

Jumping gender: Frogs change from she to he

Shrimp do it, orchids do it, even some tropical fish do it. Now biologists find that frogs do it, too — switch their sex, that is. A West German research team reports that females of two related frog species can become males without hormonal or surgical intervention. So complete is the transformation — observed so far only in the laboratory — that the newly male frogs breed successfully with members of their former sex.



During gender transition, the gonads of this female African reed frog show both ovarian tissue (black) and a testicular nodule (white).

Ulmar Grafe and Eduard Linsenmair detected the gender-bending while studying African reed frogs, *Hyperolius viridiflavus ommatostictus*, at the University of Wurzburg. The two were analyzing male life histories when a female began fighting with one of the males. “We were really excited, because that shouldn’t happen — females don’t fight,” says Grafe. In the days that followed, several females adopted the masculine mating stance, extending their forelegs and emitting a low-pitched whistle.

During the next few months, seven adult females — including six previously observed to lay eggs — developed functioning testicular nodules and aggressive behavior typical of male frogs, the researchers report in the current issue of *COPEIA*, released in January. Four of the seven “secondary males” copulated with females, fertilizing up to 70 percent of the eggs and generating normal offspring, the investigators say. Grafe and Linsenmair found that two females of a related species also changed sex in the laboratory terrariums.

“I wouldn’t be surprised if sex change is found in more amphibians,” says biologist Robert R. Warner of the University of California, Santa Barbara, who notes that these frog species show similarities to several others.

Grafe told *SCIENCE NEWS* he did not see

African reed frogs change gender during his recent three-month field trip to Zimbabwe, but “it’s hard to imagine any animal doing this in the laboratory and not in the field. We just have to keep looking.” He adds that scientists may have missed the switch in the past because the former females appear identical to ordinary males.

The sex-switching females had been housed in one of three predominantly female terrariums; a fourth terrarium with nearly equal numbers of each gender had no switches. “That behavior is very similar to [certain] fish,” notes Warner. “There’s a bigger reward [among females] to changing sex if there’s more females around, because there’s more chance to mate.” A few fish species switch

sex in the opposite direction, with males becoming females, Warner adds. But the key motivation, he says, appears the same: to maximize breeding.

Why, then, don’t more creatures change gender? Warner speculates that the energy expenditure may be too high in species with more pronounced differences between the sexes.

It remains unclear whether reed frogs and perhaps other amphibians can change sex as easily in the wild as certain orchids, shrimp and fish do, says Grafe, who is now at Cornell University. He notes, however, that tadpoles of any species consistently develop into males after experimental exposure to the hormone testosterone. Male toads, he says, have a vestige of ovarian tissue that develops into functioning ovaries when testicular tissue is surgically removed.

— R. Cowen

Smokers suffer from impaired smell

A rose may not smell as sweet to longtime cigarette smokers. New research suggests repeated exposure to chemicals in cigarette smoke damages the sense of smell, creating a deficit that can persist for years after a smoker kicks the habit.

While some research teams previously reported that smoking harms a person’s sense of smell, others found no link between smoking and olfactory function, or the ability to detect odors. The new report adds credence to the growing belief that cigarette smoking causes long-term but reversible deficits in olfactory ability.

A group led by Richard L. Doty, of the Smell and Taste Center at the Hospital of the University of Pennsylvania in Philadelphia, studied 553 men and 85 women working at a chemical manufacturing facility. The researchers interviewed the workers about current and past smoking histories and culled information from the company’s personnel office to control for workplace exposure to chemicals that could interfere with the sense of smell. Study participants took a standardized, multiple-choice “smell test” in which they were asked to identify whiffs of 40 different odors, such as pizza, motor oil and banana.

Compared with people who had never smoked, current cigarette smokers were nearly twice as likely to show impaired ability to smell, the researchers found. Ex-smokers showed a reduced ability to detect odors that improved with the number of years elapsed since quitting. In the March 2 *JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION*, Doty and his colleagues say their work shows that a person with a two-pack-a-day cigarette habit spanning 10 years would have to abstain

from cigarettes for 10 years before regaining a normal sense of smell. The researchers detected no olfactory deficits among pipe or cigar smokers, but they suggest this finding reflects the small number of pipe and cigar smokers in the study.

Although scientists have yet to pin down any biological basis for cigarette smokers’ impaired performance on the smell test, Doty says he suspects that certain chemicals in tobacco smoke, such as acrolein, acetaldehyde, ammonia and formaldehyde, damage the olfactory receptor cells in the nose. Animal studies have shown that exposure to cigarette smoke once or twice a day for a week can cause anatomic changes in such cells, he says. Researchers don’t know whether such changes persist over time.

Scientists do know that in animals, damaged olfactory receptor cells die and are replaced by healthy ones. Doty’s group speculates that a similar replacement process begins in the human nose when people stop smoking. “There is some repair possible, but it’s not a very rapid repair,” says cell biologist Robert C. Gesteland of the University of Cincinnati College of Medicine.

While an acute sense of smell enhances the taste of food and the appreciation of a rose, olfaction is far more than a frivolous sensory ability, odor experts maintain. The nose alerts people to many dangers, including fire, spoiled food and toxic chemicals. “If you can’t smell leaking gas, you’re in peril,” Doty says. Scientists don’t really know how olfactory defects affect human health, but Gesteland notes that odor cues influence a variety of human activities, including sexual behavior and mood.

— K.A. Fackelmann