UC SANTA BARBARA

THE Current

July 8, 2014
Sonia Fernandez

Not at Home on the Range

As climate change shifts the geographic ranges in which animals can be found, concern mounts over the effect it has on their parasites. Does an increased range for a host mean new territory for its parasites as well?

Not necessarily, says a team of UC Santa Barbara scientists, including parasitologists Ryan Hechinger and Armand Kuris. In a study published in the Journal of Biogeography, Hechinger, Kuris and colleagues show that for some species, the opposite may happen: Hosts may actually lose their parasites when the hosts shift or increase their range. Theirs is one of very few studies that examine the effects of climate change on the lives of often overlooked — but nonetheless significant — parasite populations. Also contributing to the paper as lead author is Julie Hopper, now a Ph.D. student at UC Berkeley. Hopper was a student at UCSB when the research was conducted.

“We asked the question: Do hosts that have expanded their range escape their parasites?” said Hopper. The researchers predicted that they might, given previous findings that invasive species — species that have also increased their range, but to areas not geographically connected to their historic ranges — tend to escape their parasites.

“Invasive species escape parasites for several reasons,” said Hechinger, an associate research biologist/professor at UCSB and Scripps Institute of Oceanography. “Many parasites do not come with the invader to begin with — they miss the boat.” He added that many parasites that accompany their invasive host do

not persist because the parasites, many of which live parts of their life cycles in different hosts, no longer have access to the environments or other hosts required to complete their life cycles. On top of this loss of parasites, invasive hosts do not acquire many new ones in their invasive ranges, which explains the hosts' overall escape from parasites.

But what happens when a species expands its range by moving into an adjoining area?

"People have barely looked at this, and never before in the ocean," said Hechinger.

To answer their question, the researchers studied Kellet's whelk, a large marine snail whose historical biogeographical range starts at mid-Baja California waters in the south to Point Conception in the north. For the last couple of decades, due to the gradual warming of the ocean, the whelks have been moving their boundaries north into what used to be cooler waters. Now they can be found as far north as Monterey.

The whelks are important players in kelp forest food webs. The whelks are also a delicacy and there is a growing appetite for them in southern California. Despite this importance, there have been no previous studies of parasites or infectious disease in the whelks, much less a study examining whether they have escaped parasites in their expanded range.

However, according to the researchers' parasitological examination of whelks throughout their historical and expanded ranges, those living beyond their historic Point Conception boundary have neither the amount nor the diversity of parasites that infect their southern counterparts, despite the relative proximity of their historical range.

The researchers suspect that the northern whelks have escaped their parasites for several reasons. One factor, said Hechinger, is that the southern California whelks do not crawl around much. "It's not as if infected snails are going to move miles, wander around Point Conception, and bring their parasites to the expanded range," he said.

The whelks that are now found north of the boundary are ones that dispersed into the area during their planktonic larval stage. These juvenile stages do not serve as hosts for the parasites that infect juvenile and adult whelks. "So we know that the northern populations 'started clean,'" explained Hechinger. Those whelks would be

free of the parasites they would acquire in the south as they mature.

But the parasite escape is still somewhat surprising when considering the types of parasites that infect the whelks. “We discovered that the whelks are mostly intermediate hosts for tapeworms and roundworms said Hopper. “These parasites eventually end up maturing and reproducing in sharks and rays.”

“These sharks and rays, they can move around,” said Hechinger. “And they should be able to move the parasites around. It’s been a few decades since the whelks moved up north. Why haven’t sharks and rays brought parasites from south to north to let the parasites catch up with the whelks?”

A likely reason is a phenomenon called “site fidelity.”

“It turns out that many of the sharks and rays that are potential hosts for the whelk parasites do not move up and down the coast a lot,” said Hechinger. Thus, although free to wander, the sharks and rays likely do not regularly make the trek from southern to northern California.

“Also important is that the hosts in the expanded range are at lower densities than in the historical range so, even if some parasites got to the north, it’s hard for them to be transmitted under those conditions,” said Kuris, UCSB professor of zoology.

According to Hechinger and Kuris, the evidence from this study suggests that perceived fallout from global warming — in terms of the fears of the spread of infectious disease associated with global warming-induced range expansions — is not as foregone a conclusion as many may think. At least for marine parasites such as the ones that live in the Kellet’s whelk, the evidence indicates that range expansion for the host does not mean the same for its parasites.

In fact, a trend of parasite escape for expanded-range species might signal a different phenomenon altogether: the spread of host species that are missing their natural enemies and are thus not as impacted by parasites as they would be in their natural, historical environments. It’s a phenomenon that happens with invasive species that escape their parasites. “Invasive species perform better without the constant drain imposed on them by parasites,” said Kuris. This “release” from natural enemies can lead to invasives causing major shifts in the ecology of the new environment, which can be extremely benign for invasive species.

However, unlike for invasive species, “expanded ranges may be no Gardens of Eden,” notes Hechinger. For instance, in the case of the whelks, nature still manages to check their northern populations because the environment is still not as optimal as their historical range. In fact, the escape of parasites may be the factor that allows them to survive at all.

While parasite escape might be a general trend for host populations shifting their ranges — and many populations are shifting poleward because of global warming — there is currently only a scant amount of data on the phenomenon. The researchers are aware of only one other similar study on a caterpillar in the United Kingdom, and hope that further investigations into parasitism in other poleward-expanding species can shed more light on the situation.

“Is it largely population size, extreme environmental conditions or availability of all the hosts in a life cycle that reduce the abundance of parasites in expanded parts of the range?” asked Kuris. “Do we ever begin to see amplification of a parasite and spread to other hosts? As more investigations happen it will be interesting to discover the mechanisms and the general role of parasites in range expansions.”

Graduate student researcher Julio Lorda, contributed to the study, as did Sara Simmonds and Crow White, who were also graduate students at the time of the research.

About UC Santa Barbara

The University of California, Santa Barbara is a leading research institution that also provides a comprehensive liberal arts learning experience. Our academic community of faculty, students, and staff is characterized by a culture of interdisciplinary collaboration that is responsive to the needs of our multicultural and global society. All of this takes place within a living and learning environment like no other, as we draw inspiration from the beauty and resources of our extraordinary location at the edge of the Pacific Ocean.