The Effects of Pollutants (zinc, lead, and aluminum) on Nerita Melanotragus and Water Quality

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Abstract

Past researchers have concluded that indicator species portray signs that give off vital information of the environment they live in: data concerning climate, pollution, resources. Nerita Melanotragus, or black Netrite snails were sentenced to an experiment in which a verdict could be made on the matter. Exploring the dangers of pollution in still water for wildlife remained the main goal of the experiment. In the past, scientists have observed odd behavior of species of snails in a natural climate: rivers, streams, etc. Asking the question, can black netrite snails be used as indicator species in a polluted environment, steered the execution in finding the answer. Three tanks, equally filled with the water and rocks from the same source the only difference across the tanks were the controlled variables: source of pollution in the form of pennies or aluminum or lack thereof for the remaining tank. Two snails to a tank were observed daily, weekly water tests calculating the amount of certain pollutants such as lead and copper were done at the closing of the experimental week (Saturday-Friday). My research can, perhaps save whole ecosystems. Inspiring further inquiry over the subject of indicator species to predict pollutants and other hazards in an ecosystem that would go unnoticed otherwise. The results going to families or big corporations involved with underwater ecosystems could benefit from the knowledge of the limitations of the essential organisms in their respective biospheres.

Introduction

Coins, foil, and other common metals can find their way to water. This water is part of an intricate ecosystem that needs it clean to keep healthy. Various studies on metal pollution and its effect on water have been conducted. Articles have been written on measuring, testing, and treating polluted water levels. Animal experiments have founded results on how water pollution affects them. To then be put together to answer a question: How does common metals affect water quality and inhabitants of the water?

In this study Snails will be used as a way to determine how the quality of the water affects their behavior. Research has been conducted to gather information on snails being used as indicators for water quality. The results concluded snails display a certain behavior that points to certain water quality levels. The scientists part of this study, included these behaviors, stating, “When toxicants are present in the water, snails may stop feeding, slough their tentacles, actively try to avoid the conditions by moving downstream” (Burris, Bamford, and Stewart 69). Understanding this behavior can assist in noticing the change in the snails used in this experiment. A study in the *Environmental Contamination Toxicology* journal, shows the mortality rate of aquatic animals under exposer of various metals including Copper, Zinc, and Cadmium. The scientists that conducted the study, M. A. Zyadah and T. E. Abdel-Baky, found each organism tested, had a set mortality rate under exposure of each metal; though, different from the organisms being used. The research based on this experiment will provide information of other organisms under similar conditions allowing comparison of the results. The article also provides an example of testing said organisms. In this particular study, “bioassays were performed to determine LC50 values” (Zyadah and Abdel-Baky 740). Using the results, combined with findings of other experiments with information on chemical/pollution removal in water, for example, it can be used as a starting point for this inquiry to find an answer.

The water quality index (WQI) is a useful tool in finding a simple single number to describe water quality. Various articles have been written on the topic of water testing materials; for example, “Surface Water (Lakes) Quality Assessment in Nagpur City (India) Based on Water Quality Index (WQI)” by P. J. Puri1, M.K.N. Yenkie, S.P. Sangal, N.V. Gandhare, G. B. Sarote and D. B. Dhanorkar, is an article based on the analysis of the WQI. In the article it was found that the WQI could be use a number of ways to get diverse results depending on what the body of water is. In the study previously mentioned the Index needed an assorted mix of water samples that where “analyzed for different physical, chemical and bacteriological parameters of water quality index (Electrical conductivity, TDS, Cl-, Total Hardness, BOD, DO, pH, Faecal Coliform)”(Puri, Yenkie, Sangal, and Gandhare 44). Another study featured in the International Journal of Science and Research, “Assessment of Water Quality Parameters: A Review” wrote on more parameters that go into the “grade” of water quality deduced from the WQI the measurement of chloride, alkalinity, turbidity, and temperature. Later in the article it was said that from there review the involved scientists found that “Water quality is dependent on the type of the pollutant added and the nature of self-purification of water” (Pawari and Gavande 1430). The facts gleaned from the two studies provide information and examples on ways to measure water quality. In this study where the water quality of the used water is the very thing being tested, this information is extremely helpful in finding an efficient way to extract a simple, single number in water quality results.

The removal of pollution in water is an important thing for organisms’ health as well as the well-being of the ecosystem of the polluted water. In a science journal article, Ali M Abdullah wrote on their findings with removing toxic metals like aluminum with a natural zeolite. They concluded that a number of factors increased the absorption rate including pH levels, saturation, temperature, and type of water (distilled). The experiment being conducted involves using metals from coins and aluminum from foil to uncover how it affects water quality. Knowing the factors of removal and ideal absorption conditions influence the amount of aluminum and conditions of the water in in this study. In the article it was noted that aluminum in water could harmfully affect humans with a possible “connection with Alzheimer’s diseases or dialysis encephalopathy” (Abdullah 1). This connection serves as a real-world reason to go over the affects have on humans, perhaps starting with a snail.

Learning more on the effects pollution has on environments is a step towards preventing water-borne diseases, like poisoning from the metals tested. The research mentioned is key information to providing reason for the reduction and removal of water pollution. The research on how water polluted by coins and foil will affect snails, will inspire deeper looks into the impact metal pollution in water has on humans. Knowing what works and what doesn't in the world of water pollution removal is valuable in the sense of progress.

The potential societal impact knowledge of metal toxicity in water has, is undeniable. Inspiration to better the world and its bodies of water will ignite once people of the earth know how, why, and where deadly water pollution is happening; hopefully, people will change their ways, and protect themselves. Not only does this research inspire society it sparks passion in scientists of the community to find effective ways to remove pollution, better solutions to problems that produce pollution, and ways to stop pollution from getting into water and then keep it from affecting the whole ecosystem as a whole.

Procedure

Nerita Melanotragus snails, or black nerite snails are freshwater bottom feeders that were explored in this experiment. Six in total, two to a tank, filled with equal parts water and aquarium rocks, were observed daily over a three-week period.

Data was collected each day for the snails and each week for the water. The water went through various tests of parameters shown in tables concerning water quality. Snails went under daily observation with notes being recorded to then be added to tables concerning snail behavior. Snail behavior like eating habits, movement, and whether or not they were active was focused on in their analysis.

The experiment in a day consisted of morning observation: which water level (lowest 0-4 highest) the snails were, the snails were then feed one tablet of bottom feeder, sinking food. Then, notes on the visible water quality were taken down. The last day of the week, at the end of the day, a water test was taken. A strip to a tank, was dunked into the water for approximately two seconds, shaken once and then laid flat on a surface. 30 seconds passed before the results were compare amongst the tanks and recorded into a table.

Results

Week 1

The first couple days of week one served as an adjustment period for the snails; they moved slow. Once adapted to their new environment, there was a lot of movement throughout the day, snails moving up and down through the levels, consistent among all the tanks. As the week passed, movement slowed; however, daily levels still varied: as the days progress the snails in the coin tank increase in level, as the days pass the snails in the foil tank are fluctuating, as the week comes to an end the snails in the water tank fluctuate. They never ate the whole tablet fed to them in the morning causing me to ask the question of whether I should keep feeding them daily or not. I decided eventually decided I would keep feeding them daily. Towards the end of the week, snails in the penny tank showed some odd behavior parallel to the research done on behavioral signs of distress in snails. They stayed at level 3.5 and not eating through the last days of the week. In the end, on the morning of day 7, both snails were discovered dead. Their underbellies look shrunken and pigmented red. The death leads me to believe pollutants from coins like copper and lead are more harmful or at least more rapidly deadly than the other explored pollutant or just water. behavior in the foil tank differs greatly indeed, they barley move (as did the rest of the snails), but the difference lie in their proximity with each other: they were nearly on top of each other for most of the week remaining in levels 2-3. The week ended with a water test. The water became noticeably murkier in all the tanks; nonetheless, the water test depicted mostly neutral results.

	Water tank	Foil tank	Coin tank
Location	**2-3 level**	**1-3.5 level**	**3-3.5**
Eating Habits	**don't eat much**	**don't eat much**	**don't eat much**
Moving Habits	**move slowly throughout the day movement getting less frequent**	**move slowly throughout the day movement getting less frequent**	**move slowly throughout the day movement getting less frequent**

Figure 1: week 1 results in snail behavior

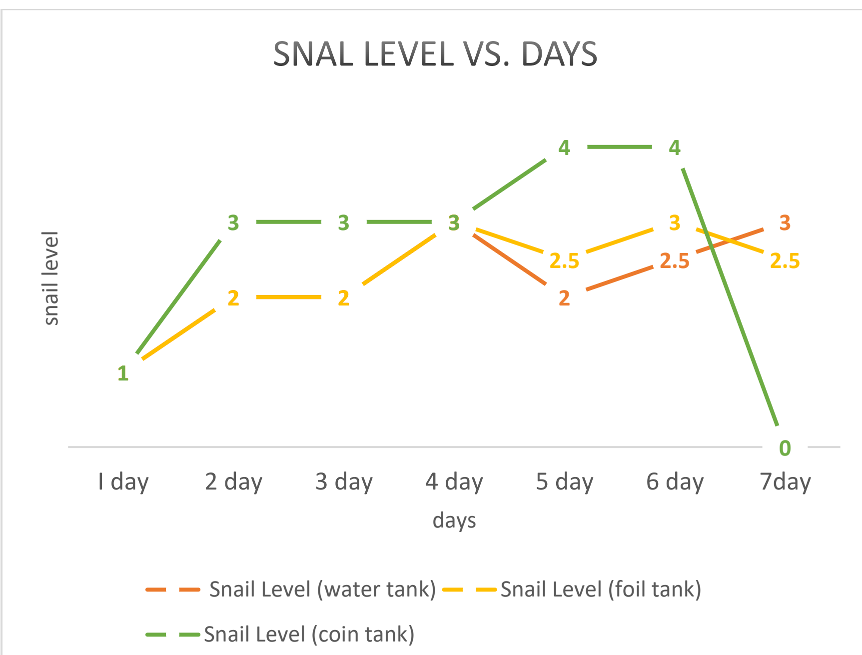

Figure 2: the average level of the snails in each tank throughout the first week

Week 2

The second week of this experiment imposed many questions. the snails apart of this experiment are appearing to slow in every aspect: eating and moving. Is there a reason for this slight change, if so, what could it be? Though they are slow, day to day, the water snails showed a lot of movement between levels but never below 2 or above 3. The water is murkier still. The foil tank showing much more grime than both. The water line in all of tanks seems to be going down. Why this is happening, I do not know. The results of the water test for week two shows little difference between the tanks, but there, nonetheless. The most surprising piece of data is the hardness for the penny sank. As well and the pH, carbonate, and total alkalinity, respectfully. The mentioned categories show the most divergence from both the water and foil tanks. This evidence could be helpful in the discovery of how much harm can be done to snails in pollution and/or still water.

	Water Tank	Foil Tank	Penny Tank
Location (level)	2-3	3	level 0 (dead)
eating habits	eats some of the pallet	eats some of pallet	no eating (dead)
moving habits	move daily	move daily	stay in one spot (dead)

Figure 3: week 2 snail behavior

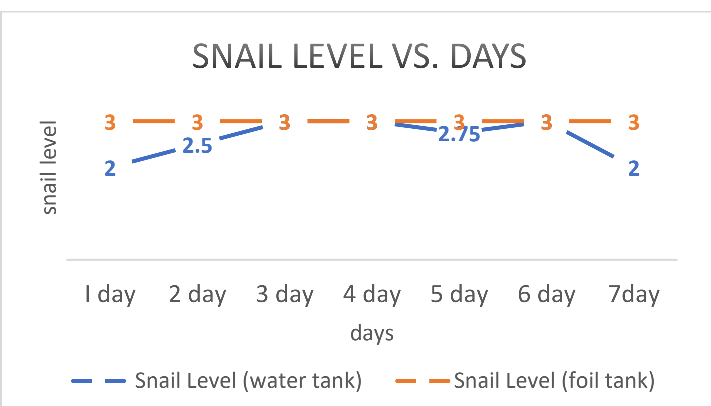

Figure 4: week 2 snail levels

	Water Tank	Foil Tank	Penny Tank
copper	0	0.5	3
hardness	50	50	250
pH	7.6	7.2	8.2
ammonium chloride	250	150	150
carbonate	80	120	240
total alkalinity	120	120	240
cyanuric acid	10	10	10
residual chlorine	0.5	0	0
lead	0	0	20

Figure 5: week 2 water test results

Week 3

the overall behavior of the snails over the third week suggests slower movement and more death, specifically to the snails in the water tank. On day 3 of the third week the two snails in the water tank died. Their deaths were very close together, in time and location. Them dying around the same time was similar to the snails in the penny tank. On the other hand, there are multiple key differences in between their deaths. For one, the underbellies of the snails in the plain water were white and had a bloated look. Secondly, they were in level 2 before their deaths. It seems to me the cause of death was different from that of the snails in the penny tank, but what could it be? Over the course of three weeks, it’s evident that there is much of the same behavior in the foil tank. The average level of the remaining snails keeps an overall consistent level; however, there is more differentiation between the three weeks. The most change, concerning water quality, over the past 3 weeks seems to come from the copper tank and its data on the amount of copper and lead. This is a giant increase from last week.

	Water Tank	Foil Tank	Penny Tank
copper	0	0.5	10+
hardness	50	50	120
pH	8.2	6.8	9
ammonium chloride	250	250	250
carbonate	120	40	240

total alkalinity	180	40	240
cyanuric acid	10	10	10
residual chlorine	0.5	0	0
lead	0	0	200

Diagram 6: week 3 water test results

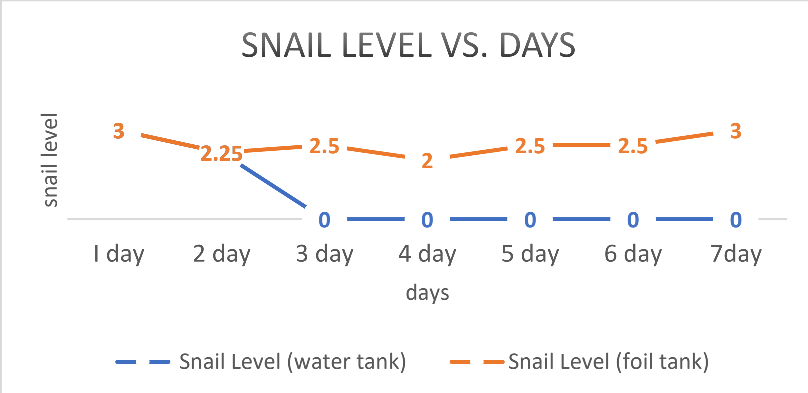

Diagram 7: week 3 snail level average per tank

	Water Tank	Foil Tank	Penny Tank
Location	level 0 (dead)	2-3.	level 0 (dead)
eating habits	no eating (dead)	eats some of pallet	no eating (dead)
moving habits	no movement (dead)	barely move from day to day	stay in one spot (dead)

Diagram 8: week three snail behavior

Overall conclusions

By conducting research on how different creatures can be used as indicator species, a warning of pollution could be easily caught in an ecosystem. Factors of that ecosystem like how much pollution is present, how long the creatures have been affected, getting a head start on clean up before further destruction is made.

If this experiment were to continue further observation on snails in foil tank for at least another week. The next step would be to conduct another trial with new snails, new water, new polluters (same type just not used), etc. Snails in penny tank showed evidence to supports the hypothesis in the affirmative: If snails are exposed to contaminated water, will they exhibit tell-tale behavior of death in comparison to snails in uncontaminated water? By conducting another trial more indepth exploration could be done to expand on the extent of how well snails can be used as indicator species.

The differences in the snails' behavior in the different tanks made me question much about their health. Though the snails in the penny tank showed signs of distress like staying above surface level, less eating, and no movement, snails in water tank still died but showed none of the same behavior. Surprising me further was the health of the snails in the foil tank. They outlived their counterparts the still exhibited movement, eating, and no consistent level. From these series of questions and discoveries it can be concluded that Black Netrite snails show changes in behavior when in distress by pollution emitted by pennies. There is also evidence to argue that still water, with no filtration is not the best habitat for these snails, the mix of food and waste in a settled environment with no movement

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