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# Predation or frequency dependence, which of them controls dimorphism oscillations in prey predator system?

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Oscillation of lateral asymmetry diorphism is first found in scale eating cichlid, Perrisodus microlepis. Fraction of their lefty morph oscillates around 0.5 in about 5 year period. Other fish or aquatic invertebrates also reveal lateral asymmetry dimorphism and oscillation of morph fractions. One of key factors of oscillation is cross predation dominance: lefty predator eats more righty prey than lefty prey, and vice versa. When lefty is major in predator, righty prey decrease, then larger fraction of lefty prey increases righty predator, and so on. This cycle appears to lead to the laterality oscillation. However the story is not such simple. A simple ODE model of prey predator system with cross predation dominance has no limit cycles, its coexisting equilibrium is stable, though almost neutral. Introduction of time delays due to growth periods destabilizes the coexisting equilibrium and leads to a limit cycle of oscillating dimorphism fraction. However, this laterality dimorphism oscillation due to time delays of growth periods and predation cycle can not explains that observed in fields. Amplitude and period of fraction oscillation are almost 1.0 and 50 ~ 250 years in the model, while they are 0.1 ~ 0.3 and 3 ~ 6 years in fields. Another factor of oscillation in morph fraction is frequency dependence. When lefty scale eaters are more common, righties eat more scales and have higher reproductive success. We introduce frequency dependent predation success into the model: rarer predator eats more prey. This frequency dependence, however, ends up with the vanish of oscillation by either stabilization of coexisting equilibrium, or fixation one laterality morph. Another frequency dependence, that of prey selection, i.e. predator eats more common prey morph, stabilizes coexisting equilibrium. The model with both of frequency dependence finally shows oscillations with realistic amplitudes and periods. We conclude that oscillation of lateral asymmetry morphs is caused not by predation cycle, but by frequency dependence in both of prey and predator, i.e. rarer predator or prey morph is advantageous and become common after a few years.

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