Oriental Landscape Painting by Predator Species

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The research story

Steele [1] conjectured that Lotka-Volterra predator-prey equations with diffusion would produce patterns of plankton patchiness. However, mathematicians showed that the solution eventually converges to a constant and there are no persistent patterns of the system. This observation motivates researchers to introduce various nonlinear functional responses and modify the equations. These modified equations successfully provide persistent patterns. The distribution landscape shows areas where the population flourishes and areas where it is not present. The figure is obtained by adding the death term (or the Allee effect) which gives finite time local extinction.

The image

Mountain and water are two main topics of oriental landscape paintings. The figure illustrates the density distribution of a predator species, which resembles oriental landscape paintings. Turing patterns are static images usually obtained when the diffusivity of two species has a big difference. The figure is such a case when the diffusivity of the predator species is much smaller than that of the prey species. As a result, the predator landscape is very spiky and exotic. The prey landscape is smoother and relaxing, which can be found at http://amath.kaist.ac.kr/predatorprey/. However, this image is a dynamic pattern and keeps evolving. See [2] to find a Turing pattern of predator-prey equations.

References

[1] Steele JH, Spatial heterogeneity and population stability, Nature 248:83, 1974.

[2] Choi J, Kim Y-J, Predator-prey equations with constant harvesting and planting, Journal of Theoretical Biology 458: 47–57, 2018.

F. Matthäus et al. (eds.), *The Art of Theoretical Biology*, https://doi.org/10.1007/978-3-030-33471-0_50