Research Horizons

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Avoiding Costly Mistakes

Some zooplankton species depend on strong sense of "taste" to find the right mate.

IF YOU ARE a male rotifer with a lifetime supply of only 30 sperm, you cannot afford to make many mistakes when it comes to mating with the right female.

Georgia Tech School of Biology

Professor Terry Snell has conducted field work on rotifers throughout the United States, and in Spain, Costa Rica, Japan and Israel. (300-dpi JPEG version - 90k)

Rotifers are a type of microscopic aquatic animal called zooplankton, which provide a primary food source for small fish. The animals are one type of zooplankton studied by Georgia Tech Biology Professor Terry Snell. He wants to understand how males of certain zooplankton species sense mating chemicals on the surface of females and then recognize them as appropriate targets for mating.

"Chemical signals from the females tell the males they are the correct species to mate with because zooplankton have no eyes," Snell says. "Their sensory world is based on mechanical and chemical reception."

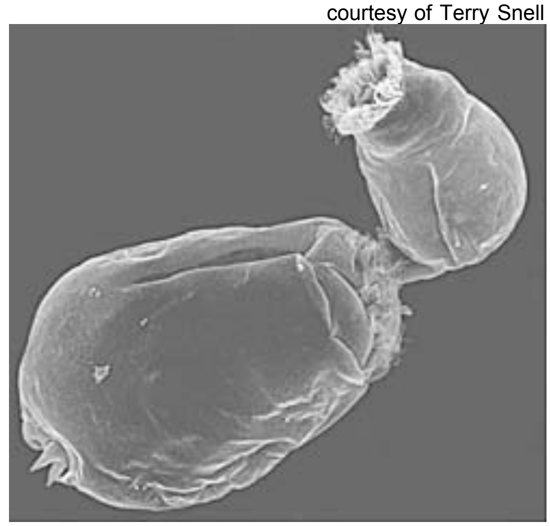
Though it may seem inefficient in their vast aquatic environment, male rotifers depend upon their chemical sense – akin to the human sense of taste, rather than smell – to find the right mate.

"With their fast swimming speeds, small body size and high population density, they will contact each other with virtual certainty during their reproductive cycle," explains Snell, who has conducted field work throughout the United States, and in Spain, Costa Rica, Japan and Israel. "Their densities typically range from one to 100 animals per milliliter. So they will bump into each other often. When they do, the male must decide if he has contacted food, a predator or a mate. If the female's surface chemicals signal that she is female and of the right species, the male will attempt to mate with her. He has only 30 sperm for his entire lifetime, and he injects three to four sperm per copulation. So he better not make too many mistakes."

The mating signal on female rotifers' bodies are critical for reproductive success, Snell adds. "These mating signal proteins are important evolutionarily. They determine species boundaries and are critical to the males' success in mating with females of his own species."

In research funded by the National Science Foundation, Snell's research team has collaborated with School of Biology Assistant Professor and biochemist Julia Kubanek to isolate and characterize a surface glycoprotein on female rotifers. "We have been able to remove the glycoprotein from the females and attach it to females from a closely related species to see if we can trick males into mating," he explains. "We have found that the glycoprotein cue is both necessary and sufficient by itself to trigger the male mating response."

courtesy of Terry Snell



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Snell has found similar mating signals in copepods, another type of zooplankton species closely related to shrimp. "The molecule we have characterized is a keystone molecule, determining species boundaries and regulating the process of speciation in zooplankton," he says.

Researchers plan to further isolate and characterize the gene responsible for these proteins, which give the molecule its structure and functionality. They want to know how the gene differs among rotifer species to prevent hybridization between species, Snell adds.

In a related research effort, Snell's research team is studying the effects of pollution on zooplankton chemical communication.

"We don't yet know what kinds of compounds specifically interfere with mating," Snell says. "But they could have a variety of effects. Some of them probably alter the male mating response. Recently in our lab, we found compounds that do not seem to affect male or female survival, but they disrupt mate recognition. We don't know the compounds yet. They could be contaminants in the lab, such as a bacterial waste product or something in the plastic dishes we use.

".... Zooplankton are extremely sensitive to certain compounds, but they can tolerate a ton of others," Snell adds. "Their most sensitive system is their sexual reproductive system. Mate recognition is one element of that."

Isolating and identifying the toxicant affecting mate recognition is a complicated process that could take years, Snell adds. Meanwhile, Snell's research team has already collected evidence that other aspects of rotifer reproduction are affected by chemical contaminants in natural environments.

Contaminants affecting the reproductive systems of zooplankton in natural environments could have a ripple effect, Snell explains. Larval fish start their lives with a diet of rotifers because rotifers are the right size and easy to catch. So fewer rotifers would, in turn, yield fewer larval fish to grow into big fish.

– Jane M. Sanders

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