

## How Many Rounds Would it Take to Complete Call of Duty: World at War Nazi Zombies?

Luke Willcocks & Mark Inch

*The Centre for Interdisciplinary Science, University of Leicester*

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### Abstract

Call of Duty: World at War (hereafter CoD:WaW) was the first of the franchise to release the mini-game Nazi Zombies; the aim of the game being to survive by killing hordes of oncoming zombies through a progression of rounds. As the rounds progress, higher numbers of zombies with increasing Health Points (HP) spawn each round. The aim of this paper is to calculate the number of rounds it would take for one player to kill a number of zombies equal to the number of soldiers in the German army during World War II (WWII), as well as to show the zombies' effect on allied resources, specifically ammunition. It was concluded that a single person would have to last 2648 rounds in order to kill 12.5 million Nazi zombies, and that the resources required would be so large that killing all these zombies would be impossible.

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### Introduction

In this paper it is assumed that the entire German army from WWII are zombies. During this time the number of soldiers in the German army was approximately 12.5 million, therefore this is the maximum number of zombies present [1]. Data was collected on the zombies map Der Reise, on CoD:WaW. The number of bullets required to kill a zombie in the final round was then calculated using the PTRS-41 and the HP of zombies per round. The PTRS-41 was used as it is a bolt action anti-tank sniper rifle and thus is an extremely powerful weapon.

### Number of rounds

In order to determine the number of rounds required to destroy the 12.5 million zombies, the zombie progression per round was examined. The CoD series rose in popularity around the release of Modern Warfare 2 and Black Ops. As a result, the zombie progressions in Black Ops onwards have already been researched. However, these progressions have changed from that used in the original CoD:WaW, which must be used, as it is the only game with Nazi zombies taking place during WWII. Independent data was collected during which 1 person would last on their own past round 10. This is because rounds 1-9 are introductory rounds; past round 10 the difficulty increases and has a different progression than previously. Over a course of 6 attempts; data was

collected and plotted for the round and the number of zombies in that round:

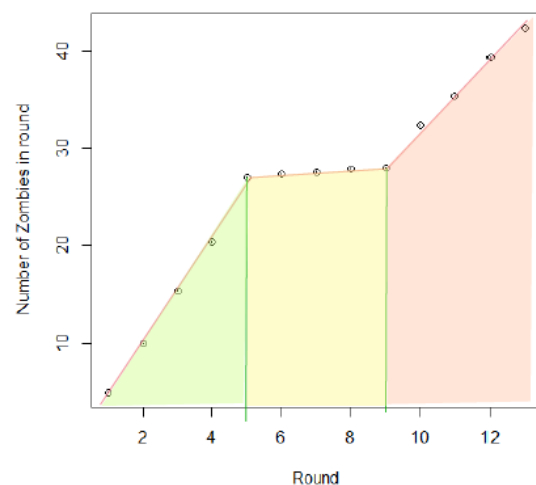


Figure 1 - Graph illustrating the number of zombies per round

As the data in Figure 1 was collected by both authors through multiple attempts, there was error in the number of zombies per round. The differences in collection was most likely due to human error; these differences were averaged and the error was calculated. These errors were plotted on Figure 1 but are too small to be seen. Figure 1 shows 3 distinct progressions during Nazi zombies. The first 5 rounds have an increasing number of zombies starting from 5 and increasing at approximately 5 per round. From

round 5-9 the progression plateaus at approximately 28 zombies per round. From round 9 onward the number of zombies progressed with rate  $3.57x - 3.77$  where  $x$  is the number of rounds. In order to find the number of rounds needed to kill all Nazi zombies, the area under the graph equation needs to be calculated. This will equal the total number of zombies i.e. 12.5 million.

$$12\,500\,000 = \int_1^9 f(x) + \int_9^d g(x) \quad (1)$$

Where the integral of  $f(x)$  is the total number of zombies in rounds 1-9, and the integral of  $g(x)$  from round 9 to  $d$  is the total number of zombies from round 9 onwards and  $d$  is the round in which 12.5 million zombies would have been killed. Therefore, the integral of  $f(x)$  can be taken straight from the raw data or Figure 1 and is equal to 160.33. Replacing  $g(x)$  with the equation of the line previously mentioned, Equation 1 becomes:

$$12\,500\,000 = 160.33 + \int_9^d 3.57x - 3.77$$

$$\begin{aligned} 12\,499\,839.667 &= [1.785x^2 - 3.77x]_9^d \\ &= (1.785d^2 - 3.77d) \\ &\quad - (1.785(9)^2 - 3.77(9)) \end{aligned}$$

$$1.785d^2 - 3.77d - 12\,499\,950.32 = 0$$

$$d = 2648 \text{ and } d = -2646$$

As the rounds cannot be negative, the round at which 12.5 million Nazi zombies would be killed, and thus CoD Nazi zombies would be completed, is round 2648. However, this assumes  $g(x)$  stays constant from round 9 to 2648 which might be incorrect but it cannot be measured directly.

### Number of bullets

Since the round at which the German army is considered beaten is 2648, the number of bullets required in each round can be calculated. The HP of a zombie increases per round, which could be due to multiple factors. One factor could reflect decay i.e. the zombies in early rounds (lower HP) could have undergone decomposition for a longer period of time due to being dead for longer. Secondly, it is never stated what type of zombies these are e.g. viral, bacterial or fungal. Specifically if these were fungal zombies, the build-up of fungus could give extra protection increasing the HP of zombies.

The HP of the zombies from round 1 to 9 increases by 100 points per round, starting at 150 [2], but from round 10 onward the HP is multiplied by 1.1 for each round, giving a geometric series [2].

$$\begin{aligned} HP &= ar^{n-1} = (950) \times 1.10^{2639} \\ HP &= 1.63 \times 10^{112} \end{aligned} \quad (2)$$

For the geometric progression in Equation 2,  $a$  is the health on the round that starts the equalling 950,  $r$  is the value by which the health is multiplied by each round found to be 1.1 [2]. Lastly,  $n$  is the number of rounds until the final round, this is the 2648 minus the 8 rounds that come before this geometric series.

Therefore, as shown in Equation 2 the health of one zombie in the last round is  $1.63 \times 10^{112}$ . This is a huge value for the health of a zombie and can be illustrated by showing how many bullets would be required to kill the zombie. Assuming the zombie was shot in the head with a PTRS-41 with each bullet hitting, the damage applied would be 3000 per hit [3]. Therefore, the number of bullets needed is:

$$\text{Number of bullets} = \frac{1.63 \times 10^{112}}{3000} = 5.44 \times 10^{108}$$

Then, as the average bullet weighs approximately 0.07kg, the mass of bullets required equates to  $3.81 \times 10^{107}$  kg [4]. Therefore, to kill just one Nazi zombie in the final round you would need a mass of bullets far greater than the mass of the sun,  $1.99 \times 10^{30}$ kg [5]. This would be impossible to produce thus if this had occurred in real life the Allied forces would have become overwhelmed. Most likely, the outcome would be that the Earth would be populated with zombies.

### Conclusion

In summation, in order to kill the number of zombies equal to the number of soldiers in the German army, round 2648 would need to be reached on CoD Nazi zombies. However this would be impossible in real life due to vast zombie HP increases. The HP increases to point at which in the final round,  $3.81 \times 10^{107}$ kg of PTRS-41 ammunition would be required to kill a zombie. This would lead to allied forces becoming overwhelmed, as this is an amount of resources they did not have access to and thus the Earth having been overrun.

## References

- [1] Simkin, J. (2014) *The German Army in the Second World War*. Spartacus Educational. [Online]. Available: <http://spartacus-educational.com/2WWgermanA.htm> [Accessed 12 February 2017].
- [2] littoblond (2009) *Weapon Damage and Health for Nazi Zombies*, Call of Duty World at War Forum, 2 March 2009. [Online]. Available: <https://community.callofduty.com/t5/Call-of-Duty-World-at-War-Forum/WEAPON-DAMAGE-AND-HEALTH-FOR-NAZI-ZOMBIES/td-p/345002>. [Accessed 19 February 2017].
- [3] Call of Duty Wikia (2009) *PTRS-41*, 6 June 2009 . [Online]. Available: <http://callofduty.wikia.com/wiki/PTRS-41>. [Accessed 2 February 2017].
- [4] Committee on Scientific Assessment of Bullet Lead Elemental Composition Comparison, Board on Chemical Sciences and Technology, (2004) *Chapter 4 Interpretation*, in *Forensic Analysis: Weighing Bullet Lead Evidence*, Washington D.C., The National Academy Press.
- [5] Williams, D. (2016) *Sun Fact Sheet*, 16 December 2016. [Online]. Available: <http://nssdc.gsfc.nasa.gov/planetary/factsheet/sunfact.html>. [Accessed 19 February 2017].