INSIDE JEB

Hot limpets can't hang on as tight as cold ones

A black oystercatcher (*Haematopus bachmani*), which feeds on limpets (*Lottia gigantea*). Photo credit: Dick Daniels (http://carolinabirds.org/) CC BY-SA (https://creativecommons.org/licenses/by-sa/3.0)

Recent reports make it clear that there are going to be many losers if we continue pumping climate-changing gases into the atmosphere. Yet, as delicate ecosystem balances shift, some species may be able to take advantage of other's setbacks. Although limpets are well known for their tenacious grip when exposed on rocky seashores, Rachel Pound, a Master's student from California State University Fullerton, USA, and colleagues wondered how well the resolute molluscs are able to cling on as temperatures rise and, more to the point, how hungry seabirds might fare as they attempt to prise their lunches loose. But first, Pound, Luke Miller, Felicia King and PI Jennifer Burnaford decided to get a handle on how hot under the shell limpets get as the tides come and go.

Dismembering iButton temperature sensors and reassembling them inside empty limpet shells, the team distributed their robolimpets on the rocks of Dana Point in Southern California to keep track of mollusc body temperatures. Over a 2-year period, the hottest limpets logged impressive top temperatures over 40°C in January, and the team noticed that limpets exposed on flat rocks and vertical southern faces tended to experience the highest temperatures. Having pinned down how hot the limpets can become, Pound and colleagues turned their attention to how hard hungry oystercatchers have to strike limpets to get them to loosen their grip, before popping them off.

This time, the team attached a limpet shell to a force transducer and enticed a captive black oystercatcher, known as 'Squeakers', at the Living Coast Discovery Center, USA, to have a go at wrestling the tasty morsel free. 'For a bird that didn't grow up eating limpets, Squeakers became fairly adept at attacking them', says Miller, from San Diego State University, USA, who was impressed that Squeakers could exert pecks of up to 37.4 N, five to six times his body weight. Then the scientists wanted to know how hard oystercatchers have to peck at real exposed limpets on the seashore to wrench them free.

After designing a mechanical oystercatcher constructed from a spring scale with a 3D printed beak to peck at limpets anchored at cool (~15°C) and hot (~30°C) temperatures, the team found that the mechanobird picked off four times as many warm limpets as cold limpets, with the warmer limpets falling free after just five 14 N pecks. And, when the team tested how vulnerable the limpets were to a hungry Squeakers, it took between 0.07 and 21.01 s for him to detach a limpet from its hold, with the cooler limpets hanging on six times longer than their warmer counterparts, although Squeakers eventually detached all of the limpets successfully.

'This was a very simple study, but our findings suggest that the body temperature of limpets in the field could affect their likelihood of being removed from the rock and eaten by oystercatchers', says Burnaford. And she adds that even though Squeakers was eventually able to dislodge all of the clinging limpets, he was able to remove the warm limpets far faster than the cooler ones, suggesting that oystercatchers could pick off many more molluscs on warmer days than on cooler occasions. 'If rising temperatures affect prey and their ability to avoid being eaten more than they affect the predators, we might see dramatic changes in this ecosystem in the years to come', says Burnaford.

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Kathryn Knight
kathryn.knight@biologists.com