Researchers offer clues to how mussels work

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Waves slam the shore with the force of a jetliner screaming at 600 mph. Yet mussels - small but mighty denizens of the intertidal zone - still manage to cling tenaciously to their rocks.

Just how they do it has fascinated researchers for decades. Now new science just emerging from the lab is pointing the way to a better understanding of mussels' remarkable stick-to-it-ness, and what their abilities might mean for people.

Could the mussels' adhesive properties be synthesized, for example, and used to seal wet wounds in surgical procedures?

"I started working on this way back in the 1970s and everyone thought I was crazy," Herbert Waite, professor at the University of California, Santa Barbara, said in a panel discussion about the mussels' adhesive capacity at the annual meeting at the American Association for the Advancement of Science in Boston last week. "It seemed heroic. Here is this little creature that doesn't even have a brain - how does it survive purely with its ability to hunker down on a hard surface?"

Mussels are common to the rocky intertidal zone. It's a tough place to survive, awash at high tide, dry at the ebb and pounded in between by surf. To hang on, the mussel manufactures a goo in its foot that it extrudes onto rocks. As the animal retracts its foot into its shell, it leaves behind strands of sticky, extensible material, called a byssal thread, affixing the mussel to its home.

It is the ability of those threads to stick even to wet surfaces that fascinates scientists. Usually water infiltrates adhesive materials, defeating their ability to stick - but mussels manage to hold fast.

Waite and other scientists are trying to figure how such an adhesive might be put to other uses.

Mussels are not equally tenacious year round. Emily Carrington, a University of Washington professor of biology, told the panel she has learned through her work in Washington's waters as well as on Vancouver Island that, with rising water temperatures, the strength of mussels' byssal threads degrades drastically.

The byssal threads, in cold water, are nature's bungee cords, able to withstand pummeling waves even though the threads are only three to 10 times the width of a human hair. "They are the gorilla of the intertidal; it's a very dangerous environment for humans, but yet very common for these organisms," Carrington said.

The threads enable mussels to thrive in all kinds of places, gluing onto sea grass, shells, rocks and even other mussels. Some species will thrive in the harsh conditions of hydrothermal vents.

Mussels naturally loosen their grip in late summer and early fall, when seas are calmer. They hang tough again come winter and spring, the more tumultuous seasons.

Carrington is doing further work on the seasonal variability of the mussels' sticking power at the University of Washington's Friday Harbor Lab. She and a team of researchers are posing new questions not only about how mussels do what they do, but also how well they'll continue to do it if sea temperatures warm because of climate change.

The mussels' mighty ability to stick is at the core of their ability to survive and dominate their niche. "It's the bread and butter of their game," Carrington said. "If they can't do that, they have lost their competitive edge."

For mussel farmers, her research could help target better growing areas, in colder waters.

But for mussels in the wild, Carrington's research raises questions for the future.

Already mussels are being exposed to longer windows of time with warmer water - leaving them vulnerable to being dislodged. That could leave a pathway for colonization by other species, potentially even nonnative invaders, she said.

"As the water warms, the whole distribution of the species could shift, we could see range shifts farther north, and erosion of their distribution to the south."