collaging is done. The system is highly interactive: an operator creates and adjusts the collages. According to Barnsley, VRIFS produces a "frighteningly high-quality" approximation to an original x-ray with a compression ratio of about 100 to 1, using approximately 100 contractive mappings.

VRIFS is specifically designed for biological modeling, Barnsley says. One system has been sold to a West European firm for an application to x-ray analysis. Hugo Rogers, a plant physiologist in the Soil Dynamics Laboratory of the U.S. Department of Agriculture in Auburn, Alabama, is interested in the ability of VRIFS to model realistic root systems. "The possibility of being able to quantify a root architecture and the spatial deployment of roots would offer us a lot," he says. One of the things that impressed Rogers during a visit to Iterated Systems, he says, "was a dirty old weed root system laying up on top of a half a million dollars worth of computers. . . . I figured that anybody that'd do that has to be on our level."

Whereas VRIFS is an interactive system, the fractal transform is a fully automated image-compression system. It features both speed and accuracy. As currently implemented on an AMT Distributed Array Processor, the fractal transform can compress a 256 × 256 pixel black and white image in under 10 seconds, and can regenerate the *exact* image in about the same amount of time. Barnsley estimates that putting the transform on a special chip would allow it to handle up to 30 pictures per second—a convenient figure for real-time animation.

Barnsley and Sloan are currently looking at applying their image-compression technology to the high-stakes game of high-definition television (HDTV), which will offer improved stereo sound and pictures with twice the resolution of standard TV. The Federal Communications Commission recently ruled that any HDTV broadcast must be viewable on current standard TVs (*Science*, 7 October 1988, p 29). The technical challenge is how to fit the extra information required by HDTV into the already clogged television spectrum.

Barnsley and Sloan think it might be unnecessary to change the signal. Their idea is to put a "fractal enhancement box" at the TV end, which would take an ordinary signal, "recode the image as a fractal, and decode it at twice the resolution—or higher," Barnsley says. Improving an existing picture is not a new idea, but using the fractal transform may allow it to be done at the speed and with the quality required for HDTV. ■ **BARRY A. CIPRA**

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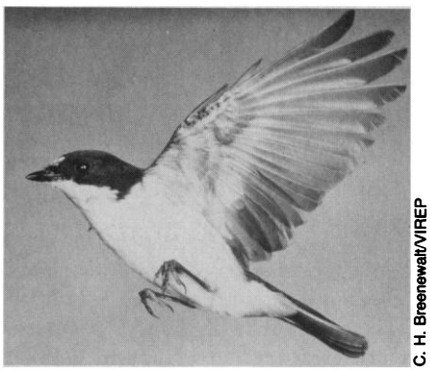
How Females Entrap Males



C. H. Breenewalt/VIREP

During the springs of 1985 and 1986, Eivin Roskaft and two colleagues at the University of Trondheim, Norway, systematically removed the males from 20 pairs of breeding pied flycatchers, leaving the females "widowed." They then observed the females' response, particularly in relation to males, and learned something interesting: the females tried—and sometimes succeeded—to entrap visiting males into a relationship with them.

It is not news that males and females seek—and achieve—different goals in relationships with the opposite sex. But for ethologists, who describe and interpret animal behavior, these differences have increasingly become the focus of attention. Specifically, researchers are interested in reproductive success and how an individual's behavior might influence this crucial Darwinian parameter. Simply put, reproductive success is the number of offspring that an individual successfully contributes to the next generation. With even a slight advantage in reproductive success over its contemporaries, an individual's genes can—generation by generation—come to predominate in a population. Similarly, burdened with just a slight disadvantage in reproductive success, an individual's genes can eventually be consigned to oblivion. The overall question is, therefore, do individuals usually behave in ways that enhance their reproductive success?

For various reasons—some biological, some practical—birds have frequently been studied with this question in view. One of the biological reasons is that even within a single bird species a range of breeding systems—monogamy, polygyny, polyandry—can often be observed, depending on the ecological and social circumstances. In the pied flycatcher, for instance, some individuals mate monogamously while others engage in polygyny. For females, polygyny can be bad news, because they are sharing the attentions of a single male, who is trying to help rear the offspring. For flycatcher females—at least some of them—polygyny is even worse news, because of his two females, the male selects one as the primary female, who receives all the provisioning help, and a secondary female, who simply bears his offspring but benefits not at all from any paternal care. As a result, the reproductive success of secondary females may be reduced by as much as 50% of that of monogamous or primary females. Roskaft and his colleagues argue that, with a difference in reproductive success of this magnitude, there is great selection pressure for individuals to try to ameliorate the disadvantage, presumably through some behavioral strategy. It was signs of such a behavioral strategy in the female flycatchers that Roskaft and his colleagues were seeking with their experiment.

By widowing the 20 females, Roskaft and his colleagues effectively produced a cohort of secondary females, whose behavior they could monitor. Seventeen were visited by neighboring males, and six solicited copulations from the new males, three of which solicitations were successful. This behavior is interesting, because by this time none of the females were fertile, having laid their clutches of eggs. Such behavior is never seen in monogamous or primary females. The researchers interpret the secondary female's activities as attempts to encourage a male into believing that it might be fathering some offspring at the nest, and therefore perhaps staying and helping rear them, thus probably improving the female's reproductive success. This is the "male deception by females" hypothesis. "Males should be most easily deceived when the deception is most plausible," say Roskaft and his colleagues. "Thus, females widowed immediately after egg laying should be more successful in deception than females widowed when they have nestlings." ■ **ROGER LEWIN**

ADDITIONAL READING

J. O. Gjershaug *et al.*, "Marriage entrapment by solitary mothers: A study on male deception by female pied flycatchers," *Am. Nat.* **133**, 273 (1989).