

Long Term Shelters to Avoid Humanity Extinction

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Giant asteroid threat

Long warning time => Moon/mars settlement

Greatest threat: Long period comet

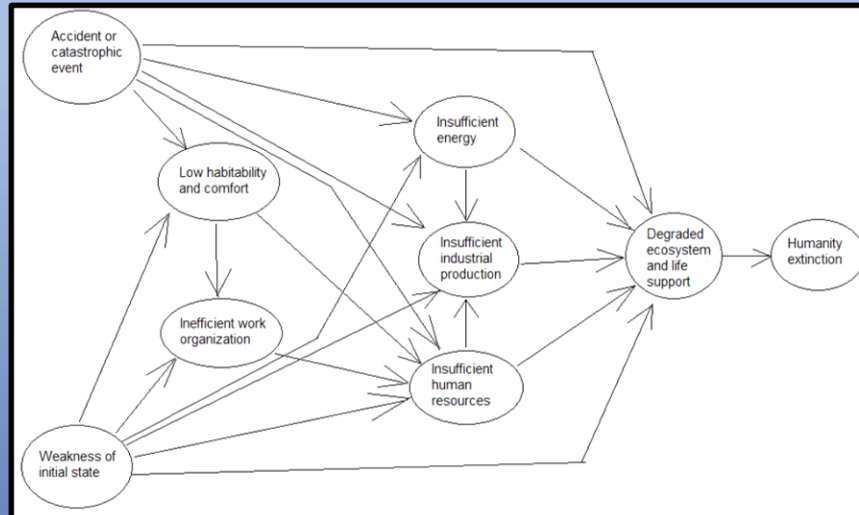
- Size: > 100 km in diameter
- Warning time: 5 years!!!
- Probability: 2.2×10^{-12} for the next century

Environmental impact:

- Giant crater, terrific fireball and air blast.
- Tremendous amounts of "shooting stars".
- Fires everywhere, all around the world.
- Temperatures above 200°C.
- Oceans boiling.
- Thick dust clouds, sun completely hidden.
- All life forms close to surface eliminated.
- Several decades of unlivable conditions.
- Slow decrease of temperatures.

Only solution:

Long Term Shelter, waiting decades underground



Minimum human working capacity condition:

$$\sum_{i=1}^{i=k_1} \frac{r(a_{1,i})}{s(a_{1,i},n)} + \sum_{i=1}^{i=k_2} \frac{r(a_{2,i})}{s(a_{2,i},n)} + \sum_{i=1}^{i=k_3} \frac{r(a_{3,i})}{s(a_{3,i},n)} + \sum_{i=1}^{i=k_4} \frac{r(a_{4,i})}{s(a_{4,i},n)} + \sum_{i=1}^{i=k_5} \frac{r(a_{5,i})}{s(a_{5,i},n)} < 2740h$$

Where:

- $r(a_{j,i})$ is the individual annual working time requirement to run activity i in domain d_j .

- $s(a_{j,i}, n)$ is the sharing factor for activity $a_{j,i}$ with n the number of individuals (see ref.)

- k_1 to k_5 are the number of activities for domains d_1 to d_5 .

- 2740 h: available annual working time;

Ref.: Salotti, J. M. Minimum Number of Settlers for Survival on Another Planet. Sci Rep 10, 9700 (2020).

<https://doi.org/10.1038/s41598-020-66740-0>

Long Term Shelters category A:

Lots of resources, low autonomy
=> limited lifetime => risky

Long Term Shelters category B:

Energy, life support, industry,
human resources OK,
But insufficient redundancy
=> will certainly fail

Long term shelters category C:

Triple redundancy principle, including
human resources (see equation)
Might be appropriate

Problems:

- Specifications unclear
 - No time for tests / simulations
 - No time for big excavations and complex systems
- ⇒ Might be unfeasible

Conclusion:

⇒ High risk of humanity extinction