

Orangutans bite back

May 27 2011, By Pete Wilton



Orangutan in Borneo: opening bananas is easy, unlike seeds.

(PhysOrg.com) -- Life as a seed isn't easy: you need to be tough enough to deter all but the most muscular-jawed predators but not so hard that you can't germinate.

A new study published this week in *Journal of the Royal Society Interface* shows just how fine this evolutionary balance between protection and [reproduction](#) is.

A team, including Susan Cheyne of Oxford University's WildCRU, analysed the properties of the seeds of the plant *Mezzettia parviflora* (Annonaceae) and the effort that seed [predators](#), such as orangutans, have to put into cracking them open.

"The intricate architecture of the *Mezzettia parviflora* seed allows its germination while impeding both small predators such as weevils and

large ones like orangutans," Susan tells us.

"Orangutans open the seed by biting into the germination bank and cracking the wooden plug, the weaker part of the seed through which the stem of the germinating seedling emerges."

Field observations by Susan and colleagues of [orangutans](#) in Sabangau, Borneo, show that whilst orang-utans consume an average of about 120 seeds per day (up to a maximum of 1001) the jaw strength they have had to evolve to accomplish this task is formidable: the force their jaws deliver is equal to the weight of up to six people bearing down on the seed.

So is all this effort worth it? "The seeds contain a small amount of a lipid-rich substance which is very high in energy, so worth the effort to break not only the seed but the hard outer shell of the fruit,' Susan explains. 'The toughness of this fruit and seed prevents consumption by other primates, for example gibbons, who lack the jaw strength to open the seeds."

The research is thought to be the first to show that the mechanical properties of a seed play a central role in stabilising the arms race between seeds evolving armor for protection and the predators evolving a way to open a nutritious snack.

More information: Evolutionary optimization of material properties of a tropical seed, *Journal of the Royal Society Interface* Published online before print May 25, 2011, [doi: 10.1098/rsif.2011.0188](https://doi.org/10.1098/rsif.2011.0188)

Abstract

Here, we show how the mechanical properties of a thick-shelled tropical seed are adapted to permit them to germinate while preventing their predation. The seed has evolved a complex heterogeneous

microstructure resulting in hardness, stiffness and fracture toughness values that place the structure at the intersection of these competing selective constraints. Analyses of different damage mechanisms inflicted by beetles, squirrels and orangutans illustrate that cellular shapes and orientations ensure damage resistance to predation forces imposed across a broad range of length scales. This resistance is shown to be around the upper limit that allows cracking the shell via internal turgor pressure (i.e. germination). Thus, the seed appears to strike an exquisitely delicate adaptive balance between multiple selection pressures.

Provided by Oxford University

Citation: Orangutans bite back (2011, May 27) retrieved 20 March 2024 from <https://phys.org/news/2011-05-orangutans.html>

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