Team packs butterfly nets for summer research expedition

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This is Rocky Mountain Apollo butterfly, *Parnassius smintheus*. Credit: University of Cincinnati

A University of Cincinnati team is about to set off on a National Science Foundation-funded research expedition in the Canadian Rocky Mountains. Led by Stephen Matter, a UC assistant professor of biological sciences, the team of three UC undergraduate researchers will continue ongoing research on how climate change can affect

populations, in particular those of the Rocky Mountain Apollo butterfly, *Parnassius smintheus*.

The research will be conducted from mid-July until late August, during the adult butterfly stage. The butterflies lay their eggs in the Alpine meadows, where the eggs remain over winter and then emerge as larvae when the snow melts in the spring.

"The butterflies use snow cover to insulate their eggs during the winter," says team member and undergraduate researcher Olivia Eads, who is majoring in environmental studies and geology in the McMicken College of Arts and Sciences (A&S). "With increasing temperatures, there's less snow accumulation, creating less insulation for the eggs and therefore less chance of survival."

"These butterflies are encountering a more variable climate with greater frequency than they have in the last century," says Matter. "We have climatological data that shows that winters that are very warm and dry are bad for the population, as well as winters that are very cold and wet. We know that the overwintering eggs will die if they experience temperatures of minus 30 Celsius. If it's warm and dry, there's less likely to be snow cover, but temperatures may still reach minus 30. If the winter is cold and wet, it is much more likely to get to minus 30, but there is usually snow cover. Where we see problems for the butterfly is when it gets very cold early in winter, before there has been much snow accumulation. It's not unusual to have minus 30-degree air temperatures. But there's usually a nice layer of snow on the ground to protect the eggs."

Although the Rocky Mountain Apollo butterfly is a common butterfly in the region, lower populations due to climate change also affect pollination and therefore plant life. "They're a good species to observe in terms of alpine habitat," says Matter. "They pollinate a lot of alpine

plants. Basically, they pollinate anything that has yellow flowers in the alpine habitat."

The paid undergraduate summer research internship program is supported by a $272,259 grant from the National Science Foundation that was awarded in 2009, followed by a $14,500 supplemental grant. Matter has led the summer undergraduate research project since 2000.

Research and Roughing It

Students who apply for the undergraduate research opportunity are warned that the trip requires hard work, including field research that demands long hikes in extreme conditions. Matter says the roads were washed out last year. They stay at the Biogeosciences Institute, which was once a Canadian-World War II POW camp for German prisoners, and is now a field station run by the University of Calgary. The field station holds a vast amount of meteorological data that follows climate change over the past 60 years or so.

"One project is a mathematical statistical project that has ecological implications. We can use the relationship between our meteorological data collected in the butterflies' habitat and the much longer data set from the field station to reconstruct climatological conditions that the butterflies experience in the past," explains Matter.

Nineteen UC students applied to be considered for the three undergraduate research positions this summer. Eads was among the three selected, as well as Elizabeth Ferguson, a UC senior environmental studies major, and Christopher Screen, a UC junior in environmental studies. The NSF funding provides for airfare, room and board and a summer stipend.

Although the team is in a meadow with GPS trackers and chasing

butterflies with butterfly nets, the exertion does not involve much running. Matter says the butterflies tend to move slowly, so they're easy to catch and mark with a Sharpie marker. They'll be using their GPS and data markers to determine where there could be the greatest snow cover and where trees can provide shade and block snow in the winter.

Biological Mating Radar

The team is also investigating whether the butterflies use a sort of biological radar to pick a mate.

"The males tend to mate with the females as they're coming out of the pupal stage," says Matter. "The females can't fly yet, because their wings are wet and they have to wait a while for the blood to go into their veins and expand their wings.

"We believe the males are relying on a pupal pheromone to find the females – they can chemically sense where the newly hatched females are. They guard those areas, wait for the females to emerge, and mate with them before they can get away. We can tell whether or not a female has mated, because the male puts down a mating plug." Matter's research teams have collected three years of data in the field and in his lab to explore the pheromone mating idea, which supports why older females rarely mate. "If they've emerged from their pupa and haven't mated after two days or so, they have little chance of ever mating."

Matter says the butterflies can live up to three weeks. The team will be collecting caterpillars to bring back to their UC research labs to further research behavior.

"I hope to gain a greater understanding of how climate change is affecting the world in which we live," says Ferguson, who's from Wayne, West Virginia. "I'm looking forward to being submerged in the

Rocky Mountains of Canada and exploring a different part of the world."

Leveraging research is among five key areas of UC's Creating Our Third Century initiative, as well as reimagining the student experience through real-world opportunities such as undergraduate research.

Provided by University of Cincinnati