A NECRO-BIOLOGICAL EXPLANATION FOR THE FERMI PARADOX

Stephen R. Kane1 & Franck Zelziz2

1 Center for Global Extinction Pandemic Control, Subterranean Bunker 32, Union Square, San Francisco, USA
2 Planetary Defense Institute - Zombie Division, Chateau Morts-Vivants, Bordeaux, France

Submitted for publication in the Necronomicon

ABSTRACT

As we learn more about the frequency and size distribution of exoplanets, we are discovering that terrestrial planets are exceedingly common. The distribution of orbital periods in turn results in many of these planets being the occupants of the Habitable Zone of their host stars. Here we show that a conclusion of prevalent life in the universe presents a serious danger due to the risk of spreading Spontaneous Necro-Animation Psychosis (SNAP), or Zombie-ism. We quantify the extent of the danger posed to Earth through the use of the Zombie Drake Equation and show how this serves as a possible explanation for the Fermi Paradox. We demonstrate how to identify the resulting necro-signatures present in the atmospheres where a zombie apocalypse may have occurred so that the risk may be quantified. We further argue that it is a matter of planetary defense and security that we carefully monitor and catalog potential SNAP-contaminated planets in order to exclude contact with these worlds in a future space-faring era.

Subject headings: astrobiology – planetary systems – zombie apocalypse

1. INTRODUCTION

The detection of planets outside of our Solar System has opened up the possibility of answering several questions which have nagged the minds of philosophers for millennia. These questions include: Is the architecture of our Solar System typical or unusual? How common are planets the size of the Earth? How common is life in the universe? Exactly how many things are out there that can kill us? It is now apparent that the process of planet formation produces an enormous diversity of planetary systems. It is also clear from more recent discoveries, most notably those from the Kepler mission, that terrestrial-size planets are exceptionally common. The primary motivation for establishing such a correlation lies within the search for life exterior to our Solar System and thus determine if life is common. The fact that Earth-size planets are relatively common is surely good news for resolving this issue. This may be true, but a positive deduction that life is common may have a serious negative consequence.

The evolution of life on Earth has been accompanied by symbiotic relationships between animal species and the bacteria and viruses which use the animals as hosts. These occasionally result in destructive outcomes which have had a devastating impact on various populations of animals due to genetic breakdowns caused by the virus. Particularly lethal pandemics which have affected homosapiens in recent centuries include cholera, influenza, typhus, and smallpox. A more recent phenomenon which has been studied in great detail is that of Spontaneous Necro-Animation Psychosis (SNAP), often referred to as Zombie-ism. This highly contagious condition is particularly nefarious in so far as its use of the host itself to provide a mobile platform from which to consciously spread the condition. Detailed modeling of various SNAP outbreak scenarios by Munz et al. (2009) have shown that human civilization would not only be unlikely to survive such an event but would collapse remarkably quickly.

Here we discuss how recent exoplanet discoveries combined with studies of infectious diseases indicate that the universe may harbor reservoirs of planets full of biodecay remains where zombie apocalypses have occurred. In Section 2 we outline the dangerous nature of SNAP, quantify the possible numbers of SNAP-contaminated planets, and their proximity to Earth. In Section 3 we describe the decomposition process and the gases released. This process is then used to establish the resulting necro-signatures and their potential for identification in Section 4. The observing window for detecting such signatures is discussed in Section 5 and we provide the final sobering and terrifying conclusions in Section 6.

2. THE REALITY OF THE DANGER

Spontaneous Necro-Animation Psychosis is undoubtedly the most dangerous viral condition to infect living organisms. The infectious nature of the condition is maximized by bestowing upon the host an insatiable desire to spread the virus at all costs. This ensures that it will spread quickly and, usually, uncontrollably.

Although there have not yet been documented cases of SNAP outbreaks on Earth, the reality of the condition has been extensively depicted in both literature and cinema (Russell 2005; Vuckovic 2011; Kay 2012). The science of zombie-ism has been investigated and found a SNAP outbreak could equally result from both natural evolution and genetic engineering (Swain 2013). In either case, defense from such an outbreak has also been explored in great detail to maximize the survival probability (Brooks 2003, 2009). Even with such defenses, the global scale of the outbreak will rapidly break down any existing civilization. The novel “World War Z” depicts one such scenario although it presents an unlikely end result in which humans are able to recover, albeit at the brink of extinction (Brooks 2007). The work of Munz et al. (2009) more accurately quantifies the likely outcome of a complete extinction event occurring.

Although detecting the necro-signatures of worlds
where a zombie apocalypse has occurred, we can also estimate the number of worlds which are affected in this way. To accomplish this, we use a modified version of the well-known Drake Equation, the original of which takes the following form:

\[ N = R_* \times f_p \times n_e \times f_l \times f_i \times f_c \times L \]  
(1)

where the purpose is to calculate \( N \) which is the number of advanced civilizations in the galaxy with radio-communication capability. The other variables include \( R_* \) (average rate of star formation), \( f_p \) (fraction of stars with planets), \( n_e \) (average number of life-capable planets per star), \( f_l \) (fraction of planets with life), \( f_i \) (fraction of planets with intelligent life), \( f_c \) (fraction of civilizations that develop radio technology), and \( L \) (length of time such civilizations communicate). For a zombie outbreak to occur, there is no reason to a priori assume that intelligent life is required. Thus the modified Zombie Drake Equation is as follows:

\[ N_z = R_* \times f_p \times n_e \times f_l \times f_i \times f_z \]  
(2)

where \( N_z \) is the total number of SNAP-contaminated planets and \( f_z \) is the fraction of planets where an outbreak has utterly destroyed the local population.

There is strong evidence to suggest that the appearance of Earth-based life occurred at a very early stage of Earth’s history, probably at least as early as 3.9 billion years ago. This lends credence to the hypothesis that life is indeed a natural consequence of having suitable conditions, which is a terrestrial planet within the Habitable Zone of the star. Based on reasonable estimates of the frequency of terrestrial planets with such conditions, we use Equation 2 with a conservative \( f_z \) value of 10%. Shown in Figure 4 is a histogram of all stars within 100 parsecs of Earth based on data from the Hipparcos mission. The dark region shows an estimate of the distribution of nearby stars which could have a SNAP-contaminated planet based on the above assumptions. This would mean that there are more than 2,500 such systems within 100 parsecs of Earth. If that doesn’t scare the bejeezus out of you then you may need to check your pulse.

Furthermore, the projected frequency of SNAP planets explains a contradiction which has long troubled the proposition that intelligent life is common: the Fermi Paradox. This premise of the paradox is that the timescale for extraterrestrial civilizations to spread throughout the galaxy is small compared with stellar lifetimes and so we should have encountered our neighbors by now. Our work here shows the resolution of the paradox to be quite simple. The desolation of a civilization requires only that they encounter a case of SNAP during their exploration phase and their entire civilization will collapse. Let us not repeat history by rushing in to where our predecessors ought to have feared to tread.

3. DECOMPOSITION

Now that your trousers are presumably the appropriate shade of brown, we must determine how the SNAP planets may be detected remotely and thus avoided them like... well, the plague. To quantify this, we first need to identify what it is we are actually looking for. A defining outcome of a zombie apocalypse is the death of all animal life on the planetary surface. This will result in the transfer of a substantial fraction of the total biomass to the atmosphere through the process of decomposition.

All animals undergo similar stages of decomposition: Fresh, Bloat, Active Decay, Advanced Decay, and Dry remains. The primary decomposition stages during which the purging of gases and fluids occur are the Bloat and Active Decay stages. For Earth-based animals, the primary gases produced during this process are carbon dioxide, hydrogen sulfide, ammonia, and methane. The extent to which this translates into strong signatures within the planetary atmosphere depends on the relative mass of the biosphere being converted to these gases. Humans constitute roughly 350 million tonnes of terrestrial biomass with an additional 700 million tonnes available via domesticated animals. The cross contamination of SNAP for humans versus animals varies depending on the movie/literature source. Even if humans are the only species to succumb to such an infection, we can expect the levels of decomposition gases described above to at least double and probably increase by factors of several. Incidentally, the animal species on Earth with the highest biomass is Antarctic krill which apparently have natural selection all figured out. However, it’s unknown what a zombie apocalypse involving krill would look like and there is certainly a cinema niche awaiting any film director who would care to portray it.

4. DETECTING NECRO-SIGNATURES

The gases released by the decomposition process described above may be used to remotely detect the zombie afflicted worlds. In particular, the strong atmospheric presence of CO₂, H₂S, CH₄, and NH₃ will reveal those locations where massive amounts of death and decay have recently taken place. The strength of the respective signatures for these gases in emission and transmission spectra will vary greatly. The presence of increased levels of H₂S for example will have a relatively weak associated

© 2021 Stephen R. Kane & Franck Zelziz
signature. However, there are other atmospheric processes that occur as part of apocalypse-level decomposition that more than compensates and delivers an unambiguous necro-signature.

Figure 2 shows the spectral signatures associated with a zombie apocalypse on an Earth-like planet. The left panel shows the transmission spectrum that can be obtained by transit spectroscopy while the right panel shows the thermal emission of the planet that can be observed either by secondary eclipse spectroscopy or infrared nulling interferometry if the planet does not transit its host star. Two cases are compared to present Earth. One is a moderate SNAP with less than 10% of an Earth-sized human and animal biomass affected by the infection. This results in enhanced levels of some atmospheric gases: 2 PAL (Present Atmospheric Level) of CO₂, and 5 PAL of CH₄, N₂O and NH₃, due to the pufraction and disruption of the nitrogen cycle (known as the Savini effect). This also results in an increased greenhouse warming and a mean surface temperature of 296 K instead of 288 K on present Earth. We also modeled a major SNAP event, assuming a biomass twice the one on present Earth and a 90% infection. In this case, we find 4 PAL of CO₂, 20 PAL of CH₄, and 50 PAL N₂O and NH₃. Spectral features associated with all these species reveal the rise of zombies at a planetary scale.

If you detect a signature such as the one described above, here is what you should do. First, hyper-ventilate into a paper bag. Second, call the person who occupies your country’s highest office whilst screaming hysterically. Neither action will help the situation but it will make you feel like you’ve actually done something useful.

5. OBSERVING WINDOW

Due to the animation aspect of a zombie and its desire to infect others, the corpse is invariably exposed to the elements. Additionally, conflict between the zombies and those not yet infected will produce high temperature conditions. The combination of these two environmental effects will be to accelerate the rate of decomposition (see Section 4) and thus produce a relatively brief win-

![Diagram of thermal emission spectrum and transmission spectrum of an Earth-analog affected by SNAP.](image-url)
on Earth, this period of maximum amplitude will be proportionally longer. Removal of these gases from the atmosphere assumes absorption by liquid water oceans and other mineral chemical reactions. However, it is possible that a new equilibrium is reached by which the necro-signatures could persist for much longer.

6. CONCLUSIONS

We have shown that there is a significantly non-zero probability that in the search for life in the universe we will also encounter large amounts of undeath. Any person who has been exposed to even a relatively benign zombie film understands the threat posed by this heinous malady. This is not to be trifled with. Therefore the risk imposed of encountering a SNAP-contaminated planet cannot be overstated.

We have shown that the sign-posts for SNAP worlds are present and detectable in exoplanet atmospheres. We have also shown that these signatures may not persist for very long in the upper atmosphere which emphasizes the need for continuous observations. An extension of the necro-signature would be produced by worlds where advanced civilizations existed due to the considerable time required for the breakdown of the industry infrastructure left behind. One may well point out that there are numerous scenarios other than a zombie apocalypse that could equally quell all life on a planet. However, we argue that none of those scenarios are anywhere near as scary as being eaten by a zombie and so we justifiably ignore those other possibilities.

The best chance that we as a civilization has of preventing a future encounter with a zombie virus is to carefully monitor and catalog the SNAP-contaminated planets. Although this requires the dedicated use of the James Webb Space Telescope (JWST) to perform this task, this will likely be insufficient to meet the challenge of monitoring all stars with the needed signal-to-noise. Thus we strongly advocate the construction of a fleet of no fewer than 10 JWSTs with increased apertures (12 meters should do the trick!). These should be designed to also operate together as a nuller interferometer so they can survey non-transiting nearby exoplanets, which represent the main threat. Transiting planets are generally far away, and we can all agree that an undead neighbor is immensely more scary than a distant zombie. Whatever the course of action, we must actively strive to address the threat and to mitigate the risk of annihilation by an exoplanet zombie infection.

ACKNOWLEDGEMENTS

The authors would like to thank Vetter Brewery in Heidelberg for the hefeweizen-fueled stagger which inspired this work. Stephen would also like to thank Sean Raymond for not turning into a zombie and eating his office-mate Franck without whom this work would not have been possible.

REFERENCES

Brooks, M. 2003, “The Zombie Survival Guide: Complete Protection from the Living Dead”
Brooks, M. 2007, “World War Z: An Oral History of the Zombie War”
Brooks, M., 2009, “The Zombie Survival Guide: Recorded Attacks”
Kay, G. 2012, “Zombie Movies: The Ultimate Guide”, 2nd edition
Munz, P., Hudea, I., Imad, J., Smith, R.J. 2009, Infectious Disease Modelling Research Progress, pp. 133-150
Russell, J. 2005, “Book of the Dead: The Complete History of Zombie Cinema”
Swain, F. 2013, “How to Make a Zombie: The Real Life (and Death) Science of Reanimation and Mind Control”
Vuckovic, J. 2011, “Zombies!: An Illustrated History of the Undead”