By trying it all, predatory sea slug learns what not to eat

June 6 2013

University of Illinois molecular and integrative physiology professor Rhanor Gillette and his team found that the predatory sea slug, *Pleurobranchaea californica* (left) shows avoidance behavior when confronted with *Flabellina iodinea* (right). This avoidance behavior is much more complex than what *Pleurobranchaea*, which has a simple nervous system, was thought to be capable of having. Credit: Rhanor Gillette

Researchers have found that a type of predatory sea slug that usually isn't picky when it comes to what it eats has more complex cognitive abilities than previously thought, allowing it to learn the warning cues of dangerous prey and thereby avoid them in the future. The research appears in the *Journal of Experimental Biology*.

Pleurobranchaea californica is a deep-water species of sea slug found off the west coast of the United States. It has a relatively simple neural circuitry and set of behaviors. It is a generalist feeder, meaning, as University of Illinois professor of molecular and integrative physiology and leader of the study Rhanor Gillette put it, that members of this species "seem to try anything once."

Another sea slug species, *Flabellina iodinea*, commonly known as the Spanish shawl because of the orange outgrowths called cerata that cover its purple back, also lives on the west coast. Unlike *Pleurobranchaea*, however, the Spanish shawl eats only one type of food, an animal called *Eudendrium ramosum*.

According to Gillette, the Spanish shawl digests all of the *Eudendrium* except for its embryonic, developing stinging cells. The Spanish shawl instead transports these stinging cells to its own cerata where they mature, thereby co-opting its victim's body parts for its own defense.

The story of Gillette's *Pleurobranchaea-Flabellina* research began with a happy accident that involved showing a lab visitor *Pleurobranchaea*'s penchant for predation.

"I had a *Pleurobranchaea* in a small aquarium that we were about to do a physiological experiment with, and my supplier from Monterey had just sent me these beautiful Spanish shawls," Gillette said. "So I said to the visitor, 'Would you like to see *Pleurobranchaea* eat another animal?'"

Gillette placed the Spanish shawl into the aquarium. The *Pleurobranchaea* approached, smelled, and bit the purple and orange newcomer. However, the *Flabellina*'s cerata stung the *Pleurobranchaea*, the Spanish shawl was rejected and left to do her typical "flamenco dance of escape," and *Pleurobranchaea* also managed to escape with an avoidance turn.

Some minutes later, his curiosity piqued, Gillette placed the Spanish shawl back in to the aquarium with the *Pleurobranchaea*. Rather than try to eat the Spanish shawl a second time, the *Pleurobranchaea* immediately started its avoidance turn.

"I had never seen that before! We began testing them and found that they were learning the odor of the Spanish shawl very specifically and selectively," Gillette said.

Gillette and his team later replicated that day's events by placing a *Pleurobranchaea* in a training arena 12-15 centimeters from a Spanish shawl, then recorded the *Pleurobranchaea*'s behavior. They returned the *Pleurobranchaea* to the arena for four more trials in 20-minute intervals, then repeated the procedure at 24 and 72 hours later.

In the experiments, *Pleurobranchaea* whose feeding thresholds were too high (meaning they were already full) or too low (they were extremely hungry) would either not participate or completely consume the Spanish shawl, respectively. Those *Pleurobranchaea* that were hungry, but not ravenously so, continued to exhibit the avoidance turn behavior when placed with the Spanish shawl even 72 hours later.

This showed that *Pleurobranchaea* was selective in its food choices, but only on a case-by-case basis; the sea slugs already trained to avoid the Spanish shawl would readily eat a species closely related to *Flabellina* called *Hermissenda crassicornis*.

Such behaviors come in handy in *Pleurobranchaea*'s natural environment, Gillette said.

"If you're a generalist like *Pleurobranchaea*, it's highly strategic and advantageous to learn what's good and what's not good so you can decide whether or not to take the risk of attacking certain types of prey," he said.

These findings show that the "simple" *Pleurobranchaea* is much more complex than originally thought.

"We already knew the neuronal circuitry that mediates this kind of decision," Gillette said. "Finding this highly selective type of learning enlarges our perspective of function, in terms of the animal's ability to make cost-benefit decisions that place it on a rather higher plane of cognitive ability than previously thought for many sea slugs."

More information: "Selective prey avoidance learning in the predatory sea-slug Pleurobranchaea californica," www.ncbi.nlm.nih.gov/pubmed/23661778

Provided by University of Illinois at Urbana-Champaign