Sand dollar larvae use cloning to 'make change,' confound predators

March 13 2008

Nature is full of examples of creatures that try to look as big as possible in an effort to scare away potential predators. But to avoid being eaten alive the larvae of sand dollars appear to have a different strategy, in a way exchanging a dollar for a couple of dimes.

University of Washington biologists have found that 4-day-old sand dollar larvae created clones of themselves within 24 hours of being exposed to fish mucous, a cue that predators are near. In each case, the cloning process resulted in a small new larva and the original larva substantially smaller than it had been.

The larvae responded to the general threat of predation rather than the immediate possibility of predator attack, said Dawn Vaughn, a UW biology doctoral student at the University of Washington's Friday Harbor Laboratories. The process caused the original larvae to shrink from about 300 microns, or about a hundredth of an inch, to about half that size, and the new larvae were even smaller.

"We think that by reducing their size they also reduce their visibility to predators," said Vaughn, who is lead author of a paper describing the work in the March 14 edition of *Science*.

Larval cloning has been observed previously among echinoderms, which include about 7,000 species of sea creatures, including starfish, sea urchins and sand dollars. However, this is the first time cloning by larvae has been seen as a survival mechanism in the face of possible predation.

The larvae of the sand dollar species Dendraster excentricus float as part of the plankton at various levels in open water, feeding as they slowly grow. After six weeks, the larvae reach a size of perhaps a three-hundredths of an inch and then settle to the ocean floor to finish developing to adulthood.

But as they float, the larvae are neither fast nor agile and have a high mortality rate, easily devoured by fish. Vaughn exposed 4-day-old larvae to fish mucous to see how they might react to the threat of predation.

"We didn't know how they would respond, or even whether they would respond," she said.

Within 24 hours, the larvae developed clone buds that ultimately detached and formed new larvae that were much smaller than the original organism. The original larvae also were substantially reduced, to about half their original size.

Larvae that were not exposed to fish mucous did not clone themselves.

Vaughn suggests that cloning might be an adaptive response for the organism to try to ensure its survival in some form if a predator strikes. That is accomplished if only one of the two larvae that result from cloning survives.

"From their perspective, if both the original larva and the clone survive that's great – then there are two of you," she said.

Vaughn noted that reduced size because of cloning could affect survival later in the sand dollar's life. In many species, greater size reduces the chances of predation, and sand dollars that have gone through the larval cloning process turn out to be smaller than non-clones when they settle to the sea floor. It is not yet clear whether that makes them more vulnerable to predators at that point, though she plans to examine that in the next stage of her research.

"At this point we would suggest that might be the trade off. But if they don't avoid predation in the first place they would never get to the sea floor," she said.

Richard Strathmann, a UW biology professor and Vaughn's doctoral adviser, is co-author of the paper. The work was funded by the National Science Foundation and Friday Harbor Laboratories.

Vaughn noted that the larval sand dollars' response did not appear to depend on the species of fish that generated the mucous. Instead, it appears the larvae reacted to the bacterial breakdown of the mucous, and interpreted that as the presence of a potential predator.

"They might respond to a fish species that would not eat them," she added.

Source: University of Washington