Animal Behavior Proposal: Do Pill Bugs Prefer Wet or Dry Substrate?

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**Introduction**

 This study will be conducted in order to determine the substrate preferences of the terrestrial isopod, *Armadillidium vulgare,* more commonly known as the pill-bug, potato bug, or roly-poly. Originally classified by Latrielle in 1804, (ITIS Report, 2019), *Armadillidium vulgare,* a species of European woodlouse, has a wide habitat range with an almost cosmopolitan distribution in both terrestrial and aquatic habitats (Catalogue Of Life, 2019). During the daylight hours, *A. vulgare* can be found in areas containing moisture such as in fallen leaf litter, under rocks and stones, and amongst tall grass (Natural England, 2011). Isopods such as *A. vulgare* are crustaceans, and therefore, also possess gills (Phipps, 2009). This would explain why these organisms tend to be found in moist environments.

Pill-bugs are classified as detritivores. They are a vital part of many biogeochemical processes, cycling nutrients such as nitrogen, carbon, and phosphorous throughout the ecosystem. These organisms feed orally on material from primary producers such as plants, but also on material from dead and decaying carnivores and herbivores, therefore, they are present throughout all trophic levels. As well as consuming detritus, *A. vulgare* also serves as a food source for secondary consumers, providing an essential component in the overall ecosystem energy cycle. A 2008 study conducted by Monteiro et al found that through bottom up regulation, isopods like *A. vulgare* actuallyserve as an important source of cadmium to their predators on higher trophic levels.

Because of their nutrient cycling abilities, pill-bugs have the ability to improve soil quality in their chosen habitats (Tripathi, 2006). This ability makes these organisms especially useful in the restoration of perturbed soils (Snyder and Hendrix, 2008). Soil macrofauna including isopods can also be used as good bioindicators of overall ecosystem health and have been used in the past as model organisms for better land use and management practices (Benito et al, 2001).

**Specific Aim of the Study**

The specific aim of this study is to determine if *Armadillidium vulgare* prefers moist substrate over dry substrate. It is hypothesized that if *Armadillidium vulgare* is put in an arena with two cells, one filled with moist substrate and one with dry substrate, then *Armadillidium vulgare* will spend the majority of the time observed in the cell with moist substrate. *Armadillidium vulgare* helps to consume decaying vegetation, helps redistribute nutrients back into the soil, and does not inflict any damage to plants, which in turn helps crops grow. Determining which substrate *Armadillidium vulgare* prefers could be used to benefit farmers and gardeners by allowing people to create a preferred habitat for *Armadillidium vulgare* to increase the amount of nutrients being put into the soil so as to produce better crop yields.

**Methodology**

 This experiment is designed around the matched sign test where the independent variable shall be categorical (wet versus dry substrate), and the dependent variable shall be continuous (time spent in wet versus dry substrate). An artificial environment consisting of a plastic tray with two arenas- one containing wet substrate and one containing dry substrate- will serve as a stage for data collection. Data shall be collected once a day over a period of three days for 15 minutes at a time. 5 pill-bugs shall be used during each trial for a total of 15 individuals in the sample population. Pill-bugs will be individually marked with colored paint in order to differentiate between individuals during each trial. During each observation period observers will count the time each individual spent in each area in seconds and will record this data onto a spreadsheet. Results for pill-bug substrate preferences will then be calculated based on this data using the matched sign test.

**Potential Conclusions**

 Based on the hypothesis that *A. vulgare* will spend the most amount of time in the arena with the moist substrate rather than the dry substrate, it can be concluded that this isopod requires a moist environment to survive. This information is valuable to know in order to utilize this organisms potential for ecosystem restoration and for future land planning and management. Although pill-bugs are not a large, charismatic, species of megafauna that can act as a poster child for environmental change such as polar bears, pandas, or the bald eagle, they are still important members of a healthy ecosystem. By analyzing the tolerance range *A. vulgare* for soil moisture content and by evaluating the ecosystem services provided by *A. vulgare,* humans can make smarter and more sustainable choices when considering how to most efficiently manage crops and plan the sustainable expansion of urban areas in a way that will not disrupt the ecosystem from the bottom up.

Literature Cited

Benito N., Brown G., Correia M., Elizabeth M., Pasini A. 2001. Diversity and functional role of soil macrofauna communities in Brazilian no-tillage agroecosystems: a preliminary analysis. [accessed 2019 Oct 6]. <https://www.researchgate.net/publication/236685983_DIVERSITY_AND_FUNCTIONAL_ROLE_OF_SOIL_MACROFAUNA_COMUNITIES_IN_BRAZILIAN_NO-TILLAGE_AGROECOSYSTEMS_A_PRELIMINARY_ANALYSIS>

Catalogue Of Life: 2019 Annual Checklist. 2019. [accessed 2019 Oct 6]. <http://www.catalogueoflife.org/col/details/species/id/d2e5a6aeaf859b07ad02787e41c32dca/source/tree>

Latrielle, 1804. ITIS Report. Armadillidium vulgare. Integrated Taxonomic Information System. [accessed 2019 Oct 6].

<https://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=93250#null>

Monteiro, M.S., C. Santos, A. Soares, R. Mann. 2008. Does Subcellular Distribution in Plants Dictate the Trophic Bioavailability of Cadmium to Porcellio dilatatus (crustacea, isopoda)? [accessed 2019 Oct 6]

<https://setac.onlinelibrary.wiley.com/doi/abs/10.1897/08-154.1>

 Natural England. July 20, 2011.Common pill woodlouse — Armadillidium vulgare. [accessed 2019 Oct 6]. [https://web.archive.org/web/20110720013031/http://www.plantpress.com/wildlife/o109-commonpillwoodlouse.php](https://web.archive.org/web/20110720013031/http%3A//www.plantpress.com/wildlife/o109-commonpillwoodlouse.php)

Phipps E. 2009 Apr 22. Habitat Preferences of terrestrial Isopods: a study of comparing moist and dry substrates. Holly Taylor's Web Spot. [accessed 2019 Oct 6]. <http://ehphipps21.tripod.com/Habitatpreferencesterrestrialisopods_finalmanuscript.htm>

Smigel JT, Gibbs AG. 2008. Conglobation in the Pill Bug, Armadillidium vulgare, as a Water Conservation Mechanism. Journal of Insect Science 8:1–9. [accessed 2019 Oct 6].

<https://academic.oup.com/jinsectscience/article/8/1/44/899593/>

Snyder, B.A. and P.F. Hendrix. 2008. Current and Potential Roles of Soil Macroinvertebrates. [accessed 2019 Oct 6]

<https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1526-100X.2008.00484.x>

Tripathi, G. and B.M. Sharma.2006. Fauna-associated changes in chemical and biochemical

properties of soil. [accessed 2019 Oct 6]

 <https://europepmc.org/abstract/med/17319265>