

The influence of abiotic factors on rough periwinkle behavior and dispersal

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Introduction

With accelerating global climate change, direct and cascading effects on different ecosystems are becoming clearer. Changes associated with climate have affected a wide range of behaviors in organisms such as reproductive strategy and dispersal. Organisms in the intertidal zone are subjected to changing conditions in both the terrestrial and aquatic zones of their habitat. Here, we investigate the influence of abiotic factors associated with climate change on the behavior of an intertidal invertebrate, the rough periwinkle (*Littorina saxatilis*), using field observation.



Methods

On a well-defined shelf on the Schoodic Peninsula, 4 tide pools were chosen as study sites. At the end of July 2015, all snails were collected from each of the pools, measured, and marked. Each individual was painted with a color denoting the tide pool it came from (i.e. Tide Pool 1 = Purple, Tide Pool 3 = Green, etc.). Individuals also received an ID number, which was printed on a small cutout of paper, glued to the shell, and painted over with a clear nail polish to promote the lifespan of the tag. Once tags were dry, all snails were returned to their pools.

Across August and September, snail activity was monitored 12 times. The total number of snails present in each tide pool, both marked and unmarked, was recorded, as well as the temperature of each tide pool. Then, snails exposed on the bare shelf were counted and, for those that were marked (originally from the four study tide pools), the shortest distance from that snail's location to its original pool was measured. Lunar phase, time difference between the present and low tide, air temperature, ocean temperature, humidity, and cloud cover were also recorded.

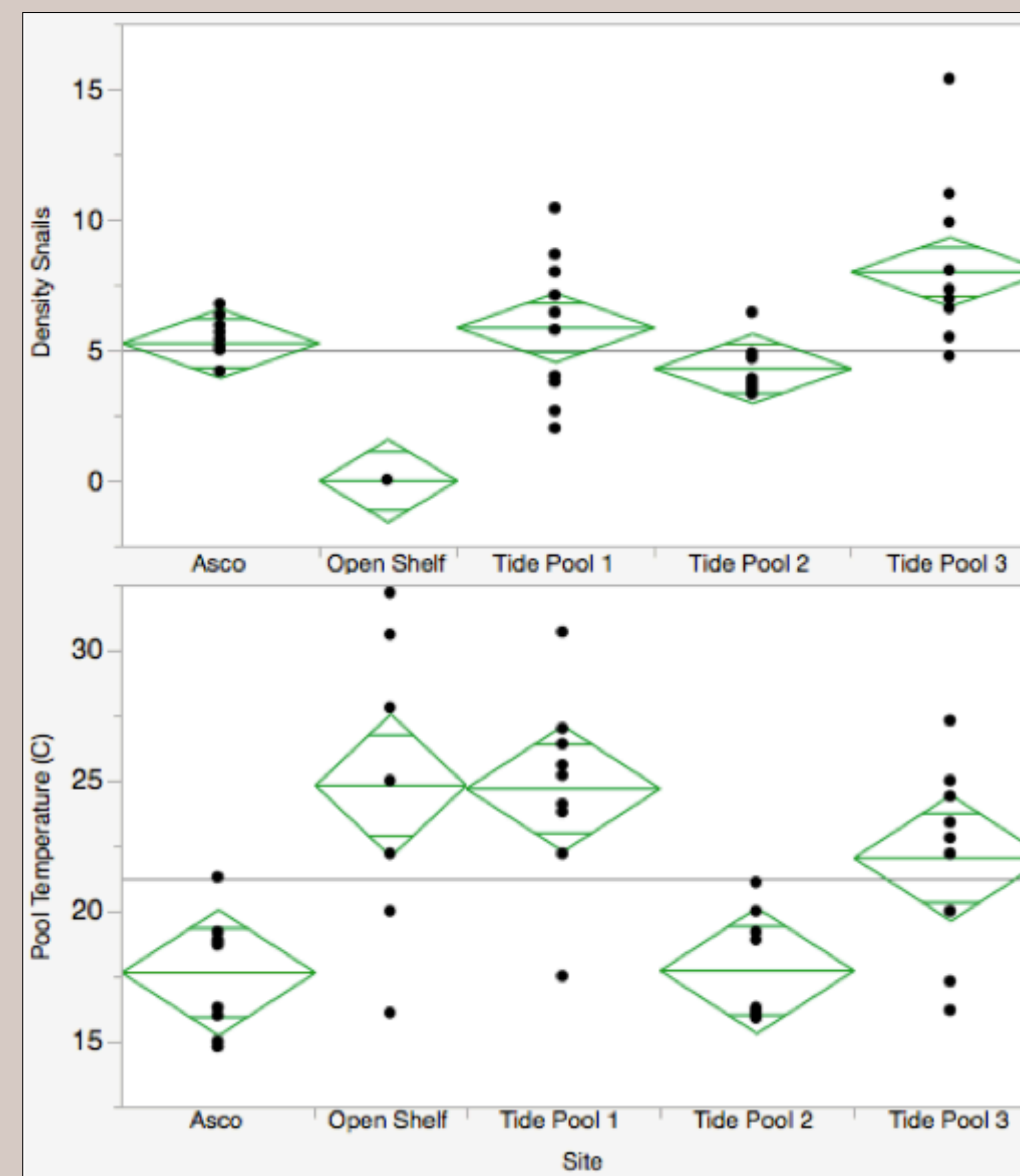


Figure 1. Pool temperature and density of snails by site

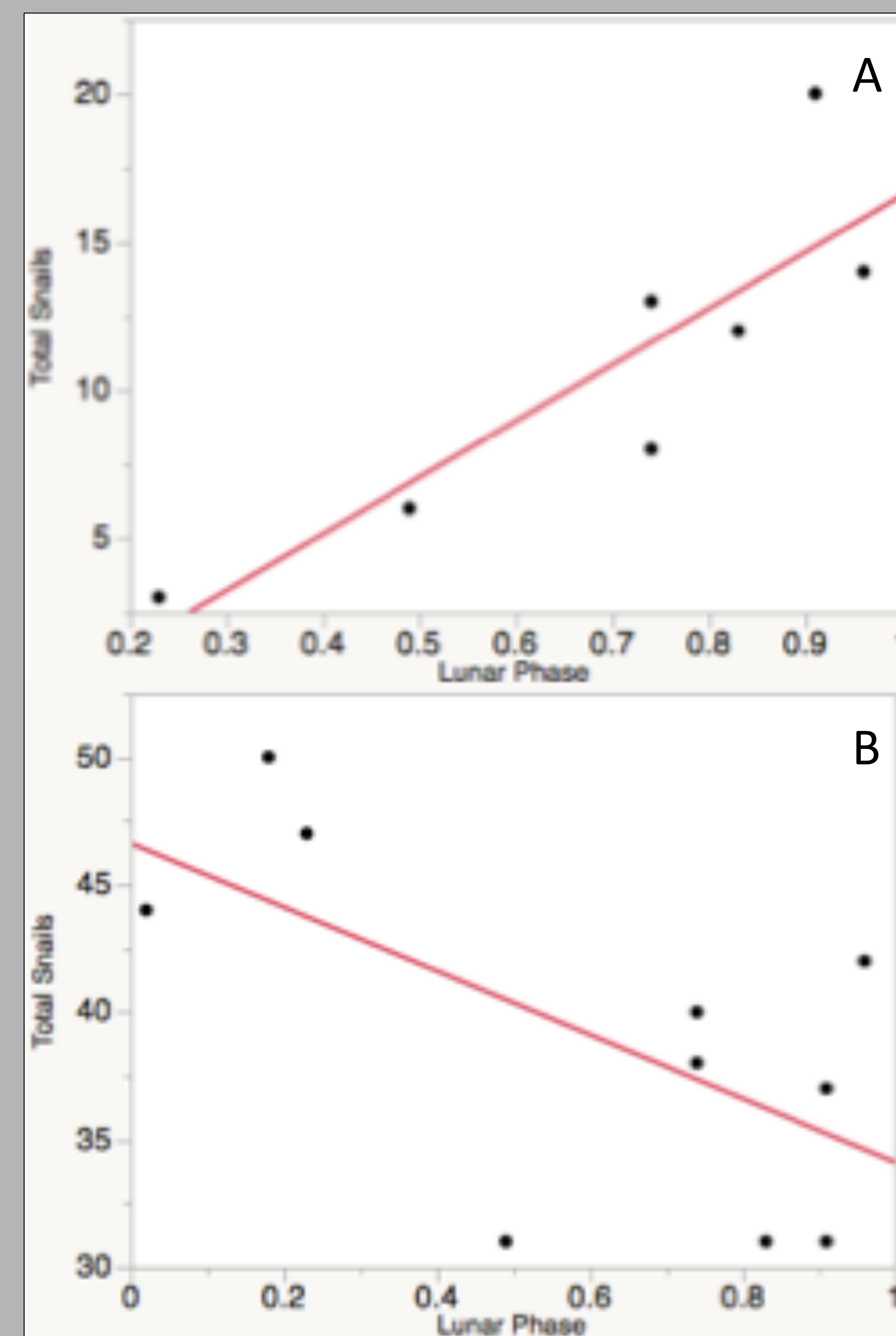


Figure 2. Total number of snails in (A) the Asco Tide Pool and on the (B) Shelf against lunar phase

Results and Discussion

Here we saw snail density was highest overall in our smallest tide pool furthest from the tide line ($p < 0.001$, Figure 1). However, Tide Pool 3 also had one of the lowest average return rates for marked snails (25.5%). So, where are the snails in that pool going? Is this high density site simply a stopover point for snails on the move? Dispersal is fundamental for periwinkle reproduction, making Tide Pool 3 a potential “oasis” while the deeper, cooler pools (Tide Pool 2 and “Asco”, both 17.7°C on average) with higher return rates (41.8%, 49.6%) may serve as more of a home base.

No abiotic factors appear to have influenced the number of snails copulating on any given day, but cloud cover and air temperature do affect how many snails are outside their pools and how far they are willing to go, with cooler temperatures leading to increased dispersal (Figure 3, $p = 0.018$ and $p = 0.024$). Lastly, lunar phase plays a large role in this phenomenon, with more snails present on the shelf during a full moon, but increased numbers of snails in pools under a new moon ($p = 0.048$).

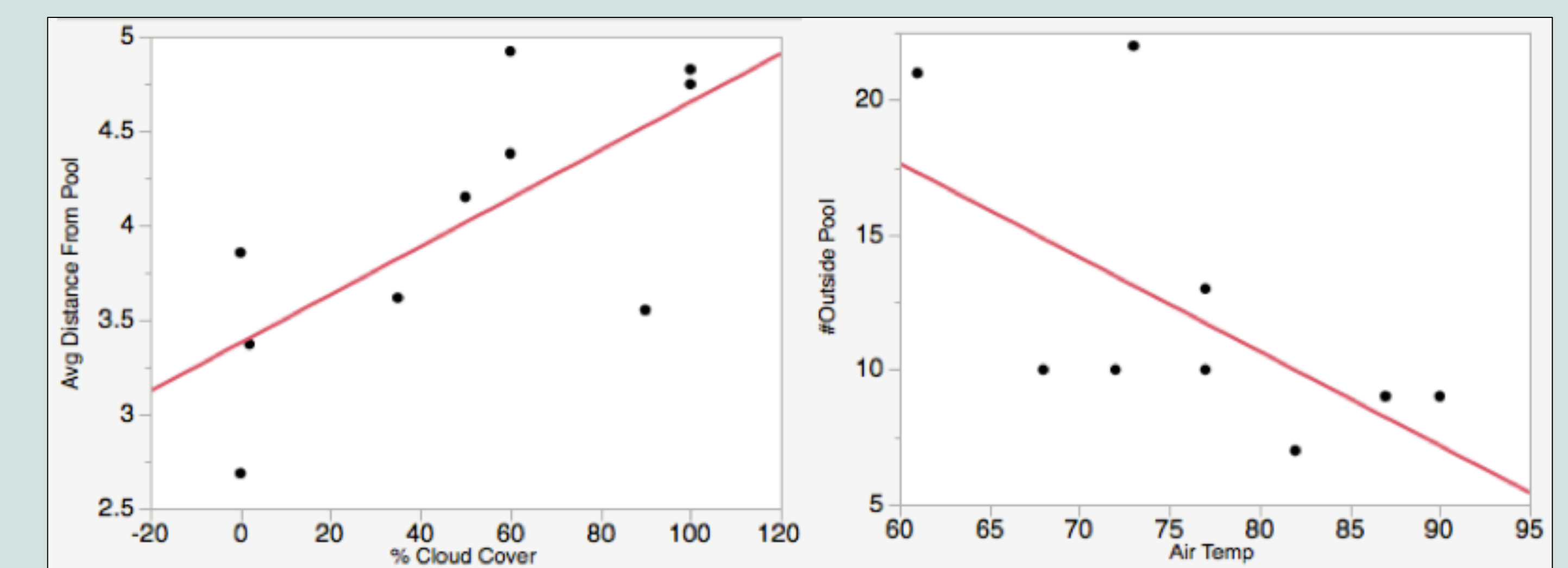


Figure 3. Average distance from pool with regard to cloud cover and the number of snails outside their pools vs. air temperature

Conclusions

Though none of our abiotic variables appear to have influenced snail behavior directly day-to-day, factors associated with temperature and lunar phase did have strong effects on where snails were most often and how willing they were to stray. Continued monitoring of snails across these sites will lead to a better understanding of periwinkle behavior and phenology in response to other abiotic factors associated with climate change across the seasons

Acknowledgements

Special thanks to Schoodic Institute and the National Park Service for permitting me this opportunity and to M. Roselli for her snail hunting prowess.