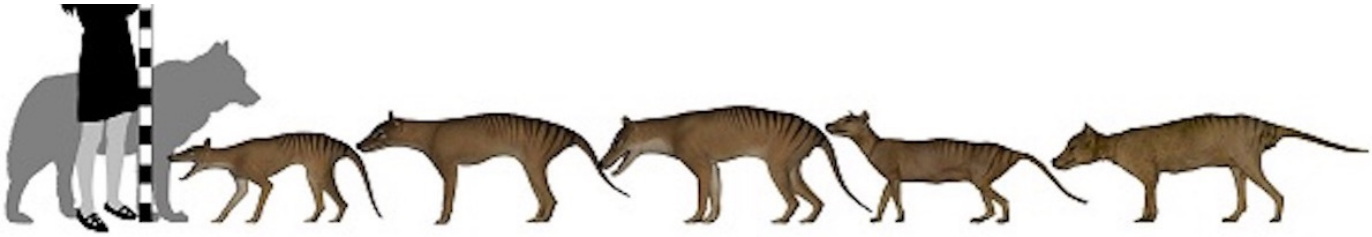
The instruments combine motion and environmental sensors with video cameras and record data 20 times a second.

This allowed UWA's Samantha Andrzejaczek and colleagues to monitor every tailbeat, in the same way that a FitBit records human footsteps, then calculate the energetic costs as the sharks searched for prey.

AIMS's Mark Meekan says up-and-down movements reduce the energetic costs of swimming relative to swimming the same distance at a level depth.

"Even for large predators such as tiger sharks, there is no such thing as an easy meal or any certainty when that meal may arrive, so it's very important for these animals to conserve energy while they search," he says.

The findings are published in *Royal Society Open Science*.



Credit: Douglass Rovinsky

Tassie tiger was fierce but not so big

There is new news, too, about another type of "tiger". The extinct thylacine, colloquially known as the Tasmanian Tiger, was apparently only about half as big as once thought.

Researchers from Monash University have revealed that it only weighed about 17 kilograms on average, which, they say, changes the way we look at its position in Australian ecosystem.

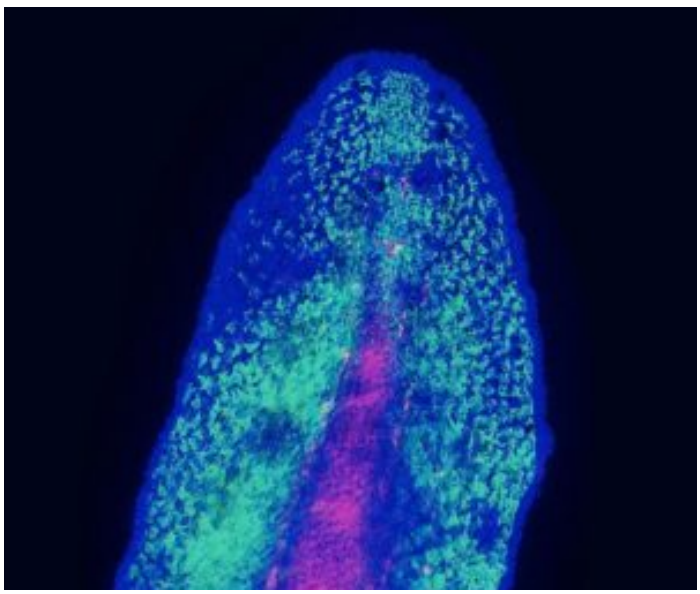
The lighter body mass would place thylacines as specialists on small prey, challenging prior interpretations of them as convergent with species like wolves that specialise in pack-hunting prey substantially larger than themselves.

"[W]hat a predator can and needs to eat is very much dependent on just how big they are," said Douglass Rovinsky, lead author of a paper in the journal *Proceedings of the Royal Society B*. "Many of the 19th century newspaper reports just might have been tall tales – told to make the thylacine seem bigger, more impressive, and more dangerous!"

To make their findings, the researchers combined traditional measurement techniques with advanced 3D scanning and volumetric methods and a database of 93 museum specimens of thylacines drawn from six countries.

Lungfish and the evolution of limbs from fins

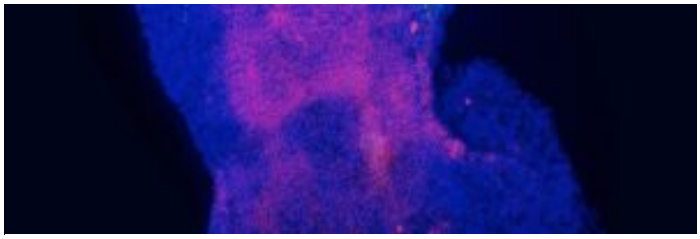
In the fins of the Australian lungfish, the closest living fish relative to four-limbed vertebrates (tetrapods), scientists have identified a gene expression region they say is similar to regions that, in tetrapods, control development of wrists or fingers.



This uncannily limb-like structure and the gene that cues its development existed before tetrapods evolved, pointing to a long-missing piece of the fin-to-limb evolutionary puzzle, they write in a paper in the journal *Science Advances*.

The evolution of hands as we know them has remained mysterious, with some scientists

genes, which help map out a developing embryo's body plan and ensure that structures form in the correct places.



An embryonal fin of a lungfish stained to visualise the developing internal skeleton (red) and the position of the external skeleton (green) that is specific to fish. Credit: Joost Woltering

Joost Woltering from Germany's Universität Konstanz and colleagues from Australia and Italy analysed gene expression patterns in the Australian lungfish (*Neoceratodus forsteri*), which has larger fins that species from Africa or South America.

They report finding that hoxa13 gene expression defines the same region of the skeleton in developing lungfish fins as it does in developing tetropod limbs, laying out the blueprint for a wrist- and finger-like region in the fish's skeleton.

Nick Carne

Nick Carne is the editor of Cosmos Online and editorial manager for The Royal Institution of Australia.

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PO Box 3652,
Rundle Mall SA 5000, Australia

55 Exchange Place,
Adelaide SA 5000, Australia