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### Why is Canada's Largest Butterfly, the Giant Swallowtail (*Papilio cresphontes*), Moving Northwards?

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Over the past ten or so years, *P. cresphontes* has moved into Ottawa, Ontario. Scientists think the butterfly is likely tracking the changing climate, but what remains a mystery is why they are.

Some recent work from our lab shows that we can rule out warmer fall temperatures and later frosts as the reason for their move northwards. Instead, it could be that winters are now warm enough for the butterfly to survive. It could also be that summers in Ottawa are getting longer, so the butterfly now has enough time to develop before it enters diapause for the winter.

We took another step towards tackling this question by asking whether winter could be the main factor leading to their move northwards. While we know that *P. cresphontes* overwinters in the pupal stage, no one has observed their pupa during the winter in Ottawa. In other words, we don't know for sure that the butterfly can survive the winter this far north.

In the summer of 2021, my MSc student Hannah Keefe collected a combination of *P. cresphontes* eggs and larvae (n=48) from two locations: Queen's University Biological Station, and Mud Lake in Ottawa. She collected them in mid-August, and reared them on prickly ash (*Zanthoxylum americanum*) plants in mesh enclosures in a courtyard at the University of Ottawa. Of these 48 individuals, only 23 made it to pupation.

Interestingly — perhaps because of the warmer, urban environment — Hannah had six (6) pupa eclose from September to mid-October. This represented a partial or failed third generation in the region, when there is usually only two generations. Remarkably, most of them survived a few weeks.

In early November, we moved the remaining pupa to two overwintering sites that were about one (1) km apart from each other in the New Edinburgh area in Ottawa.

We made cages for the pupa to protect them from snowfall and larger predators. We used one dryer vent cage and used a flattened gutter strainer to close them off at the bottom (see **Figure 1**). We carefully removed the pupa from where they had chosen to pupate in the enclosures — either on the prickly ash, the plant pots, or the enclosures themselves—and used fishing line to tie the silk from the pupa to the cages. We placed the cages five to six (5-6) ft. above the ground (and above the snowline), and secured the cages to branches on a tree. We placed three to four (3-4) pupae per cage (two to three (2-3) cages total) at each location.



**Figure 1:** Collection of images showing how the pupae/chrysalis' were strung up inside the overwintering cages, and the set-up of the cages at their overwintering sites in Ottawa.

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In June 2022, we moved the pupa back to the courtyard at the University to facilitate daily monitoring. None of the pupae ( $n=9$ ) from one of the sites survived the winter. Either there was damage to the chrysalis, or the chrysalis had completely disappeared. At the other location, all chrysalis pupae appeared to be intact at the time of the move back to the University, but none of them ended up eclosing ( $n=8$ ). This means the pupa were killed by the winter conditions.

Although none of the pupa survived in our study, we still don't know for sure whether and how *P. cresphontes* survive the winters in Ottawa. It could be that we placed the cages too high, and that pupa actually overwinter closer to the ground and in the snow cover where it is warmer.

We hope to repeat this experiment in a future year with more individuals, and some placed lower to the ground. This will allow us to know for sure whether *P. cresphontes* can successfully survive the winters in Ottawa. Our hope is that a better understanding of the overwintering strategies of cryptic species, like *P. cresphontes*, will help us gain a clearer picture of how climate change is likely to affect overwintering insects.



**Figure 2:** Adult Giant swallowtail butterfly, October 2021



**Figure 3:** Natural pupation position

