GREASY LIZARD STUFF

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Many species of lizards communicate using visual signals. Stereotyped headbobs, in which dominant males face-off and nod vigorously at one another in defense of their territories, are familiar to anyone who has watched lizards at the zoo or in their natural habitat. Although visual communication is an important feature of lizard social life, lizards may have problems using only headbobs to advertise their presence. Visual signals can sometimes be blocked from view by leafy vegetation, and they do not persist beyond the time they are transmitted. Recent evidence suggests that lizards also communicate using smell. In collaboration with Drs. John Phillips and Nancy Pratt of the Comparative Physiology Division at CRES, I have been investigating the importance of pheromones in the social interactions and mating behavior of green iguanas.

Green iguanas are large, herbivorous lizards that live in trees along rivers and lakes in lowland tropical forests from southern Mexico to South America. Despite their widespread geographical distribution, green iguanas are endangered in every country in which they occur as a result of over-hunting and habitat destruction. In recent years, however, efforts devoted to their conservation have been initiated in Costa Rica, Panama, and Belize, through the hatching and release programs of the Pro Iguana Verde Foundation, the Belize Zoo, and the Zoological Society of San Diego. At CRES, we have been studying several aspects of behavior and physiology in captive breeding groups of green iguanas. For the past two years, one area of our research has focused on the role that chemical communication plays in green iguana reproduction.

Like many other lizards, green iguanas are well-equipped to release and detect chemical signals. In addition to a nasal olfactory apparatus somewhat like our own, they also possess vomeronasal organs. The vomeronasal organ lies below the nasal cavity, opens into the roof of the mouth, and is designed to sample odors from the environment that are brought in on the tongue. Although humans and many other primates do not have vomeronasal organs, most other terrestrial vertebrates do. A variety of lizards and snakes are noted for their tongue-flicking behavior, which probably serves to deliver molecules to the vomeronasal organ for chemical investigation.

Many lizards possess scent glands that are specialized for releasing pheromones. These glands, referred to as femoral glands because of their position on the underside of the hindlegs, open to the exterior through a series of pores. Each pore contains a small amount of white secretion with a greasy, paste-like consistency, called a secretion plug. In green iguanas, femoral glands are substantially larger and more active in males than in females. In the wild, male green iguanas rub secretions from their femoral glands onto twigs and branches as they move through their home ranges. Research in our laboratory has shown that the secretions of individual males differ slightly in their chemical composition, suggesting that these secretions may act as chemical "signatures" allowing green iguanas to recognize one other.

Green iguanas in the wild exhibit a highly developed, complex social structure. During the mating season, the largest dominant adult males hold territories in and around which several females and subordinate males reside. Medium sized males may attempt to court resident females by remaining on the periphery of mating territories, whereas small males are often so similar in appearance to females that they sneak into the territories of dominant males undetected and may attempt to mate there. At CRES, we have discovered that social relationships among male green iguanas are established at an early age.

Researchers at CRES collect a blood sample from the tail vein of a male green iguana to determine how hormone levels correlate with scent gland activity. *Photograph: Michael Worley/On The Brink*

Almost immediately after they hatch, certain hatchlings, because they are more successful at aggressively competing for resources, become socially dominant. These dominant hatchlings grow faster and mature earlier than their subordinate counterparts.

Over the course of a year, we studied the hormonal and behavioral correlates of femoral gland productivity in the male green iguanas inhabiting the outdoor iguana exhibit on reptile mesa. We found that the socially dominant males produced far more secretions than the socially subordinate males, and that the amount of secretion produced by a given male was positively associated with the level of testosterone in his blood. The secretions of dominant males contained a higher percentage of greasy lipids than those of subordinates, making them easier to detect in the environment. Presumably, males that produce more secretions can scent mark their territories more effectively, and as a result may be more successful at attracting females and defending them from potential rivals. Among juveniles, dominant males have femoral glands that develop sooner and to a greater degree than subordinate males, indicating that chemical signals may begin to influence social status very early in life.

Now that we better understand the importance of pheromone signals in green iguana social behavior, we are beginning to examine several aspects of communication in this species in more detail. Specifically, we are interested in unravelling how chemical and visual signals may work together to advertise social status, and how both types of signals may affect the physiology and behavior of receiving animals over the long term. Stay tuned, and remember, next time you meet up with a green iguana, all you see isn't necessarily all you get.

References

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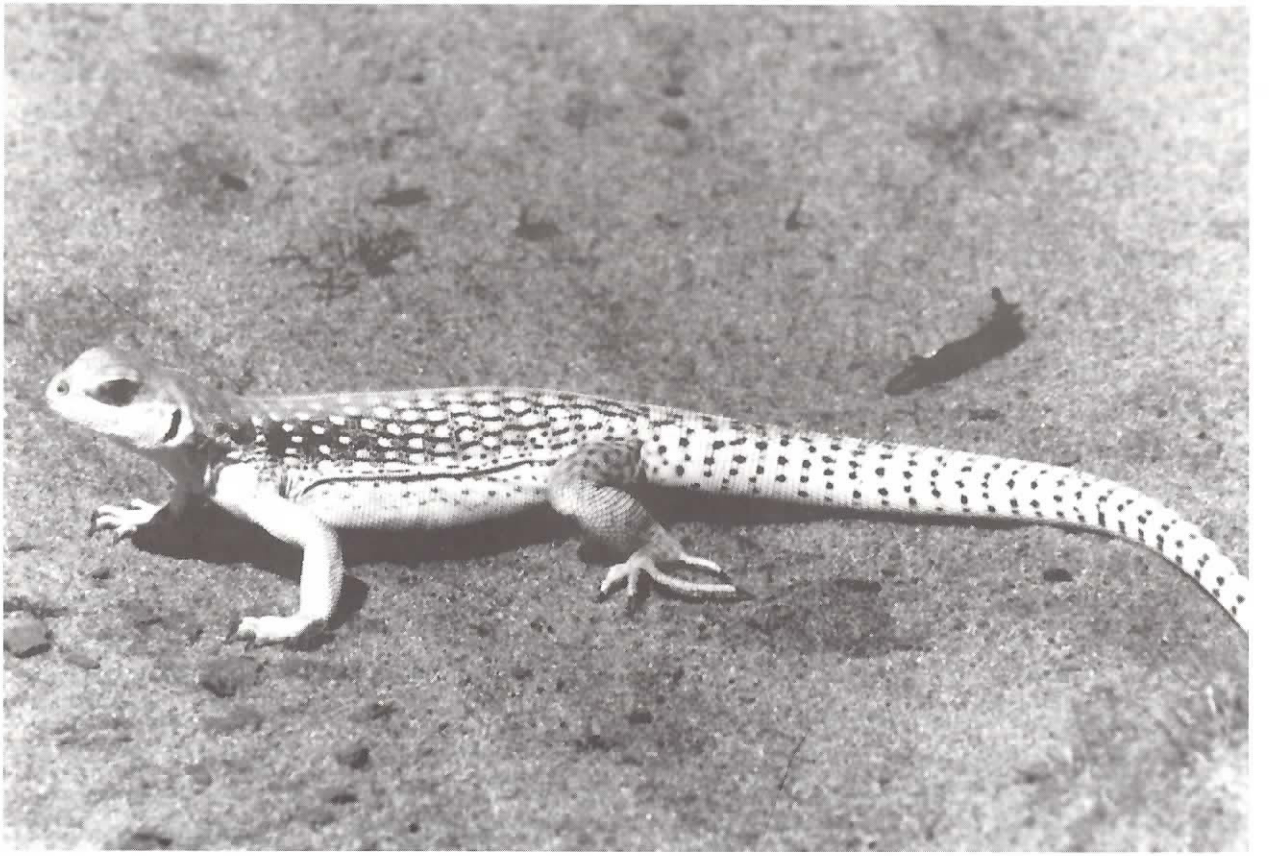
The environment in which a lizard lives may determine how easily its scent marks can be located by other lizards. Both desert iguanas and green iguanas possess femoral glands on the underside of the hindlegs (Cole, 1966). They use pheromone secretions from these glands to mark their territories. Desert iguanas live in extremely hot and arid habitats, whereas green iguanas live in humid tropical forests (Burghardt and Rand, 1982). Because these two species of lizards live under such different environmental conditions, it is not surprising that the way their pheromone signals are transmitted differs.

Desert iguanas have scent marks that are non-volatile, meaning that they evaporate very slowly into the atmosphere. These marks are also very resistant to chemical breakdown at high temperatures. The low volatility and thermal stability of desert iguana scent marks ensure that they persist under harsh desert conditions, a necessary quality if they are to be used effectively for territory marking. Although these characteristics make scent marks more durable in desert environments, they pose a problem for desert iguanas attempting to detect them: if the marks are not very volatile, then they may be difficult or impossible to locate using smell. Desert iguanas avoid this problem by combining a unique type of visual signal with their scent marks.

One striking property of desert iguana scent marks is that they strongly absorb longwave ultraviolet light. Although these wavelengths are invisible to human eyes, they probably appear dark to animals able to see ultraviolet light, much as ultraviolet absorbing honey-guides on flowers look black when UV sensitive camera film is used to view them. Recent studies have shown that desert iguanas are able to see longwave ultraviolet light, and may use this adaptation to detect scent marks from a distance (Alberts, 1989). After scent marks are localized using visual cues, desert iguanas can approach and investigate them in more detail through tongue-flicking. Although it is not known to occur in mammals, visual sensitivity to ultraviolet light has been shown in certain insects, spiders, fish, frogs, and birds. The ability of desert iguanas to detect ultraviolet light may help them solve some of the problems associated with finding scent marks in a desert environment.

In contrast to those of desert iguanas, the scent marks of green iguanas contain a variety of volatile chemical compounds, and they do not absorb ultraviolet light. Behavioral studies indicate that green iguanas, unlike desert iguanas, can detect these scent marks by smell alone. Because the chemical components of green iguana scent marks remain active and transmit well under the humid conditions of tropical forests, green iguanas do not appear to need a visual cue in order to locate scent marks. Research on both iguana species demonstrates how the environment in which animals live can influence the nature of the communication signals they employ.



Male desert iguana, *Dipsosaurus dorsalis. Photograph: David Blair*