

New Host, New Species? Life Cycle Timing

Guiding Question

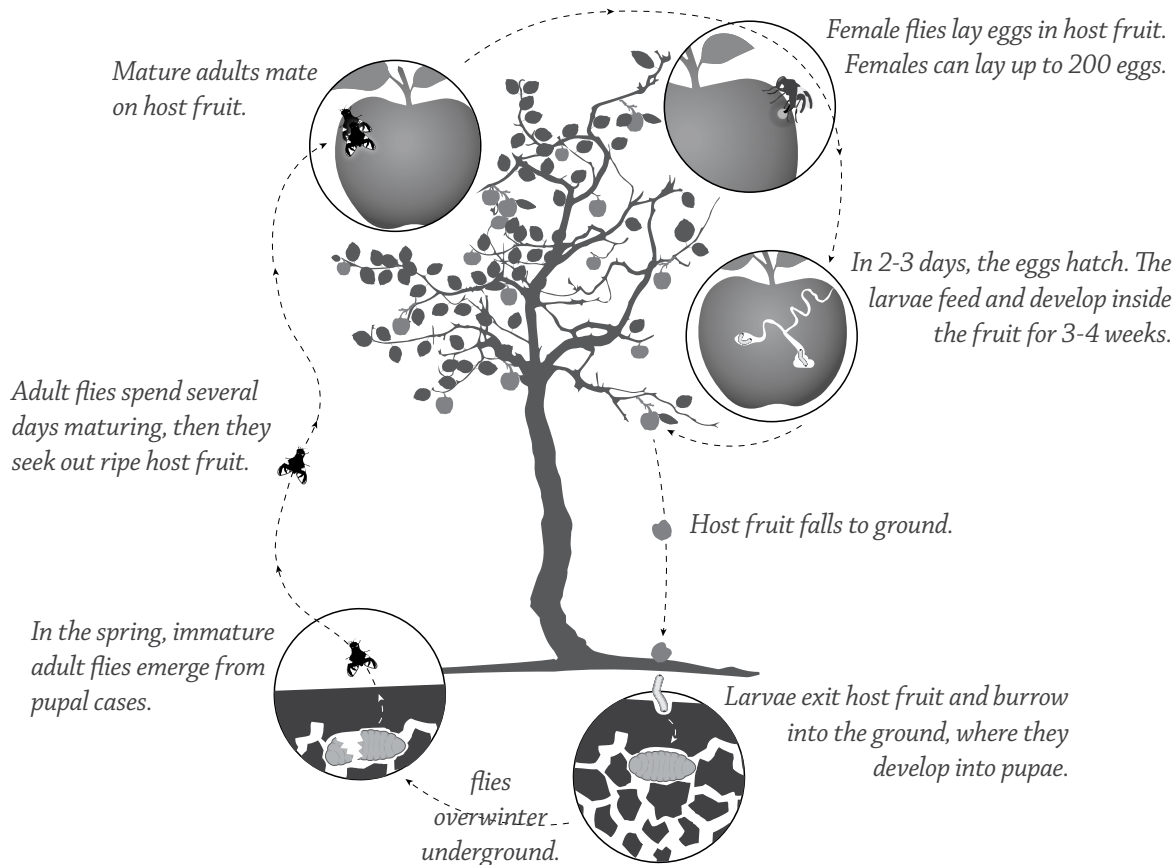
Apples were brought to North America, about 400 years ago. Sometime around 1850, some *Rhagoletis* flies moved from living on their native hawthorn fruit to living on apples. Is the population of hawthorn flies living on the apples becoming a new species?

Background

All species of *Rhagoletis* flies spend most of their lives underground and dormant. Adults emerge from the ground as their host fruit is getting ripe. They mature, mate, lay eggs, and die—all within a few weeks.

Timing is key to successful reproduction. Each species has a life cycle that is tied very closely to that of its host fruit. Dogwood fruit, for example, are ripe several days *after* hawthorn fruit—and flies from the dogwood species reach adulthood about 30 days *later* than hawthorn flies. Even though these two fly species live in the same area, adult flies exist at different times, and so they do not interbreed.

Could differences in life cycle timing also be a barrier to reproduction between apple and hawthorn fly populations?



Most *Rhagoletis* flies spend their whole lives very close to their host plant.

Experiment 1

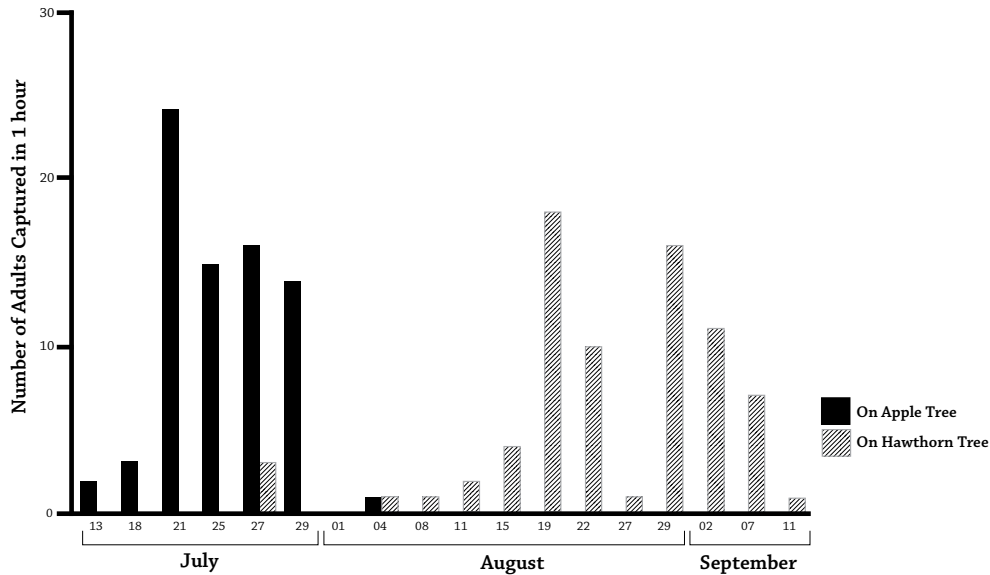
Adult flies mate on the fruit of their host plants, and they begin laying eggs in the fruit a short time later. For successful mating and egg laying, the fruit must be ripe enough for flies to smell it and soft enough for the female to puncture its skin. New groups of adult flies come out of the ground each day for several weeks. Each adult lives for about a month.

Research question: When are apple and hawthorn fruit ripe enough for flies to be mating on them?

Procedure

1. For one hour, capture and count flies that are mating on and laying eggs in hawthorn fruit. Repeat for apple fruit.
2. Repeat daily until no more flies are mating and laying eggs.

Results *(data based on Feder et al, 1993)*



Questions

1. In one sentence, summarize the results.
2. Given that adult flies live for only a few weeks after they begin mating, do you think the same flies are mating on both apple and hawthorn fruit? Explain.

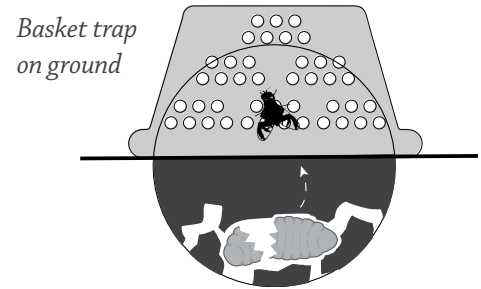
Experiment 2

Research question: When do apple and hawthorn fly adults emerge from the ground? How does this compare to when fruit are ripe?

Since fly larvae crawl out of fallen fruit and directly into the ground, adults emerge directly below the tree where its parents mated and laid eggs.

Procedure

1. Shortly before adult flies begin to emerge, place fly traps over the ground directly below apple and hawthorn trees.
2. Every week, empty the traps and count the flies.
3. When no more adults are emerging, add up the total numbers of apple and hawthorn flies that emerged, and calculate the percentage of flies that emerged each week.

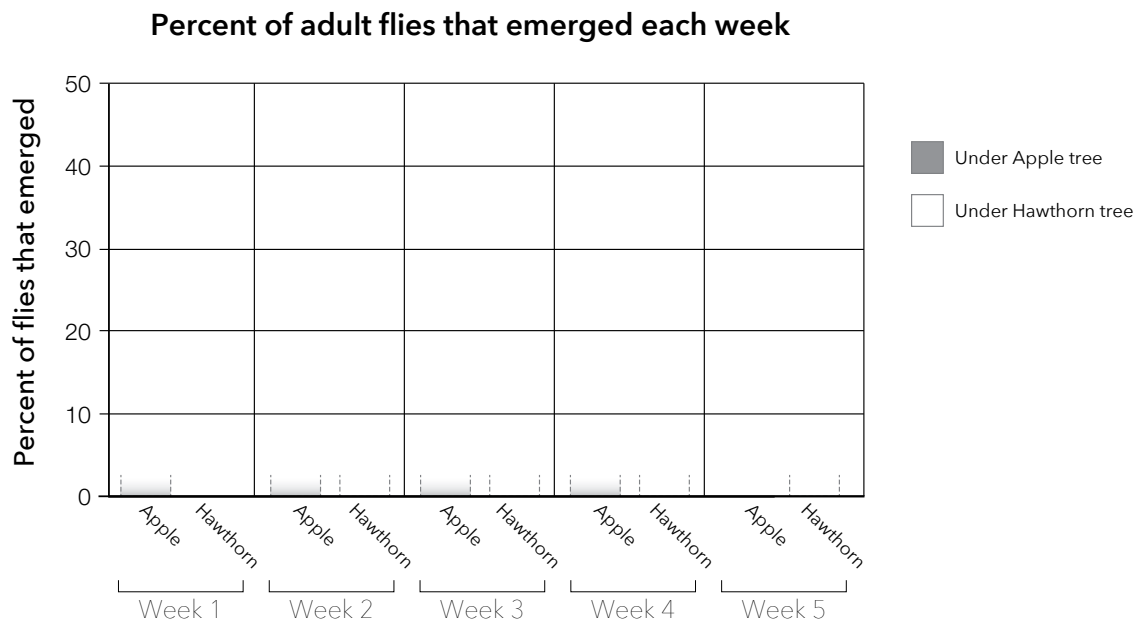


Results (data based on Feder et al, 1993)

Week	Dates	Percent of adult flies that emerged each week	
		Under Apple tree	Under Hawthorn tree
1	June 25 - July 1	12	0
2	July 2 - 8	38	4
3	July 9 - 15	43	39
4	July 16 - 22	7	42
5	July 23 - 29	0	15

Questions

3. Using the data from the table above, add bars to the graph:



4. In one sentence, summarize the results.

Experiment 3

In experiment 2, there were many variables that researchers could not control. For example, maybe there was a difference in the nutrients or temperature of the soil that was affecting when the flies emerged. They decided to test emergence time in the lab to see if the results were the same.

Research question: Is earlier emergence time a heritable trait that could be selected for in the apple fly population?

Procedure

1. In the fall, collect apple and hawthorn fruit with fly larvae inside of them.
2. Take the fruit to the lab and store each type of fly separately. Wait for them to become pupae.
3. To mimic winter, keep the pupae cold for several months. To mimic spring, warm them.
4. Wait for adults to begin to emerge.
5. Every day, collect and count the newly emerged adults.

Results *(data based on Feder et al, 1993)*

Population	Number of pupae	Average emergence time of adults (number of days after pupae were warmed)
Larvae from apples	268	53
Larvae from hawthorns	106	61

Questions

5. In one sentence, summarize the results.

6. Flies from apple and hawthorn fruit were raised in exactly the same conditions in the lab. Do the data from experiment 3 suggest that emergence time is environmentally driven, or is it more likely a heritable trait?

NAME _____ DATE _____

7. Data from other experiments (not shown) show that apple flies emerge from the ground and immediately begin to mate and lay eggs on ripe fruit. In contrast, hawthorn flies begin to mate and lay eggs on ripe fruit about 7-10 days after they emerge.

Do you think life cycle timing could be a barrier to reproduction between apple and hawthorn fly populations? Make a claim, and support it with evidence and reasoning.

8. Do you think that different heritable traits are being selected for in apple vs. hawthorn fly populations? Make a claim, and support it with evidence and reasoning.

Reference

Feder, J.L., Hunt, T.A., & Bush, G. L. (1993). The effects of climate, host phenology and host fidelity on the genetics of apple and hawthorn infesting races of *Rhagoletis pomonella*. *Entomologia Experimentalis et Applicata*, 69(2), 117-135. doi: 10.1111/j.1570-7458.1993.tb01735.x