Why care?

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09/12/05 Creationists sue University of California

The latest creationism battle may be fought in federal court once again. This time, the Association of Christian Schools International, the Calvary Chapel Christian School in Murrieta, California, and students at the school have filed a complaint because of a UC policy that **rejects high school biology courses** that use textbooks published by Bob Jones University Press and A Beka Books. The books have been described as "inconsistent with the viewpoints and knowledge generally accepted in the scientific community."

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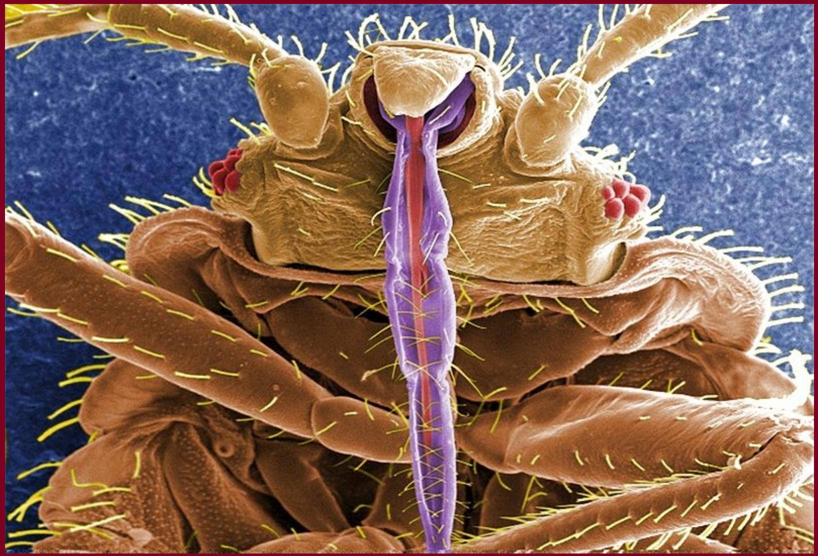
Why care?



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Flat-tailed horned lizard (*Phrynosoma mcalli*)

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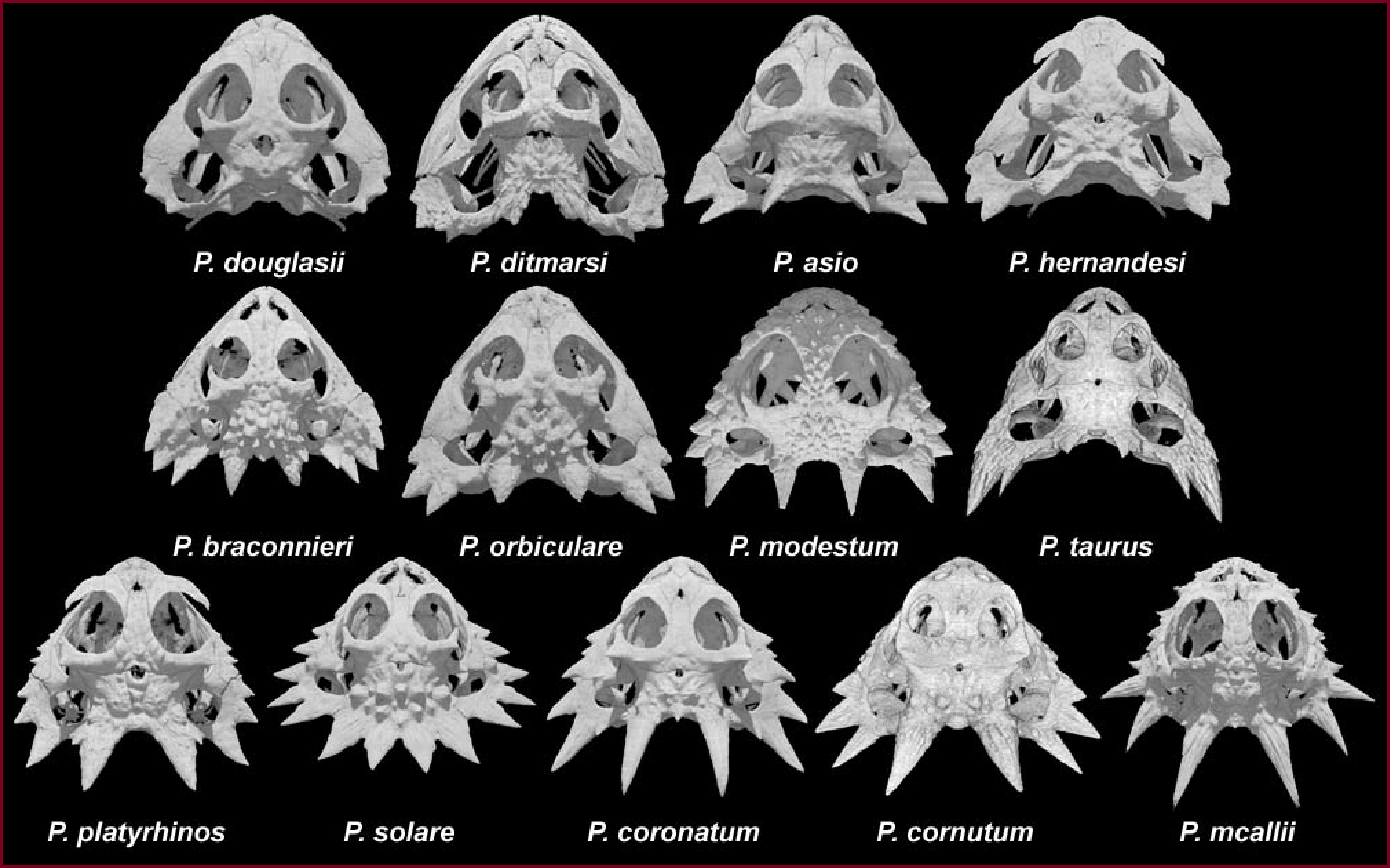
P. douglasii
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P. coronatum
P. cornutum
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How the Horned Lizard Got Its Horns

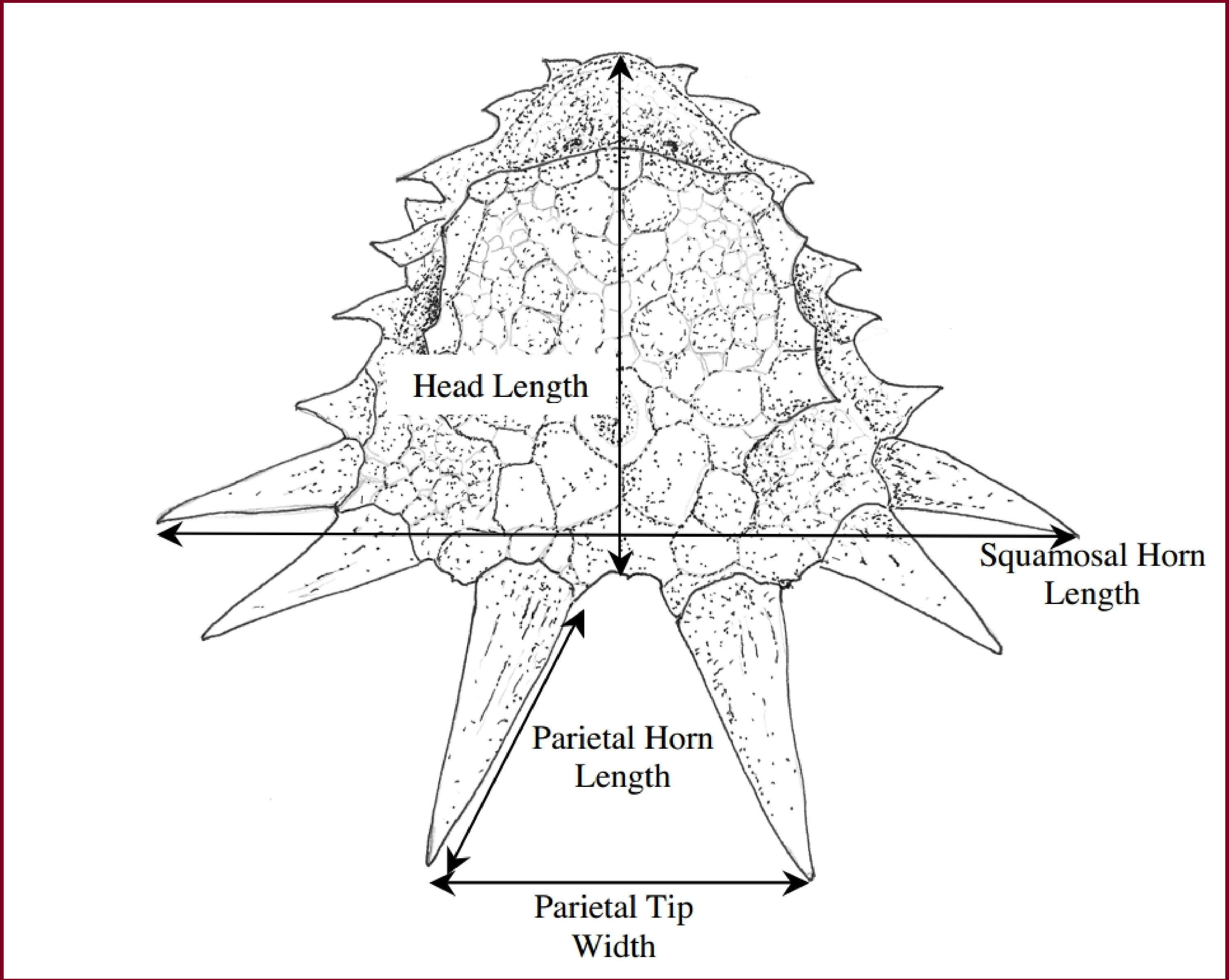
Kevin V. Young,[1] Edmund D. Brodie Jr.,[1] Edmund D. Brodie III[2*]

Many descriptions of evolutionary adaptations are criticized as "just-so stories" (*1*) that are based more on intuition than on direct tests of adaptive hypotheses. The elaborate crowns of horns possessed by many species of horned lizards (genus *Phrynosoma*) are classic examples of intuitively adaptive features that lack direct tests of function. The bony horns that give horned lizards their name are presumed to function as a defense against predators (Fig. 1B). Here we present data from the wild showing that natural selection by loggerhead shrikes favors longer horns (fig. S1) in the flat-tailed horned lizard (*Phrynosoma mcalli*).

Predation is difficult to document in the wild. Some predators, however, leave behind explicit records of individual predation events that can be exploited to assay natural selection. Loggerhead shrikes (*Lanius ludovicianus*) often impale their prey onto thorns, twigs, and even typically spear the lizard through the neck and pull off the soft tissue. What remains is a record of the successful shrike predation attempts marked by desiccated skulls of horned lizards hanging in trees and bushes (Fig. 1A).

We quantified selection (*3*, *4*) on relative horn lengths of flat-tailed horned lizards by comparing the skulls (n = 29) of shrike-killed lizards with the heads of live lizards (n = 155). Our results showed predation by loggerhead shrikes generated selection that favored longer parietal and squamosal horns (Fig. 1, C and D). The average parietal horn length of live horned lizards was 10.0% longer ($\bar{x} \pm SE: 9.65 \pm 0.01$ mm) than that of shrike-killed lizards (8.77 ± 0.21 mm), and the average squamosal horn length was 10.4% greater in live lizards (24.28 ± 0.21 mm) than in those killed by shrikes (21.99 ± 0.49 mm). Visualization of the selection function indicates that both traits experience positive directional selection with [measured in standard deviation units (*3*)] suggest that selection is stronger on the length of squamosal ($\beta' = 0.0945$; $P = 0.007$) than on the length of parietal horns ($\beta' = 0.0549$; $P = 0.055$). These magnitudes of selection are less than the median observed in most selection studies ($\beta' = 0.15$) (*5*) but nonetheless indicate that constant selection with moderate heritability (0.5) of horn length would change squamosal and parietal horn lengths a full standard deviation in 21 and 36 generations, respectively.

Modern methods for analyzing natural selection have increased our understanding of which traits experience selection (*6*). These methods, however, typically cannot identify agents of selection or reveal the functional relations that result in natural selection (*3*). Even most classic data sets demonstrating selection in the wild, including Bumpus's sparrows (*7*) and Lande and Arnold's pentatomid bugs (*8*), did not reveal the agents responsible for the observed patterns of survival. Our results present a rare opportunity to link the statistical form of selection to an identifiable agent, in this case predation by shrikes. Our study does not show that other agents and forms of selection do not play a role in the evolution of horn size, but clearly illustrates that defense against shrike predation is one factor driving the radical elongation of horns in some spe-


Head Length
Squamosal Horn Length
Parietal Horn Length
Parietal Tip Width