Leaping Lizards and Male Impersonators: Are There Hidden Messages?

By imitating male mating behavior, all-female lizard species apparently enhance their own ability to reproduce. Is this a lesson in sexual development, or a curiosity of science?

By DIANE D. EDWARDS

What do dandelions and certain species of fish have in common? There's not a male among them—yet they do very well, thank you. As one of several procreation options available in nature, all-female species are intriguing. But can this extreme form of asexual independence teach anything about the evolution of sexual behavior in higher animals, including *Homo sapiens*? Maybe, maybe not, say scientists who study lizards lacking the true male touch.

For most, life without the male of the species would lack a certain *joi de vivre*. The same might be said of a female-free world, with an added technicality: Life itself would be in shorter supply. While females and their eggs are crucial in species with sex differentiation, males can be superfluous in those that rely at least in part on the process called parthenogenesis, in which egg cells develop into individuals without fertilization.

Some species can alternate between parthenogenesis and sexual reproduction, depending on environmental conditions. Others stay true to parthenogenesis and its production of identical daughters—which, biologists point out, is a far more efficient way to reproduce than by sexual means, in which two cells are required for reproduction instead of one.

Giving a twist to the tale of parthenogenesis, David Crews in 1979 reported a type of male impersonation among parthenogenetic whiptail lizards of the genus *Cnemidophorus* (SN: 12/22&29/79, p.423). While at Harvard University, he found that captive members of the all-female *C. uniparens* imitated mounting and mating postures of the male *C. tigris*, a *Cnemidophorus* species containing both males and females that reproduce sexually (see photos). Crews, now at the University of Texas in Austin, and his co-workers have since described this pseudosexual behavior in captive lizards from four other parthenogenetic whiptail species collected in the southwestern United States.

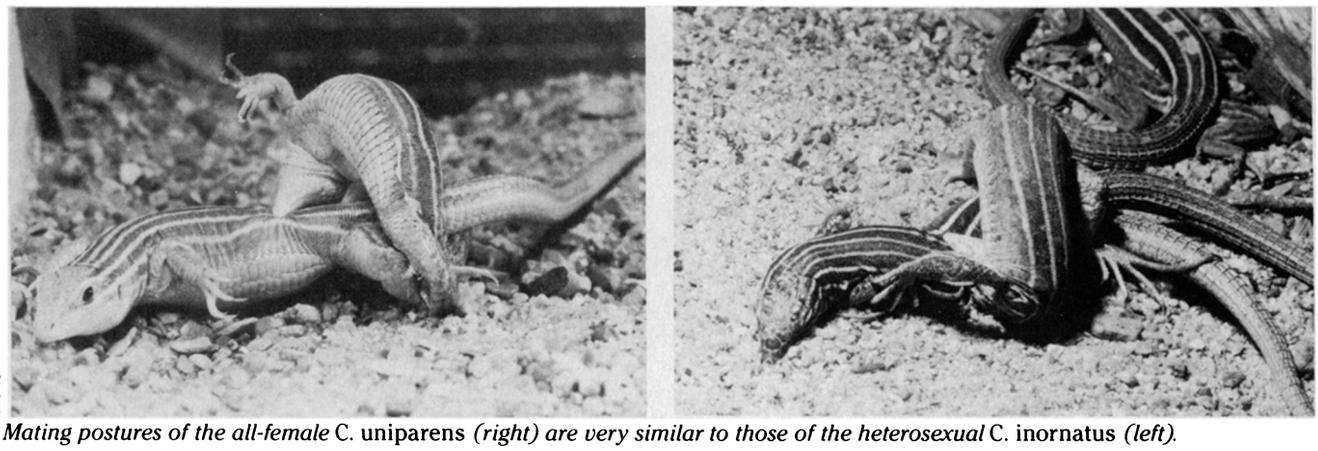
The lizards could change some old theories about sex, says Crews. He suggests that sexual behavior in animals may have evolved before the two sexes evolved. This may represent "a reversal of the old argument of first there was sex, then there was sexual behavior," he says.

Although all are females, individual *C. uniparens* lizards are in a sense bisexual in their behavior, alternating their roles, says Crews. Which one plays the male in the aggressive pseudocopulatory event appears to be related to ovulation cycles, rather than size and age. The "male" of the pair either is past the point of ovulation (egg release) in its reproductive cycle, or its reproductive system is inactive. The preovulatory "female," however, has large ovarian follicles and lays eggs about a month after the spurious mating dance.

Crews began searching for an explanation of the male-like behavior, which seems unnecessary in an all-female species capable of parthenogenesis—unless it actually serves some biological function. From observations made during a series of subsequent laboratory experiments, Crews concludes that pseudosexual behavior in *C. uniparens* does actually enhance the reproductive capability of the parthenogenetic lizard — a conclusion that has been met with some skepticism as well as interest.

Crews examined how productivity in *C. uniparens* is affected by such variables as male hormones and the presence or absence of different female cagemates. Similar studies in a parthenogenetic strain of fly were used for comparisons.

Data collected by the Texas group show that, if *C. uniparens* are placed in isolation or with cagemates that have had their ovaries removed, the average number of

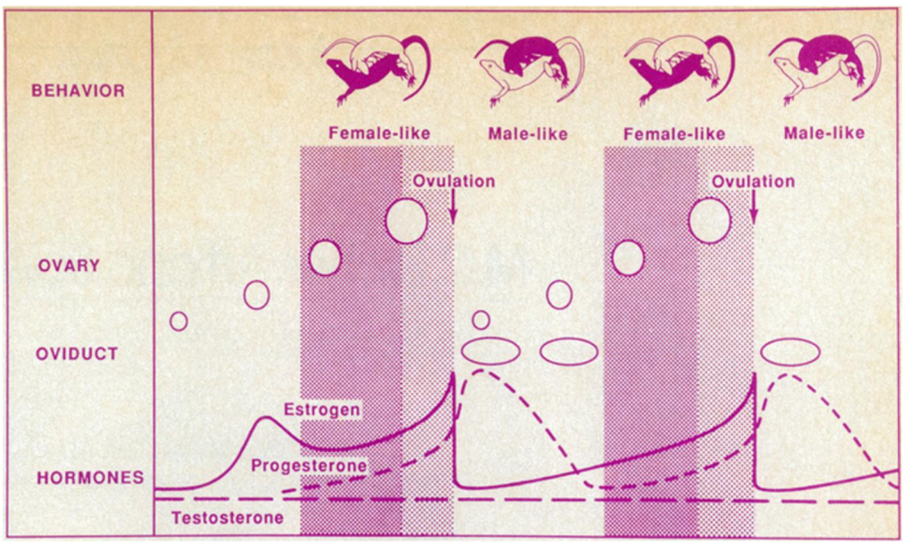


Crews

Mating postures of the all-female C. uniparens *(right) are very similar to those of the heterosexual* C. inornatus *(left).*

egg batches (clutches) laid each breeding season drops to about 1, compared to an average of 1.5 clutches born to individuals housed with a cagemate having ovaries. But if a cagemate without ovaries is treated with the male hormone androgen – which causes male-like behavior in the lizards – the average number of clutches is comparable to the 2 to 3 clutches laid each season in a natural environment.

On the basis of these and other experiments, Crews told SCIENCE NEWS that cyclic levels of the female hormones estrogen and progesterone regulate the male-like behavior seen in *C. uniparens* (see diagram) – and that the male-like behavior enhances reproductive capability.



Crews

Whether an individual in the all-female lizard species Cnemidophorus uniparens *acts as a male or female in pseudocopulatory events appears to be regulated by cyclic levels of the female sex hormones estrogen and progesterone, which control ovulation. Male hormones are not detectable at any stage of the cycle. Circles and ovals in the diagram represent relative sizes of the ovaries and oviducts during the cycle.*

In studies with Hampton L. Carson and others at the University of Hawaii in Manoa, Crews observed that, in a bisexual strain of the fly *Drosophila mercatorum*, reproduction is enhanced when females are put with either fertile or sterile males. Whether the males are fertile or sterile does little to affect the total number of eggs laid, but females housed with males produce six times as many eggs as do those housed with other females, and 13 times more eggs than isolated females.

However, members of a parthenogenetic strain of the fly – which scientists developed from virgin flies in 1961 – lay about 15 times more eggs than do isolated females from the original bisexual strain, a feat unaffected by the presence of male behavior (in contrast to the whiptail lizard). Carson and his co-workers had earlier observed that the parthenogenetic flies had lost their interest in males over the years (SN: 10/2/82, p.212). At the same time, they have increased their reproductive capabilities (measured by the average number of eggs laid in a given period) more than five-fold, according to a 1985 SCIENCE article by Crews, Carson and Linden T. Teramoto.

In the December 1986 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES, Crews, Mark Grassman and Jonathan Lindzey write that their research on all-female, parthenogenetic lizard species like *C. uniparens* "afford a unique test of hypotheses regarding the nature and evolution of sexuality." In that study, which Crews says parallels the *Drosophila* work, the researchers compared ovulation, follicular growth and productivity in *C. uniparens* and in a whiptail species called *C. inornatus*, in which females copulate with males. Based on DNA analyses done in the late 1960s, some scientists feel that ancestors of *C. inornatus* and those of another heterosexual species joined genetic material to create the all-female *C. uniparens*.

Female test animals were placed in cages simulating their Arizona desert home, in isolation or with other animals that were either castrated males with or without male hormone treatment, ovariectomized females with or without female hormone treatment, or untouched females. None of the isolated *C. inornatus* ovulated, but 33 percent of the females housed with females, and 25 percent put with castrated males, did ovulate. The authors point out that these numbers are not statistically different from the isolation group, and attribute the figures to small sample sizes. However, when castrated males given male hormones to induce sexual behavior were present, 93 percent of the *C. inornatus* females ovulated.

In the all-female *C. uniparens*, this "social housing" also made a difference. Compared with individuals living with cagemates lacking both ovaries and progesterone treatment, lizards in the presence of a female with ovaries ovulated nearly three times as often, those with a hormone-treated female nearly four times as often. This, say Crews and his coauthors, is an example in which a trait – in this case, pseudosexual behavior – has not outlived its apparent usefulness, and remains because it still enhances the all-important process of reproduction.

The Texas researchers suggest that the parthenogenetic lizard and fly, with their different origins and needs for a "male" presence, uncouple the tight association between gonadal sex and behavioral sex. But more research is needed. Crews says he is expanding work begun at Harvard that attempts to change the sex of *C. uniparens* to male by treating embryos with hormones. A soon-to-be-published report by his group suggests that neural circuits governing male sexual behavior, probably inherited from bisexual ancestors, exist in the brain of *C. uniparens*.

But do these lizards support the possibility that sexual behavior evolved before separate males and females? There are multiple examples in the animal world of females sexually mounting other females, and of male presence enhancing female productivity, says Frank Beach, professor emeritus at the University of California at Berkeley and an expert in hormones and sexual behavior since the 1930s. He says it is "naive" to think of this behavior only as procreative. Although Beach told SCIENCE NEWS that Crews's work is "very interesting stuff," he feels that asking whether two sexes evolved from a unisexual species on the basis of *C. uniparens* data is "a very unanswerable question" that is perhaps better left to evolutionists.

Orlando Cuellar, a whiptail lizard specialist at the University of Utah in Salt Lake City, is more direct in his criticism of Crews's conclusions, saying Crews hasn't demonstrated the phenomenon in free-roaming populations of parthenogenetic whiptail lizards. According to Cuellar, pseudocopulation has no real significance in nature: "Captivity results in a series of bizarre activities, of which female-female copulation is one."

Regarding his ideas about sex evolution, Crews says that the evolving brain would act in the interest of the organism's reproductive organs: "The bottom line is to reproduce. . . . The brain is plastic, so it will change in any way it needs to enhance reproduction."

As to what lizard sex may teach us about *Homo sapiens*, Beach replies tongue-in-cheek, "We ain't lizards . . . at least not in the biological sense." Nonetheless, some whiptail lizards might agree with Ralph Waldo Emerson that "the finest people marry the two sexes in their own person." □