Letters to the Editor

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How Did the Horned Lizard Get Its Horns?

IN THEIR BREVIA "HOW THE HORNED LIZARD got its horns," K. V. Young *et al*. present an important example of natural selection in the wild, suggesting that loggerhead shrike predation drove the evolution of elongated horns in the flat-tailed horned lizard (2 Apr., p. 65). Although the authors acknowledge that selective forces other than shrike predation may also be involved, they make no mention of the possibility that one of these potential forces could have been the first instigator of the directional selection for horn elongation. Under this hypothetical scenario, the horns would have then only subsequently served to reduce shrike predation. Other likely cases of preadaptation [or exaptation (*1*)] have been described in vertebrates (*2*–*5*), some of which involve important transitions in evolutionary history. Perhaps the role of preadaptation in evolution is of great importance and is deserving of more widespread appreciation. Given the possibility of a preadaptation scenario in the evolution of crown horns in horned lizards, I find it ironic that Young *et al*. commented on the weakness of "just-so stories" (*6*) and also chose a title that reads remarkably like the titles of Kipling's stories. Until presented with evidence suggesting that the horns were mere nubs until the onset of shrike predation, I will remain convinced that "How the horned lizard got its horns" is a poor choice for what is presumably meant to be an informative title.

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IN THEIR BREVIA "HOW THE HORNED LIZARD got its horns" (2 Apr., p. 65), K. V. Young *et al*. claim to have direct evidence of the defensive function of the long bony horns that fringe the lateral and posterior margins of the head of the flat-tailed horned lizard (*Phrynosoma mcalli*). They show elegantly and convincingly that loggerhead shrikes (*Lanius ludovicianus*) prey on lizards with relatively short horns (corrected for body size) and that this source of mortality produces directional selection favoring longer horns. Unfortunately, the authors incorrectly conclude that "defense against shrike predation is one factor driving the radical elongation of horns in some species of horned lizards." This conclusion is incorrect because they did not show that the lizards use their horns to defend themselves against shrikes, nor did they show that longer horns are better for defense. Suppose that lizards with longer horns also are more vigilant, escape faster, spend less time in the open, are more cryptic, or have other traits that reduce the chance they are seen, caught, killed, and eaten by shrikes. Any of these correlated traits could also explain the observed pattern of predation and selection. Observations of how shrikes attack lizards and how lizards defend themselves, and measurements of predation rates on lizards with experimentally shortened and lengthened horns are needed to test the validity of the intuitively attractive suggestion that the horns of horned lizards are defensive. At present, this explanation for the adaptive function for horns remains a "just-so story."

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IN THEIR BREVIA "HOW THE HORNED LIZARD got its horns" (2 Apr., p. 65), K. V. Young *et al*. explain the causal processes of how the flat-tailed horned lizards (*Phrynosoma mcalli*) developed parietal horns as a defense against the impaling capabilities of the loggerhead shrike (*Lanius ludovicianus*). However, the actual selection factor that the horns help to defend the lizards from—how shrikes kill their vertebrate prey—was not discussed. Shrikes prey differentially on invertebrates and vertebrates. A shrike (*Lanius* spp.) kills its vertebrate prey (*1*, *2*), including species that may weigh as much as an adult shrike (30 to 75 g depending on the species of shrike), with a bite directed at the portion of the prey's neck immediately posterior to the skull. The bite disarticulates the vertebral column. When the prey is dead, a shrike will fly to a convenient perch where the prey is either impaled on a sharp point or dragged and lodged into a fork of a branch (*3*). This allows a shrike to pull the prey apart with its bill into portions that can be swallowed.

CREDIT: K. V. YOUNG

Flat-tailed horned lizard in defensive posture.

Natural selection can only occur if individuals survive a given experience and are able to transmit that information to conspecifics or their progeny (*4*). Given my long experience in the field with shrikes, the attack period is the only possible event when a horned lizard could experience and escape the attacks of the shrike to the nape. Further, it is also possible that attacks by inexperienced juvenile shrikes, allowing for a greater percentage of escapes (*3*), on the horned lizards gave rise to the selection for elongated horns. It also does not make evolutionary sense for a trait to be incorporated into a prey species, as a result of a predator's behavior, that results in all cases in its death (i.e., the impaling stage). Hence, although I accept the authors' conclusion that "defense against shrike predation is one factor driving the radical elongation of horns," I suggest that the parietal horns developed as a defense against shrike attacks to the nape region and not against their being impaled after they are dead. Thus, the posterior-directed (and perhaps even the lateral-directed) cranial horns of a *Phrynosoma* lizard are a potential danger to a shrike, aimed as they are at a shrike's eye when it goes in for a lethal bite at the lizard's neck.

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