Evolving by Accident, Not Fitness

Published: October 14, 2003

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"We're living in this age of narrowing and reductionism," he said, "and Mike is one of the few who has kept true to the idea that there are many different questions you can ask about animal behavior."

Son of a truck driver and a secretary, Michael Ryan grew up in Northern New Jersey and went to college thinking he would teach high school. But the pleasures of research caught him, through a master's (Rutgers), Ph.D. (Cornell), postdoctorate (Berkeley) and his post here, where he has taught for 20 years. With his fieldwork tan and his reedy, cheerful voice, Dr. Ryan, 49, is the model of a happy researcher. He has been thinking about biology since a high school teacher, a Benedictine monk, got him excited about science.

Dr. Ryan enjoys every facet of a biologist's life — from abstract theorizing to a jungle night recording amphibian sex acts. One fish study began after he noticed unusual-looking males as he snorkeled a Mexican river. Several major findings emerged from thoughts that popped into his head as he was gabbing about experiments. He even likes writing papers, and he has published about 140.

"I tell my students, writing and explaining is part of life in science, so you'd better find a way to make it fun," he said.

In a small lab area filled with the country-night sounds of chirping crickets (the frog food), Dr. Ryan reaches into a moss-filled container and pulls out a tiny brown túngara, which hops once and then perches on his finger. "She's kind of fat. Probably has a few eggs," he says. "A male would have this big vocal sac to make his calls."

That call is the problem for a male túngara. A sliding whine followed by abrupt chucks, it sounds a bit like a little boy imitating a dive bomber. Female frogs hop to when they hear it. But hungry fringe-lipped bats also tune in; the call is their beacon for finding frogs to gobble.

Rebecca Cooney for The New York Times

Dr. Michael J. Ryan prepares a túngara frog for acoustic tests.

Marc Danzker

So a male túngara is caught between two evolutionary pressures. And as Darwin himself pointed out, sexual selection creates paradoxical traits in males of many species, like huge peacock tails — so useless for flight, so good for impressing peahens.

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

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To a biologist who thinks traits serve fitness here and now, all this is just natural selection with an extra step. In the case of the túngara, for instance, the big, hearty male frog who can take the risk of ending up in a bat stomach is the best possible mate. Risking death is a show of strength and quality, a sign of "good genes." So females evolved to prefer the loud chuck that so appeals to bats.

Dr. Ryan was giving a talk along those lines a dozen years ago and ad libbed. Of course, he said, this idea could be tested by comparing the túngara species, Physalaemus pustulosus, to its near relatives — other species of frog whose mating call is all whines, no chucks.

That comparison surprised him. Dr. Ryan's colleague Dr. Walt Wilczynski, a neuroscientist, established that the hearing systems of the species Physalaemus coloradorum are tuned to be sensitive to the same frequencies as the túngara ear. One inner-ear organ responds to the whine, and the other to the chuck.

If all the ears were tuned alike, might a female of this species actually prefer the túngara chuck to her own male's call? That would be a bit like a woman finding a chimp hoot sexier, say, than "Love Me Tender." Yet that is what happened when the scientists tried it.

So it was not the need for good genes that pushed túngara females to prefer a chuck, Dr. Ryan says. An ancestor's brain and hearing system were wired, for some reason, to like sounds in the chuck range. The túngara females inherited it, as did their cousins in other species. That the preference happens to lead females to larger males, who fertilize more eggs, is a side effect, not a cause.

Dr. Ryan calls this "sensory exploitation" — a new behavior that succeeds in evolution because it takes advantage of existing ways of perceiving the world. The same principle causes a female fish of the swordtail species to prefer males with "swords" extending from their bodies. The swords fit the existing tuning of the fish visual system, inherited from some ancestor. A related species, the platyfish, has no swords. But when a male platyfish has a sword sewn onto his tail, platyfish females prefer him.

To all this, adaptationists answer, essentially, So what? The important principle is that only traits that pass on genes will survive natural selection. How those traits arose is beside the point, argues Dr. Paul W. Sherman, a neurobiologist at Cornell and a leading researcher in the evolution of behavior. He and Dr. Ryan have continuing debates in the journals.

"Regardless of how female preferences and male traits originated," Dr. Sherman wrote in an e-mail message, "they will subsequently co-evolve depending on their reproductive consequences for females."

Though Dr. Sherman says he and Dr. Ryan do not know each other well, Dr. Ryan, characteristically, says they are friends. Nothing seems to ruffle his lively geniality. When he recalls how a big name in neuroscience fiercely demanded at a conference, "If you don't want to do science, why don't you just say so?," he describes the incident in the tones he uses for talking about Austin restaurants or hiking in Panama.

"Yeah, that's what he said," Dr. Ryan said. "Anyway, let me show this computer array. We just awarded a Ph.D. for it yesterday. It lets us analyze every single call that a lab frog makes for its entire life."

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