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Comparison in Decomposition Rates in Freshwater and Surface Environments

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Abstract

The goal of this study is to present observers with information of different forms of decomposition. We created a case where decomposition of two domestic pig heads will be observed over a 21-day period in freshwater and above ground in a wooded area in Yamhill County, Oregon. One head was placed outside in a 10-gallon aquarium with water from the Willamette River. The other freshly killed pig head was placed above ground in a live animal cage trap to keep animals from moving the carcass. We anticipate the carcass above ground will decompose at a faster rate because insects have easier access to colonize and the temperature of the exposed carcass will be higher. This research can be used to understand factors about decomposition in different environments ultimately helping estimate time since death.

Introduction

In this experiment we tested the decomposition rates in fresh water vs. on the surface with the purpose of determining which environment leads to quicker decay. Little research has been conducted on freshwater decomposition rates on human bodies. In most circumstances, postmortem changes to the body follow a similar pattern despite the environment. However, the changes occur at different rates. These changes are grouped into five different stages (Tersigni-Tarrant & Shirley, 2013). Forensic anthropologists typically generalize water decomposition rates at half the rate of open air decomposition. For example, a body in the water for two weeks will exhibit the same stage of decomposition as a body that has been in open air for one week (Aylers, 2010). The study aimed to answer two questions: 1) In which environment will the rate of decomposition be faster and 2) What will the differences in decomposition be, if any? The objectives of this research, therefore, were to compare and contrast decompositional rates between carrion in a freshwater environment and carrion outside in a wooded surface environment in the Pacific Northwest.

Materials & Methods

For this experiment we used the heads of two domestic pigs (*Sus scrofa*). The initial objective of the experiment changed slightly, therefore the pig heads were stored in water for five days and on the sixth day were moved to a wooded area in Yamhill County, Oregon. An animal trap was obtained for the surface variable pig head and placed approximately 1 foot away from the water variable. Decomposition, temperature, insect and animal activity was monitored daily for 21 days.

Results

Week 1 - (04/26/2018 – 05/02/2018)

The pig head submerged in freshwater was labeled number 1 and the pig head above ground labeled number 2. The average temperature the first week was 61°F and rainy. At this time, the discoloration and bloat (active decomposition) stages had occurred. Slippage, loosening of the skin, autolysis, the chemical process that results in the destruction of tissues by intracellular enzymes within an organism (Dupras, Schultz, Wheeler & Williams, 2012), and distention of tissues was visible in both carcasses. On day 3, carrion insects were present in pig head 2. As water evaporated from the tank, the ears of pig head 1 were slightly exposed to oxygen. This exposure caused livor mortis in the ears. Livor mortis is defined as hypostasis of the blood following death that causes a purplish red discoloration of the skin (Merriam-Webster, 2018). On day 4, pig head 2 had red bumps and a fuzzy white substance on the snout. The eyes were cloudy, large flies were present, maggot activity was visible in the mouth and there was a strong foul odor. By day 5, adipocere, wax-like insoluble fatty acids resulting from slow hydrolysis of the body's fat during decomposition (Dupras, Schultz, Wheeler & Williams, 2012), was present in pig head 1. A few flies and odor were present. Pig head 2 had started to turn red. Maggot activity was present in the eyes, ears and snout. The nostrils had a maggot mass. On day 7 there was a very strong foul odor coming from both carcasses. Pig head 1 was white with a wax-like appearance, the water was red and many flies were present. Pig head 2 also had heavy insect activity, the skin was hardened, the head appeared smaller in size, the eyes were white and the maggots were still active.

Week 2 - (05/03/18-05/09/18)

The average temperature for week 2 was 71°F and dry. On day 9, pig head 1 rotated 45° to the right leaving the left eye and side of the face exposed. There were signs of slippage and adipocere on the newly exposed tissue. It looked like there may have been animal activity in the area. Pig head 2 had many large blow flies present, there was an abundance of larvae and the eyes and skin were hardened and dry. It had a golden brown appearance due to the drying tissue. Active decomposition is a direct result of autolysis and putrefaction (Tersigni-Tarrant & Shirley, 2013). Throughout the week, the eye of pig head 1 started deteriorating and small flies were floating in the water and flying around. Maggots in pig head 2 were present in numerous stages of life. The carcass began to turn a translucent pink color, deflate, and wrinkle.

Week 3 - (5/10/18-5/16/18)

The weather for week 3 was dry and sunny with an average temperature of 74°F. On Day 18, livor mortis was present in the newly exposed tissue of pig head 1. The eye was completely gone. Our hypothesis was that it was removed by turkey vultures recently seen in the area. There have been small flies, but still no maggot activity in the water or the exposed tissue of pig head 1. The submerged tissue had a paste-like texture. The same day, pig head 2 had maggot masses in every orifice. The skin continued to shrink and harden. On day 19, the eyes, nose, ears and mouth of pig head 2 were black. There was a black residue on the ground under the carcass and a major reduction in the amount of blowfly larvae activity, as well as a migration of blowfly larvae away from the carcass. It has reached the advanced decomposition (initial skeletonization stage) (Tersigni-Tarrant & Shirley, 2013). Day 21 showed slippage and hardened skin in pig head 1. The eyes of pig head 2 were completely gone. The sockets were black and hardened with multiple small holes.

Conclusion

During the 21 days the pig heads were observed, pig head 1 showed signs of putrefaction, slippage and distention of tissues. It reached the third stage, bloat or active decomposition. The tissue submerged in water decomposed very slowly while any tissue exposed to oxygen began decomposing at a much faster rate. In pig head 2, we saw four stages of decomposition, ending with advanced decomposition (initial skeletonization). This process was congruent with textbook stages of decomposition. It was difficult to tell if carcasses submerged in water decompose at half the rate of carcasses in surface environments, however it was a noticeably slower process. Our hypothesis was correct that the surface environment exposure would decompose at a faster rate.

	PIG HEAD 1	PIG HEAD 2
WEEK 1	Fresh, Discoloration, Bloat (Active Decomposition), Slippage, Autolysis, Distention of tissue, Livor mortis, Odor, Insect activity, Adipocere	Discoloration, Bloat (Active Decomposition), Slippage, Autolysis, Distention of tissue, Livor mortis, Odor, Insect and maggot activity
WEEK 2	Active Decomposition	Active Decomposition
WEEK 3	Active Decomposition	Advanced Decomposition (Initial Skeletonization), Purging of body fluids

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Figure 1. *Sus scrofa* placed outside. One in 10 gallon aquarium with freshwater from Willamette River and one in an animal cage above ground.



Figure 2. Day 21- Freshwater *Sus scrofa* (pig head 1) stage 3 decomposition, surface *Sus scrofa* (pig head 2) stage 4 decomposition.



Figure 3. Day 1 - Superior view of pig head 1. Livor mortis on top of head where it was previously exposed to oxygen.



Figure 4. Day 21 - Superior view of pig head 1. Head has been rotated due to unknown reasons and left eye is missing. Suspected animal activity.



Figure 5. Day 1 - Anterior view of pig head 1.



Figure 6. Day 4 - Anterior view of pig head 1.



Figure 7. Day 21 - Superior view of pig head 2.