1 Introduction

- Biological robustness is an important method for organisms to maintain its function facing complex environments, while biological fragility is just the opposite. Both robustness and fragility affect the survival of individuals and ecosystem. This essay will explore a few solutions to combat biological fragility to avoid potential threats as much as possible.

2 Biological Robustness and Fragility

- Biological robustness refers to the ability of an organism or system to maintain its function in the face of perturbations or disturbances(1); Biological fragility refers to the susceptibility of an organism or system to failure or collapse when exposed to perturbations or disturbances.
- A vivid example of biological robustness is that when faced alien invasion, vertebrates can detect and eliminate these potential threats in time through the immune system to maintain the stable operation of biological systems(2). A typical example of biological fragility is monogenic genetic disease, such as phenylketonuria(3). In the complex and huge gene pool of human beings, insignificant single-segment gene mutations may even cause serious diseases in biological systems. This indicates the fragility of biological system to some extent.

3 Biological Robustness is an Integral Part of Survival

- Biological robustness has manifested itself as an indispensable part of survival. For one thing, biological robustness enables organisms to adapt and thrive in changing environments(4). Biological systems will face complex external or internal environment changes (i.e., morning and evening temperature changes, hormone concentration changes, etc.), organisms do not need to maintain all conditions at an extremely stable level all the time. For example, an animal's survival does not require the exact amount of food it consumes every moment to maintain an extremely constant blood sugar level. This is the role of robustness in maintaining the stability of biological systems, making it more possible for organisms to survive and adapt to changing environments.
- Meanwhile, robustness is only one of the necessary conditions for survival. It is the result of the continuous evolution of organisms and is a long-term process(1). Biological systems need to develop other means to ensure that their systems remain within the tolerance range of robustness.
- For another thing, biological robustness promotes biodiversity(5) as organisms that are robust to different conditions can inhabit different niches, thus promoting ecosystem stability and resilience. For the whole ecosystem, individuals can inhabit different niches because of the robustness of individual organisms. This promotes biodiversity and has a positive effect on the stability of the entire ecosystem. Individuals are more likely to survive in a stable ecosystem, so the robustness of individuals and ecosystems have a certain mutual promotion effect, and both have a positive impact on the survival of biological systems.
- In summary, robustness is an important characteristic that enables organisms to survive and thrive in the face of environmental challenges and promote biodiversity, ecosystem stability and resilience(6), which means a lot for biological survival.

4 Biological Fragility's Potential Consequences

- Potential consequences of biological fragility are discussed in this section.
- **Vulnerability to extinction.** Organisms have low adaptability to environmental changes(7), such as temperature changes, acid-base, and the amount of living resources. Changes in these factors can lead to problems in fragile biological systems.
- **Limited range of habitats.** Fragile organisms may only be able to survive in a narrow range of conditions, which can limit their ability to inhabit different habitats and adapt to changing conditions(8).

- **Disruption of ecosystem function.** For example, loss of a dominant species in an ecosystem can have cascading effects(9) on remaining species and ecosystem processes.

5 Possible Solutions to Biological Fragility

- Biological fragility has potential serious consequences. Thus, we need to find out possible solutions.
- **Promote genetic diversity(10).** Genetic diversity can help promote robustness by providing a range of different traits that can be selected for in changing conditions.
- **Promote ecosystem diversity(11).** Maintaining a diverse range of habitats and ecosystem processes can help promote robustness by providing organisms with a range of different conditions in which they can survive.
- **Encourage adaptive management(12).** By monitoring changes in conditions and adjusting management strategies accordingly, organisms and ecosystems can be better protected from the effects of fragility.
- **Implement conservation practices(13).** By protecting important habitats and promoting sustainable use of resources, organisms and ecosystems can be better protected from the effects of fragility.
- **Promote research in related fields.** Increasing investment in research in related fields help us better understand the biological fragility.

(700 words in total)

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