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For coexistence, from mutual invasibility, we can rearrange :

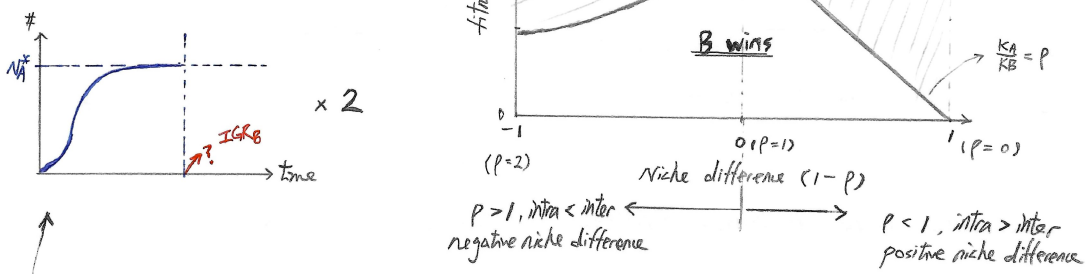
$$\begin{cases} \frac{\alpha_{AA}}{r_A} > \frac{\alpha_{BA}}{r_B} \\ \frac{\alpha_{BB}}{r_B} > \frac{\alpha_{AB}}{r_A} \end{cases} \Rightarrow \begin{cases} \frac{r_A}{r_B} < \frac{\alpha_{AA}}{\alpha_{BA}} \\ \frac{r_A}{r_B} > \frac{\alpha_{AB}}{\alpha_{BB}} \end{cases} \Rightarrow \frac{\alpha_{AB}}{\alpha_{BB}} < \frac{r_A}{r_B} < \frac{\alpha_{AA}}{\alpha_{BA}}$$

multiply the inequality by $\sqrt{\frac{\alpha_{BB}\alpha_{BA}}{\alpha_{AA}\alpha_{AB}}}$

$$\sqrt{\frac{\alpha_{AB}\alpha_{BA}}{\alpha_{AA}\alpha_{BB}}} < \frac{r_A}{r_B}\sqrt{\frac{\alpha_{BB}\alpha_{BA}}{\alpha_{AA}\alpha_{AB}}} < \sqrt{\frac{\alpha_{AA}\alpha_{BB}}{\alpha_{AB}\alpha_{BA}}}$$

- $\sqrt{\frac{\alpha_{AB}\alpha_{BA}}{\alpha_{AA}\alpha_{BB}}}$: niche overlap (ρ), measure of stabilization
- $\frac{r_A}{r_B}\sqrt{\frac{\alpha_{BB}\alpha_{BA}}{\alpha_{AA}\alpha_{AB}}}$: demographic ratio
- $\sqrt{\frac{\alpha_{AA}\alpha_{BB}}{\alpha_{AB}\alpha_{BA}}}$: sensitivity to competition
- demographic ratio × sensitivity to competition : fitness ratio ($\frac{K_A}{K_B}$), competitive hierarchy

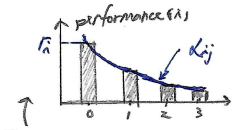
$$\Rightarrow \rho < \frac{K_A}{K_B} < \frac{1}{\rho}$$



ⓐ How to empirically assess competition & niche difference ?

1. Invasion experiments

- pros : model free & direct
- cons : only for fast generation & clear monoculture equilibrium



2. Parameterize model

- pros : have model to do any analysis via simulation
- cons : confidence for the model & difficulty for experiment