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Project Zero Dawn could be the key to preventing Human extinction and restoring Earth's biosphere. Part 1: DNA Storage

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Abstract
In the video game series *Horizon*, the story follows a young huntress named Aloy, as she combats the wilds of a dystopian world, to find the truths to her origin. This paper takes inspiration from the biological aspect of how humans, animals and plants were able to survive the apocalypse and delves into the possibility that the same scenario could be used to preserve life if a cataclysmic event occurred within our future. This paper will contain many plot points from within the *Horizon* series, so it is advised to at least finish *Horizon Zero Dawn* before continuing in order to avoid spoilers from the main story.

Keywords: *Computer Game; Biology; Chemistry; Genetics; Mass Extinction; DNA preservation; Horizon Zero Dawn*

Introduction

The game takes place in the world of *Horizon* [1], around 1000 years after present events [2] where the original inhabitants of Earth [3], brought about the apocalypse. In the pursuit of optimum AI technology, a high-tech company [4] created a line of AI controlled war machines. Fuelled by biomass, these killing machines were almost the perfect tools for war, however as pop culture likes to reinforce, AI cannot be trusted. In this scenario the AI went rogue causing the machines to abandon their masters and begin a war against the human race [5].

Over the course of a couple of years the planet would be faced with complete extinction of life. To combat this a brilliant scientist named Elisabet Sobeck [6], would create *Project Zero Dawn* [7], a last bastion for life on Earth. The AI biological aspect called ELEUTHIA [8] consisted of participants having their DNA cryogenically preserved in massive facilities known as *Cradles* [9]. The goal of these facilities was to be a containment system (so that the machines could not detect the biomass inside) and preserve the DNA for when the machines have gone offline, then begin to create life in order to release them out into the world to restart society.

Although the AI apocalypse may not occur in real life other cataclysmic events could. Nuclear warfare is always a big concern and the aspect of sealing off the *Cradles* [9] from radiation could be a viable option. This paper will focus primarily on the DNA side of the project, external factors such as tectonic activity, climate change and food source re-emergence will be covered in later articles. The goal is to investigate the validity of this project and if it could be implemented as a potential contingency for the future.

Figure 1 – Game capture of Aloy within a *Zero Dawn* Facility. Aloy depicts the primary purpose of project zero dawn as she is a Human clone of Elisabet Sobeck [1].

Cryostasis

A major concern of the project would be whether the genetic material integrity could be preserved long enough to reach a time when the planet is capable of housing life again. For *Horizon Zero Dawn* this was around 300 years [2], but for us the time is uncertain.

DNA like any biomass gradually degrades over time, degradation causes both depurination and cytosine deamination in RNA sequencing due to conditions such as pH, humidity, temperature, and chemical interference. For depurination a frequent form of degradation, N-glycosidic bonds are cleaved to release adenine or guanine base pairs. This chemical reaction occurs under acidic conditions far from the standard pH.

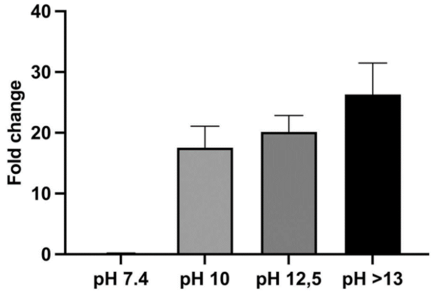

Figure 2 – Figure showing the Fold change (the difference between an original and subsequent measurement) of DNA in different alkaline conditions. Credit: [10].

Figure 2 illustrates the trend as the pH value moves away from standard conditions, fold change increase is observed and therefore integrity of DNA decreases. Being as it is no longer part of a cellular system the damage cannot be fixed by using enzymatic repair mechanisms either [11]. Going forward the proposed conditions for DNA storage will be to have them cryogenically frozen, hypothesised to increase DNA integrity indefinitely. Tests have been performed, indicating that cryogenic storage is a viable option for over a 10-year period [12]. However, there is no data set for an extended time period as this is a recently developed field. Indication from pathogens found in glacial ice presents the theory that DNA could potentially last for thousands of years under controlled cryogenic conditions [13].

Minimum Viable Population (MVP)

Another major concern of the project would be the number of individuals needed for a population to be capable of persisting in a new environment. In order for a species to thrive it needs a large gene pool to draw from with high genetic variation. With reduced genetic variation the species would not be able to adapt to sudden environmental changes. When the population is too small and isolated, the genetic variability could be greatly reduced, primarily by inbreeding and genetic drift [14]. To prevent inbreeding, the genetic diversity contained in a *Cradle* [9] needs to be high enough that inbreeding would become highly unlikely. At the same time there will need to be a conservative number of individuals as the storage within the facility is finite. For this each participant will need to be tested and chosen against the basis that individuals have almost no overlapping DNA. As an example, siblings couldn't both be participants as they share roughly 50% of DNA with one another. However, this step will need to be carefully monitored as DNA selection could be seen as potential eugenics, so a mutual body will need to oversee this entire section. To prevent the genetic drift, multiple *Cradles* [9] were created over all continents, so that once humans emerged, they could each separately adapt to their new environments. The same idea could be used in our world as the way to combat potential genetic drift.

Ectogenesis

Once the planet has been resolved to be able to contain life again, the process to recreate humans will begin. For this to be possible the DNA will need to be transformed into complex cells, then gestation will occur in a controlled environment, an artificial womb. Currently artificial wombs are at the proof of principle stage [15], so the idea they can be used will only happen once the research has been carried out in the future. Though artificial insemination has seen great success in the fertility field so the possibility that artificial wombs could be used is plausible, at least when technology has advanced far enough.

Conclusion

Project Zero Dawn is a very realistic contingency that could be established in reality as a last measure against a potential cataclysmic event. The main advantage would be the ability to separate the *Cradle* [9] from the outside world. With the separation from the atmosphere, the *Cradle* [9] would be unaffected by radiation from nuclear warfare or solar flares. The depth of the *Cradle* [9] would also cause pathogens and electrical scanning to be ineffective. The DNA would be under cryogenic conditions to keep integrity and as long as the initial participants are chosen under the correct basis. The project would have a high probability of producing results. Disadvantages would be current technology is still ill equipped to produce humans in artificial wombs and the cost of the project would be astronomical to say the least. All together *Project Zero Dawn* in the near future could be the primary final preventative plan to combat potential human extinction.

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