Modeling the population dynamics of a human Mars colony in the event of catastrophe

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Introduction

If humans needed to move to Mars, what factors would affect population size, and how would the population change?

What is Catastrophe?

- Dramatically reduces the human population on Earth
- Limits access to basic needs[1]

Mars as an Alternative

- Humans could colonize Mars if Earth was no longer viable

Figure 1. NASA's Curiosity rover on Mars.[2]

Challenges

a) Cost and technology
b) Cold temperatures
c) Limited atmosphere
d) Solar radiation and solar wind
e) Substrate is not fit for farming

Figure 2. Artistic rendering of what a future Mars colony could look like. [3]

Methods

- Models estimate changes in populations over time
- Based on logistic growth model
- c is probability that a catastrophic event will occur

Dispersal: leaving a source population, traveling across a distance, and inhabiting a new location.[4]

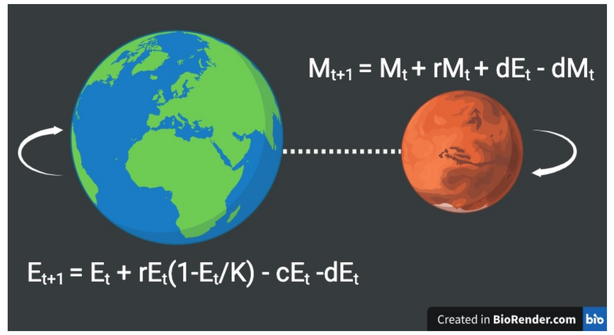

Figure 3. Diagram of Earth and Mars dispersal featuring equations used for population modeling.[5]

Results

Earth

Low Disturbance | Moderate Disturbance | High Disturbance

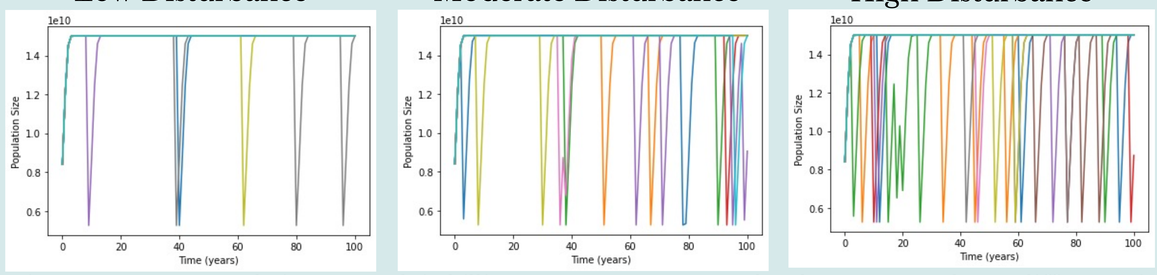

Figure 4. Human population on Earth in billions across 100 years. Each color corresponds to a different trial (10 trials total), K = 1.5*1010. c = 0.005, c = 0.015, c = 0.03, respectively.

Mars

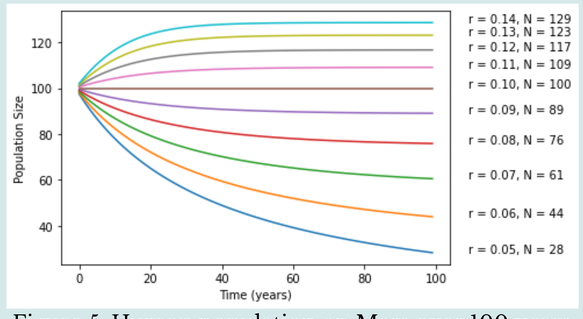

Figure 5. Human population on Mars over 100 years. Each color corresponds to a different reproduction rate. Reproduction rates over 0.10 resulted in an increase in population size.

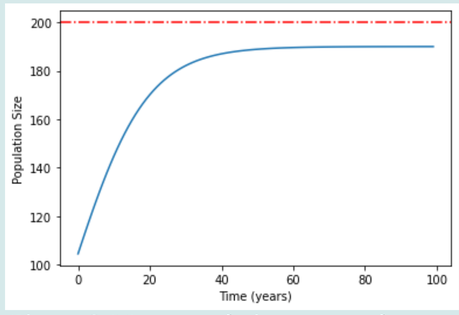

Figure 6. Mars population approaches carrying capacity when r = 0.10 and dispersal from Earth to Mars is positive.

Discussion

- In a catastrophe scenario, dispersal to Mars would be minimal
- Population on Mars strongly depends on reproduction rate
- Work on Mars should start long before catastrophe occurs
- A colony on the Moon would be more feasible in a critical situation

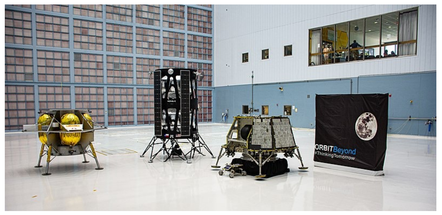

Figure 7. Three landing systems of the NASA Artemis Missions, which will establish infrastructure on the Moon with corporate partners. [6]

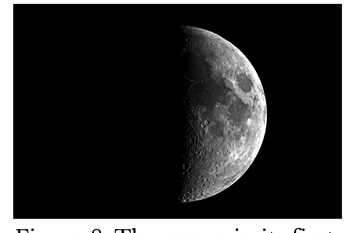

Figure 8. The moon in its first quarter phase.[7]

Sources/Acknowledgements

1. Servigne, P., & Stephens, R. (2020). *How Everything Could Collapse: A Manual for our* Times. John Wiley & Sons.
2. https://www.nasa.gov/centers-and-facilities/jpl/nasas-curiosity-takes-selfie-with-mary-anning-on-the-red-planet/
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4. Jordano, P. (2017). What is long-distance dispersal? And a taxonomy of dispersal events. Journal of Ecology, 105(1), 75–84. https://doi.org/10.1111/1365-2745.12690
5. Figure made using biorender.com
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7. Image taken using Slooh Community Observatory, slooh.com

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