Research Title

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Introduction

- Ubiquitous threat of antibiotic resistant bacteria
- Investigate effect of different cellular transformation rates on antibiotic resistant bacterial population growth

Diagram of cell with plasmids

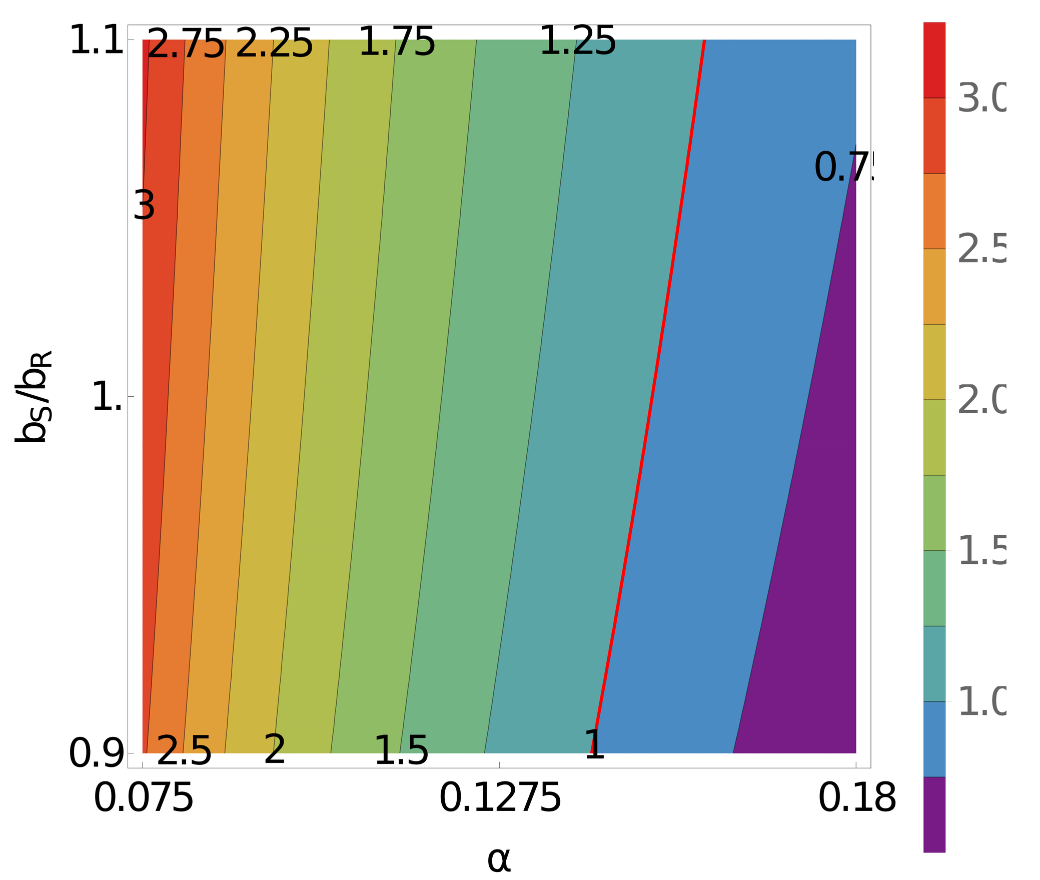
Biological Background

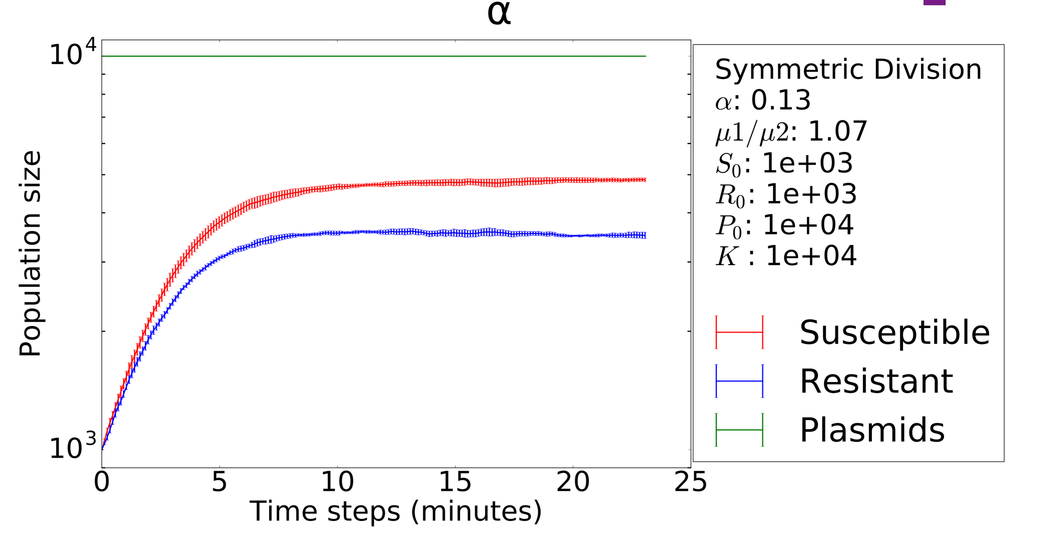
- Plasmids
- Fitness cost
- Transformation

Simulation Methods

- Combined approach of Kinetic Monte Carlo simulation and numerical modeling
- Gillespie algorithm
- Well-mixed population
- Carrying capacity
- Constant, Linear, Recycled α
- Symmetric division

Constant α





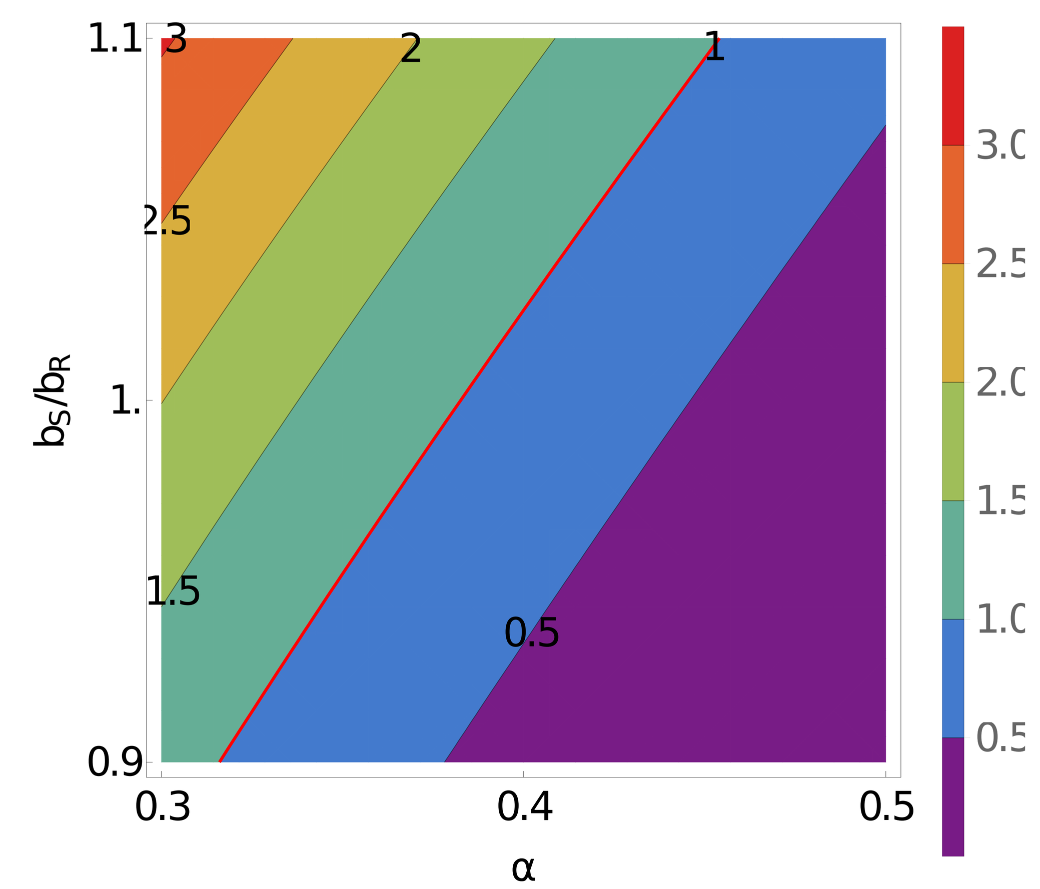
Reactions

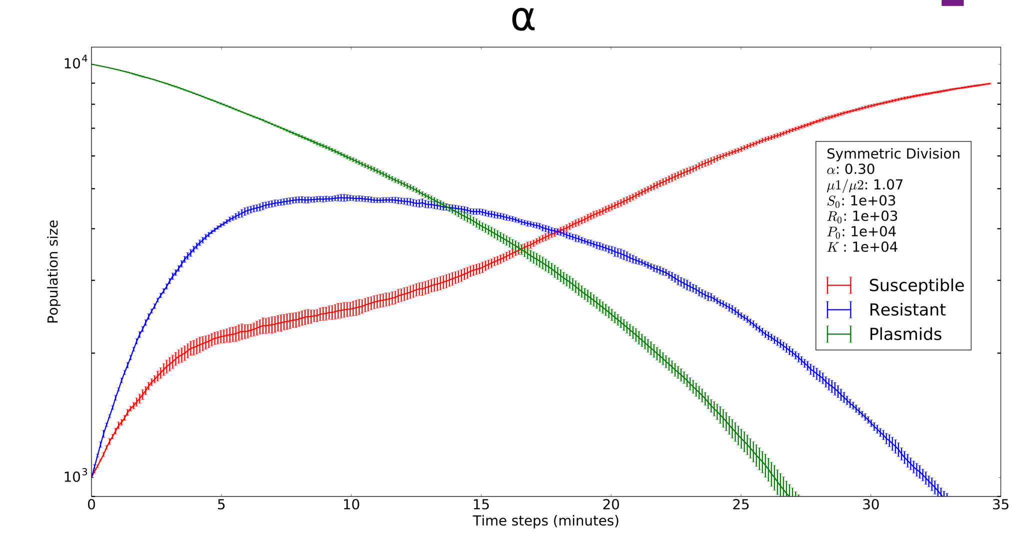
$$S \xrightarrow{b_S} 2S$$
$$S \xrightarrow{\alpha} R$$
$$R \xrightarrow{b_R} 2R$$
$$R \xrightarrow{\delta} \varnothing$$

Equations

$$\frac{dS}{dt} = \mu_1 \left(1 - \frac{S+R}{K}\right) S - \alpha S$$
$$\frac{dR}{dt} = \mu_2 \left(1 - \frac{S+R}{K}\right) R + \alpha S - \delta R$$

Linear α





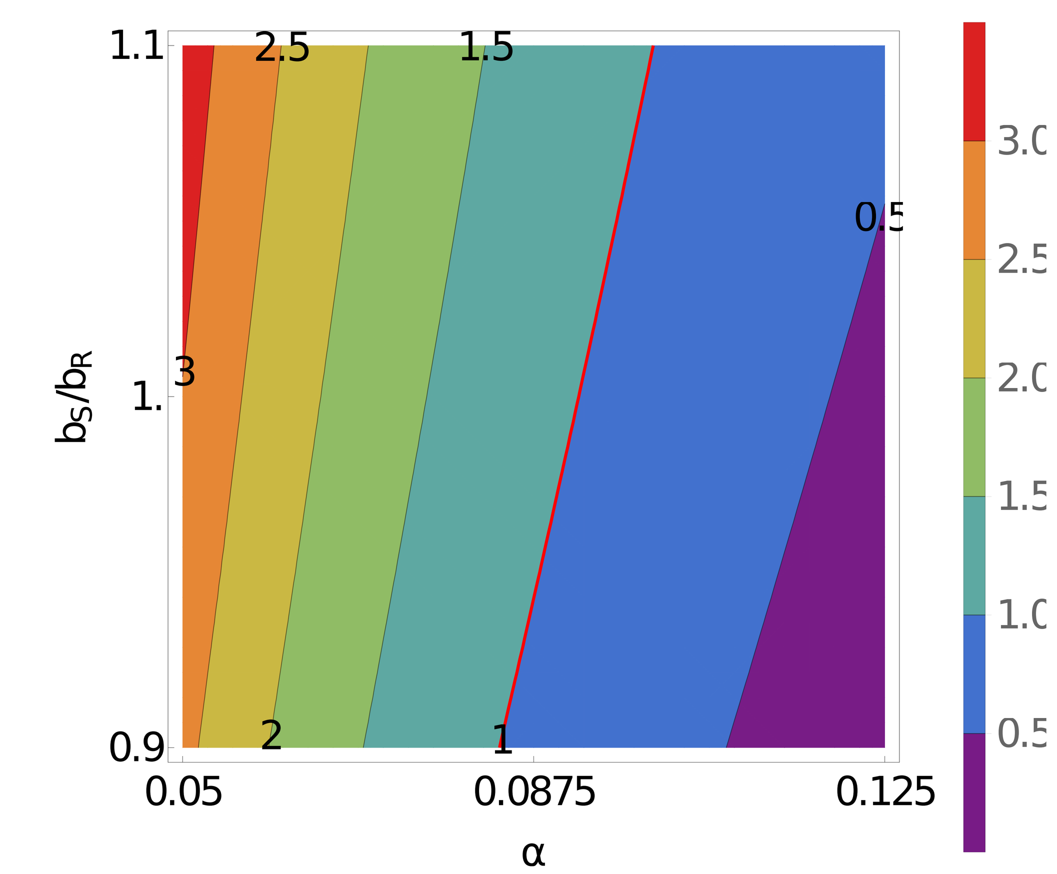
Reactions

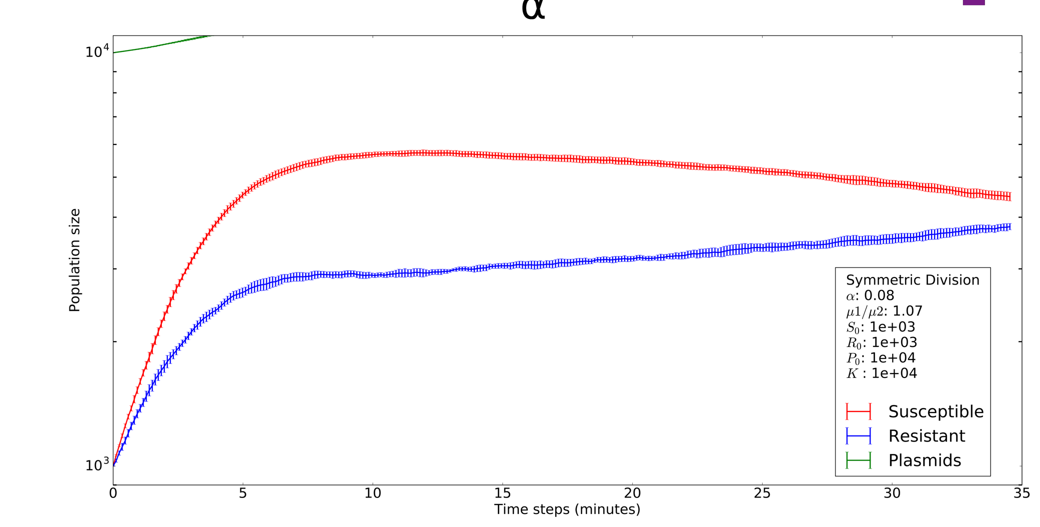
$$S \xrightarrow{b_S} 2S$$
$$S + P \xrightarrow{\alpha} R$$
$$R \xrightarrow{b_R} 2R$$
$$R \xrightarrow{\delta} \varnothing$$

Equations

$$\frac{dS}{dt} = \mu_1 \left(1 - \frac{S+R}{K}\right) S - \alpha \left(\frac{P}{P_0}\right) S$$
$$\frac{dR}{dt} = \mu_2 \left(1 - \frac{S+R}{K}\right) R + \alpha \left(\frac{P}{P_0}\right) S - \delta R$$
$$\frac{dP}{dt} = -\alpha \left(\frac{P}{P_0}\right) S$$

Recycled α





Reactions

$$S \rightarrow 2S$$
$$S + P \rightarrow R$$
$$R \rightarrow 2R$$
$$R \rightarrow \varnothing + P$$

Equations

$$\frac{dS}{dt} = \mu_1 \left(1 - \frac{S+R}{K}\right) S - \alpha \left(\frac{P}{P_0}\right) S + +\mu_2 \left(1 - \frac{S+R}{K}\right) R$$
$$\frac{dR}{dt} = \alpha \left(\frac{P}{P_0}\right) S - \delta R$$
$$\frac{dP}{dt} = -\alpha \left(\frac{P}{P_0}\right) S + \delta R(t)$$

Conclusions

- Point
- Point
- Point

Future Work

- Simulation on a lattice
- Adding antibiotics
- Asymmetric division

Acknowledgements/References

Thank you etc etc

- Source 1
- Source 2