

# Styrofoam Biodegradation: Comparing the capabilities of mealworms, woodlice, and millipedes

Dominic Polycarpou

Sleepy Hollow High School

# Styrofoam: A Global Problem

- Difficult to degrade
- Not recyclable
- Mild carcinogen
- Moves up food chain

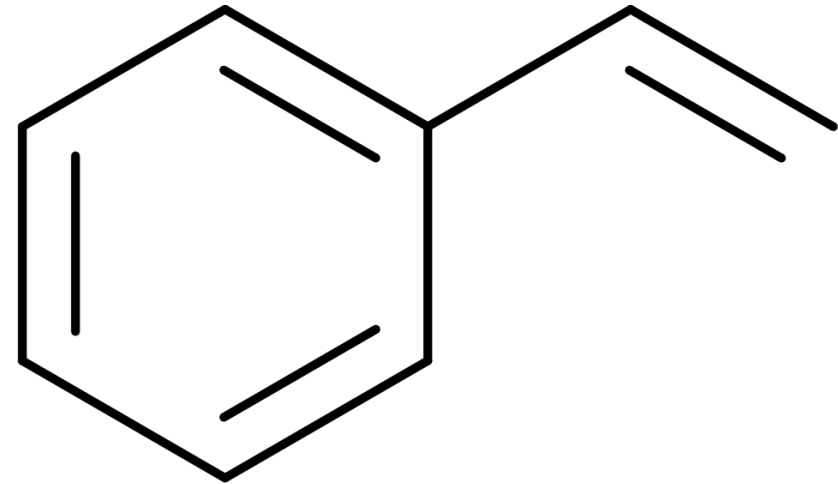


Retrieved from: <https://medium.com/age-of-awareness/why-styrofoam-expanded-polystyrene-should-be-banned-everywhere-in-the-world-4101552f5e2b>

# Degradation Methods

Degradation uses a lot of:

- Time
- Heat/Energy
- Harsh Chemicals



Styrene Molecule

# Biodegradation

- Certain fungi (w/ help from Fenton's reagent)
- Mealworms -> Eat polystyrene (Styrofoam)
- Limited in scope/potential



Yellow Mealworms

Retrieved from:

<https://www.rainbowmealworms.net/1000-mealworms/>



Fenton's reagent

Retrieved from:

<https://chemdemos.uoregon.edu/demos/Household-Fentons-Reagent>

# My Prior Research

- Fed polystyrene to mealworms
- Degraded by 20% over 2 weeks
- Polystyrene eaten, not broken down
- Research very new, more needed



Photos taken by student

# Other methods

- New field of research, not studied much
- Other organisms may have biodegradative abilities
- Very few tested, some local organisms may be useful



# Other Organisms

- Wood lice (*Oniscidea spp.*) eat polyethylene/starch mix
- Greenhouse millipedes (*Oxidus gracilis*) are common decomposers



Greenhouse millipede

Retrieved from :

[https://en.wikipedia.org/wiki/Greenhouse\\_millipede](https://en.wikipedia.org/wiki/Greenhouse_millipede)



Woodlice

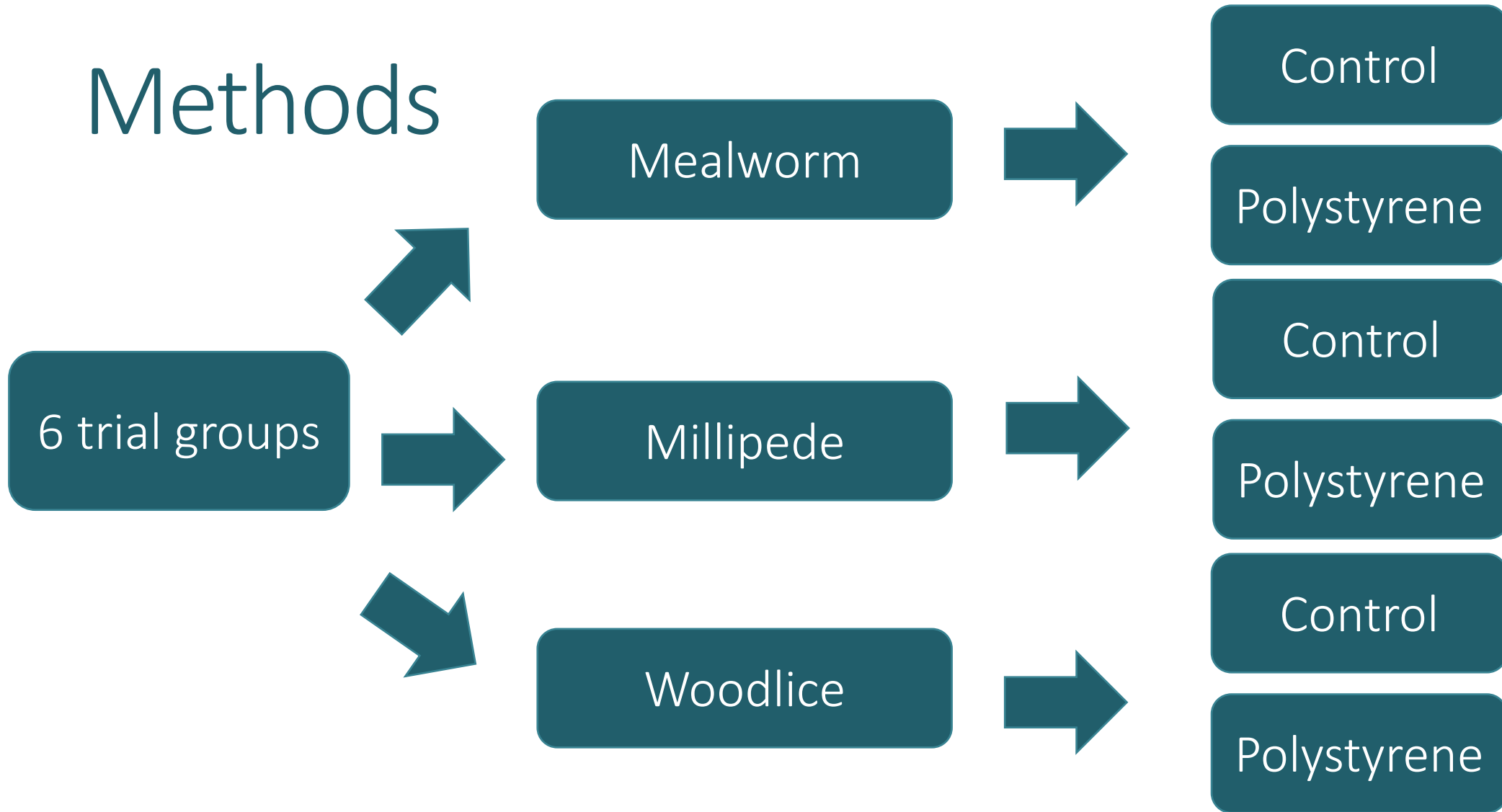
Retrieved from: <https://www.discoverwildlife.com/animal-facts/insects-invertebrates/facts-about-common-rough-woodlouse/>

# Hypothesis

If greenhouse millipedes and common woodlice can biodegrade polystyrene, then the weight of the polystyrene will decrease over time, comparable to mealworm biodegradation.



# Methods



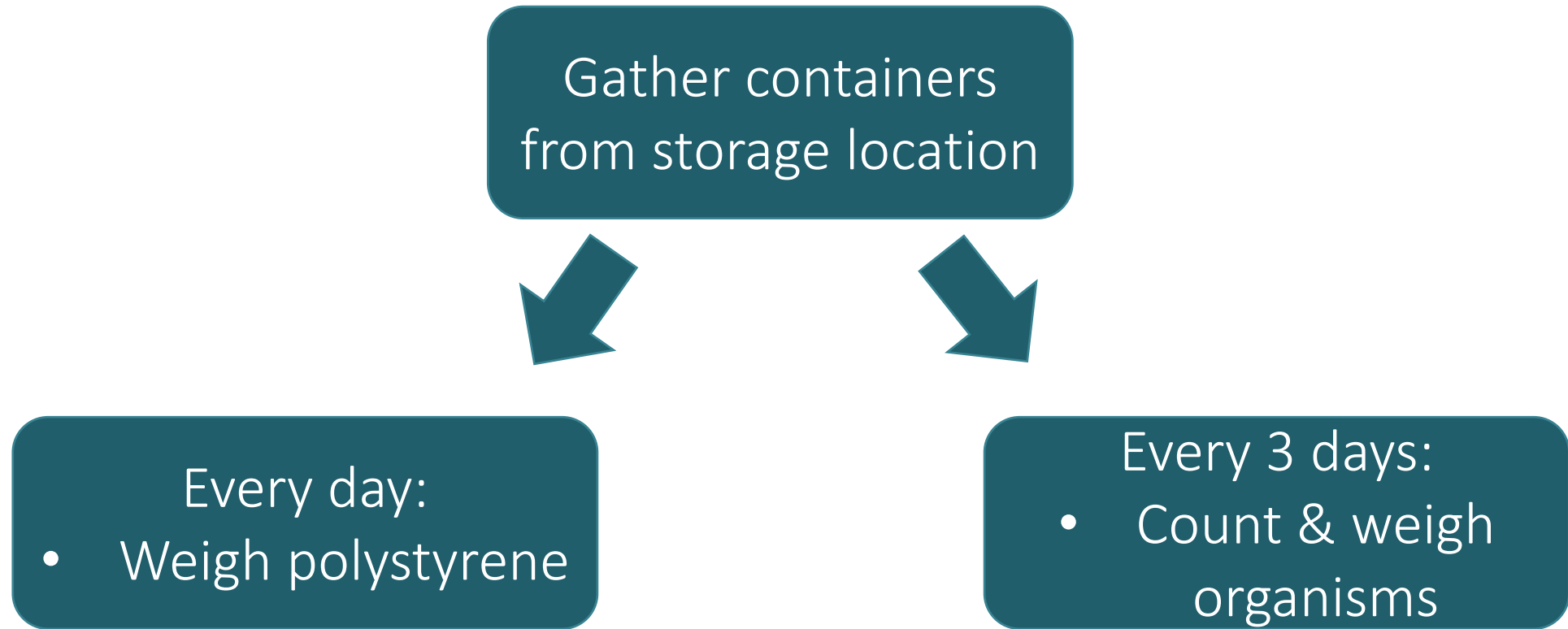
# Container details

- 34.6 cm x 21 cm x 12.4 cm plastic container
- Bedding of leaf litter, dirt
- Polystyrene chunks placed on surface
- Given apples every 3 days
- Misted every day
- Kept in semi-dark room
- Avg pH = 6.73 (SD = 0.312)



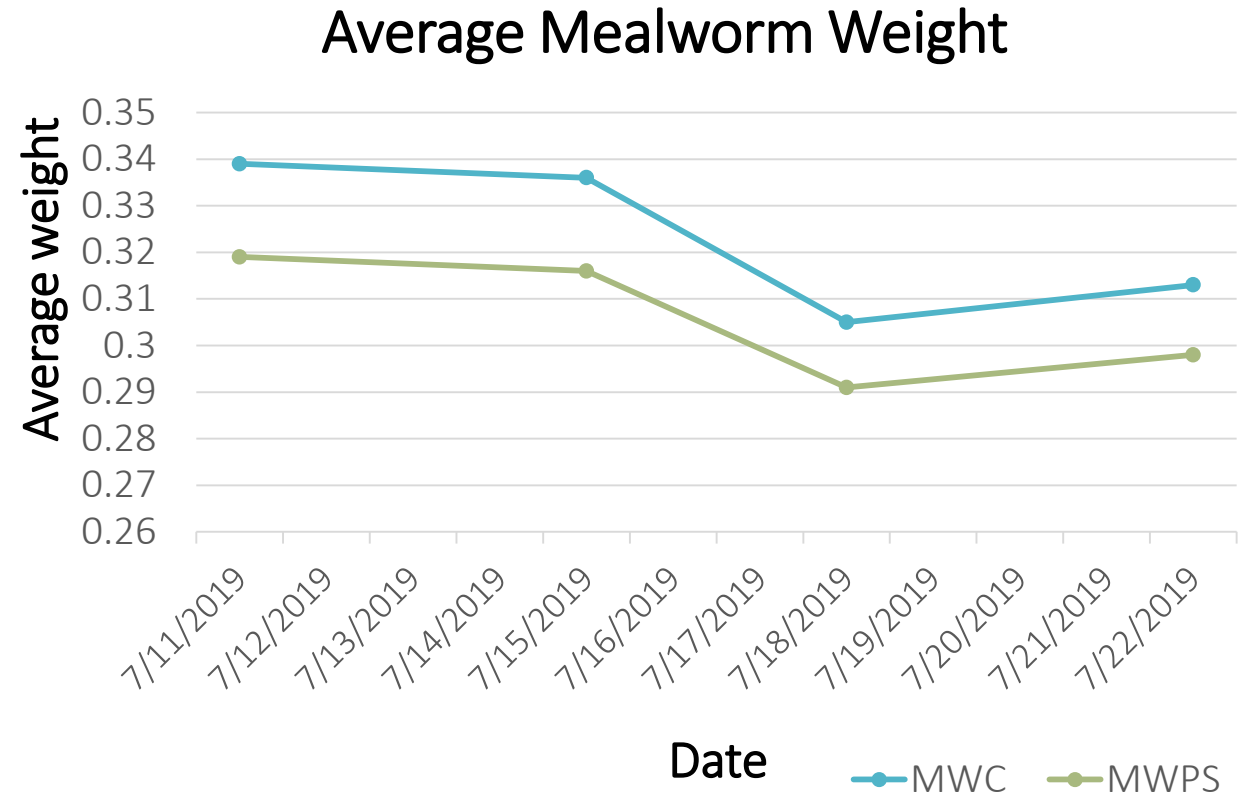
Photos taken by student

# Measurement Procedure



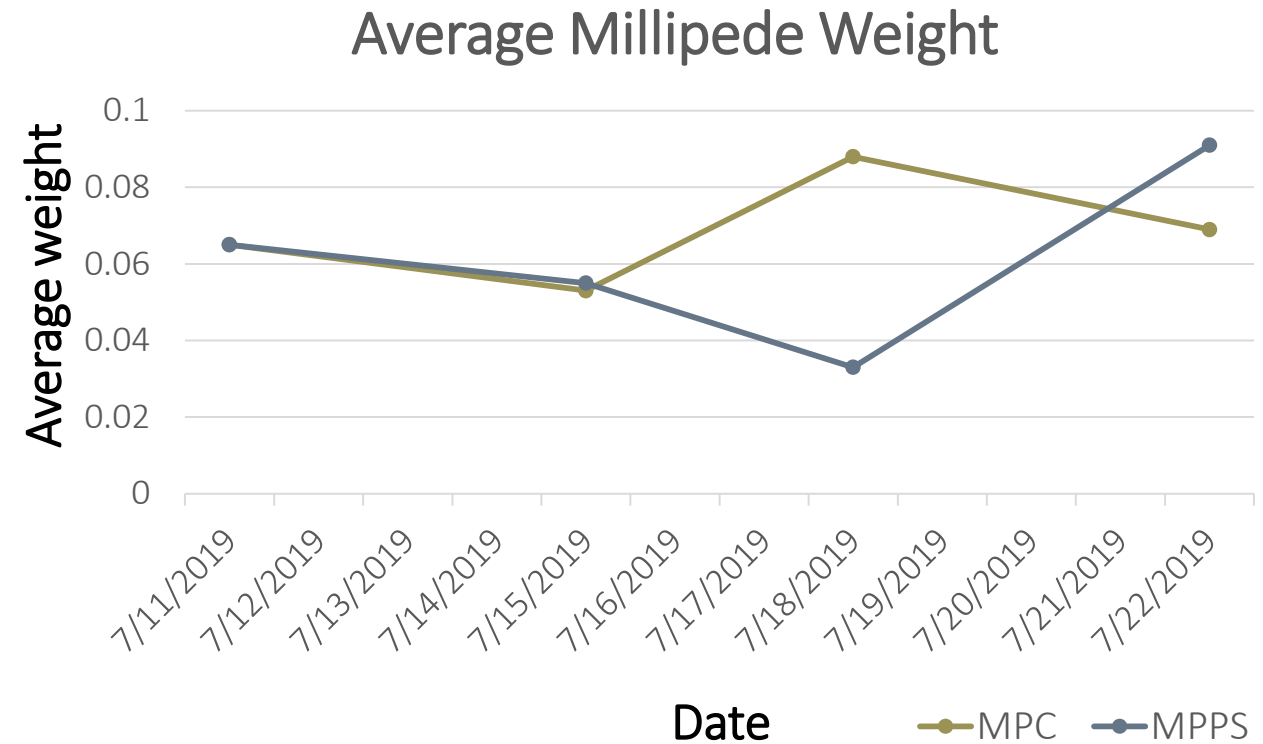
# Mealworm Weight Change

- PS trial started smaller
- Groups did not diverge
- Mealworms trended downwards



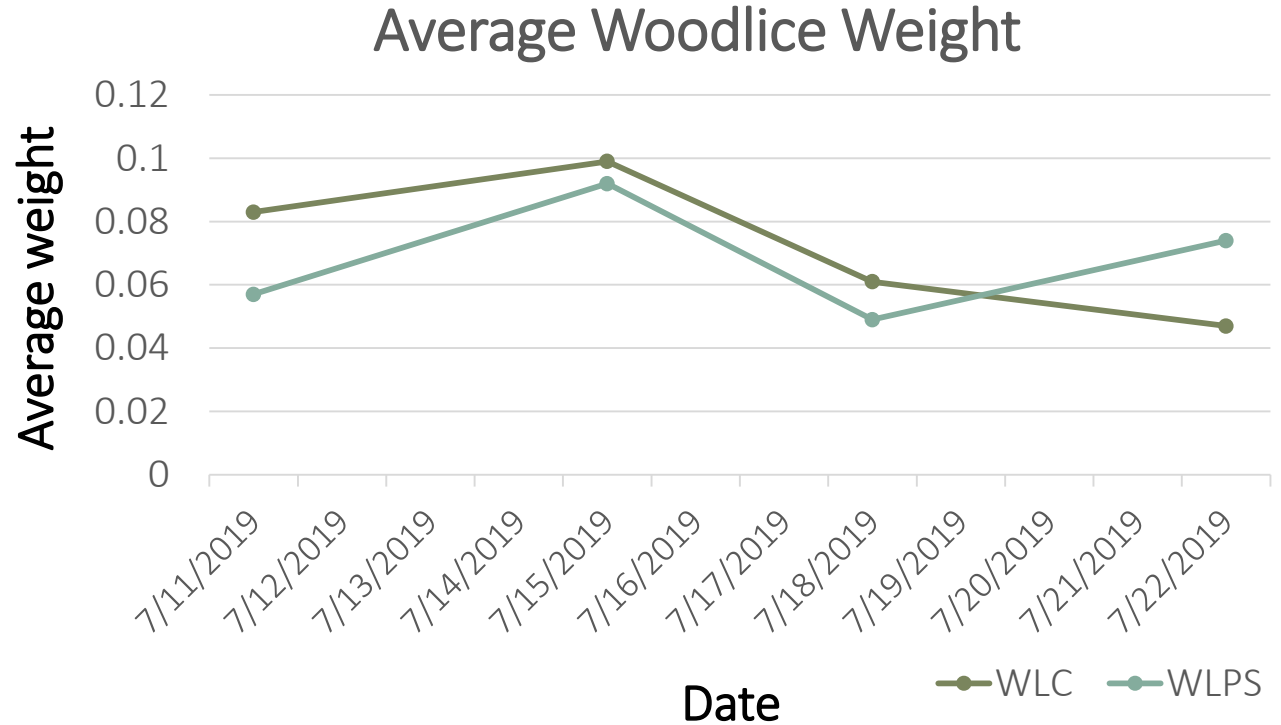
# Millipede Weight Change

- No significant variance
- Measurements small/sensitive to other variables
- Not indicator of health



# Woodlice Weight Change

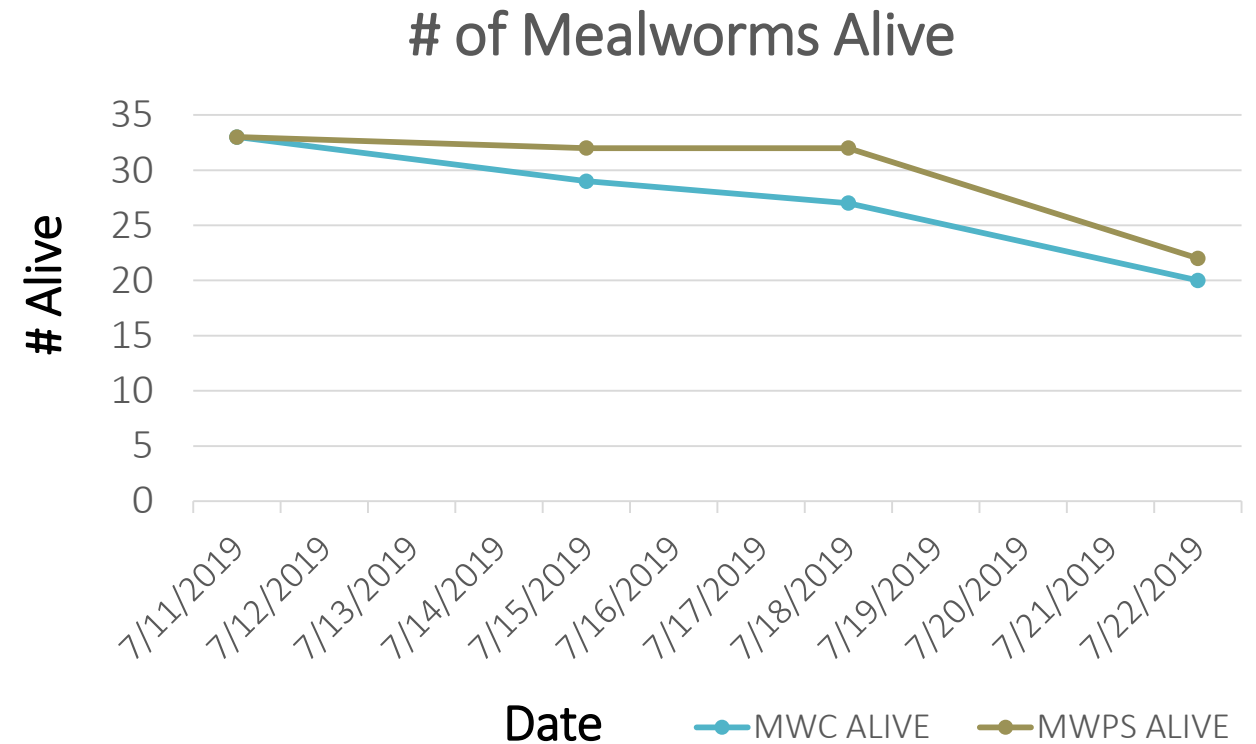
- No significant variance
- Measurements small/inaccurate
- Small sample size





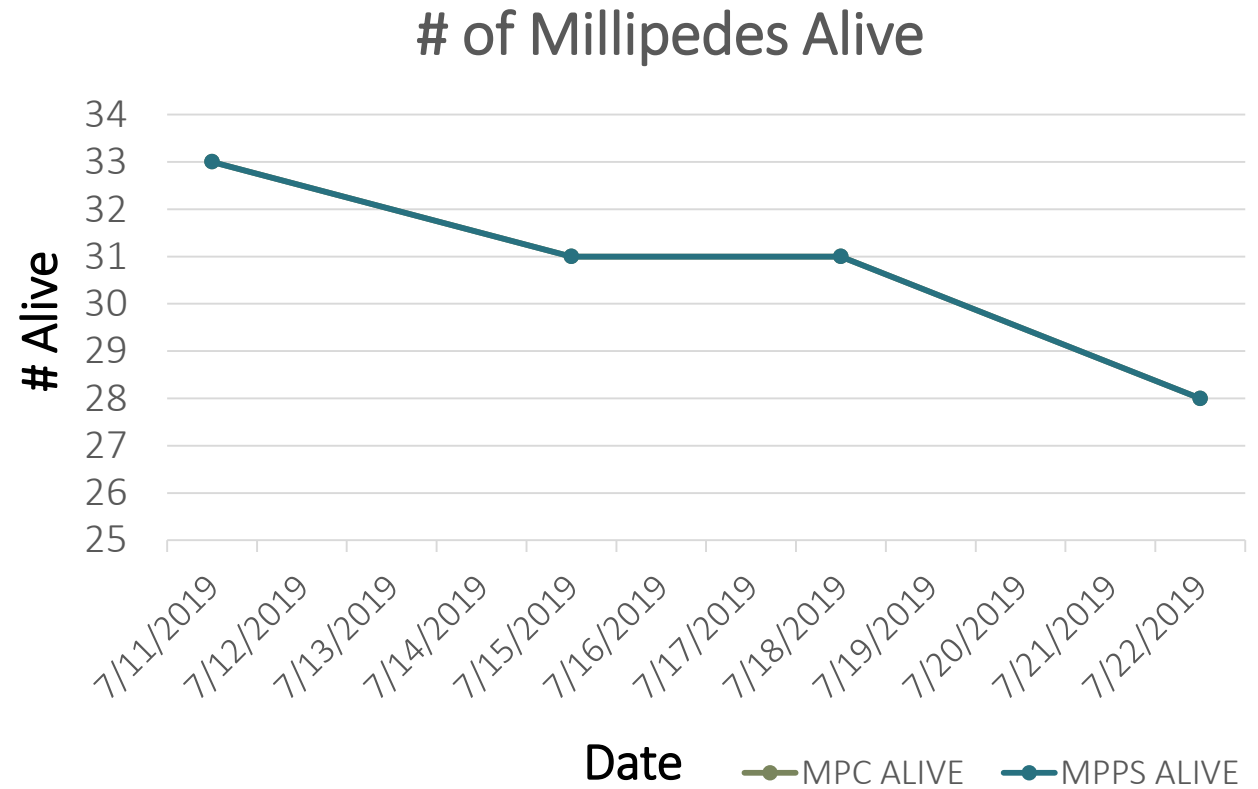
# Mealworm Mortality

- Mortality similar in both groups
- Some death expected



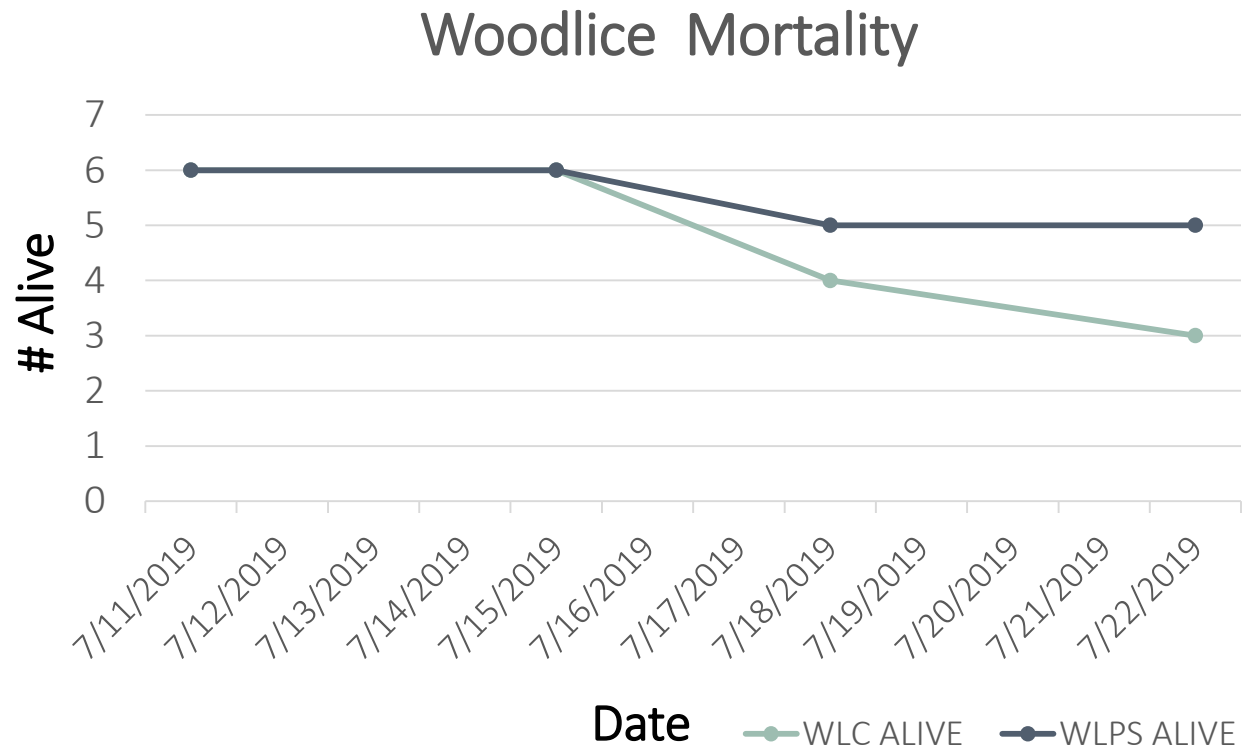
# Millipede Mortality

- Mortality same in both groups
- Some millipedes disappeared



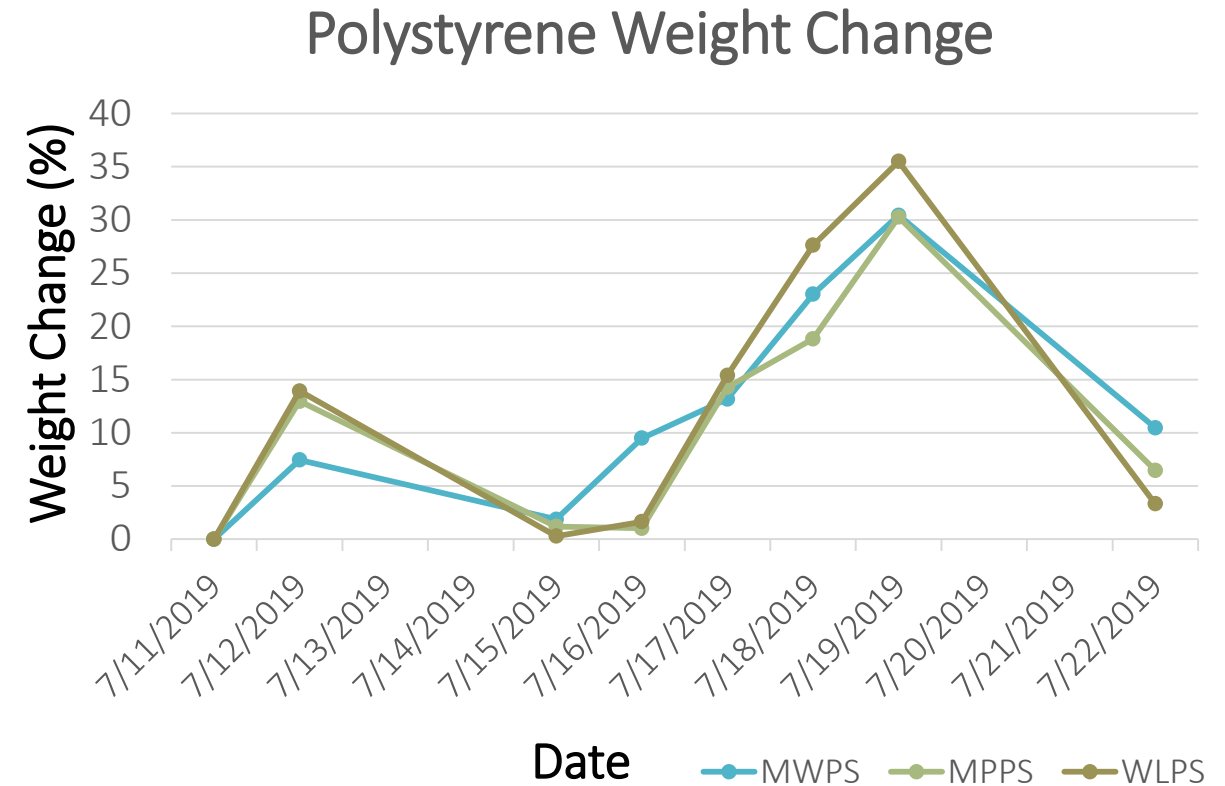
# Woodlice Mortality

- Similar mortality
- Small numbers in each group
- Most woodlice survived



# Polystyrene Weight Change

- Variance due to water misting
- Groups generally similar
- No indication of degradation
- No negative weight change



# Discussion

- Mealworms decreased instead of increasing in weight
- May be unhealthy due to excess water from misting
- Polystyrene not shown to be degraded
- Millipedes aware of polystyrene, didn't eat
- Small number of wood lice, results unreliable

# Sources of Error

- Small sample sizes
- Scale may be inaccurate
- Short experiment time
- Misting changed weight of polystyrene (uncontrolled variable)
- Dirt/leaf litter adhered to polystyrene



# Conclusion

- Millipedes and woodlice did not degrade polystyrene
- Mealworms did not degrade polystyrene (different from prior research)
- Degradation limited by different habitat
- Mealworms are limited in degradative abilities

# Future Focus

- Effect of environment on mealworm degradation
- Test other secondary decomposers
- Test mealworms in compact mesocosms

# Acknowledgements

I'd like to thank:

- Dr. Danielle Begley-Miller and Dr. Mike Rubbo
- My science research teachers
- TESA students
- My family

Any Questions?