Black, white and stinky: Explaining coloration in skunks and other boldly colored animals

May 30 2011

Striped Skunks (Mephitis mephitis) Image: Wikipedia, CCA3.

(PhysOrg.com) -- In a first-of-its-kind analysis of the evolution of warning coloration in carnivores published this week by University of Massachusetts Amherst evolutionary biologist Ted Stankowich and colleagues, the researchers explain why some species such as skunks use bold coloration to warn predators either that they risk being sprayed with stinky gas or getting into a vicious fight, while other species don't.

Stankowich says most evolutionary research attention to date on warning coloration in animals has been paid to species like newts, poison dart frogs and insects, so this new investigation is a rare comprehensive analysis of mammalian warning coloration, also known as aposematic coloration, such as the skunk's bold stripes.

He adds, "It's important to be clear that bold coloration is not just advertising the ability to spray your anal glands, it's often an advertisement for ferocity. Some of these small black and white animals are extremely ferocious, for example the honey badger."

Stankowich, who is also a visiting postdoctoral and teaching fellow at Harvard, with Tim Caro of the University of California Davis and UMass Amherst undergraduate Matthew Cox, conducted this first systematic examination of the evolutionary drivers of bold coloration patterns and placement in carnivores such as skunks, badgers, civet cats and wolverines.

The researchers collected data on 188 species of mammalian carnivores and found those who are more boldly colored are more likely to be stocky, able to spray noxious chemicals from their anal glands, burrowing, nocturnal and living in exposed environments. Results appear in the current online edition of the journal Evolution.

"One question we're asking is what are the possible evolutionary advantages of bold coloration in mammals," he says. "Why would you want to be so bold, calling more attention to yourself when camouflage is such an effective strategy? We've tested how certain aspects of species ecology and lifestyle might shape the evolution of this phenomenon."

Among the evolutionary advantages these strategies may carry is the ability to move into a new habitat that is relatively exposed to predators but not exploited by other animals or the ability to remain living in a habitat that suddenly experiences an influx of new predators.

To investigate eight factors that are potentially involved in the evolution of aposematic coloration, Stankowich and colleagues categorized 188 carnivore species by pelage: from a single color to extravagantly and boldly marked, which contributes to a feature they call salience, an

expression of how well a species stands out in its environment due to its color pattern. Other variables included in the analyses are the ability to spray noxious anal gland secretions, body shape and habitat openness.

The researchers then used a series of statistical steps including phylogenetic independent contrast methods, which are based on information about species' evolutionary relationships, to look at changes in a particular trait. They analyzed these contrast scores with a measure known as Akaike's information criterion (AIC) to obtain the relative goodness of fit for variables to a statistical model. AIC analysis reveals which variables play the strongest role in explaining the variation in the data, Stankowich notes.

In this case, the authors identified the 10 strongest models, then looked at which variables most commonly occurred in those models. These strongest models were used to calculate summary weights for each factor, an indicator of the importance of each predictor. They found that the evolution of boldly colored body patterns was best explained by body length, habitat openness, anal spray ability and burrowing behavior.

They also found that species with horizontal stripes along the body leading to the tail are more likely to be able to spray their anal gland secretions at predators in defense, suggesting that the stripes also direct the predator's attention to the area where the weapon is found. Similarly, a previous study found that facial stripes in this group were found in species that defend themselves by fighting, often with strong bites.

Overall, these anti-predator strategies appear to have evolved independently several times among the *Carnivora*, say Stankowich and colleagues. So, for example, other nocturnal, slow, stocky, small-to-medium animals with bold black-and-white coloration signaling the presence of noxious anal gland secretions and/or the ability to fiercely defend themselves can be found living in open areas in Africa as well as

North and South America and Europe.

Provided by University of Massachusetts Amherst