entire mouse genome or waiting for tumors to develop. Now, Winn and his colleagues have introduced the same bacterial genes into fish, and they found in early tests that the transgenic fish are just as sensitive at picking up mutations as the modified rodents are.

Experts caution that more work will be needed before the fish find widespread use as guinea pigs. But if the research does pan out, the fish should help make toxicology testing cheaper as well as less politically sensitive than it is in rats or mice. A standard 2-year testing regimen on rats, for example, can cost $1 million or more; nobody's done such an estimate for fish, but keeping a fish costs "pennies a year," compared to about 20 cents a day per rodent, Winn says.

Hoping to find an alternative, Winn turned to medaka, the small, Japanese, freshwater fish already used for toxicology tests. These fish had previously been modified so that they carry a foreign gene to detect mutagens, but this target is so small that it can pick up only certain small-scale chemical effects—those that alter a single A-T base pair.

In the first phase of its experiment, Winn's group took two bacterial genes, called *LacI* and *cII*, which are used in mice to detect mutations caused by chemicals, and spliced them into a bacterial virus. The researchers then injected this bacteriophage into medaka eggs, where it carried the new genes into the nucleus. The fish that developed, Winn found, carried the genes in all their cells and had a low rate of spontaneous mutations in those genes.

Winn's group next dumped a standard mutagen, *N*-ethyl-*N*-nitrosourea (ENU), into the fish tanks and, after waiting 1 to 16 hours, ground up the fish and retrieved the bacterial DNA for analysis. The researchers found that they could detect even slight genetic changes, charting a two- to threefold increase in mutations at low exposures to ENU.

Winn also described a transgenic medaka with a third gene called *LacZ*, which he says works well for detecting radiation-induced damage. Radiation tends to knock out or rearrange big chunks of DNA, and this gene is big enough—and its carrier, a circular piece of DNA called a plasmid, is sturdy enough—that there is sufficient DNA left for analysis after a radiation hit. In collaboration with University of Georgia colleagues who work at the site of the Chernobyl reactor accident and at nuclear waste dumps, Winn has begun exposing these fish to radiation-tainted sediments and looking for effects on the gene.

"I was really thrilled" to hear about Winn's progress, says toxicologist Barbara Shane of Louisiana State University in Baton Rouge, who studies cancer in mice. She and others are eager to begin tests on transgenic medaka. Winn cautions, however, that more work is needed to prove that the fish give predictable results with many more chemicals. "We're still at an early stage, but it's time to talk about it," he says. **–JOCELYN KAISER**

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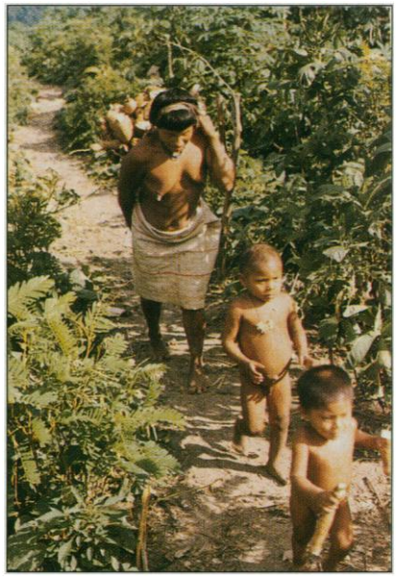
AAAS MEETING

▶ANTHROPOLOGY

More Questions About The Provider's Role

Of all sexual arrangements, monogamy is the rarest of the rare—only a small percentage of animals do it. Why did our ancestors adopt such an unusual arrangement? One theory has been that early human fathers provided food for their mates in exchange for fidelity. But according to reports presented at the meeting, multiple partners and blurred lineages have developed in some modern cultures. The existence of such societies, one anthropologist suggests, raises questions about whether the nuclear family, with a faithful couple at its heart, arose as a result of the food-for-fidelity bargain. Other evolutionary models, such as mitigating males' fierce competition for access to females, may better explain monogamy's origin, argues anthropologist Kristen Hawkes of the University of Utah, Salt Lake City.



Daddies' kids? The Barí belief that a child can have several fathers raises questions about monogamy's origins.

For a long time, many anthropologists thought monogamy arose in our early ancestors as part of an unspoken bargain, in which males bought fidelity by filling the family cooking pot, seeking to avoid investing resources in another man's child. In this view, the gender bargain was a key adaptation that set off the evolution of our genus, *Homo*. But when Hawkes heard about isolated primitive societies in which paternity is often fuzzy, she started wondering whether other models could better account for such diverse family arrangements.

While living among the Aché tribe of Eastern Paraguay and later the Hadza tribe in northern Tanzania off and on for several years, Hawkes and her team found signs of a remarkably egalitarian society. After the men returned from a hunt, each family received equal portions of meat. This doesn't fit the bargain hypothesis, Hawkes says. What's more, the few Hadza men who scored a kill—not an easy task when hunting big game with a daily failure rate of 97%—had younger (and therefore presumably more fertile) wives and other sexual partners, and they fathered more children than other men did. The hunters' offspring also had a higher survival rate, perhaps because the fathers tended to mate with skilled, hard-working women who gathered most of the food by foraging for plants.

Other research presented at the meeting also undermines the bargain hypothesis. Among the Aché as well as the Barí of Columbia and Venezuela, the belief that a child can have several fathers (a phenomenon called partible paternity) is quite common, says anthropologist Stephen Beckerman of Pennsylvania State University in University Park. About 24% of the Barí children and 63% of the Aché children had more than one cultural "father," and all of the fathers offered the children food gifts and protection. Such children had a survival advantage, Beckerman reports, noting that "80% of the children with secondary fathers survived to age 15, compared to only 64% of the children with a single father." Thus, "partible paternity is a poke in the eye for the bargain hypothesis." Beckerman says this shows that being certain of paternity is not necessary in some human cultures—and therefore may not have been "a crucial element in the evolution of modern humans."

If not male provisioning, then what did spur monogamous arrangements? Hawkes has her own theory: Monogamy arose as "negotiations between males" about access to females, to cut the high risks of direct fighting.

Other anthropologists like Hawkes's critique. "It was way too simple an idea that monogamy is exclusively based on male provisioning," says Frank Marlowe, a biological anthropologist at Harvard. Still, not everyone is convinced. "Some anthropologists bitterly disagree with [Hawkes]," says Nicholas Blurton-Jones, a biological anthropologist and professor emeritus at the University of California, Los Angeles. "But she's gaining ground."

–MICHAEL HAGMANN