Bacterial Growth in the Presence of Several Resources

Aluno: Rita Gonçalves
Orientadores: Rui Dilão
Isabel Gordo
Instituto Superior Técnico, Lisboa
Theories of Biodiversity
Theories of Biodiversity

1934 - Gause’s Law:

Georgy Gause biologist
Theories of Biodiversity

1934 - Gause’s Law:

Limited resources → Extinction of species
Theories of Biodiversity

1934 - Gause’s Law:
   Limited resources → Extinction of species

1960 - Competitive Exclusion Principle (CEP):

Garrett Hardin
ecologist
Theories of Biodiversity

1934 - Gause’s Law:
  Limited resources → Extinction of species

1960 - Competitive Exclusion Principle (CEP):
  Number of species cannot exceed number of resources
Theories of Biodiversity

1934 - Gause’s Law:

Limited resources $\rightarrow$ Extinction of species

1960 - Competitive Exclusion Principle (CEP):

Number of species cannot exceed number of resources

1961 - Paradox of the Plankton:

George Hutchinson
ecologist
Theories of Biodiversity

1934 - Gause’s Law:
Limited resources → Extinction of species

1960 - Competitive Exclusion Principle (CEP):
Number of species cannot exceed number of resources

1961 - Paradox of the Plankton:
Plankton can grow with limited resources
Theories of Biodiversity

1934 - Gause’s Law:
Limited resources $\rightarrow$ Extinction of species

1960 - Competitive Exclusion Principle (CEP):
Number of species cannot exceed number of resources

1961 - Paradox of the Plankton:
Plankton can grow with limited resources
$\rightarrow$ violation of the CEP
In what circumstances do competitive exclusion and sustainable coexistence take place?
Adaptive consumer-resource models can explain diauxic shifts and the violation of the CEP

Leonardo Pacciani-Mori
physicist

Samir Suweis
physicist

Amos Maritan
physicist
Adaptive consumer-resource models can explain diauxic shifts and the violation of the CEP

Species adaptation:
Adaptive consumer-resource models can explain diauxic shifts and the violation of the CEP

Species adaptation:

- behavioural
Adaptive consumer-resource models can explain diauxic shifts and the violation of the CEP.

Species adaptation:

- behavioural
- physiological – like hibernation
Adaptive consumer-resource models can explain diauxic shifts and the violation of the CEP

Species adaptation:

• behavioural
• physiological – like hibernation
• structural – by natural selection
Adaptive consumer-resource models can explain diauxic shifts and the violation of the CEP

Species adaptation:

- behavioural
- physiological – like hibernation
- structural – by natural selection

Species try to maximize their growth rate
Adaptive consumer-resource models can explain diauxic shifts and the violation of the CEP

Species adaptation:
• behavioural
• physiological – like hibernation
• structural – by natural selection

Species try to maximize their growth rate
My Work

• Mathematical model:
My Work

• Mathematical model:
  • with dynamic metabolic strategies
My Work

• Mathematical model:
  • with dynamic metabolic strategies
  • without maximization principle
My Work

- Mathematical model:
  - with dynamic metabolic strategies
  - without maximization principle
  - explaining the Plankton Paradox
My Work

- Mathematical model:
  - with dynamic metabolic strategies
  - without maximization principle
  - explaining the Plankton Paradox

- Calibration of models with E. coli experiments
My Work

• Mathematical model:
  • with dynamic metabolic strategies
  • without maximization principle
  • explaining the Plankton Paradox

• Calibration of models with E. coli experiments
  • in stirred reactor
Questions?