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### SCIENTIST AT WORK

## Evolving by Accident, Not Fitness

By **DAVID BERREBY**

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**A**USTIN, Tex. — Ambition or love? Freedom or security? Perfect job here or perfect mate in Utah? Life forces painful choices on Dr. Michael J. Ryan's colleagues, but it is even harder on his research subject, the male túngara frog: the more sex it gets, the surer it is to be eaten.

Dr. Ryan, who leads the integrative biology section at the University of Texas, is best known for work on the túngara, but he ponders other animals that live between a rock and a hard place: an all-female species of fish that clones itself but must mate with an alien male to do it; tiny salamanders with cells too big for their body plans; birds that must feed the chicks of another kind of bird to support their offspring.

Biologists should learn from life's existential quandaries, he says, but many do not. Instead, they sweep the difficulties under the rug of "adaptationism," the notion that everything about an animal's body and behavior has been honed to enhance its "fitness" or chance of passing on genes.

That idea reminds him of Dr. Pangloss in Voltaire's satire "Candide," who says all is for the best in this best of all possible worlds — even earthquakes, plagues and torture.

"Our take is not the strict Panglossian approach," Dr. Ryan said, over the nachos and beer that friends correctly predicted would be a part of a Ryan talkfest. "Ultimately, what we want to know is why animals are the way they are. Saying some behavior enhances fitness doesn't tell you why birds signal with songs while coral-reef fishes have flashing colors and mammals use odors."

The túngara, a brown-backed, white-bellied creature scarcely bigger than the last joint of his thumb, made him abandon adaptationist thinking, he says. More than 20 years of work on the frog has shown that adaptive pressure alone did not shape it, he said. Its anatomy and ancestry also played a role.



Rebecca Cooney for The New York Times  
Dr. Michael J. Ryan prepares a túngara frog for acoustic tests.

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That emphasis has made Dr. Ryan prominent in an evolutionary debate that extends well beyond the love lives of stoic amphibians and weird fish. After all, humans make mysterious choices, too.

They gather, for instance, in groups of 100,000 to listen to patterns of sound from loudspeakers. If Dr. Ryan and his allies are right, then immediate adaptive value is the wrong place to look for a phenomenon like rock concerts. Music may appeal to brain wiring that was in place for thousands of years before anyone sang a note. In any event, he says, anatomy, not adaptation, is the right place to start.

"If we want to understand music preferences, let's look at what the brain is doing," he said. "Then we can ask, What in history made the brain like this?"

In developing his argument, Dr. Ryan has made the túngara (pronounced TOON-guh-ruh), native to Central America and the Caribbean, into a star. It is now one of biology's "model systems" — animals studied by so many scientists, from so many angles, that knowledge about them snowballs, feeding on itself. When he began working on it, he had it almost to himself.

That was in the mid-1980's, when his dissertation research established that female túngara prefer larger males.

Now, field workers at the Smithsonian Tropical Research Institute in Panama observe frogs doing what comes naturally in their home range. Other scientists track how mating calls turn genes on and off. Still others prepare electrodes to measure how calls affect the living brain. ("I've been talking to people about doing M.R.I.'s, too," Dr. Ryan said, "but you know, these frogs are tiny.")

Then there are other colleagues who have used computers to simulate evolution of the frog's mating call. Still others plumb its evolutionary history, using DNA differences to reconstruct details about extinct frogs, like the shape of an ear or the sound of the call. The research illustrates how biology's once separate branches now intertwine: jungle frogs, lab frogs, frog genes and frog brain cells are linked in a single body of work. "If you want to understand living things, you really have to let all these levels of analysis interact," Dr. Ryan said.

That approach used to be common, but now it bucks the intellectual tide, said Dr. Marc D. Hauser, a psychologist at Harvard who has made use of Dr. Ryan's ideas.



Marc Danzker

The male túngara frog has a large vocal sac that it uses to perform its mating call, a sliding whine followed by chucks.

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