1, Biological robustness

Biological robustness is defined as biological systems use a variety of mechanisms to maintain its structural and functional stability against external and internal perturbations. It is prevalent at all structural levels and is reflected in the adaptation of organisms to environment.[1]

Robustness is demonstrated by bacterial convergence, systemic feedback, redundancy mechanisms, etc. One example of this is the treatment of endothelial cells with different concentrations of $H_2 0_2$ reagent as an exogenous perturbant to test the intracellular calcium system. The Ca^{2+} concentration of the cells was measured before and after the addition of the perturbations, and the intracellular calcium concentration was maintained at a steady state with the addition of a range of $H_2 0_2$ concentrations. This demonstrates that the intracellular calcium system is able to maintain the relative homeostasis of the internal environment in response to exogenous stimuli, demonstrating biological robustness.

The ability of robustness is related to physical development and disease, and evolution. It is inextricably linked to the ability of organisms to survive. Firstly, robustness reduces the dependence of organisms on the external environment and reduces the harm that change can bring to an organism or system. An organism with robustness has a relatively stable internal environment that is relatively independent of the outside world, greatly increasing the range of ecological factors to which it can tolerate. In turn, systems with robustness are less susceptible to damage from exogenous disturbances. Secondly, robustness helps organisms to adapt to change through regulation, and is central to the maintenance of normal functioning of organisms. For example, E. coli ensures relative stability through positive and negative feedback during shocks. Thirdly, from an evolutionary point of view, robustness allows genetics to become more stable, making organisms more adaptable to their environment. On the other hand, mutational robustness of a system or population of organisms helps to accumulate mutations. It makes variant traits less susceptible to elimination, thus increasing the direction of discovery of beneficial variation, which is important for biological evolution.

2，Biological fragility

Biological fragility indicates the nature of an organism that is sensitive to external perturbations or encroachments and has difficulty in returning to its original state after suffering damage. It is an inherent property of the inner structure.

A typical example of biological vulnerability is the study of the energy control system of our human body. However, this vulnerability is reflected in specific mutations such as high energy content and low energy consumption lifestyles. In this case, when food intake is excessive, the homeostatic energy regime is exceeded. And then triglycerides will accumulate faster and leptin will increase. This is the normal way of human daily regulation. But when there is an extreme glucose excess, it is not possible to cope with this mutation and the regulatory mechanisms are powerless. As a result, when the body's mechanisms manifest themselves in this state of disruption by external stimuli, incurable diseases can arise.

Biological fragility has many consequences. Firstly, it makes the system unable to cope in the face of natural disasters such as species distribution, climate change, biological invasions and other factors. This phenomenon leads to species extinctions, changes in ecological structure and a deterioration in species diversity and ecosystem diversity. Secondly, in terms of human development, the vulnerability of natural plants and systems to hazards reduces food production and causes significant losses for humans in times of change in the natural and economic environment. Also， for some humans, diseases caused by vulnerability after being subjected to mutations are sustained by the positive and negative feedback of the system, incurable and eventually fatal.[2]

We should take actions such as timely quantitative assessments and more scientific evaluation models. Control, reduce vulnerability caused by anthropogenic 'profit-taking' and optimise the human-land structure. It is also important to help with anthropogenic adaptation activities. Systems need to adapt to perturbations but are unable to do so because of their vulnerability, so it is necessary to help species adapt, conserve genetic diversity and increase their capacity to cope with external changes.

3,citation

[1]. Kitano, H. (2007). Towards a theory of biological robustness. Molecular systems biology, 3(1), 137.

[2]. Yung-Keun Kwon, Kwang-Hyun Cho, Quantitative analysis of robustness and fragility in biological networks based on feedback dynamics, Bioinformatics, Volume 24, Issue 7, April 2008, Pages 987–994,