



ZOMBIE SURVIVAL GUIDE

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The “zombie” virus, commonly misconceived as originating first in West African voodoo during the seventeenth century, is actually believed to have existed as early as sixty thousand BCE (Table 1) amongst our predecessors *Australopithicenes* and *Homo erectus* (AIA, 2006). Hosts of this condition, also known as the *solanum virus*, experience a disconnection from the normal physiology of the brain, leading to a complete body reanimation into something undead like. In fact the term zombie stems from the Nzambi word ‘zombi’, meaning spirit of the dead (UM, 1999).

As population continues to grow, so do the threat of viruses. The reason for this is: the rate of transmission is directly correlated to population density. The zombie virus is transmitted through an exchange of body fluids between an infected host and a susceptible individual. The susceptible is now infected with the virus. It travels through the host body to the

frontal lobe. Where it uses this area of the body to multiply, destroying all brain cells in the replication process. The virus then simultaneously sends the victim into multisystem organ failure while mutating

Timeline of Known Prehistoric and Historic Zombie Outbreaks (Brooks, 2003)	
60,000 B.C.E.	Katanda, Central Africa
3000 B.C.E.	Hierakonpolis, Egypt
500 B.C.E.	Africa (reports from Hanno of Carthage)
329 B.C.E.	Afghanistan
212 B.C.E.	China
C.E. 121	Fanum Cocidi, Caledonia (Scotland)
C.E. 140-41	Thamugadi, Mumidia (Algeria)
C.E. 156	Castra Regina, Germania
C.E. 177	Tolosa, Aquitania (southwest France)
C.E. 700	Frisia (northern Holland)
C.E. 850	Saxony
C.E. 1073	Jerusalem
C.E. 1253	Fiskurhofn, Greenland
C.E. 1587	Roanoke Island, North Carolina

Table 1

the glia, suppliers of nutrients and oxygen in the brain, into anaerobic cells. With no functioning organs, no heart beat the infected is technically dead (Brooks, 2003).

The host will then awaken with the desire to feed on the flesh of living beings. Undead for the most part cannot communicate, rationalize or display signs of their former personality (ZombieHub, 2008).

Severing the spinal cord of a zombie is the only way to terminate it. This is most easily achieved through decapitation. Archeological digs have recovered many bodies separated from their skulls. In one instance four percent of the bodies found in a burial site were discovered decapitated. A partially decomposed corpse found in a tomb, tested positive for solanum. Over thousands of years descriptions, folklore, and art of cannibalistic, undead humans have enriched the history and escalated the belief in some form zombie (Friedman, 2007).

Planning Process

This model displays the realistic transmission rate of solanum across a dense population as well as highlights resourceful locations and safe routes based on the virus in order to increase the user's chance of survival.

*Zombie*₁:

Zombies are undead humans. Once an individual has become a zombie he or she may look like the person they once were. A zombie's appearance is merely a façade; that person is no longer alive. What the user is looking at in reality is a flesh eating animal. In this simulation the zombie will only infected susceptible target. They will be not removing them from the population. The infected have the same range of movements as their prey however lack comparable mobility. They have no conscious brain function. And because of this, zombies are restricted from doing activities like swimming, climbing,

₁ Designed especially for the purposes of this research project

driving, or even running for any extended amount of time. These zombies will remain within the extent of Tacoma, Washington.

*Solanum*¹:

As mentioned before, the solanum virus is passed from an infected individual to a susceptible human via the exchange of bodily fluids. It will transform that person into cannibalistic monster that seeks flesh of the living. Their viral transmittance rate is one human per hour. Additionally there is no current cure or vaccine against this agent. Solanum will spread across the population until all individuals have been infected.

Population:

The population of Tacoma was chosen for this project, based on the city's high population density, transportation routes, and the large metropolitan area. All of these reasons make this area one of the most dangerous places in Washington for an endemic to occur. The individuals, being hunted by zombies, will not fight back in this simulation. Additionally the susceptible population will be stationary, unlike the user of this map should be.

*Resourceful Locations*¹:

Resources are always a scarce commodity in times of crisis. Therefore the helpful locations, in this project, are displayed to increase the chances of surviving a zombie attack. They will be represented in this model, until the surrounding area is infected. After then these places will no longer be considered resourceful to the user.

¹ Designed especially for the purposes of this research project

Methods

This map has been designed, in ArcGIS, to help users survive an endemic zombie outbreak across Tacoma, Washington. The data needed to represent this infection began with the collection of a basemap, water, and road layer which were clipped, to show just the extent of Tacoma. Tax parcels were also brought in, for the purposes of digitizing resourceful locations.

Survival against the undead requires many supplies from places like grocery stores, gas stations, sporting goods stores, and many other places. To obtain these locations each parcel was selected, depending on the store type, and then exported as a resourceful location layer containing polygons. The polygons were then converted into points, to symbolize each as an icon rather than a parcel. The one other resource that did not involve parcels was places that have natural fresh water. All rivers, streams, lakes and ponds were taken from the water layer and exported as fresh water resources. These features will be crucial to surviving against the undead.

The zombie virus itself required a logistic function,

$$I(t) = \frac{P}{(1+Ae^{rt})} ; \quad \text{Where } A = \frac{P-P_0}{P_0}$$

to model the transmission rate of infection through a dense urban population. The variables to this equation, I =infected population, t =hour(s) after initial viral transmittance, p =susceptible (total) population, r =transmission rate of the zombie virus per hour, P_0 =susceptible population minus one, work together to show how quickly the zombie condition will spread through the susceptible population of Tacoma. At each hour after the initial infection, this function was analyzed in order to receive an output, $I(t)$ (fig. 1), of infected individuals.

Using ArcMap to model this infection, the total population was placed randomly around the city. An individual located in heart of downtown Tacoma was selected to be patient (zombie) zero. From this point the zombie will transmit solanum to one susceptible victim per hour, turning all of these individuals also into infectious, flesh hungry zombies (fig. 2).

Figure 1

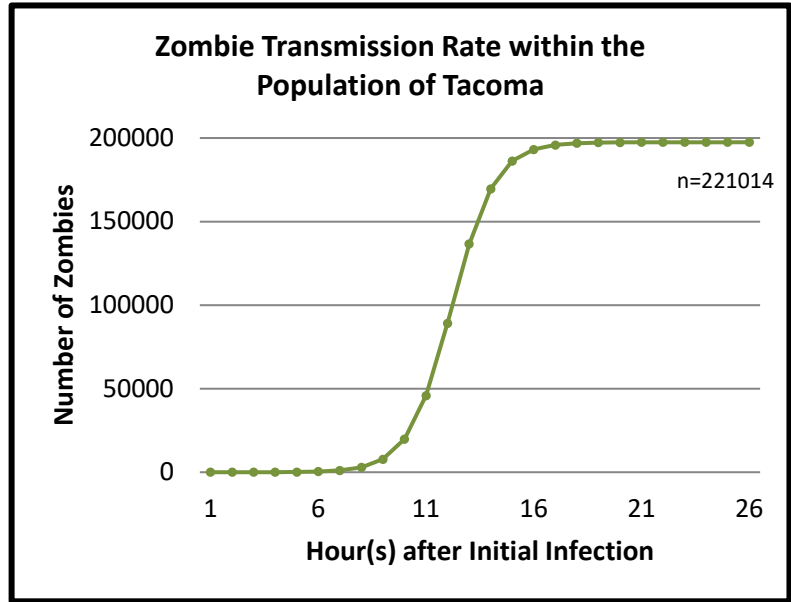
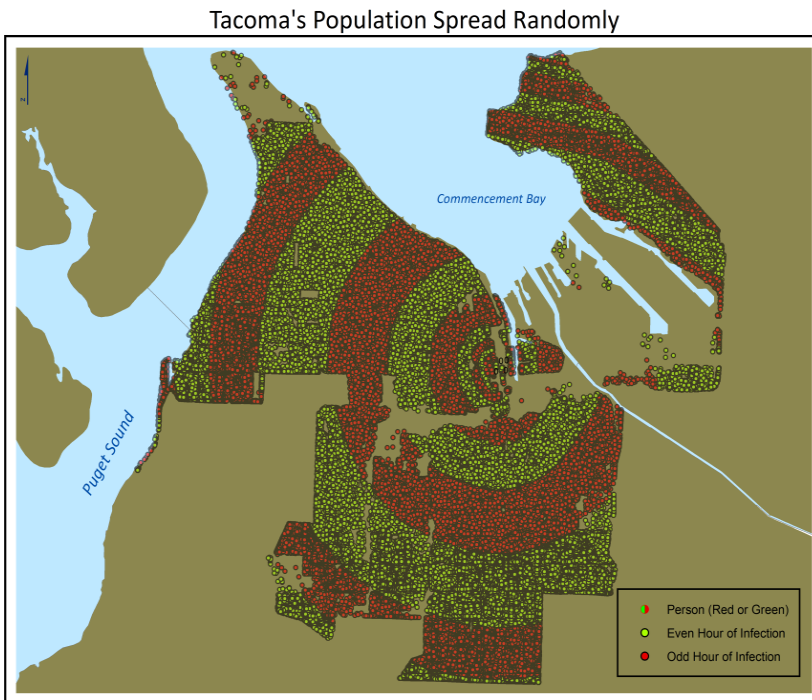


Figure 2

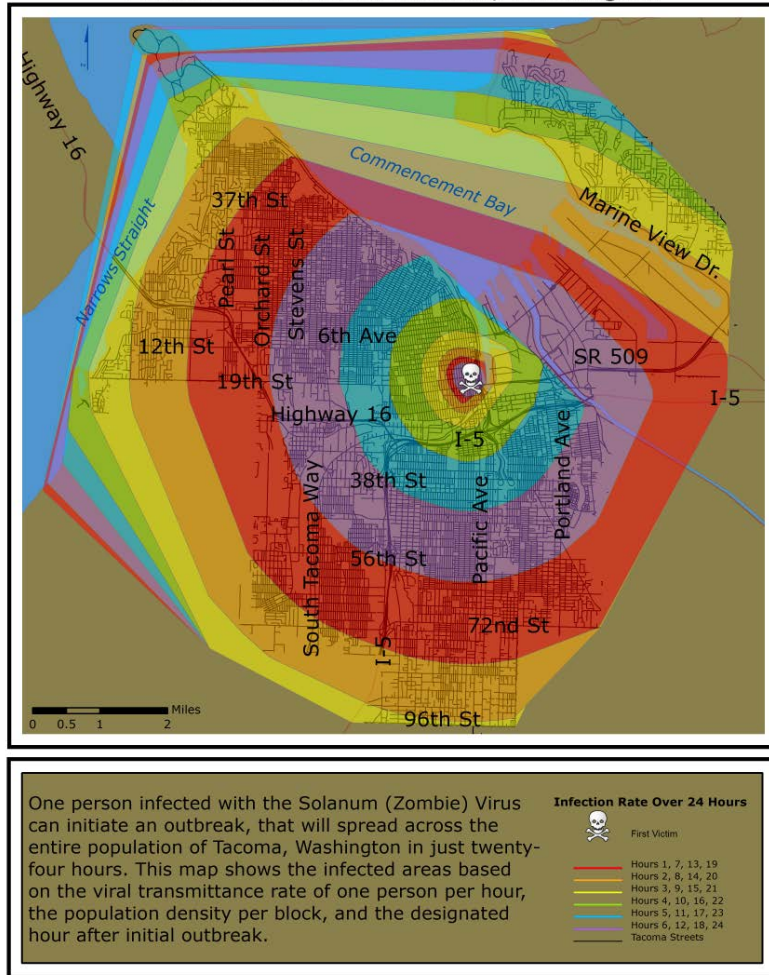


The people infected every hour increased exponentially over the first 18 hours, then slowed down until there was no one left susceptible. Each hour, represented by a different band of points was aggregated to form a polygon. The polygons, displayed over top of Tacoma, were used to show

the spread of zombies (much like the points in Figure 2). The reason for choosing polygons, over points (people), is that they visually opened up the map to explore the addition of survival resources.

Figure 3

Zombie Outbreak in Tacoma, Washington



As Tacoma becomes more and more over run by zombies areas of town will no longer be safe (fig. 3). The survival guides are most useful broken down into four, six hour intervals (fig. 4-7). The outbreak was overlaid onto a parcel map of Tacoma where streets and resourceful locations were also identified. These were the key elements needed to map a survival guide, which will assist any user in getting to resourceful areas in Tacoma, then hopefully to safety.

Figure 4

Initial Hours: One through Six

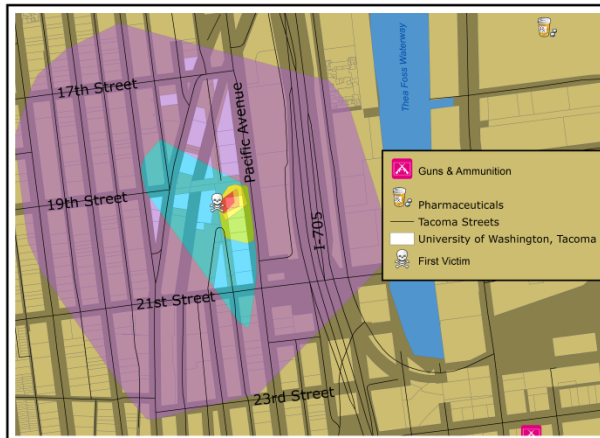


Figure 5

Hours: Seven Through Twelve

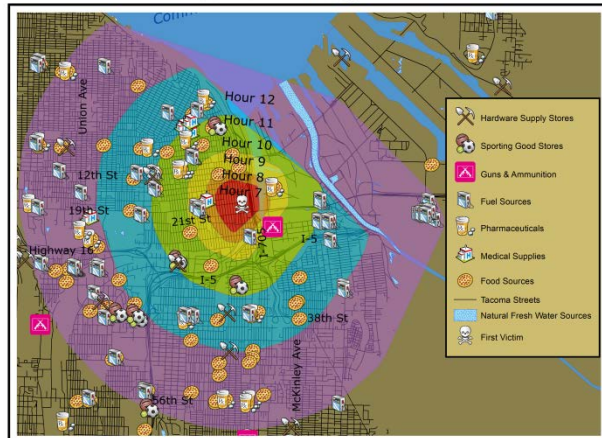


Figure 6

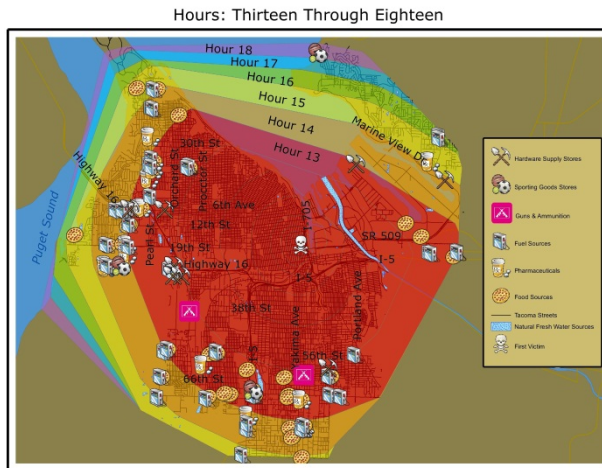
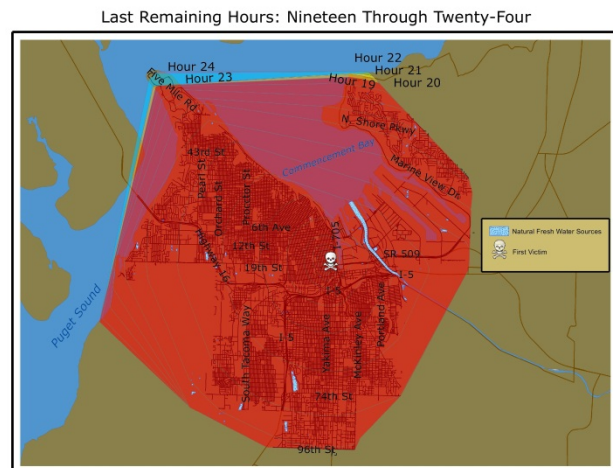


Figure 7



Results

Zombies, even with the mild infection rate of one person per hour, can take over an entire city in just one day. This simulation used a human at the University of Washington in downtown Tacoma, as the initiator of the outbreak and first zombie. This spot (represented by the skull and crossbones) served as the epicenter to what turned out to be an alarming infection rate.

With many layers involved in this survival guide, the results were challenging to visualize and hard to believe once it was. The logistics model showed that it would take twenty-six hours to overrun the whole town. The time it actually took, was two hours less; which in hindsight makes sense because it is the difference of one person. That one person [error] was most likely the human removed from the population initially to become the first zombie. Using the six hour interval maps (fig. 4-7) the survivalist can grab resources along their pathway to safety. As shown on *figure 6* most of the resources by hour fourteen will fall into infected territory. Being prepared before those hours arrive is a crucial for survival. The spreading of this model over twenty-four hours ended with removal of the last susceptible victims, in the Brown's Point and Point Defiance area. Should this scenario occur (population quarantined to

Tacoma) either of these locations would be ideal for the user to navigate to. Being surrounded by water in both final-hour locations is a great advantage. Remember, zombies cannot swim.

Recommendations

This simulation could have been more realistic in many ways. The epidemiology (logistic) function, used to spread the virus throughout the population of Tacoma, was very general. It only took into consideration two things the rate of transmittance and the population count of Tacoma. There are many Susceptible-Infected (SI) Models that would take into consideration the time to reanimate once infected, the odds of actually infecting a susceptible versus removing them all together, or even the environmental conditions in which this virus thrives. These models were not used because they required important data to be defined by hypothesizing in great detail how the solanum virus works.

A better SI model and more participatory data would have improved the simulation of this zombie outbreak. The parameters could have been more representative of their true nature. The integration of participatory data, like a purposefully placed population instead of a population randomly spread amongst Tacoma, would have benefited the validity of this model. However this would require learning about the flow of Tacoma's population in, out, and around town during a normal day. The susceptible population and zombies also would not normally be restricted within the boundaries of Tacoma. The susceptible population would do anything it could to defend itself including travelling outside the city limits and taking on the undead physically. This in turn would slow the rate of infection quite a bit.

Conclusion

Epidemiology models using GIS are very challenging to represent accurately at a city-wide scale.

Populations now are so large that viral outbreaks are actually a huge threat. This model wiped out the entire population of Tacoma in twenty-four hours and diminished almost all our resources in about half

that time. It is concerning and relieving that the Center for Disease Control has begun preparing for outbreaks like this one. They too have a survival guide, written to aid people trapped in a zombie pandemic (CDC, 2012). Knowing how quickly viruses can spread through a population and seeing how dangerous or contagious their hosts can be, will better prepare us for any viral outbreak-even zombies.

Citations

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