Efeito do distúrbio nas estratégias de vida

Dinâmicas ecológicas e evolutivas

Luísa Novara Monclar Gonçalves

Orientador: Prof. Dr. Alexandre Adalardo de Oliveira

Coorientador: Prof. Dr. Paulo Inácio Prado

dinâmica
evolutiva

dinâmica
ecológica

dinâmica evolutiva

mudanças na frequência de um atributo na **população** a partir de alterações na **frequência relativa dos alelos**

dinâmica ecológica

dinâmica evolutiva

mudanças na frequência de um atributo na **população** a partir de alterações na **frequência relativa dos alelos**

dinâmica ecológica

mudanças na frequência de um atributo na **comunidade** a partir de alterações na **frequência relativa das espécies**

dinâmica evolutiva

- seleção
- deriva genética
- fluxo gênico
- mutação

dinâmica ecológica

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dinâmica ecológica

- seleção
- deriva ecológica
- migração
- especiação

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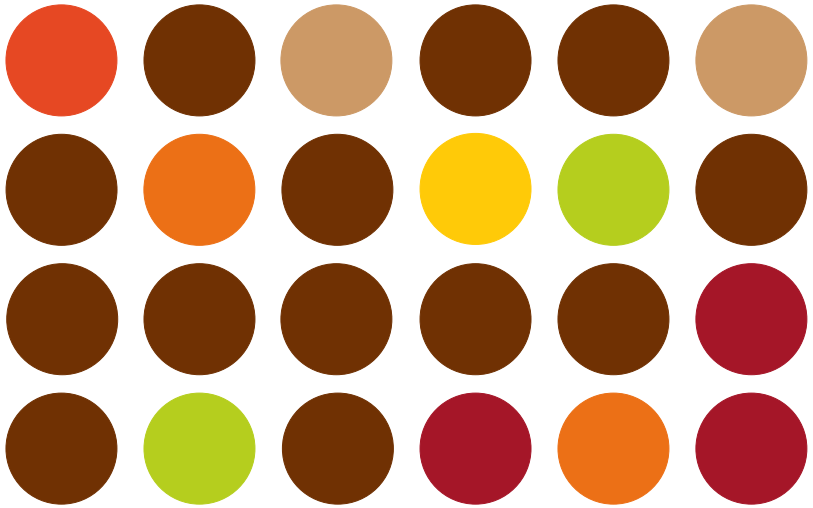

dinâmica evolutiva

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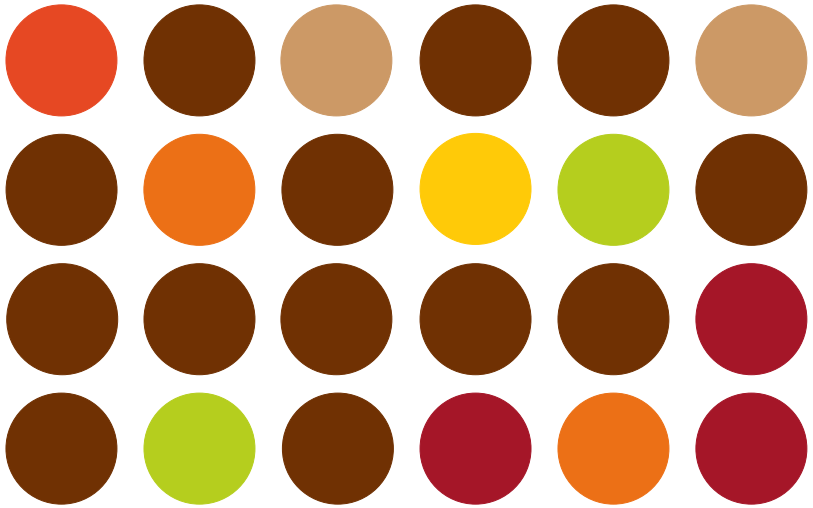

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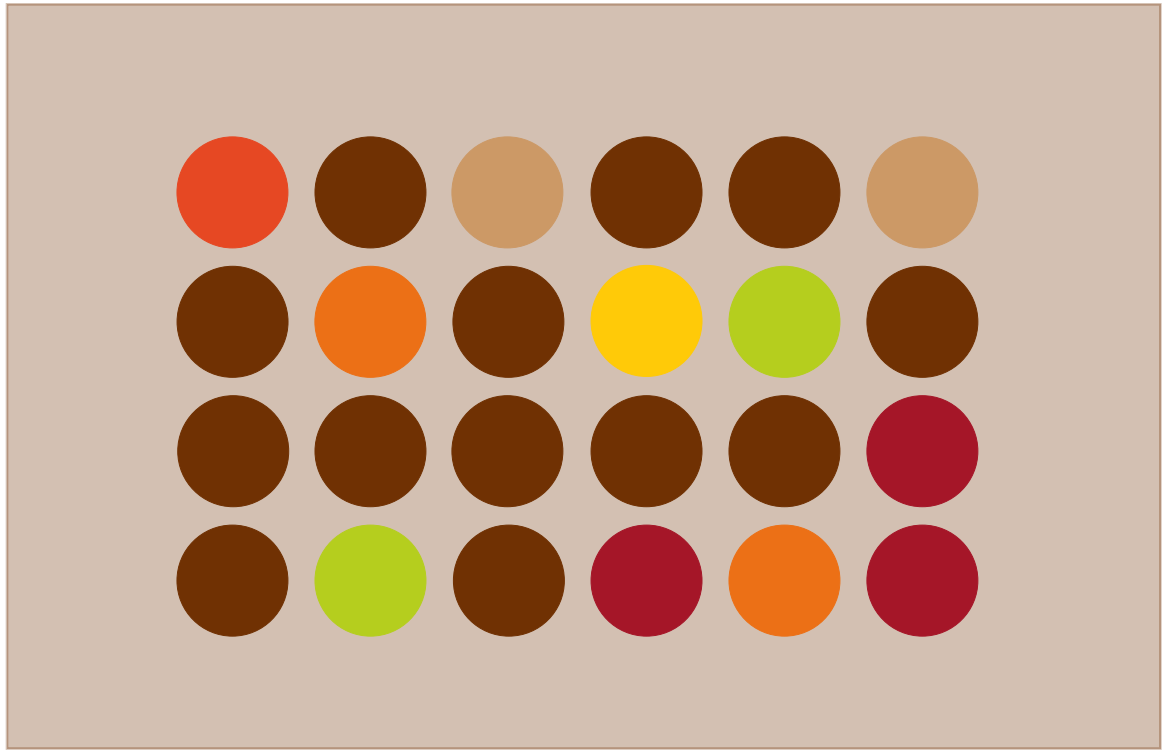

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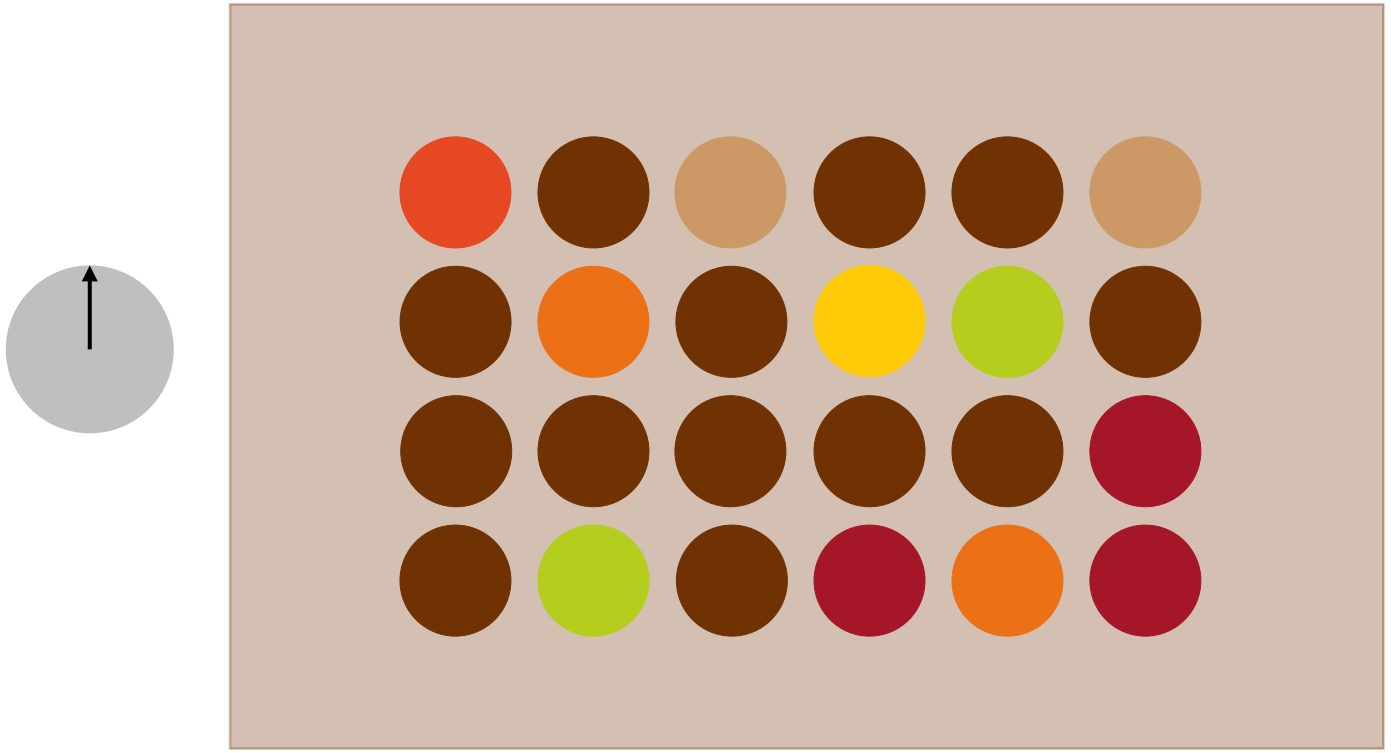

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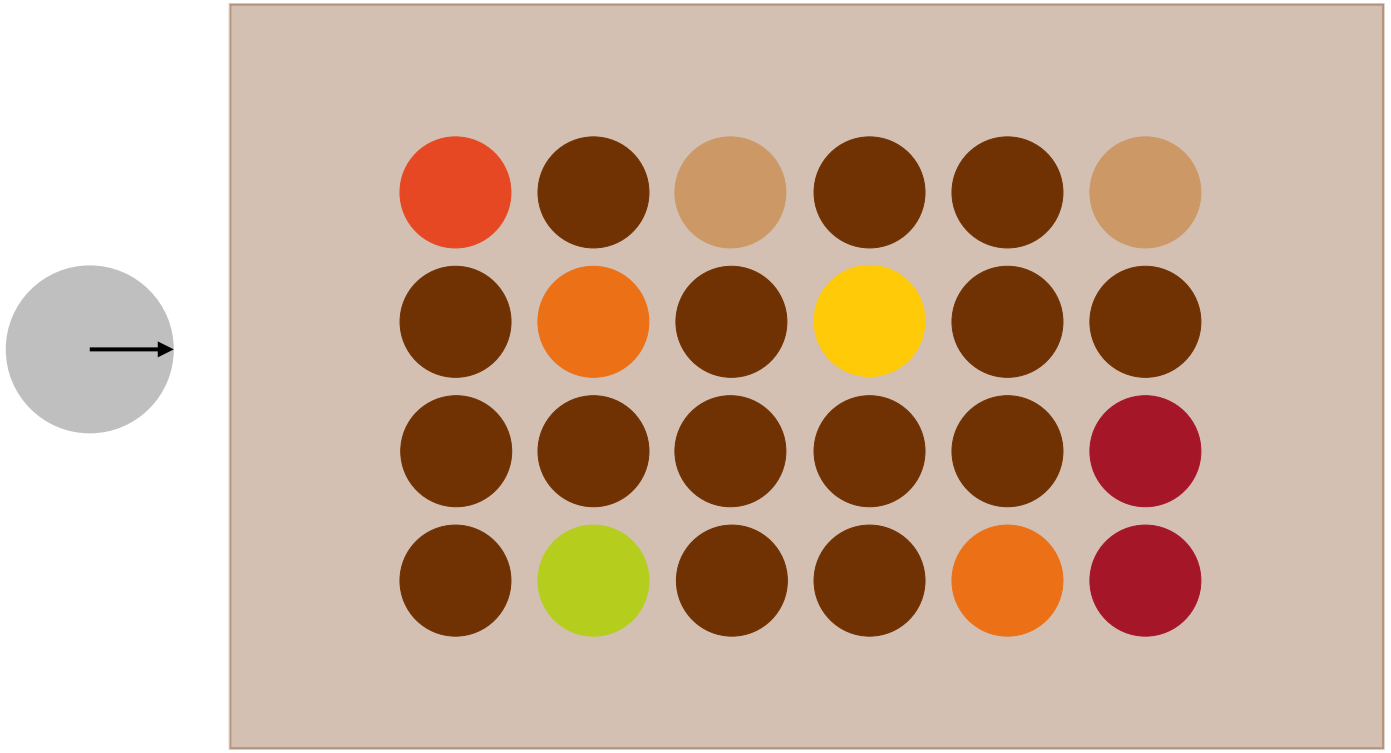

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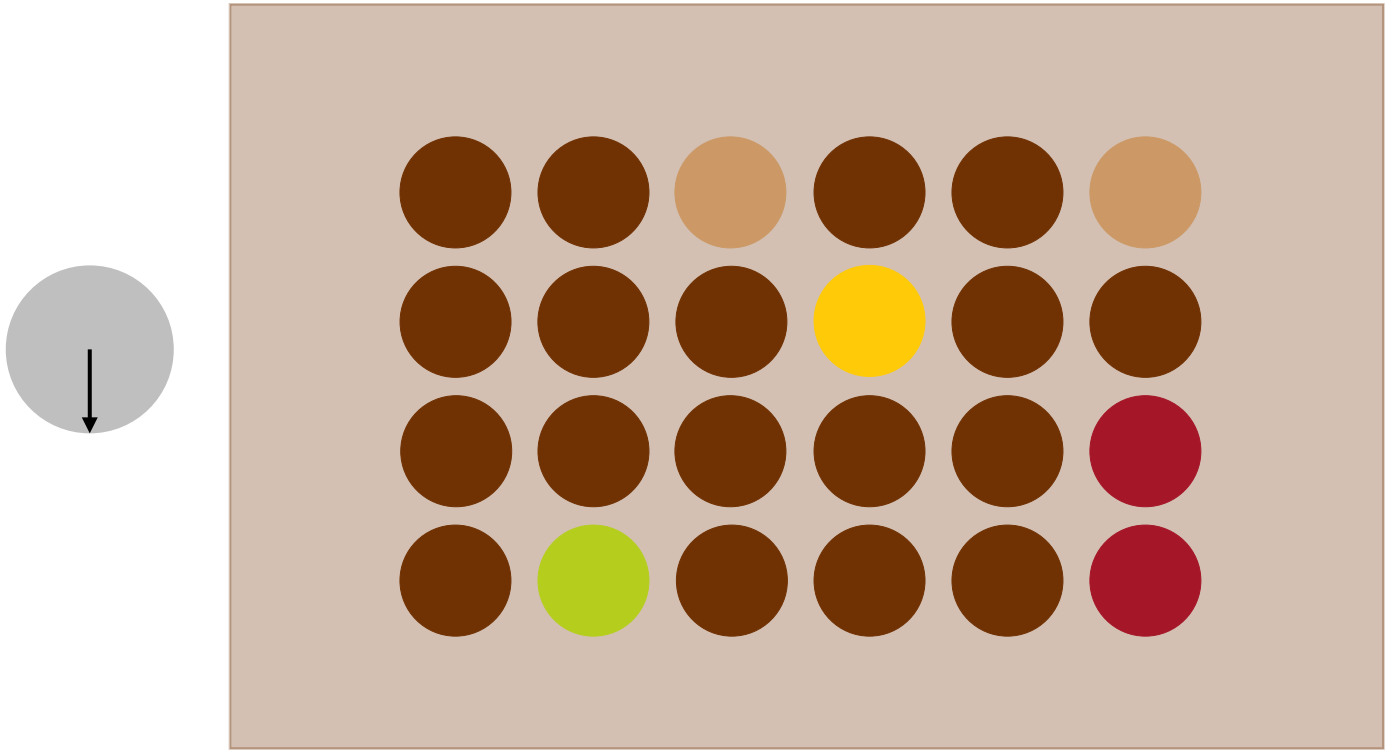

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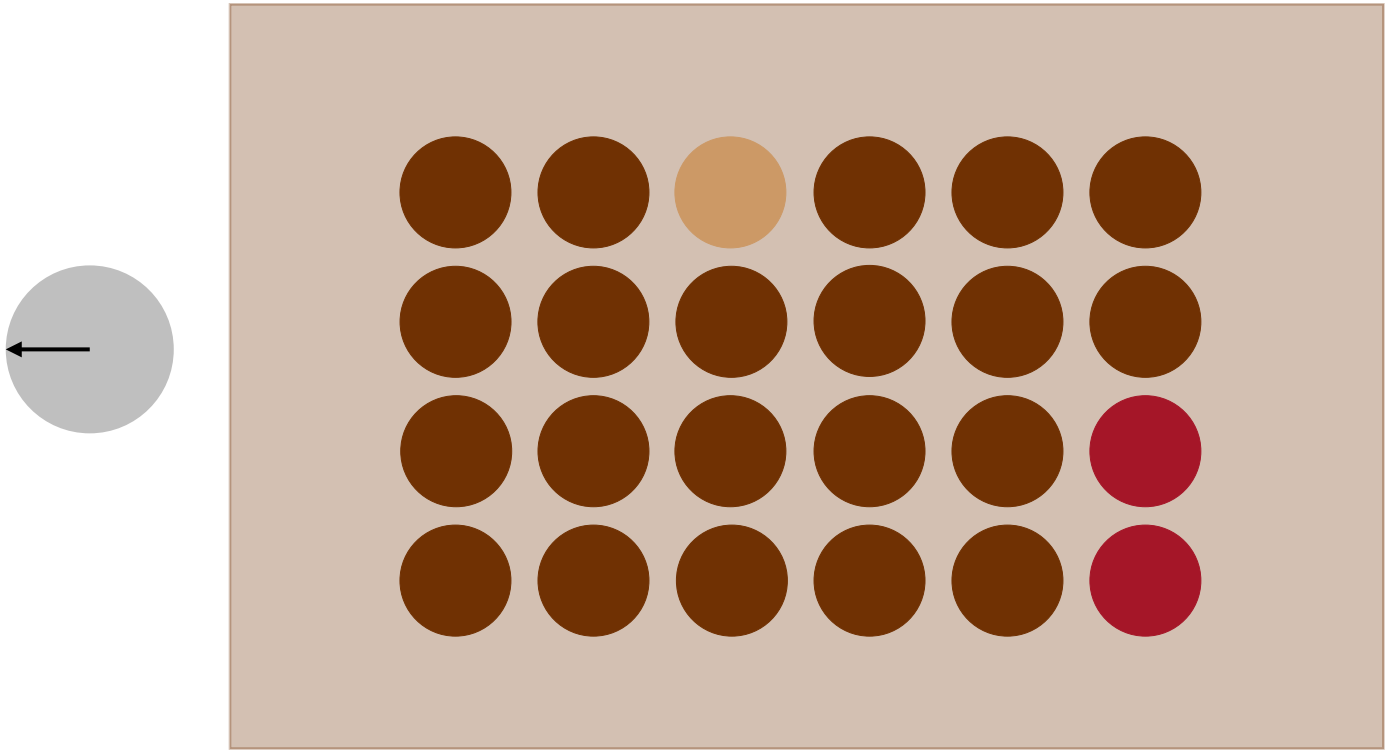

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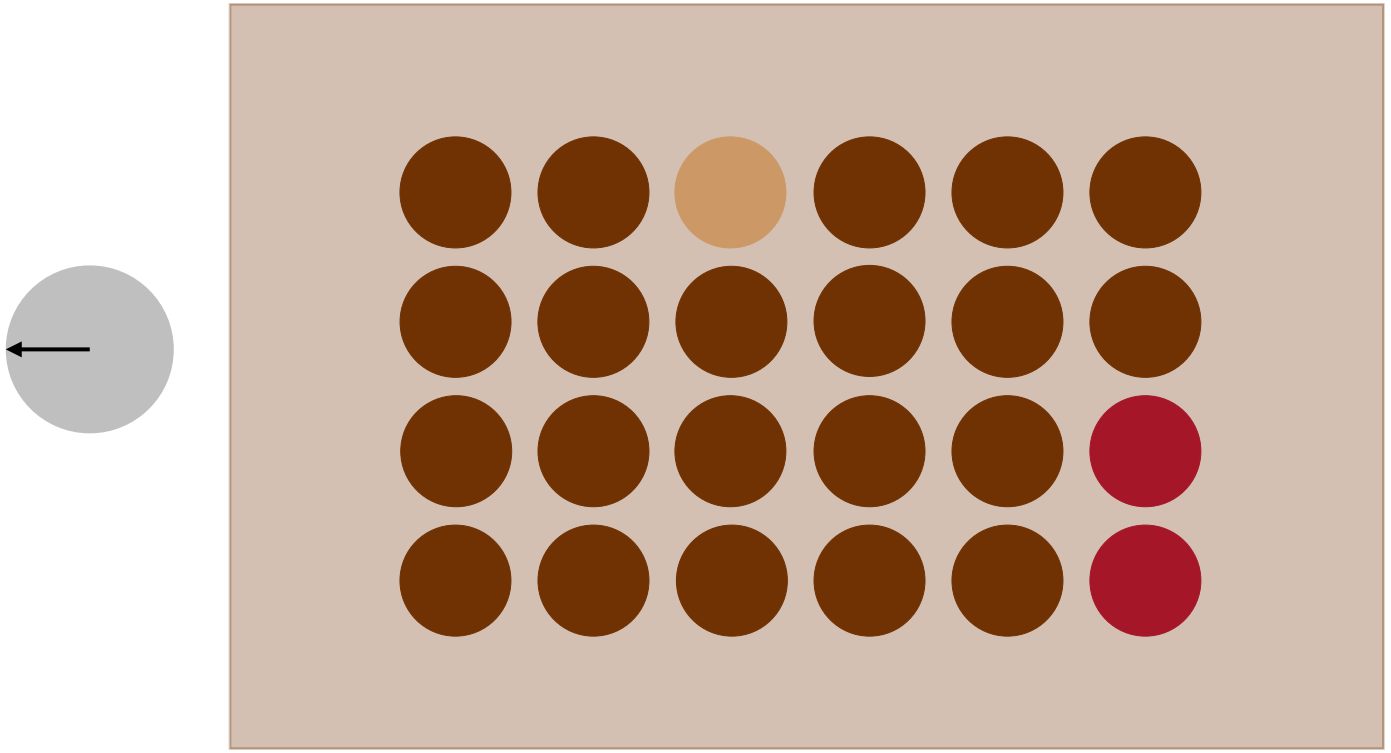

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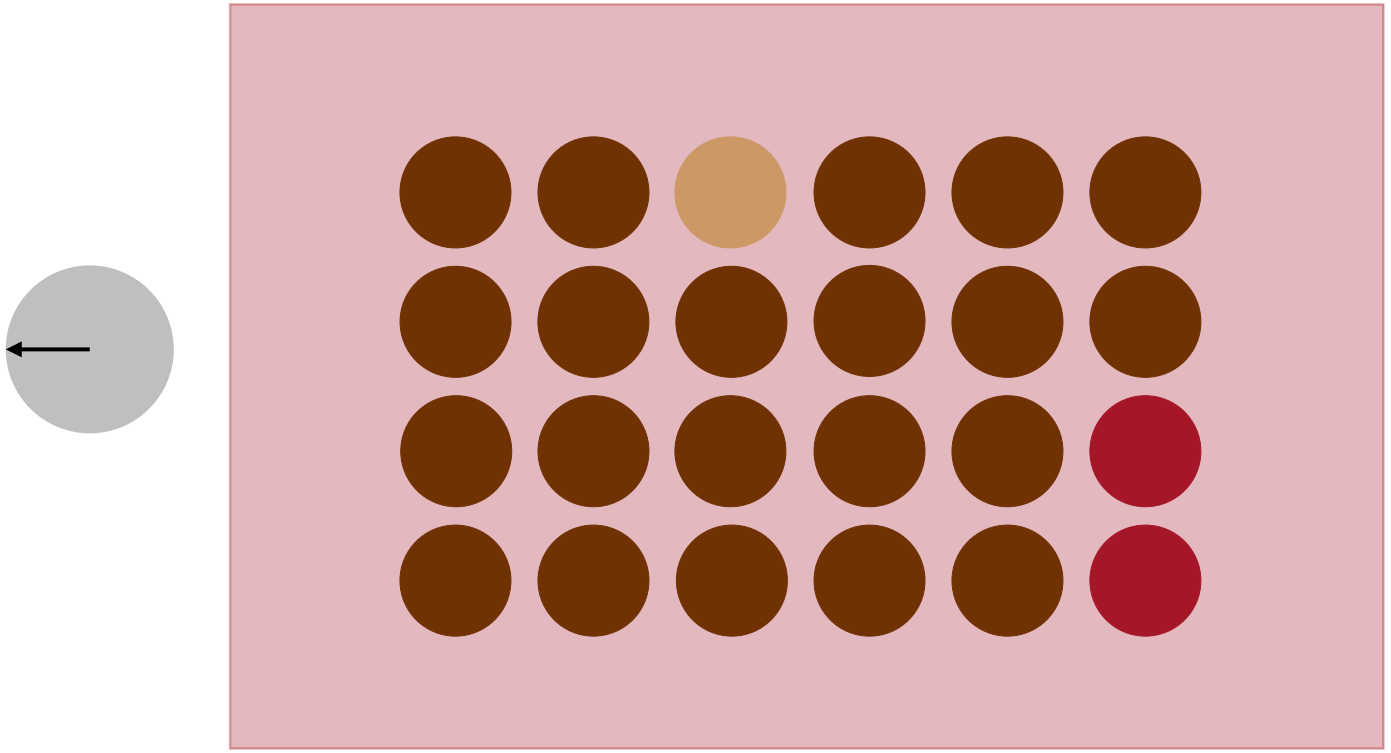

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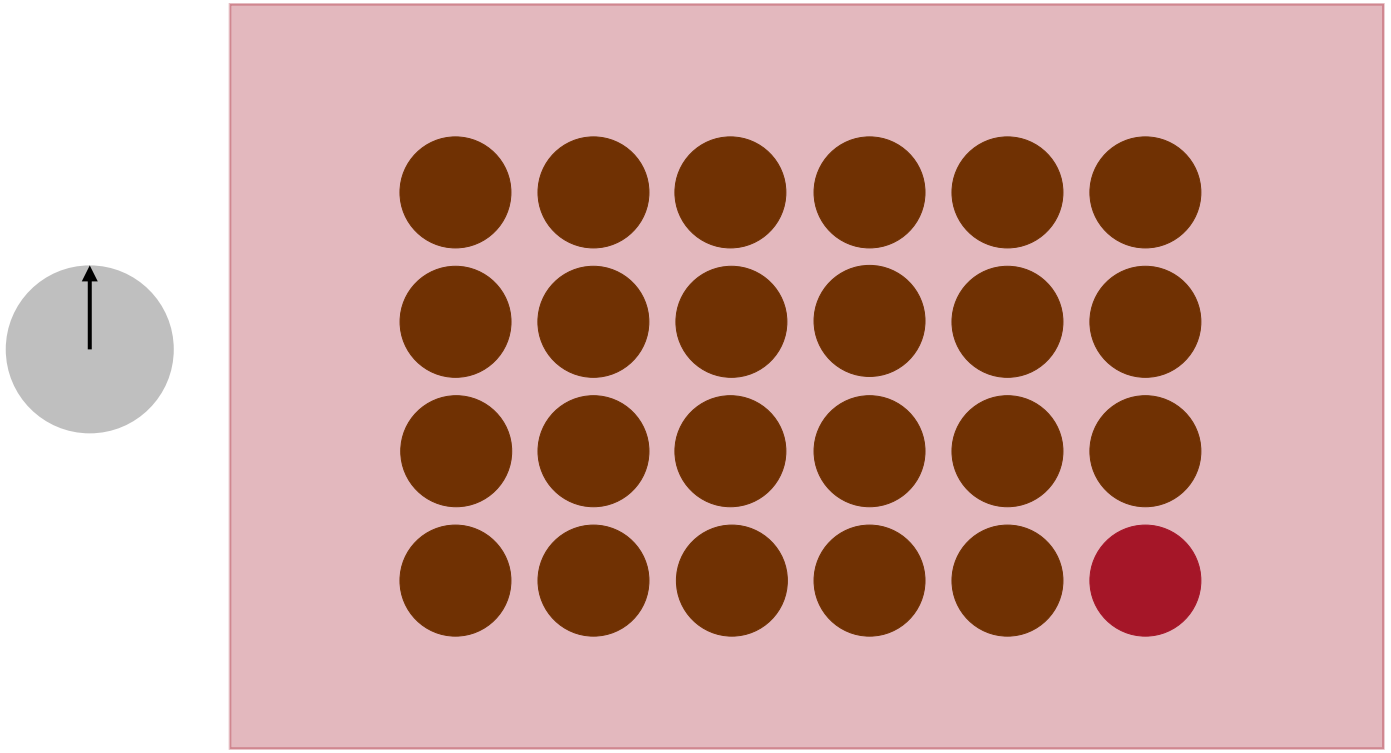

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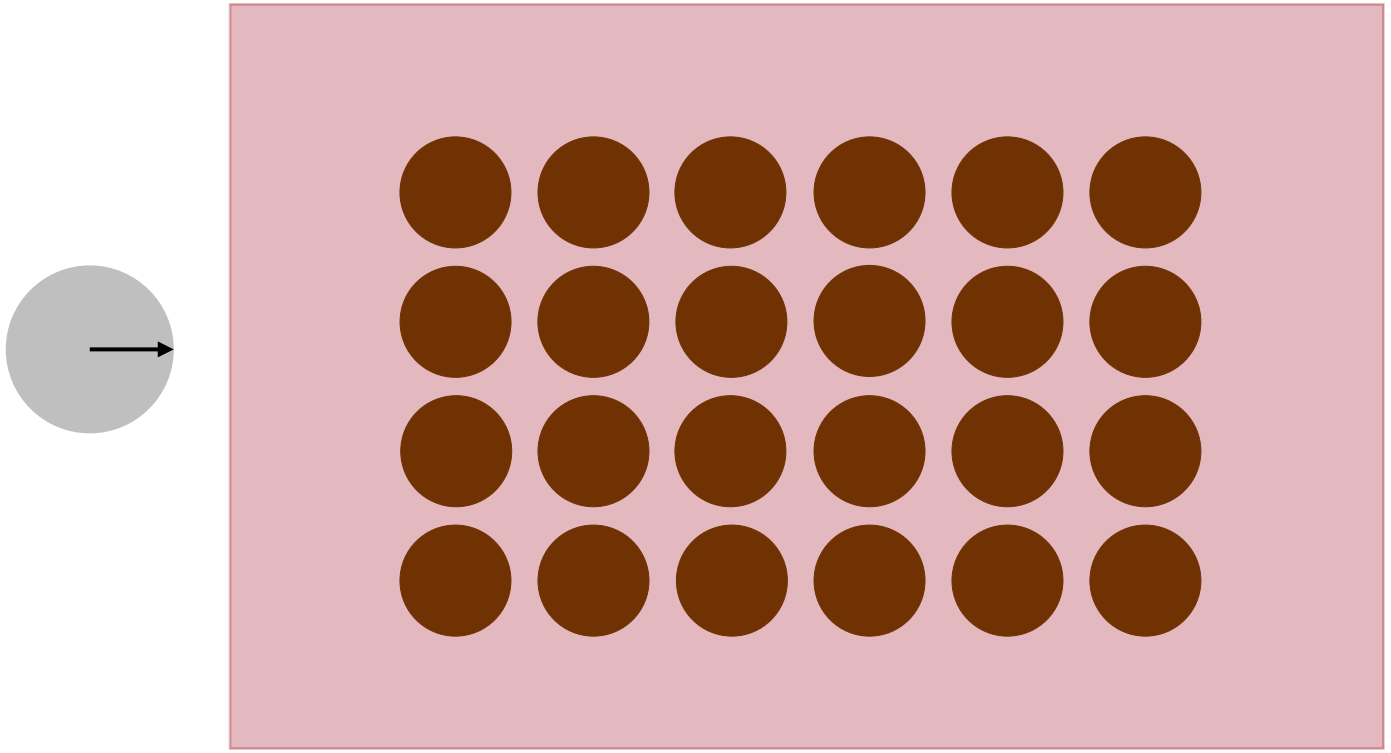

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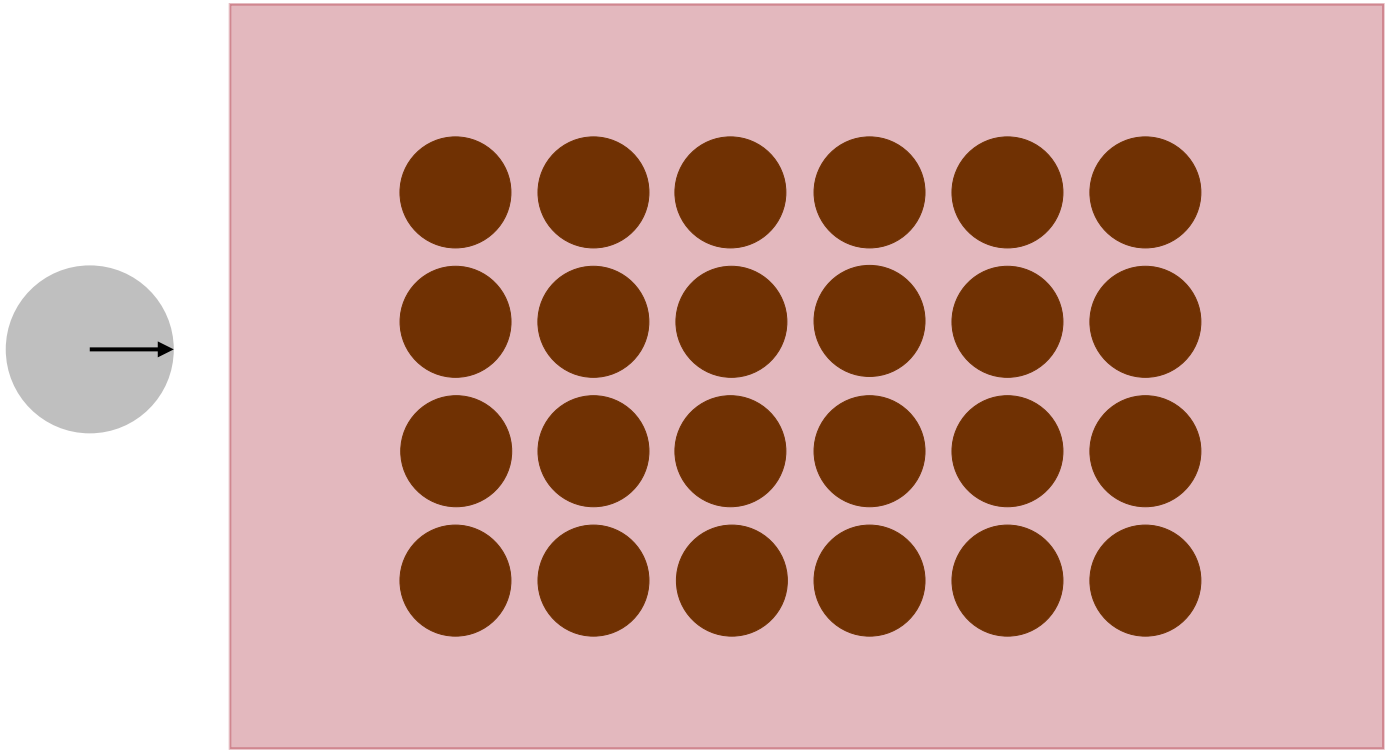

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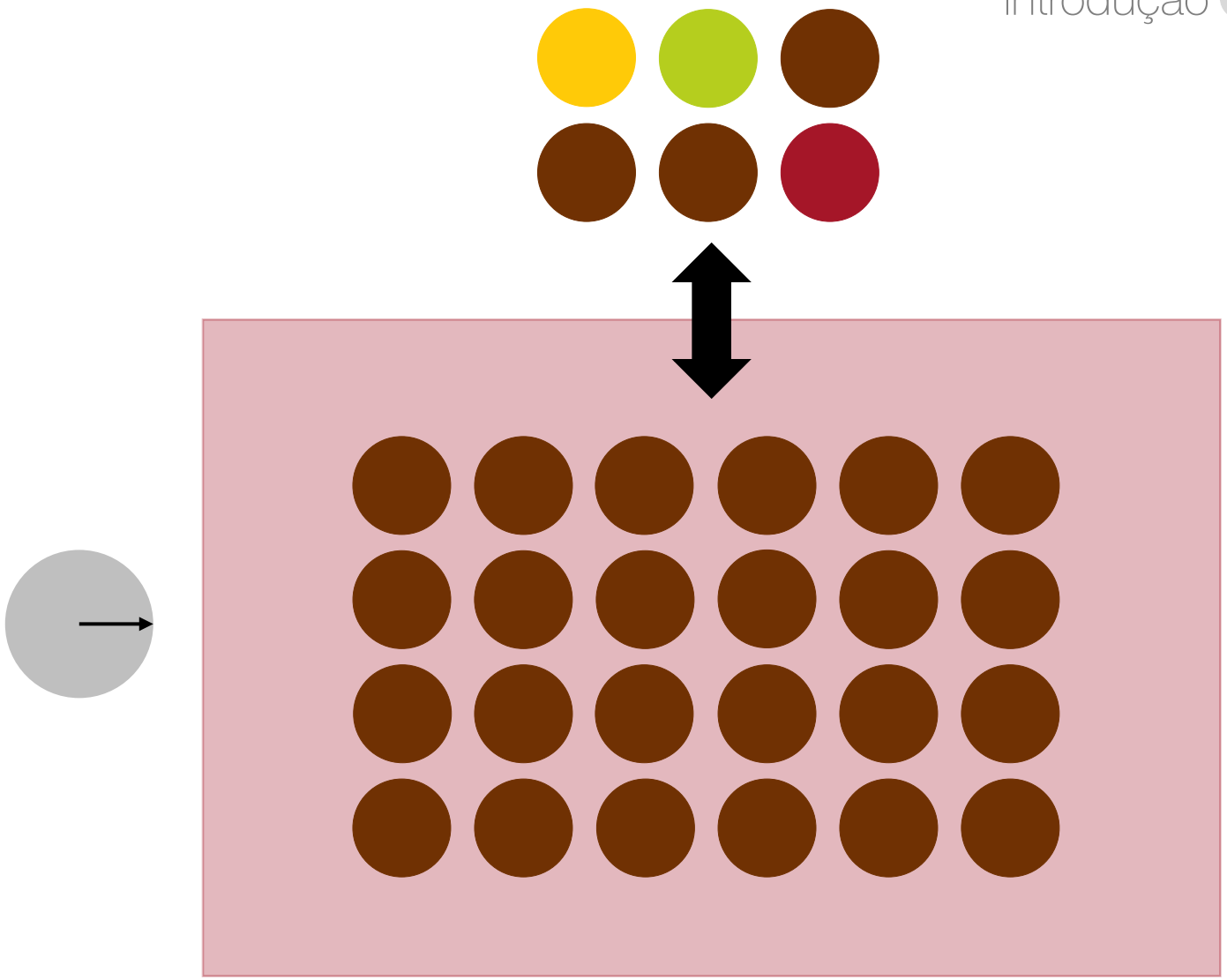

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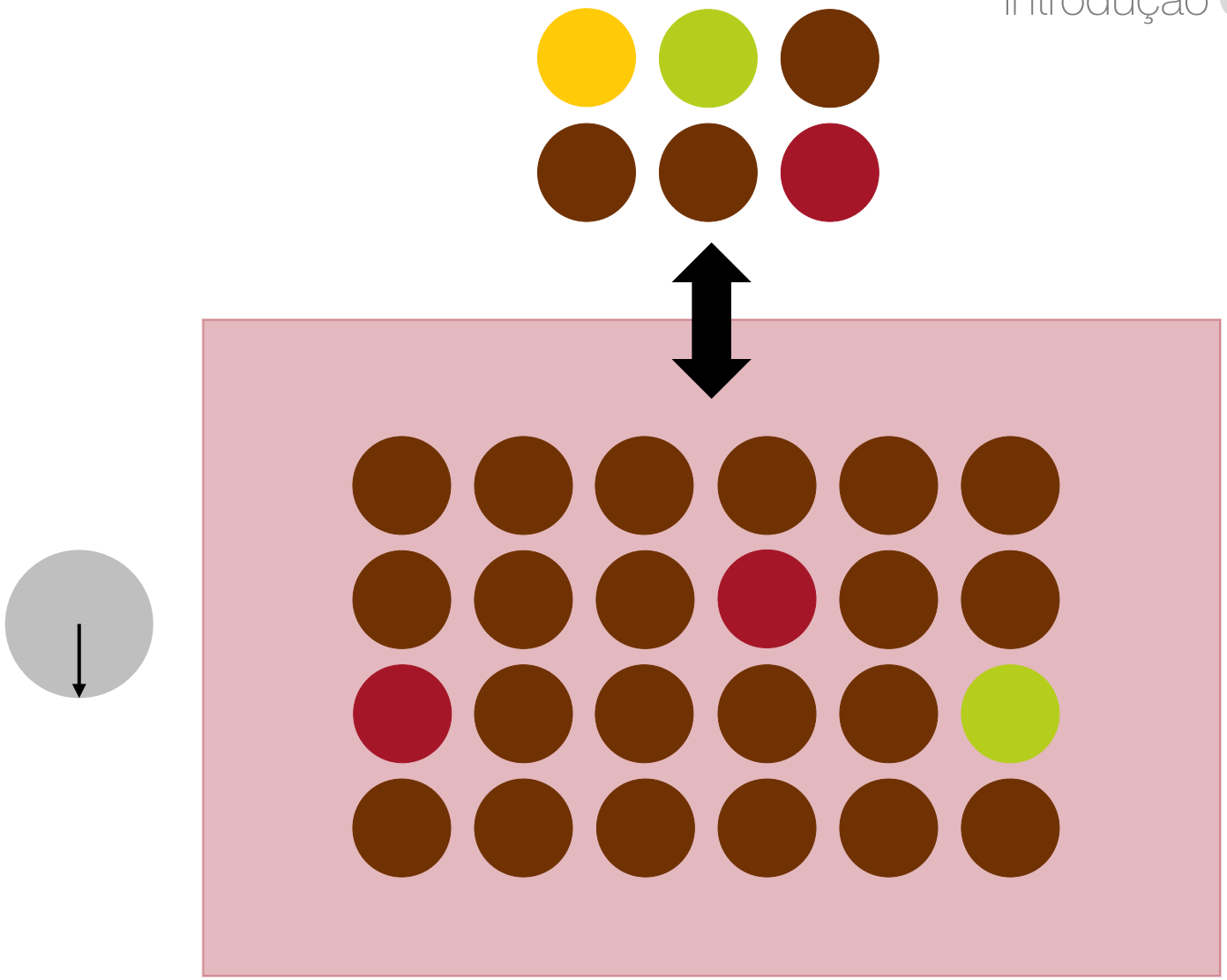

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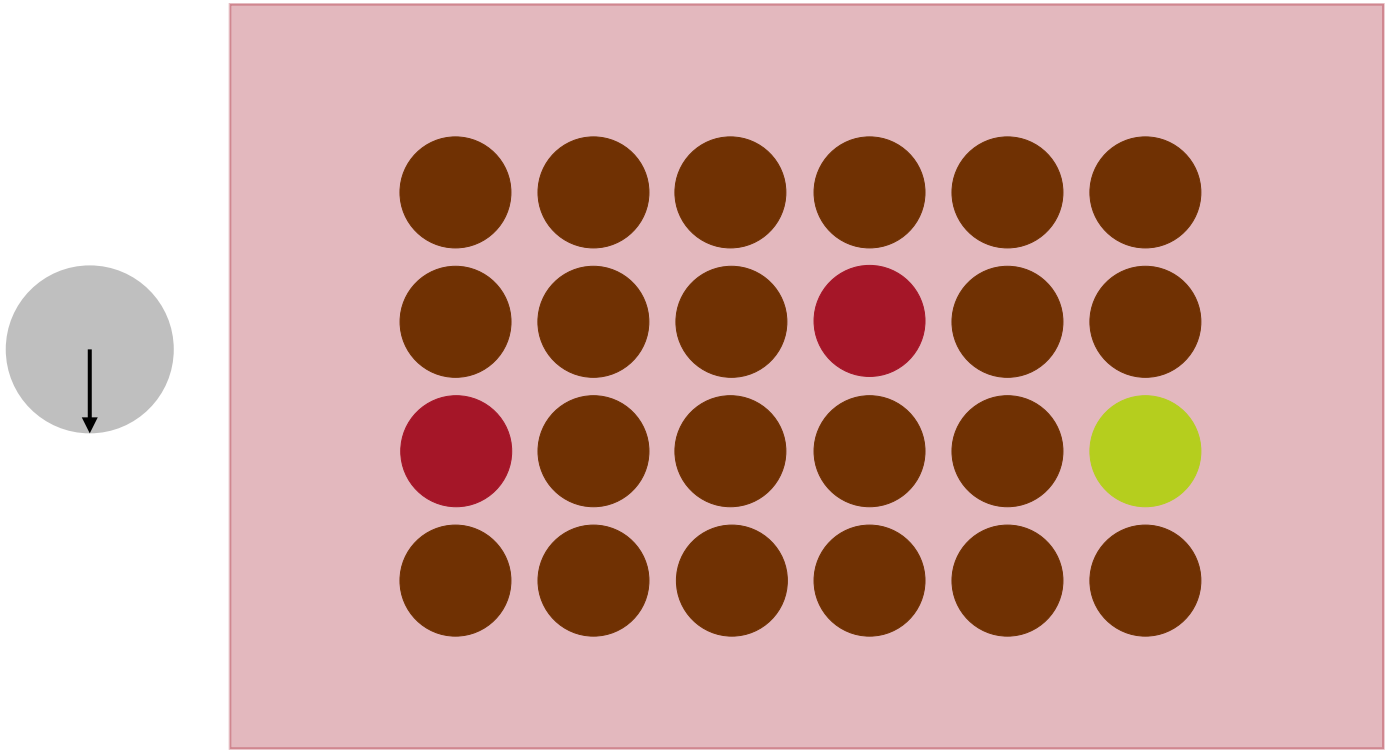

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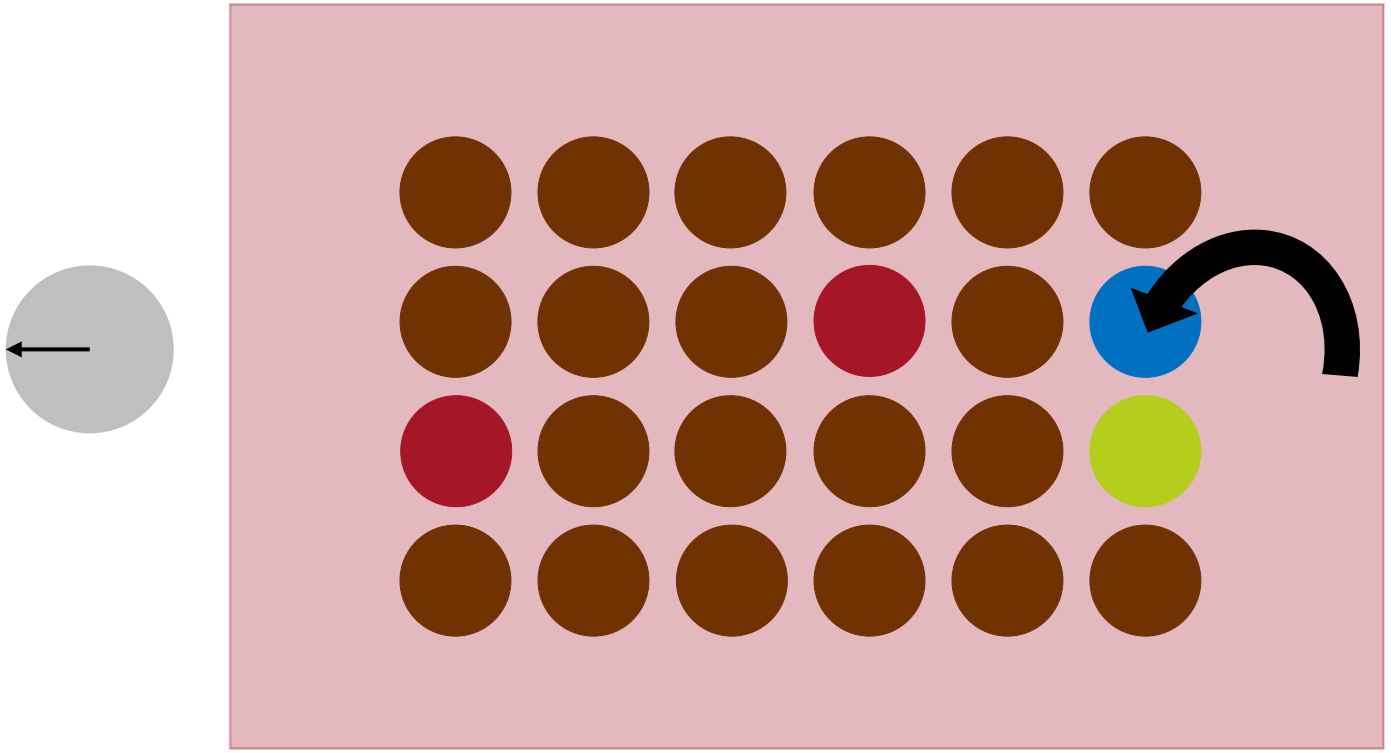

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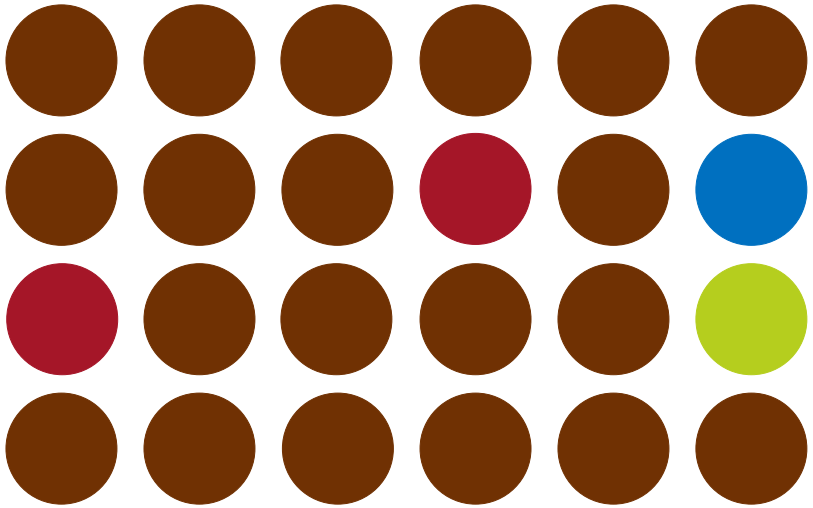

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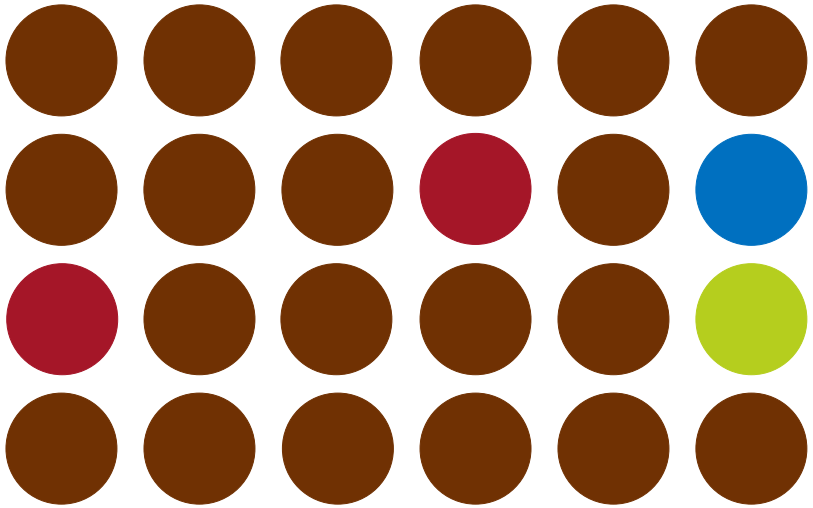
diversidade



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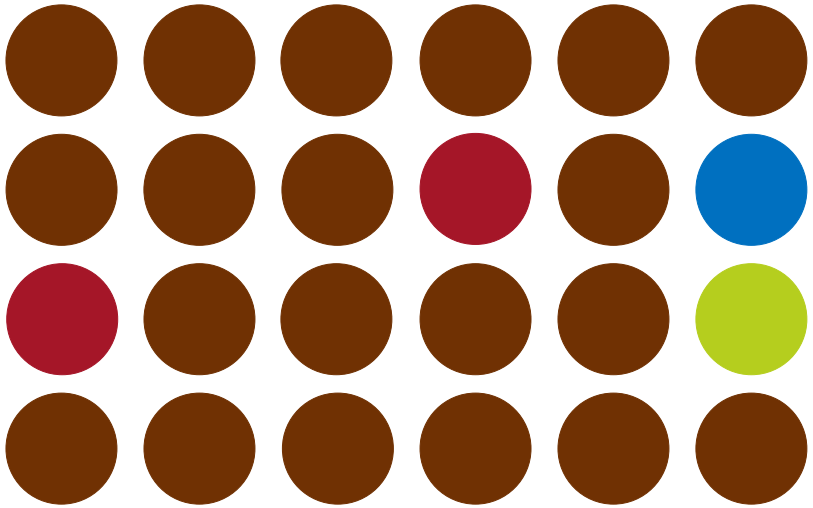

dinâmica ecológica

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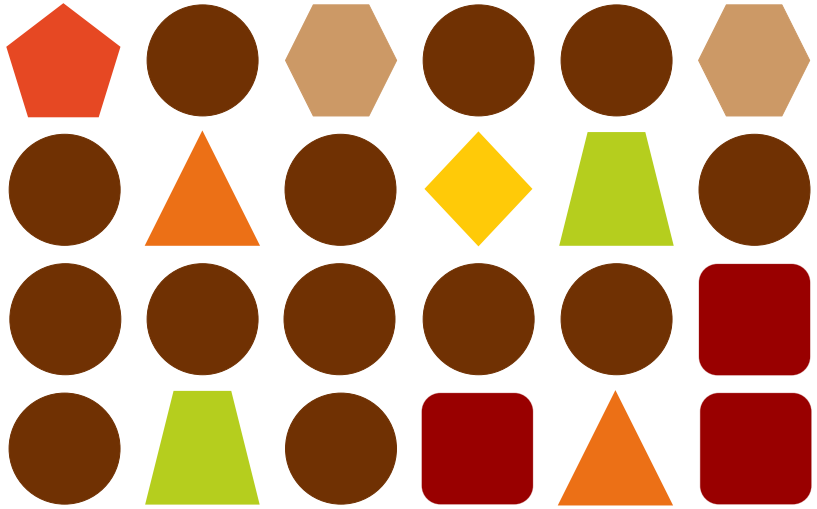

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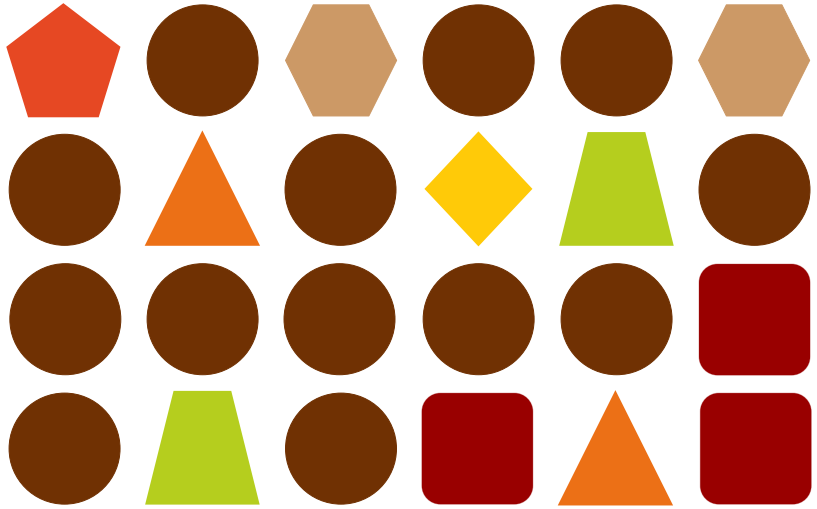

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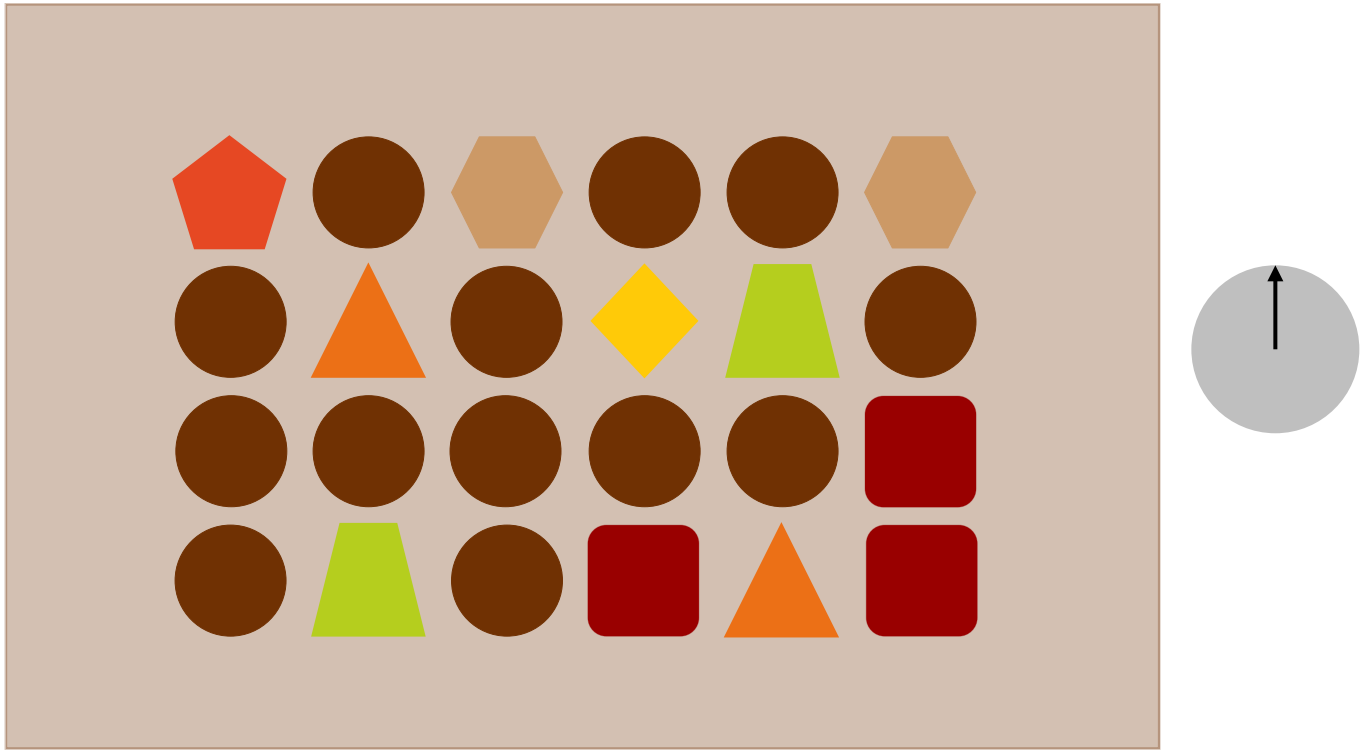

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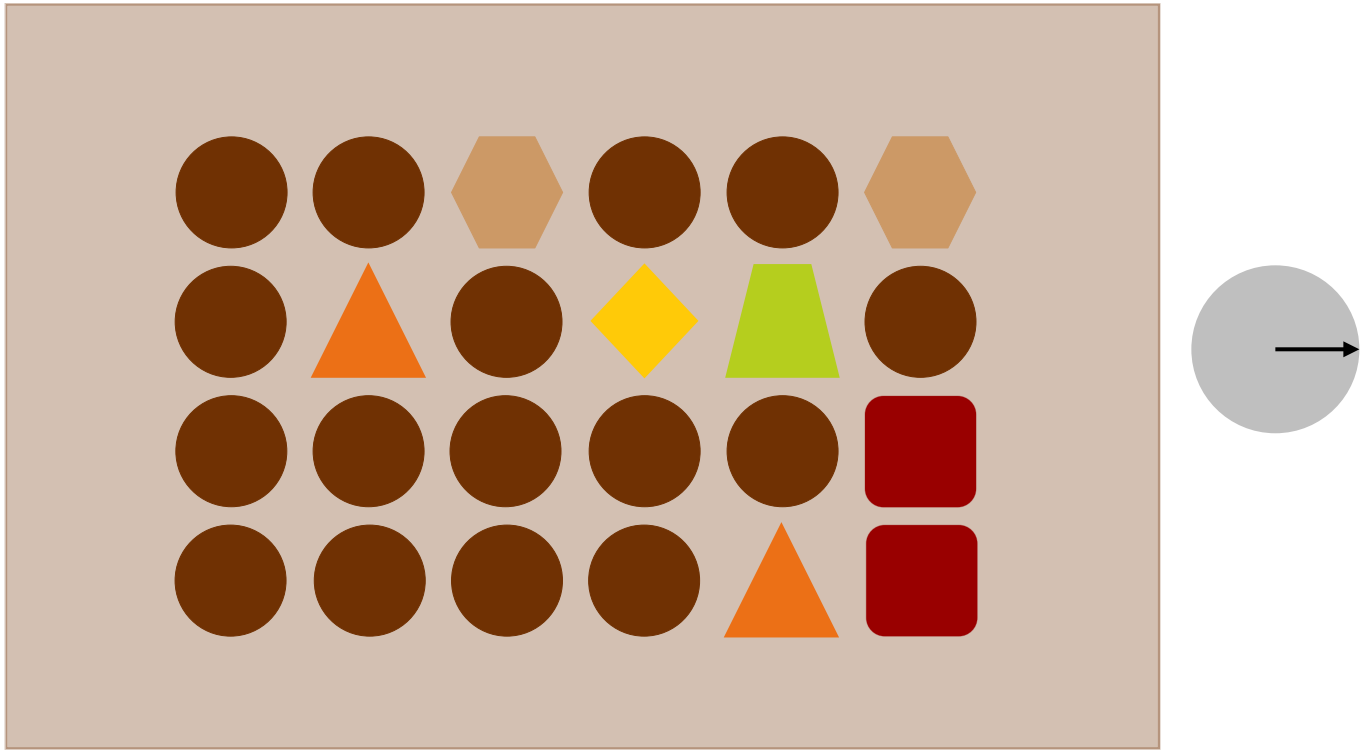

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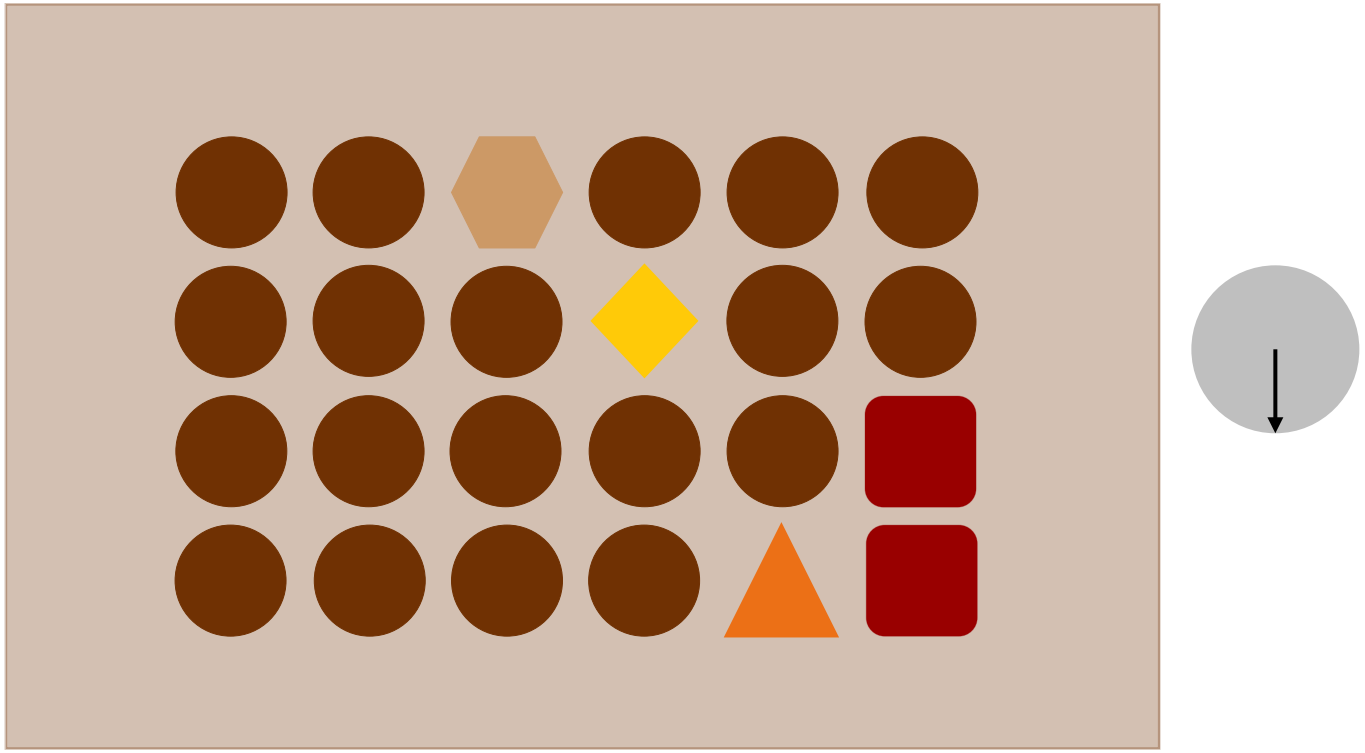

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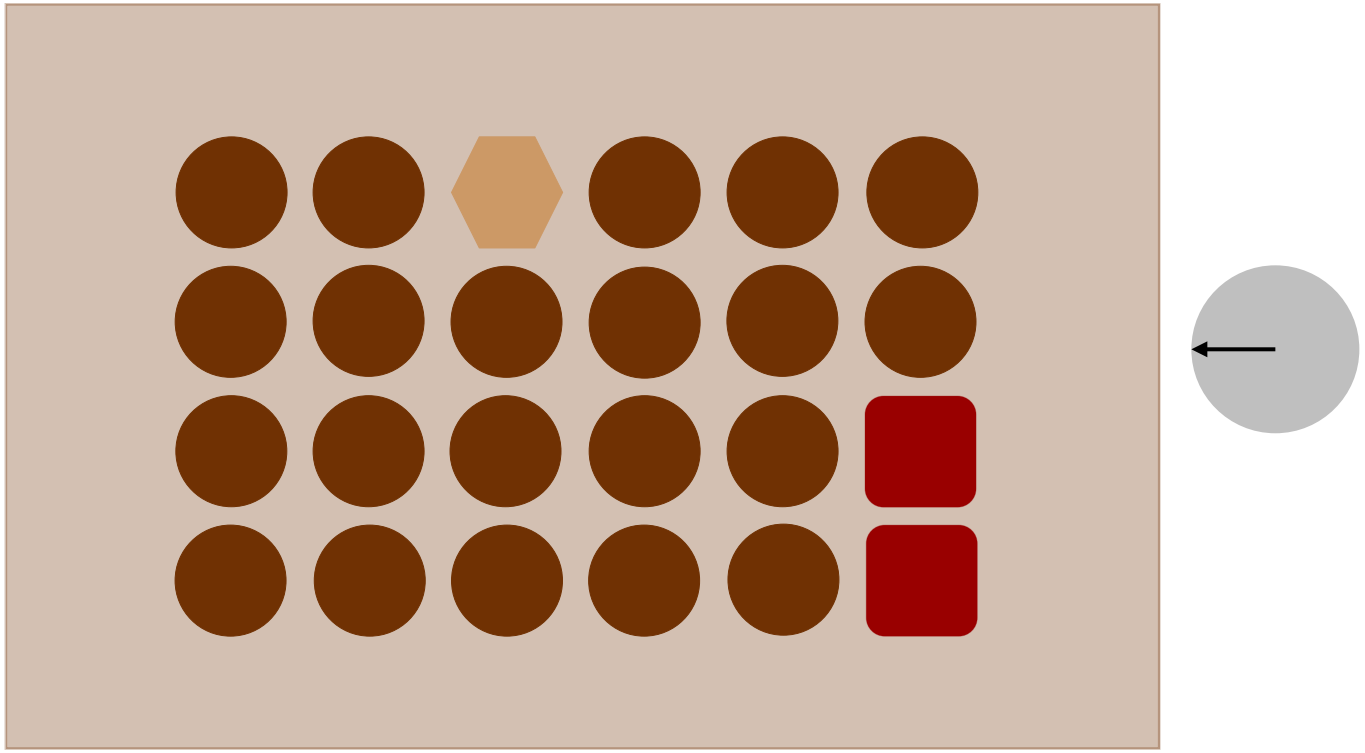

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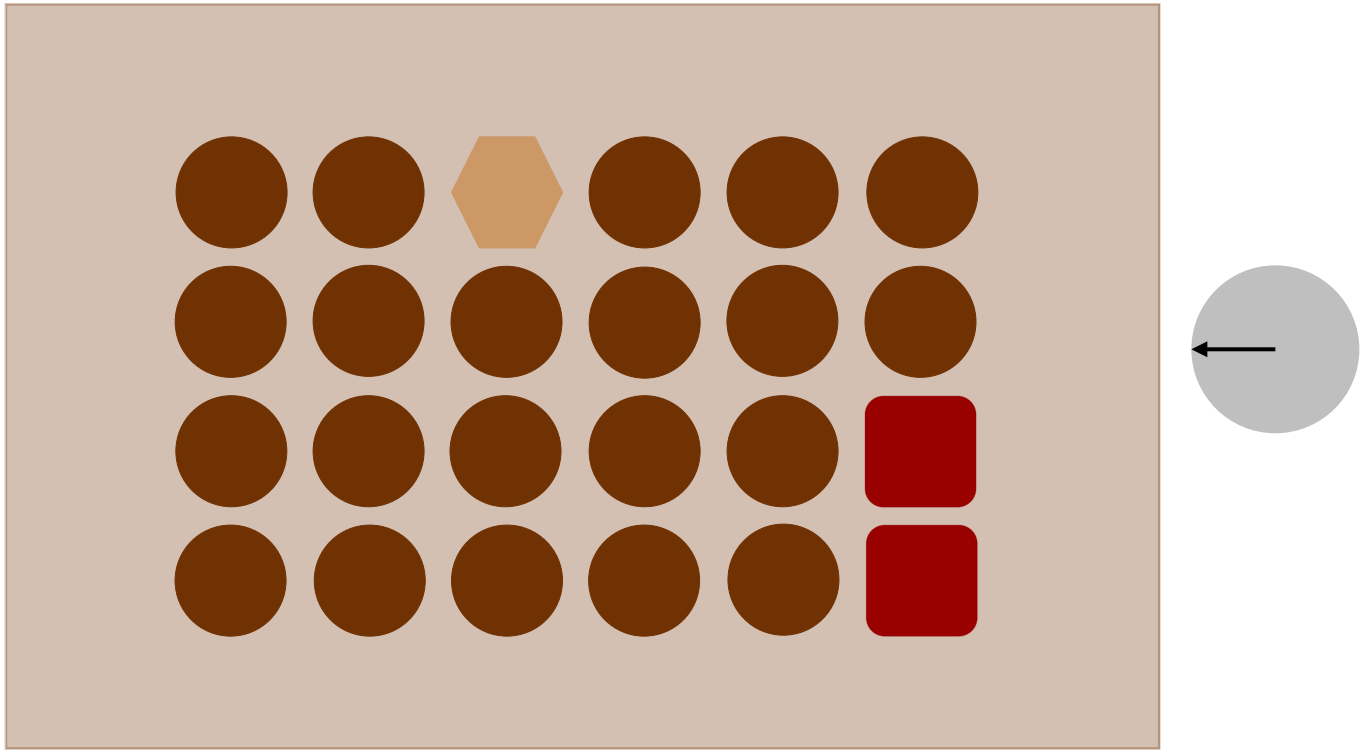

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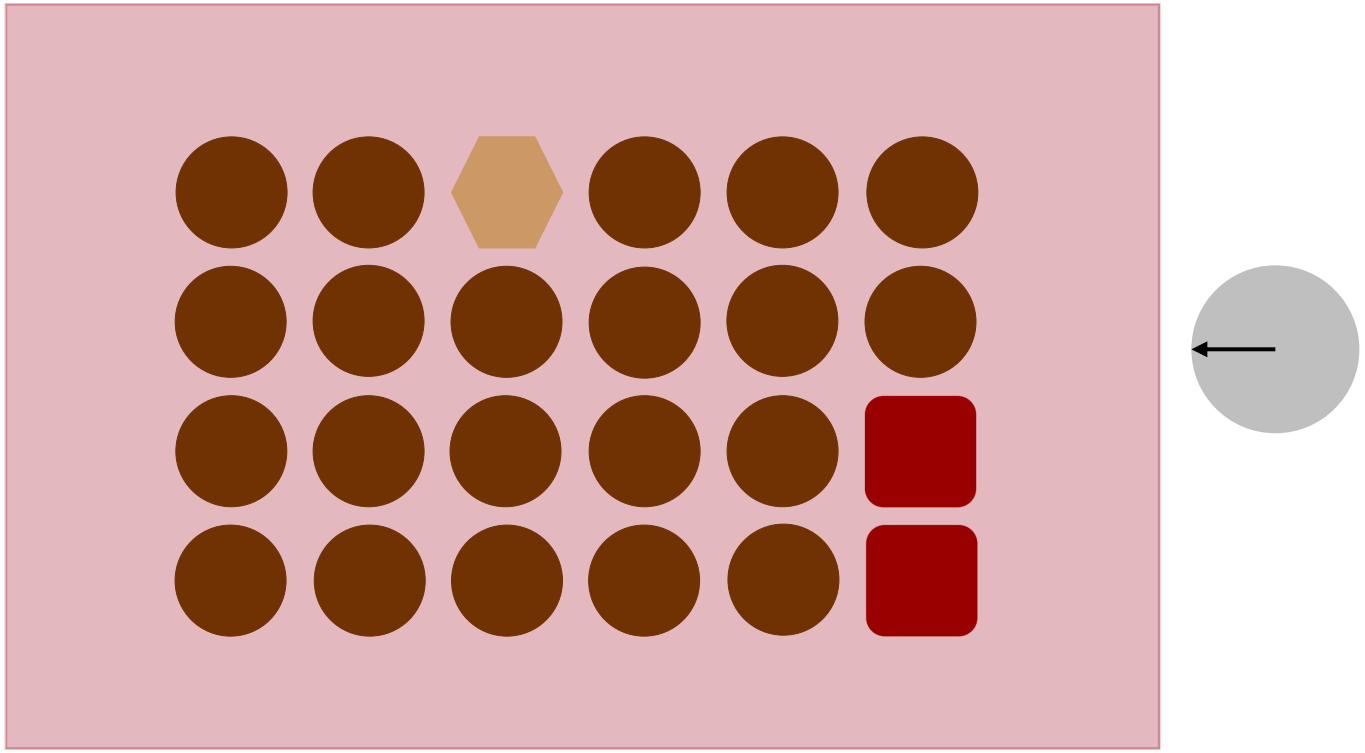

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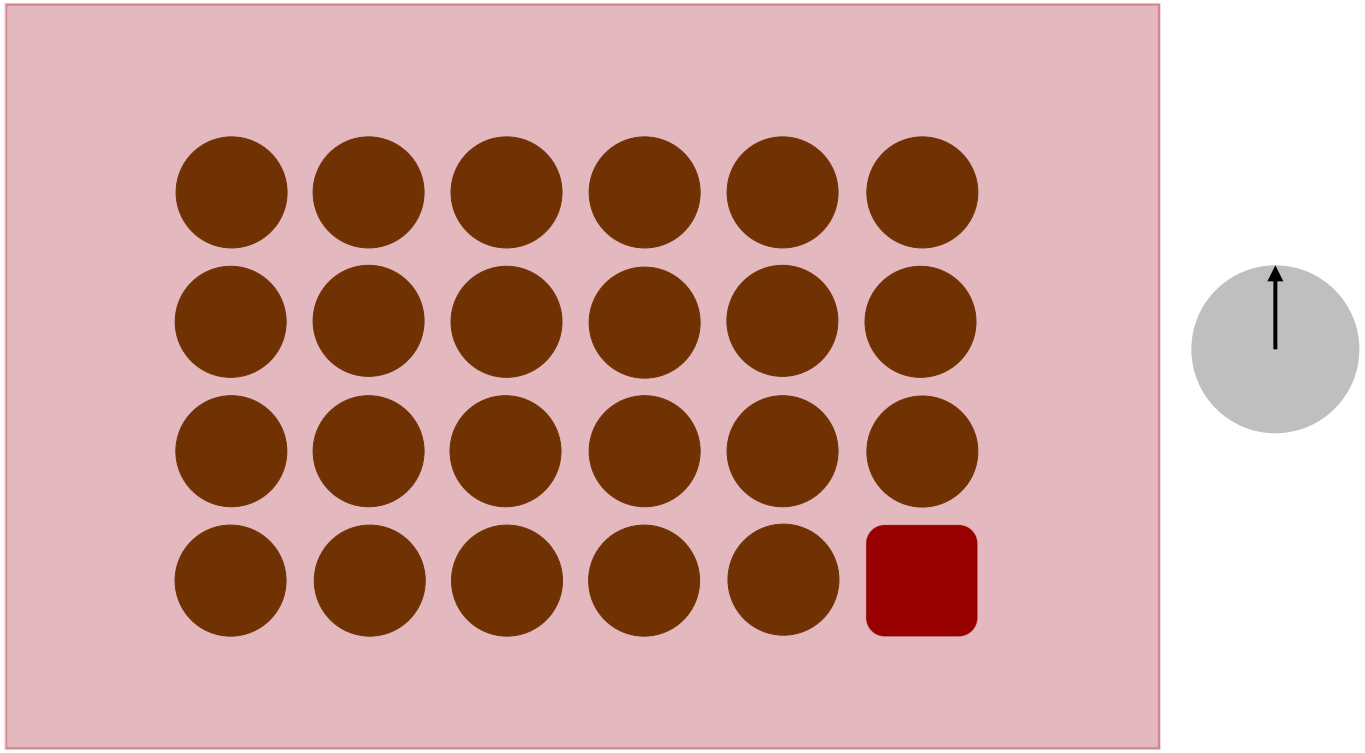

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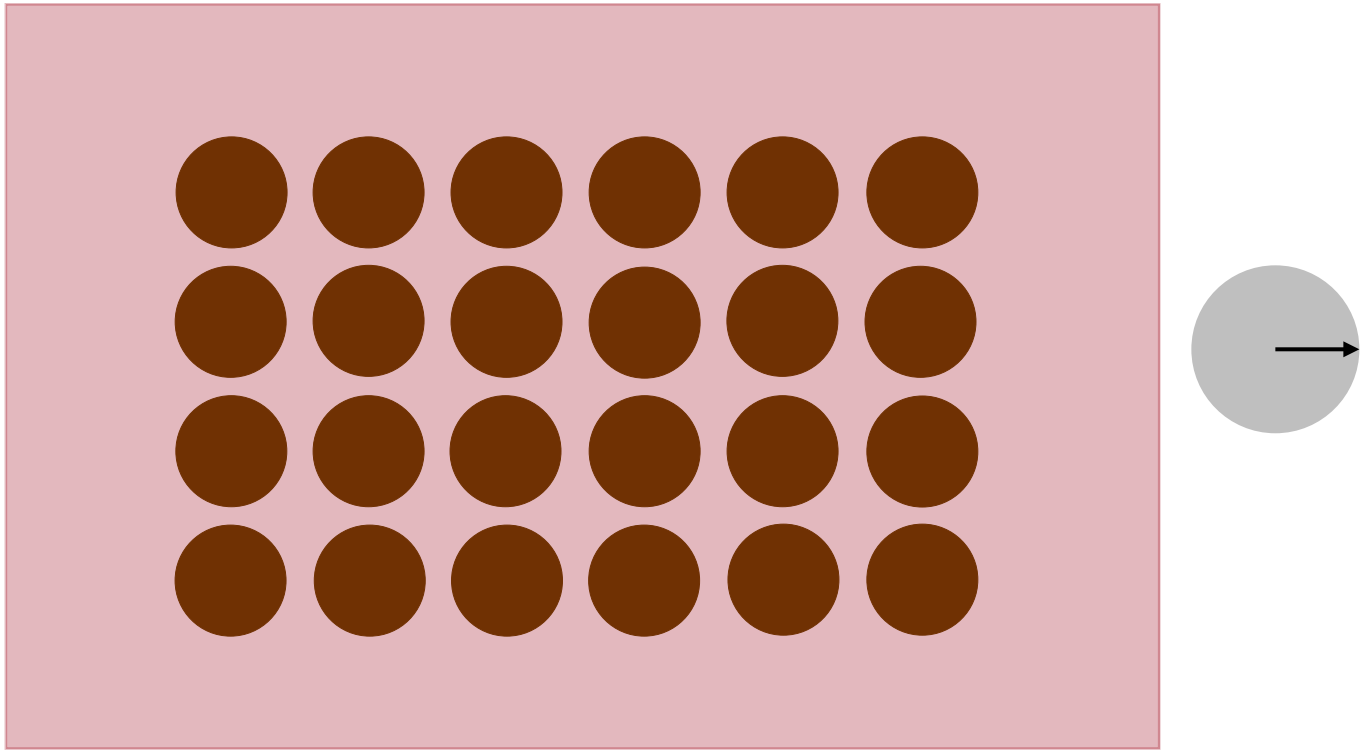

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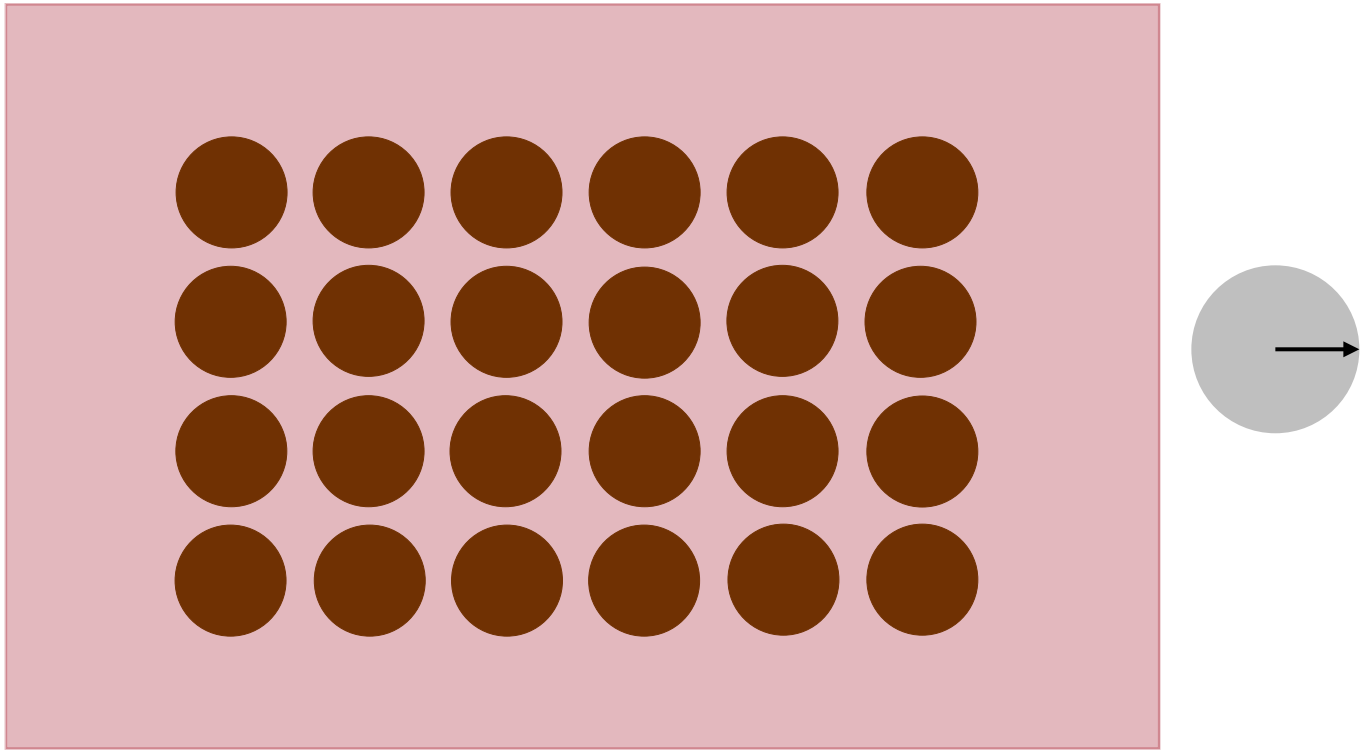

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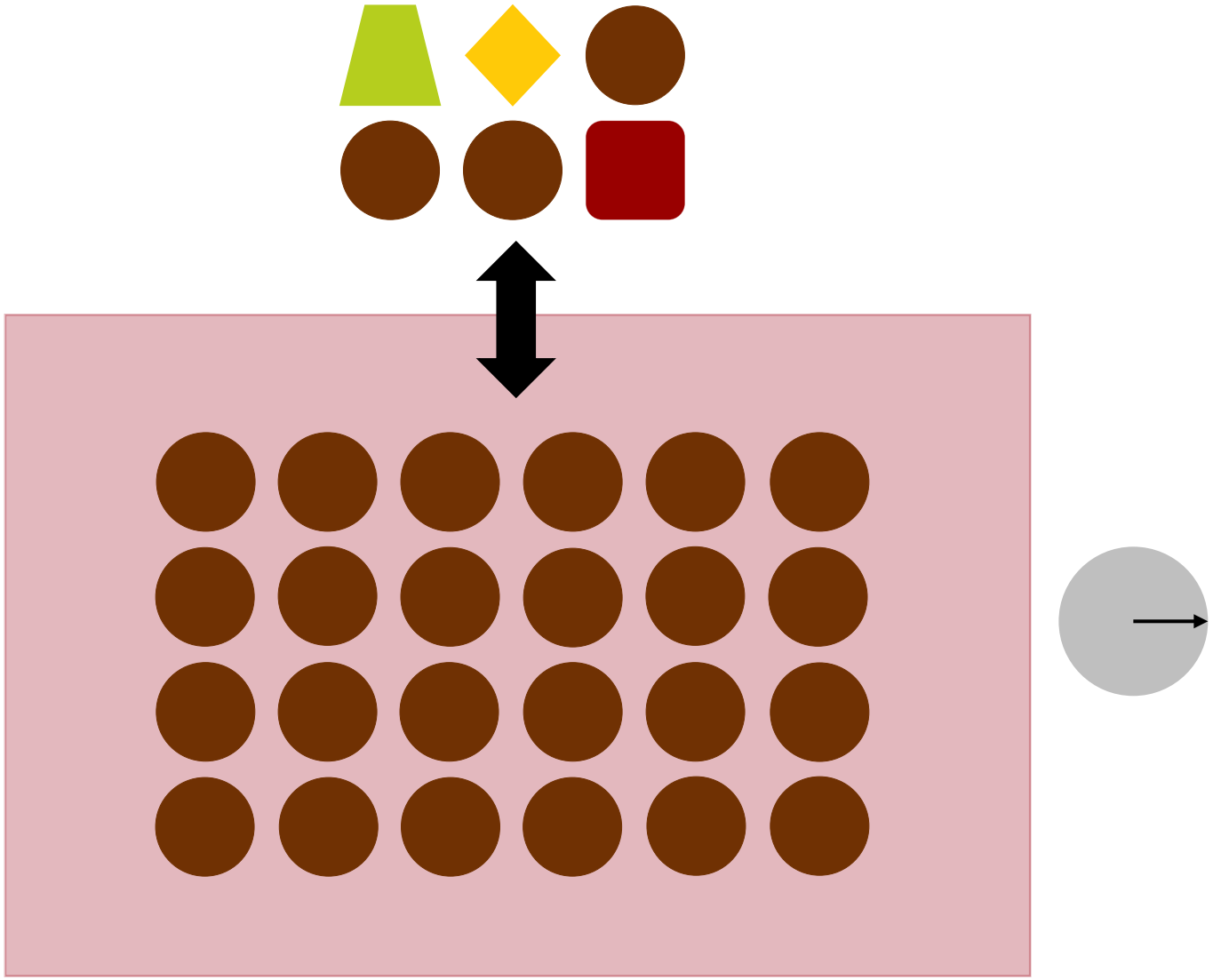

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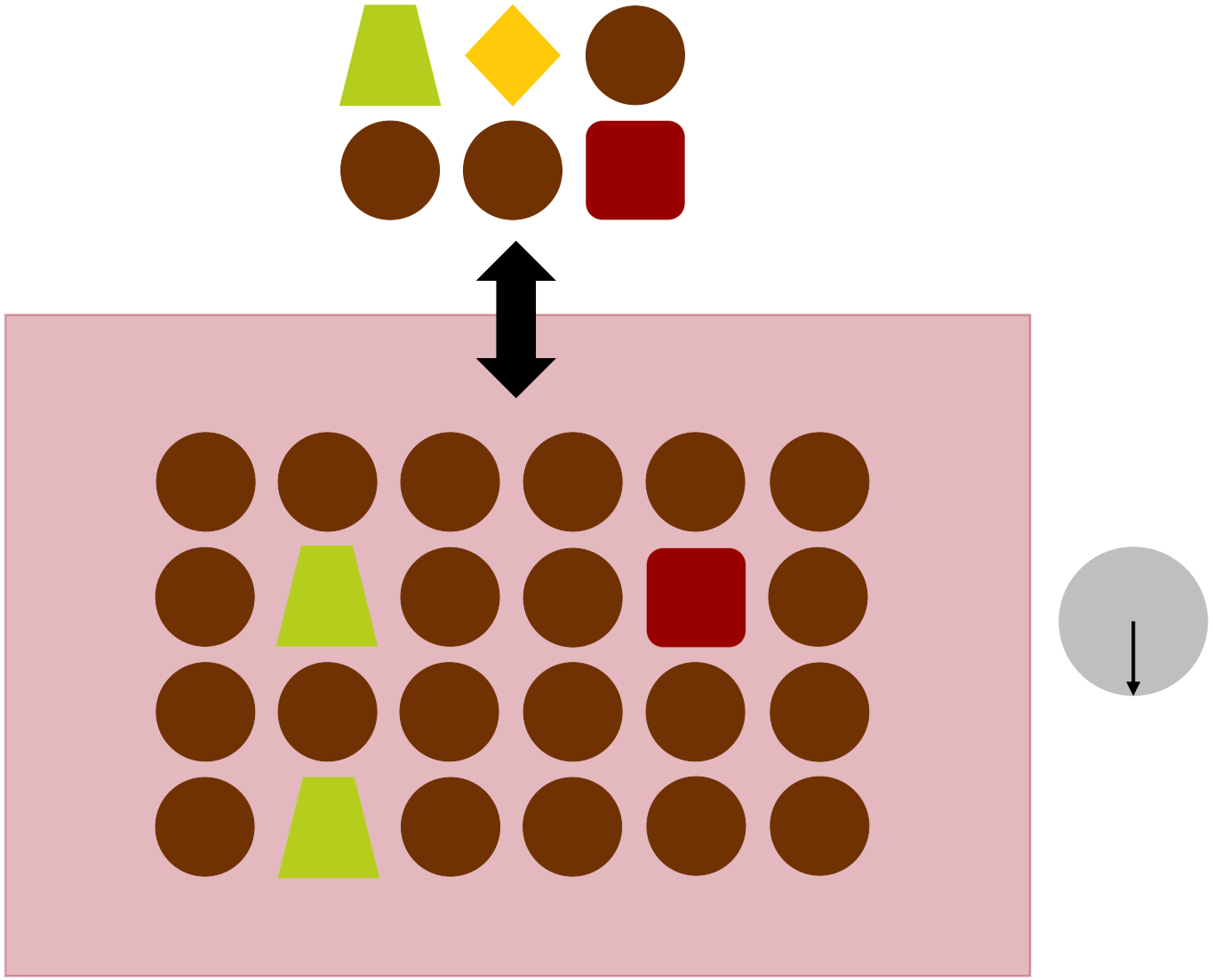

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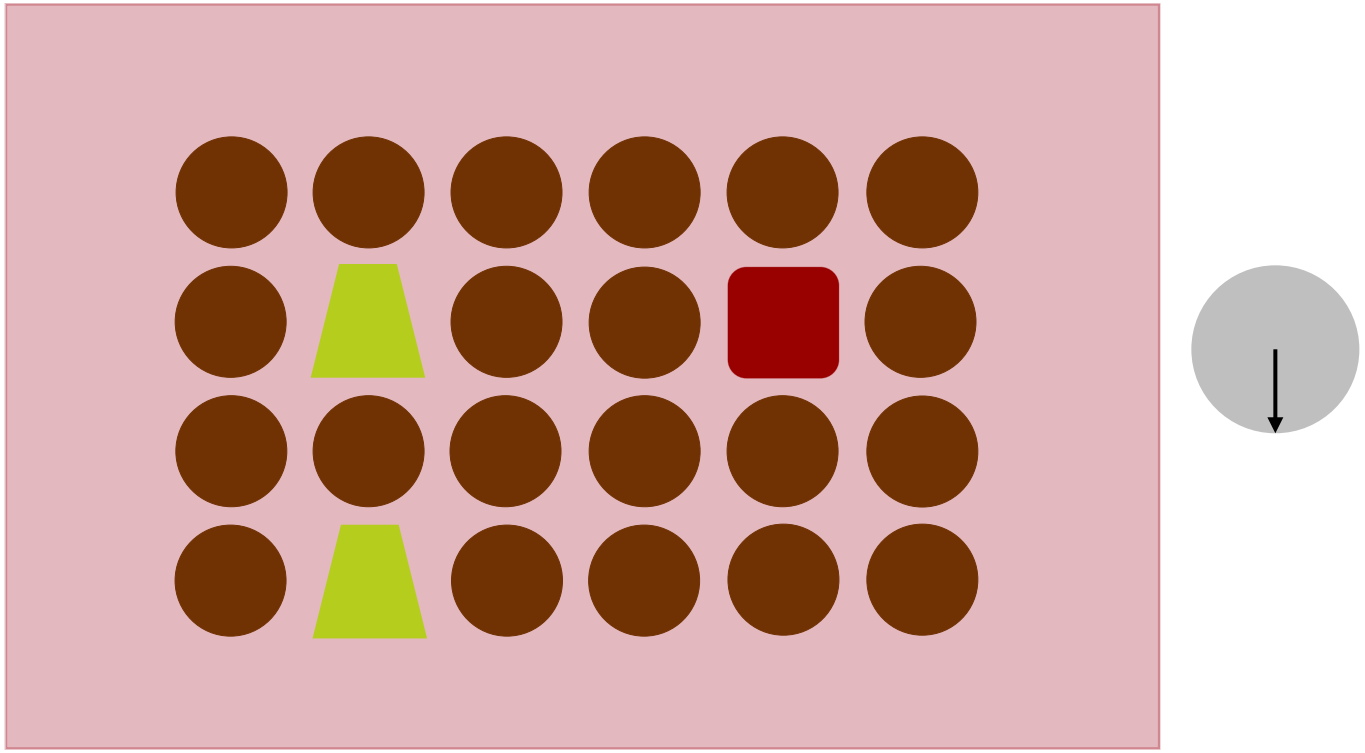

- filtragem ecológica
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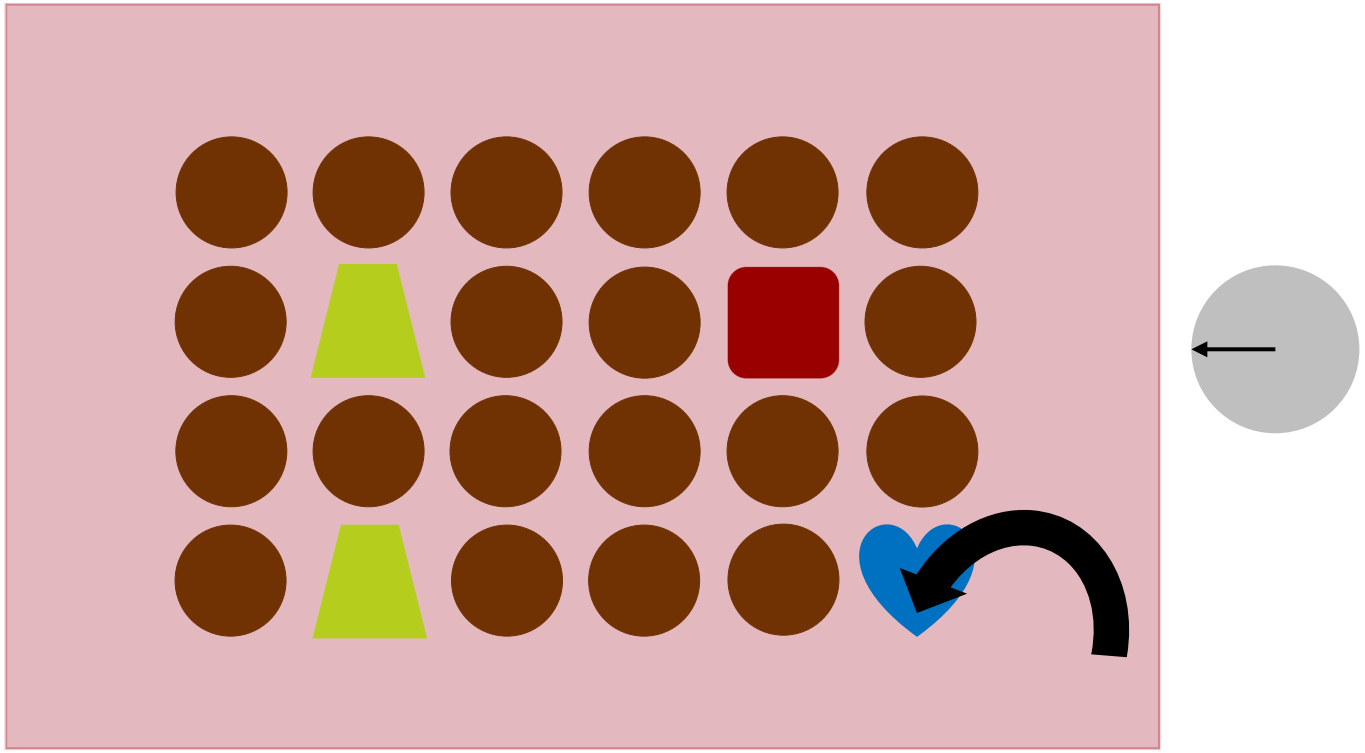
- **especiação**

dinâmica ecológica



- filtragem ecológica
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- **especiação**

dinâmica ecológica

diversidade

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- migração
- especiação

dinâmica ecológica

diversidade

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- deriva ecológica

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dinâmica evolutiva

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diversidade

diversidade

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dinâmica evolutiva ⟷ dinâmica ecológica

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dinâmica
eco-evolutiva

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dinâmica eco-evolutiva

dinâmica evolutiva ⟷ dinâmica ecológica

melhores competidores = mais aptos

- seleção
- deriva genética
- fluxo gênico
- mutação

- filtragem ecológica
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- migração
- especiação

dinâmica eco-evolutiva

dinâmica evolutiva ⟷ dinâmica ecológica

- seleção → filtragem ecológica
- deriva genética
- fluxo gênico
- mutação

- filtragem ecológica
- deriva ecológica
- migração
- especiação

dinâmica eco-evolutiva

dinâmica evolutiva ⟷ dinâmica ecológica

mudança nos atributos = mudança nas interações

- seleção → filtragem ecológica
- deriva genética → deriva ecológica
- fluxo gênico → migração
- mutação → especiação

dinâmica
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dinâmica eco-evolutiva

dinâmica evolutiva ⟷ dinâmica ecológica

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dinâmica eco-evolutiva

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dinâmica
evolutiva

dinâmica
ecológica

estratégia de vida

dinâmica
eco-evolutiva

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evolutiva

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ecológica

estratégia de vida

dinâmica
eco-evolutiva

dinâmica
evolutiva

dinâmica
ecológica

estratégia de vida

aptidão

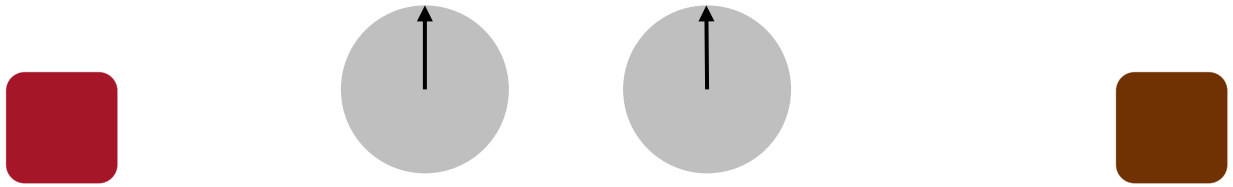
habilidade
competitiva

estratégia de vida

sobrevivência ⟷ reprodução

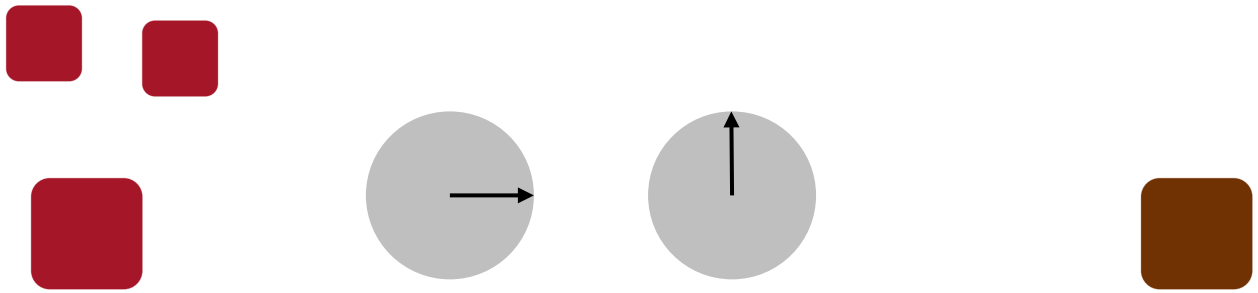
estratégia de vida

sobrevivência ⟷ reprodução



estratégia de vida

sobrevivência ⟷ reprodução



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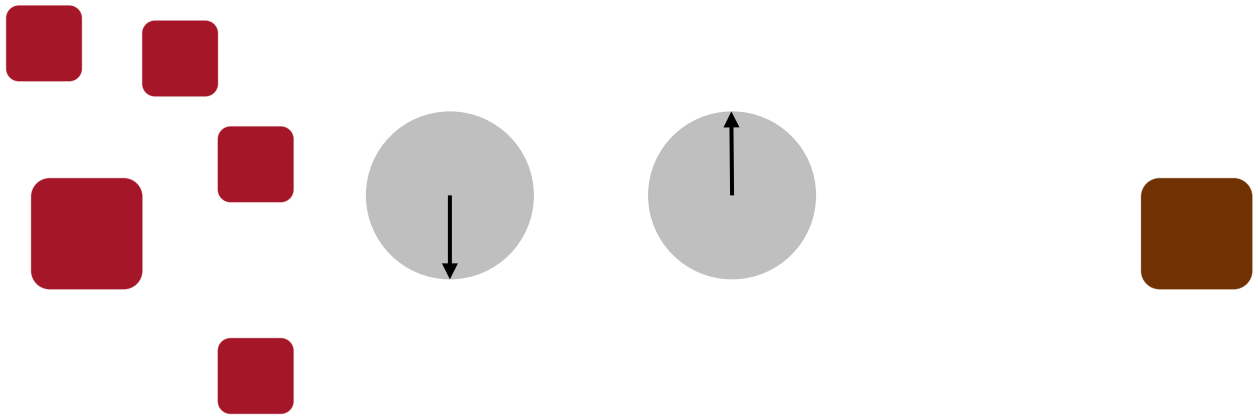

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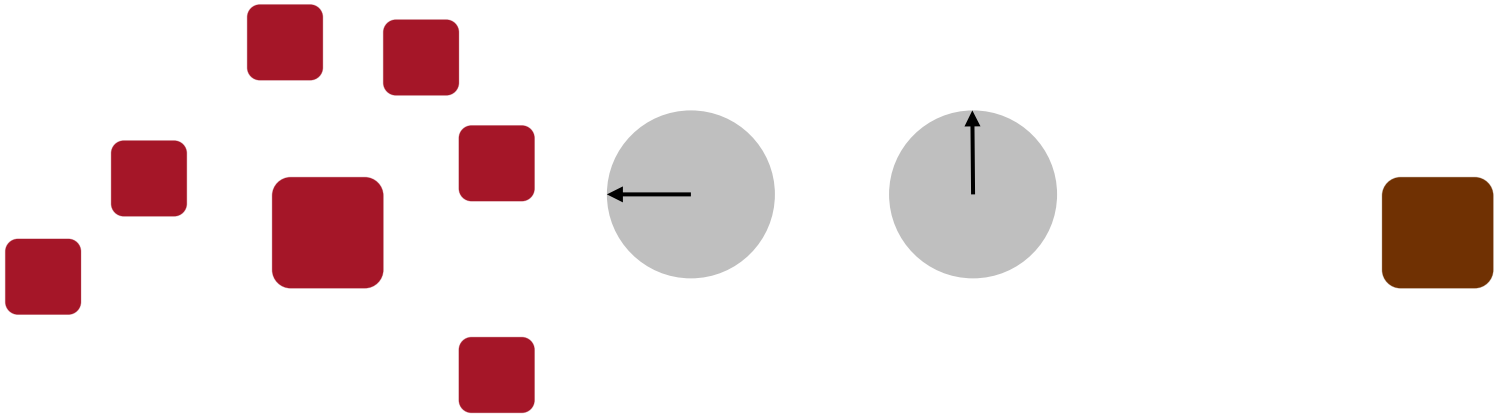

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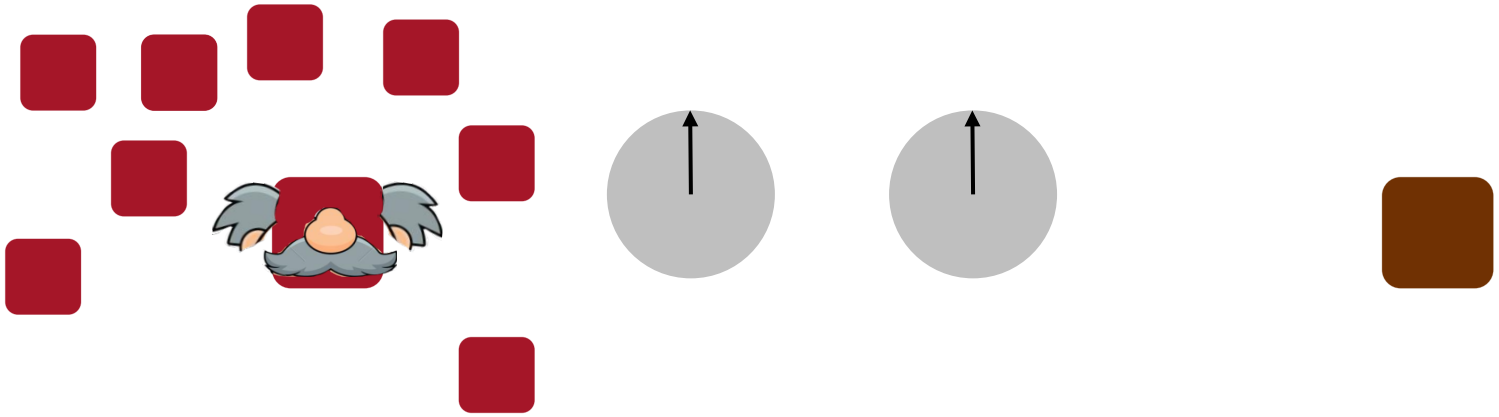

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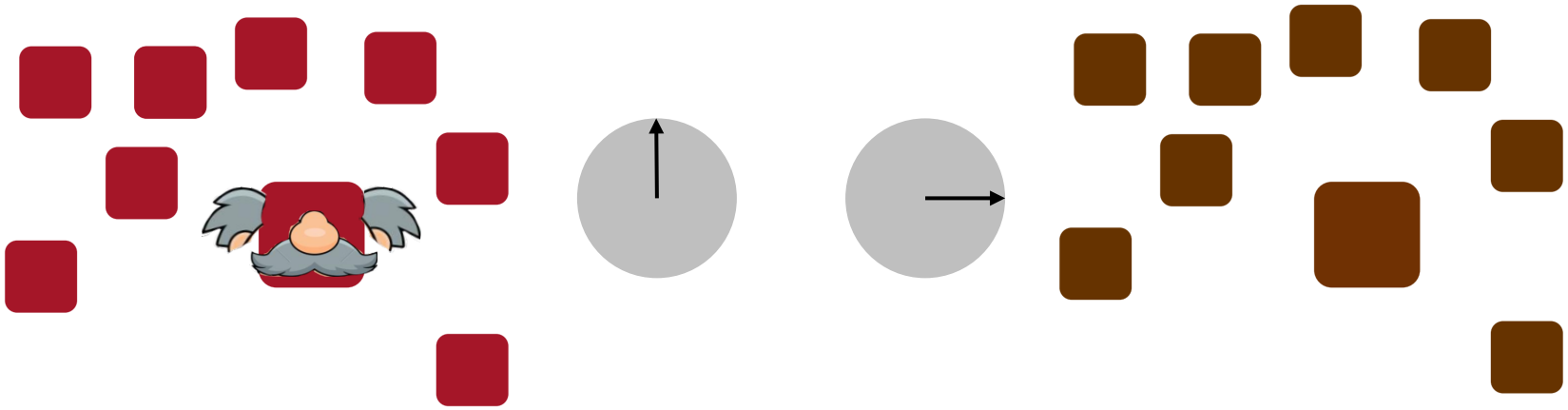

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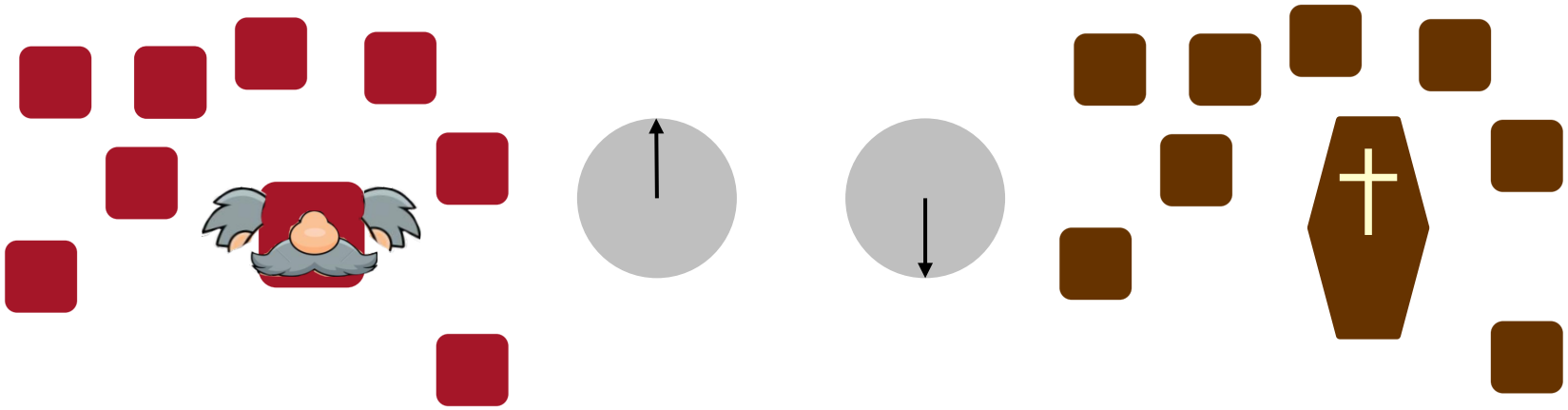

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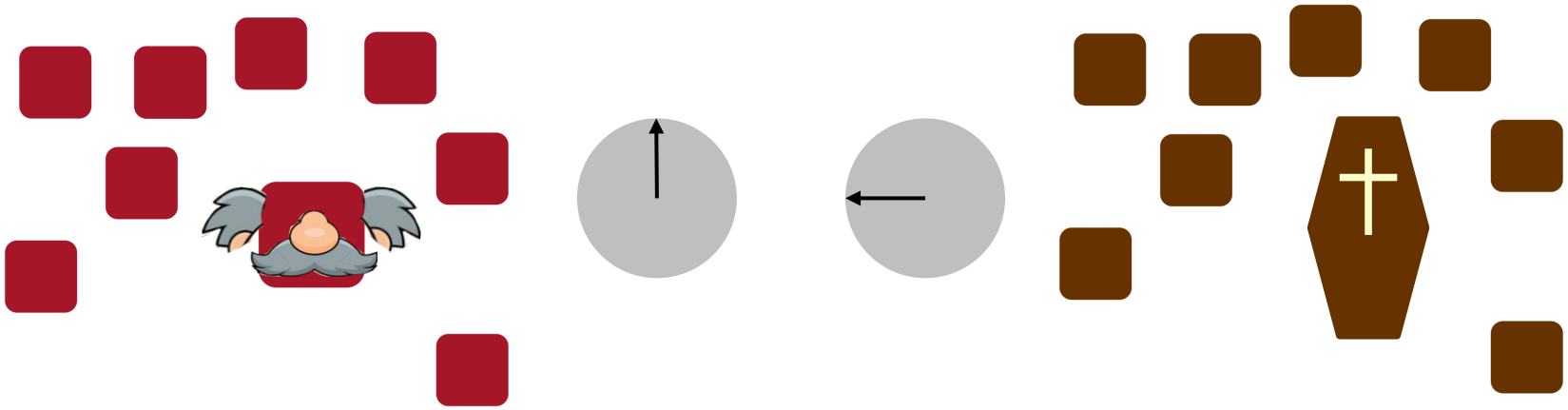

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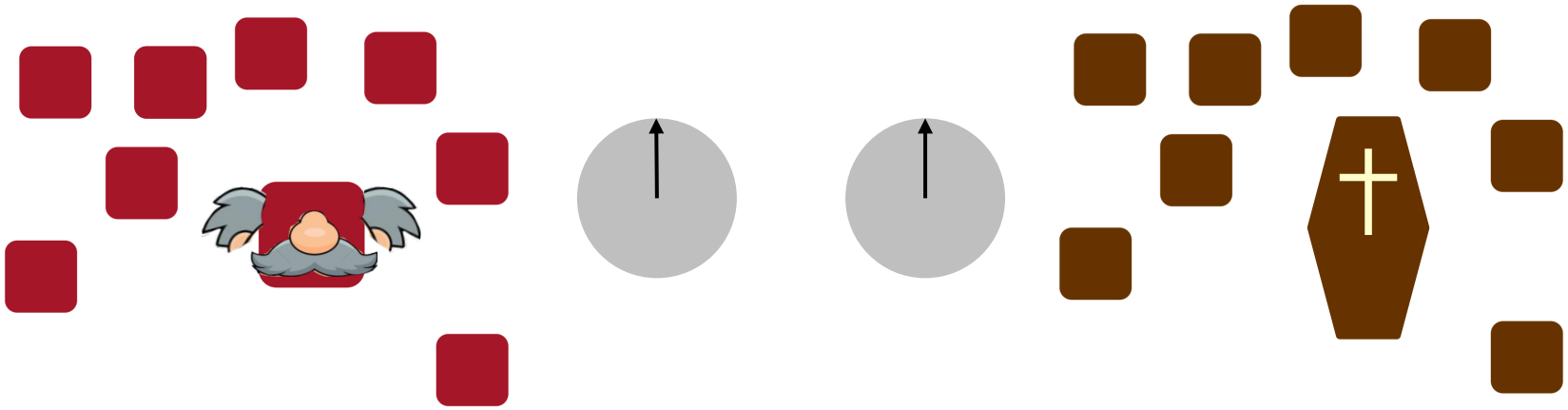

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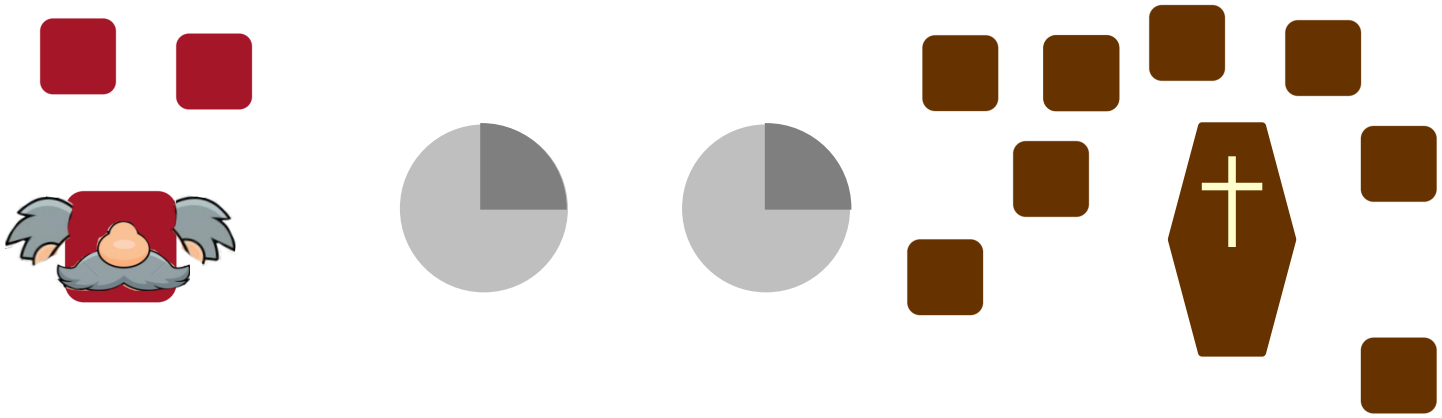


estratégia de vida

estratégia de vida

aptidão

estratégia de vida

número de
descendentes

estratégia de vida

número de descendentes

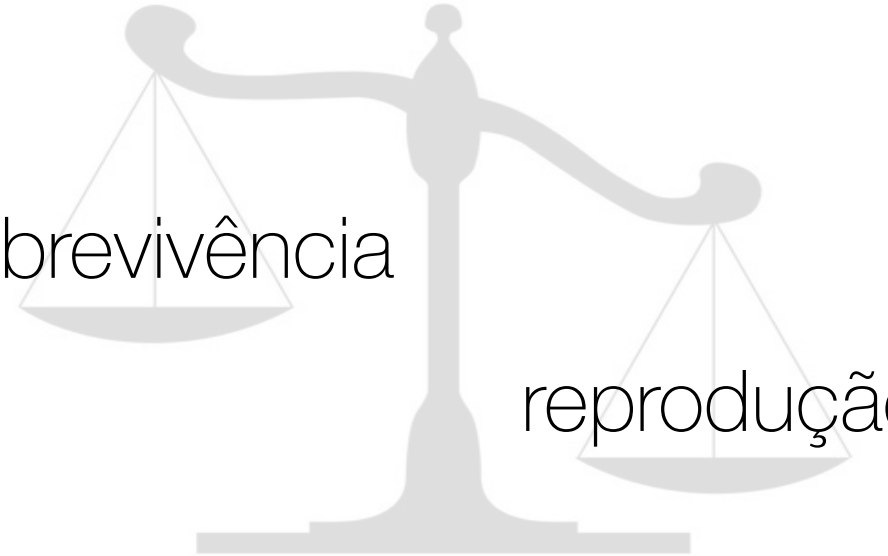
habilidade competitiva

estratégia de vida

número de descendentes

uso eficiente do recurso

estratégia de vida



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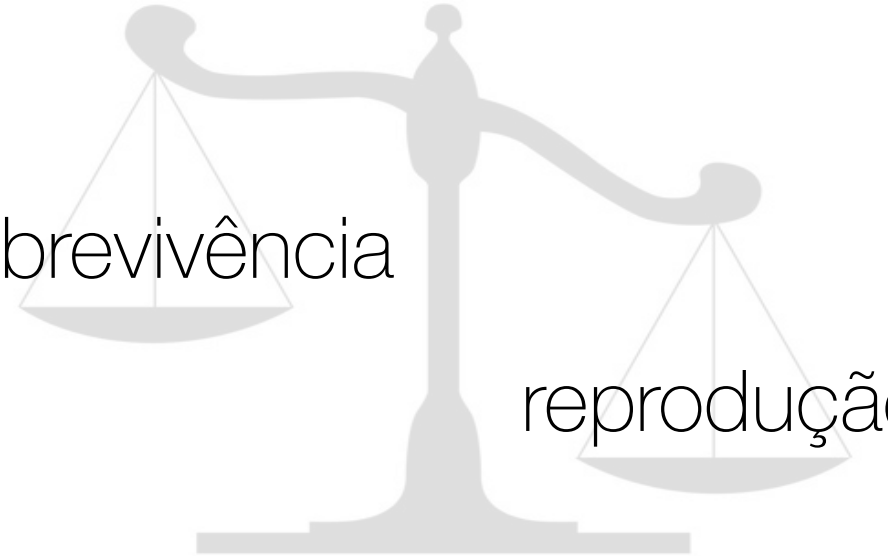
reprodução



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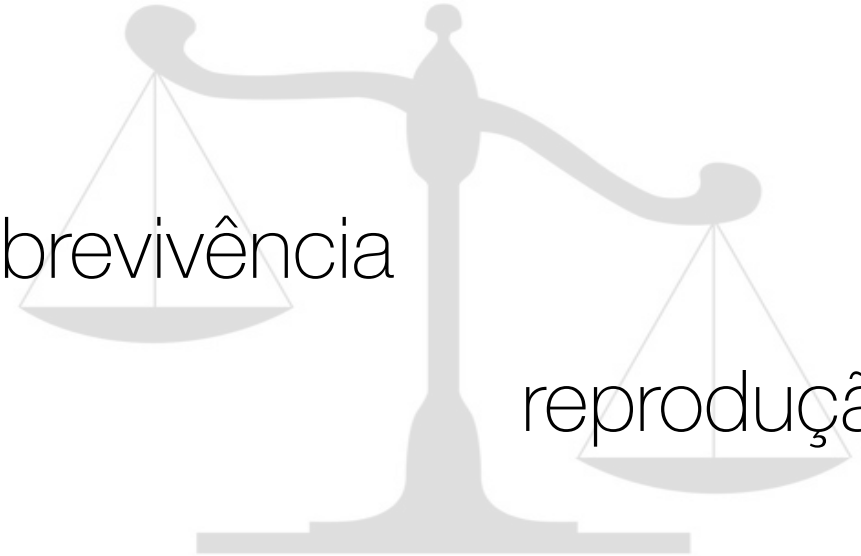
reprodução

fatores ambientais



sobrevivência

reprodução

recurso

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recurso

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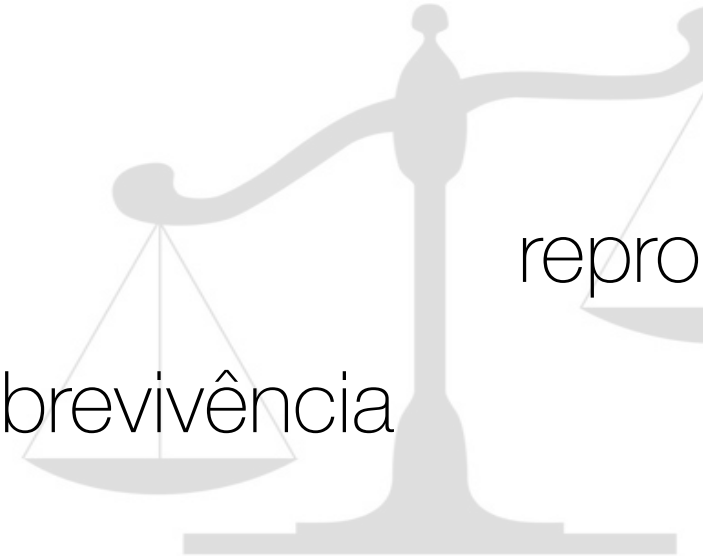
sobrevivência

distúrbio

recurso

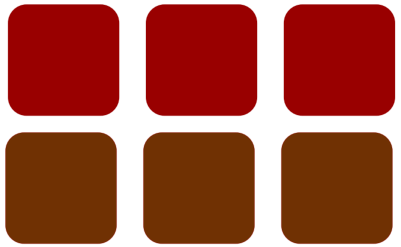


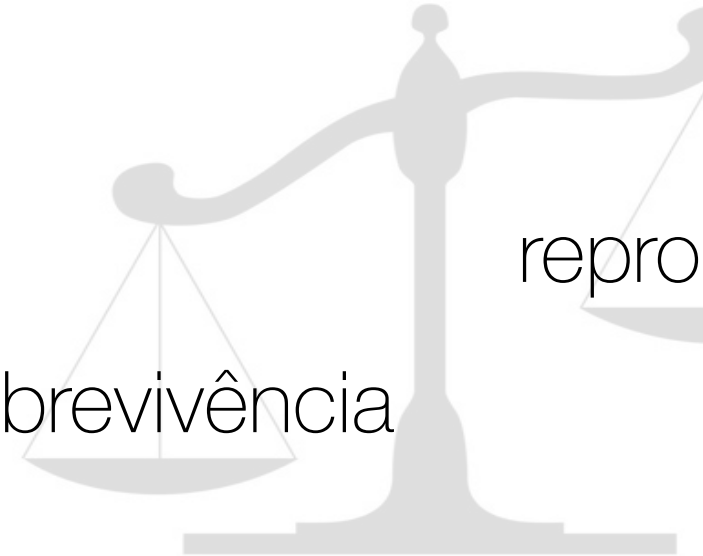
reprodução

sobrevivência

distúrbio

recurso





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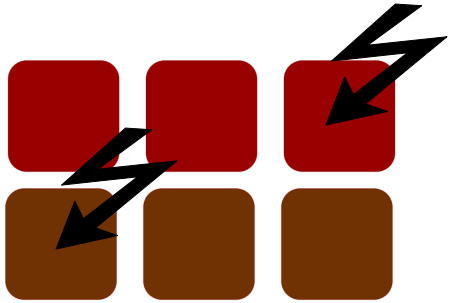
sobrevivência

distúrbio

recurso



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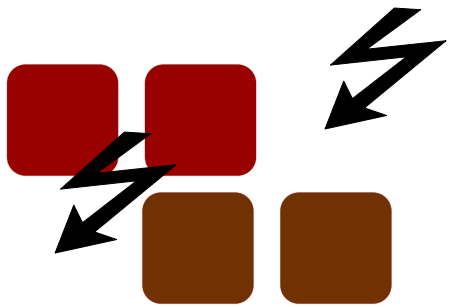

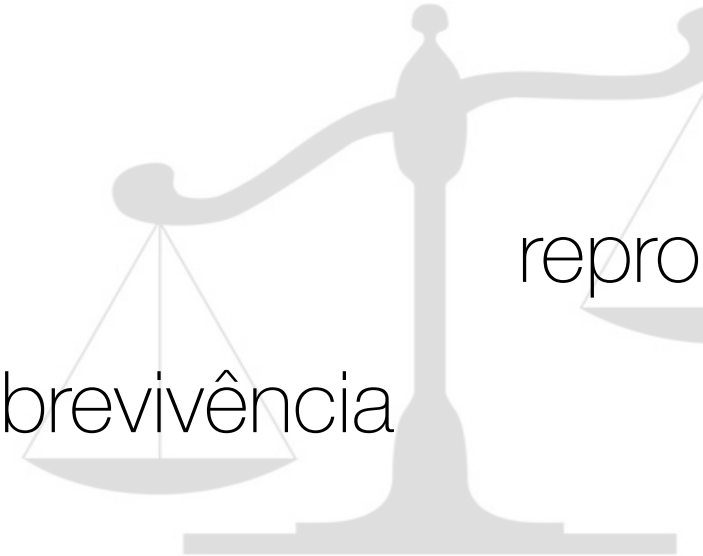

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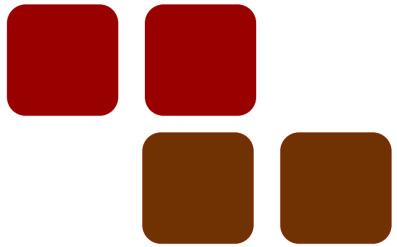

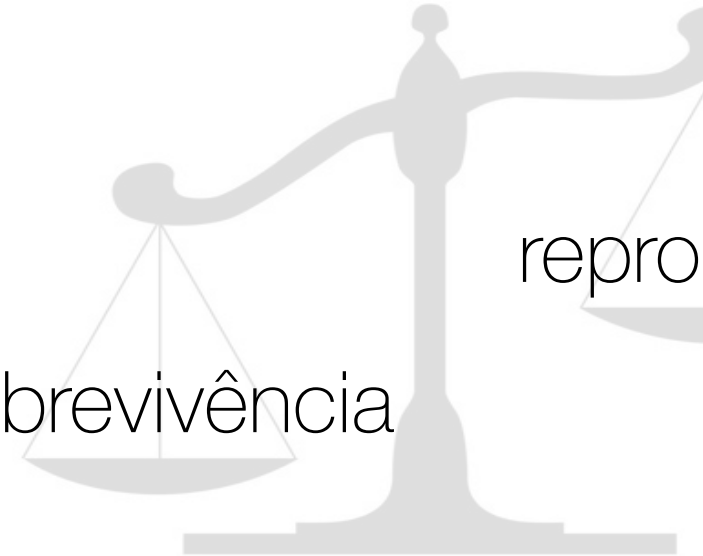

reprodução

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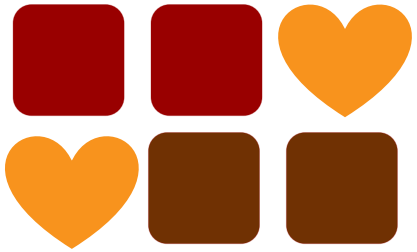

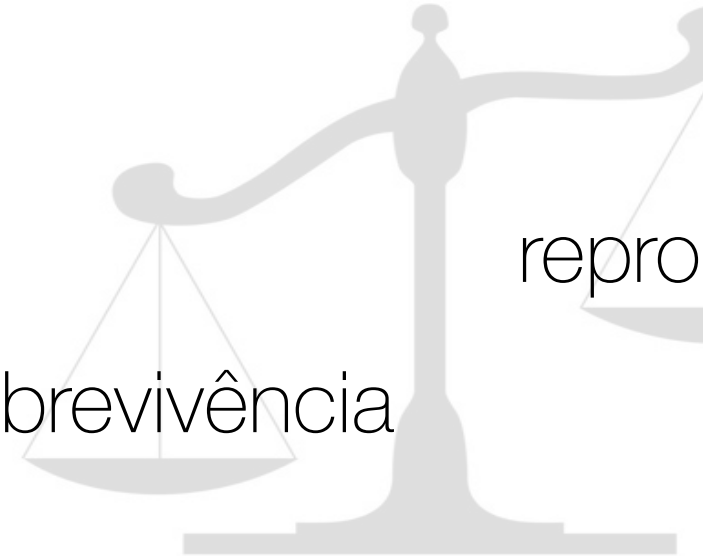

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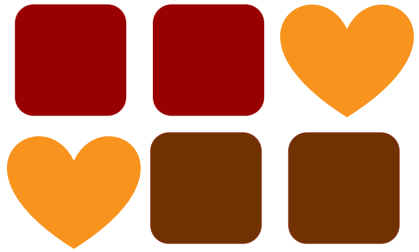

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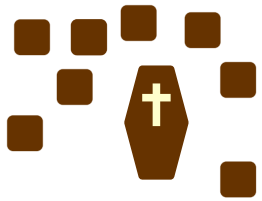

distúrbio

- abundância
- recurso

distúrbio

- abundância
- recurso

dinâmica evolutiva

- seleção
- deriva genética
- fluxo gênico
- mutação

dinâmica ecológica

- filtragem
- deriva ecológica
- migração
- especiação

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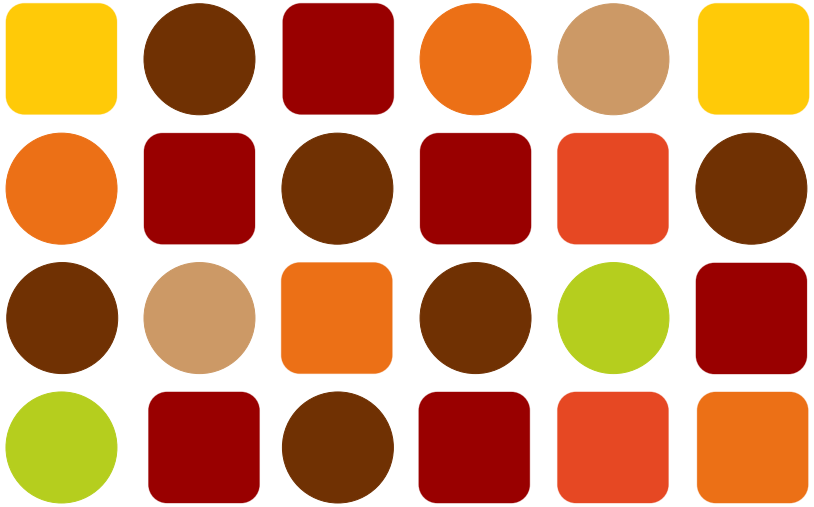

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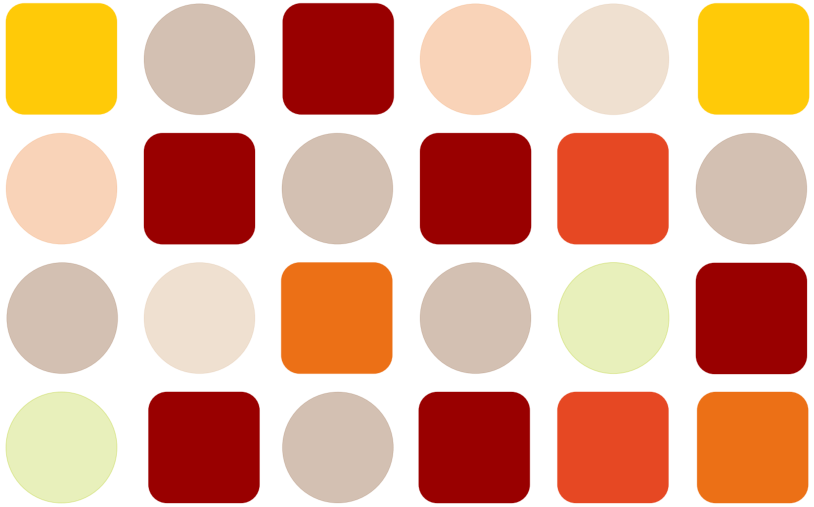

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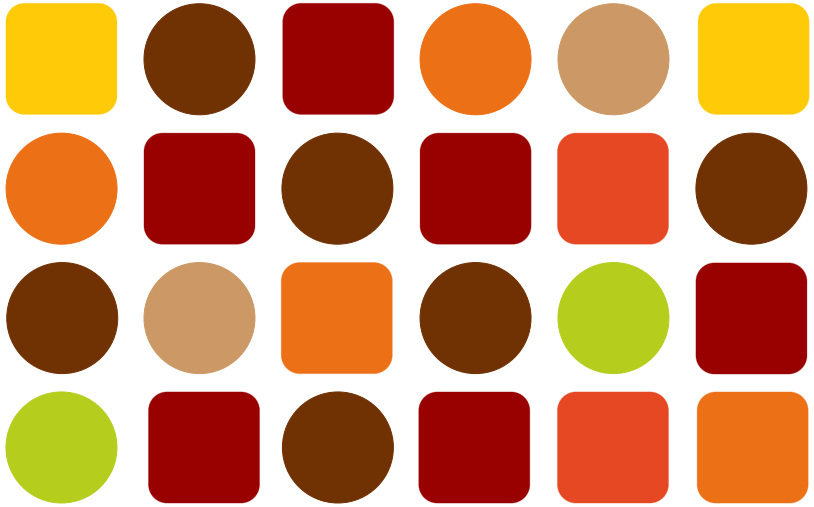

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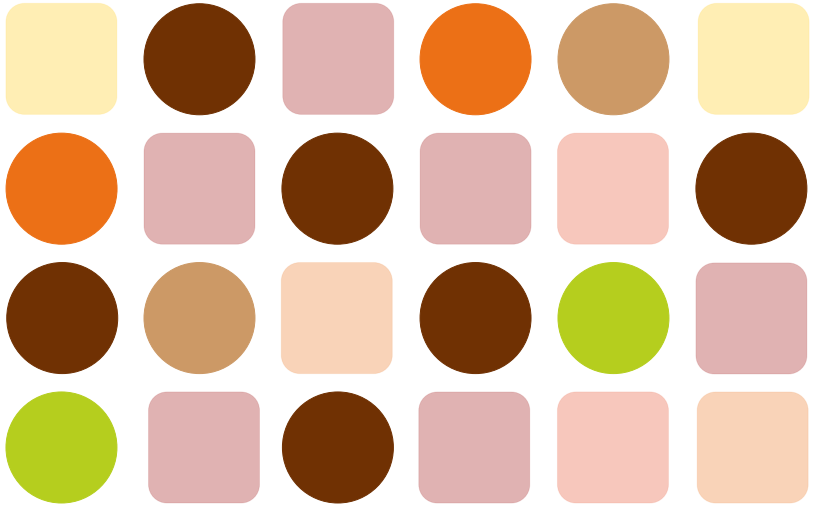

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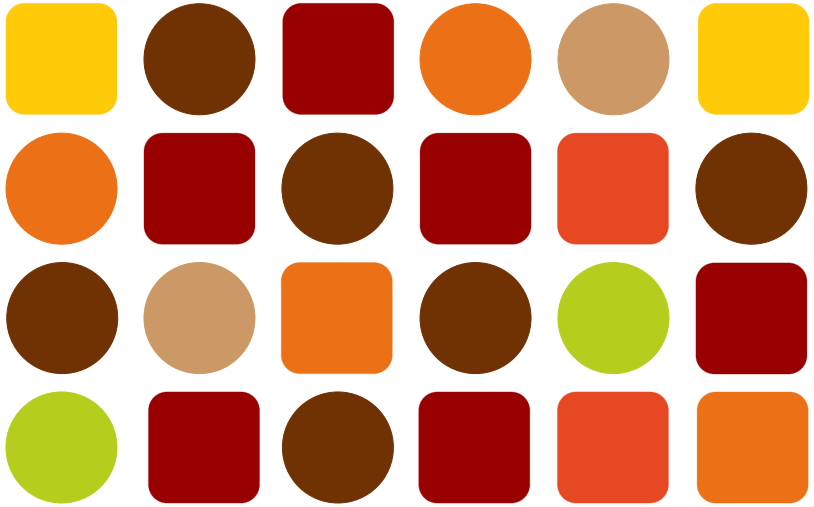

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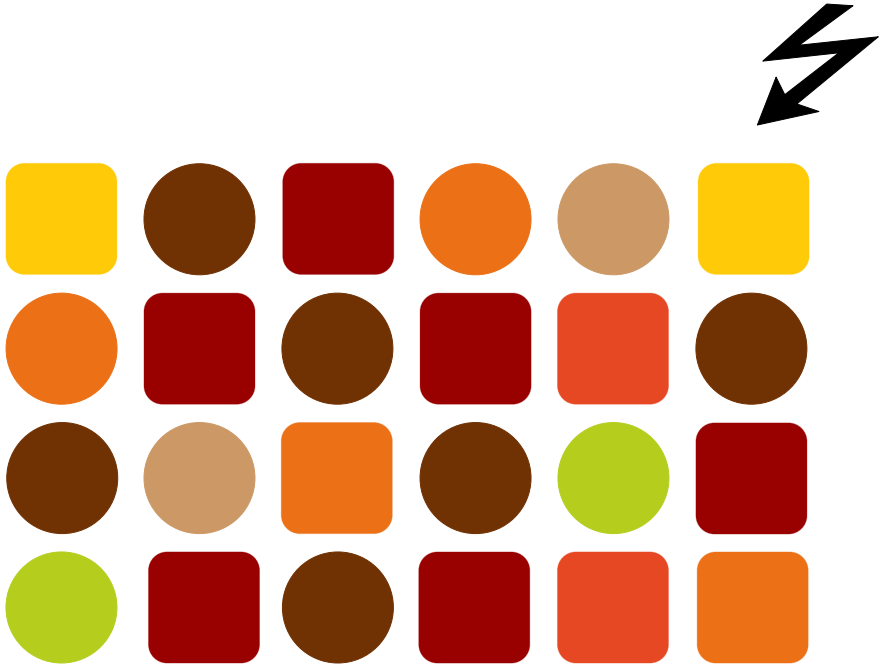

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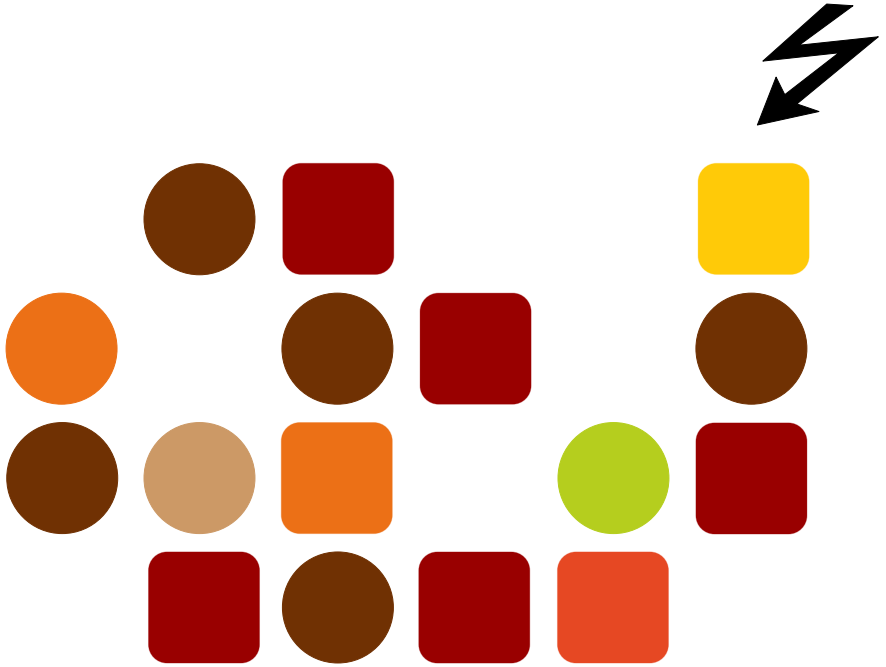

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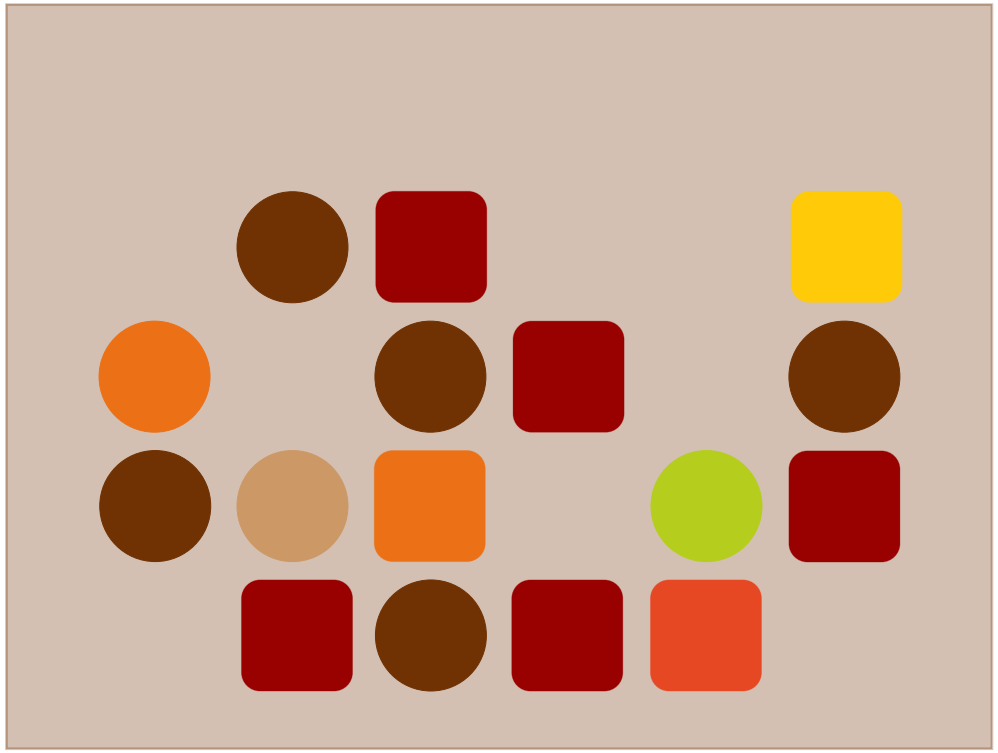

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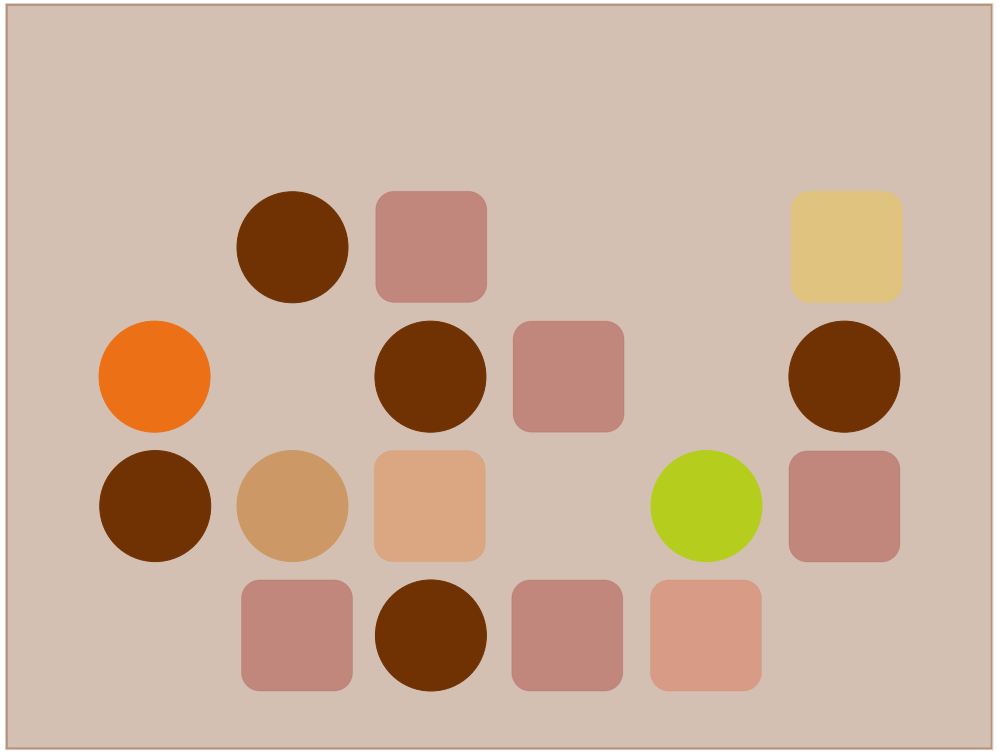

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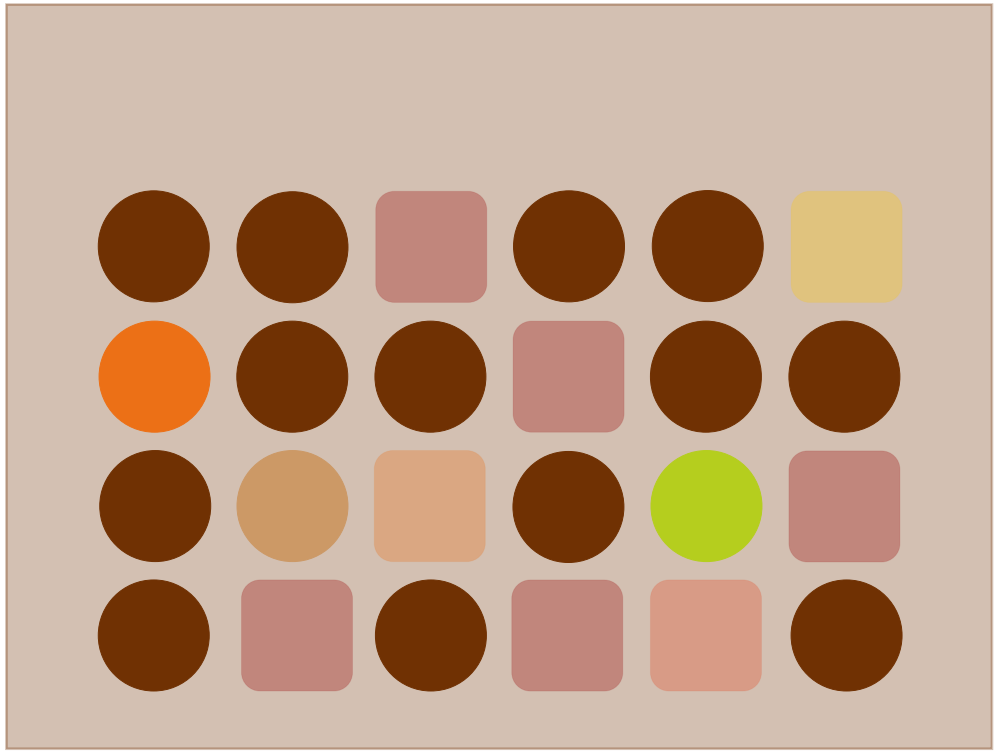

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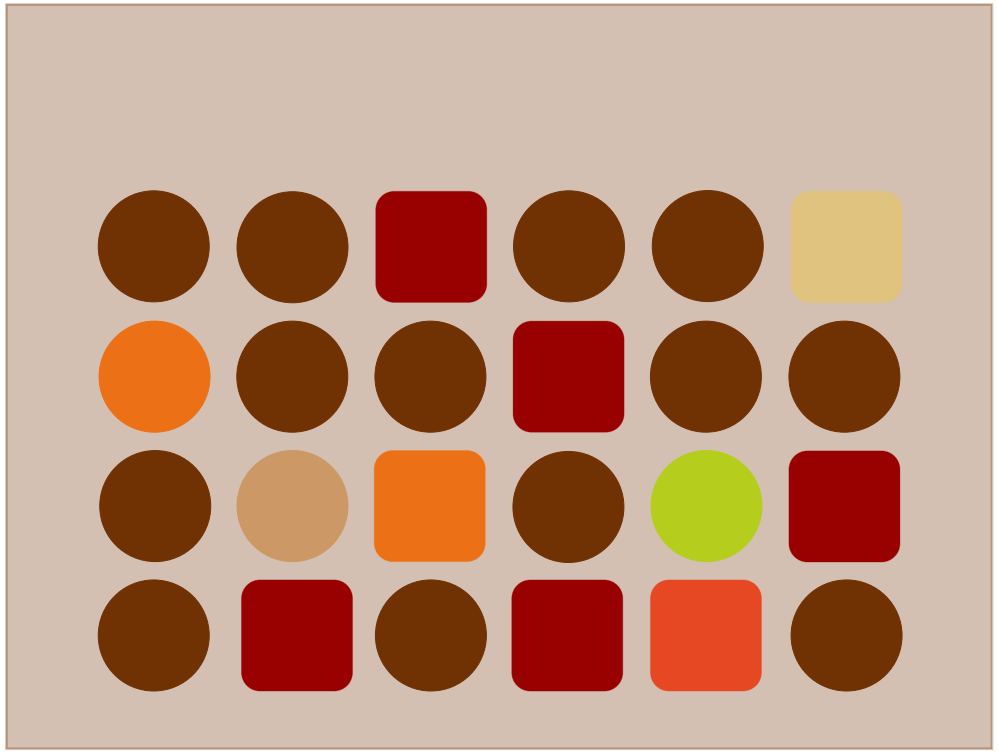

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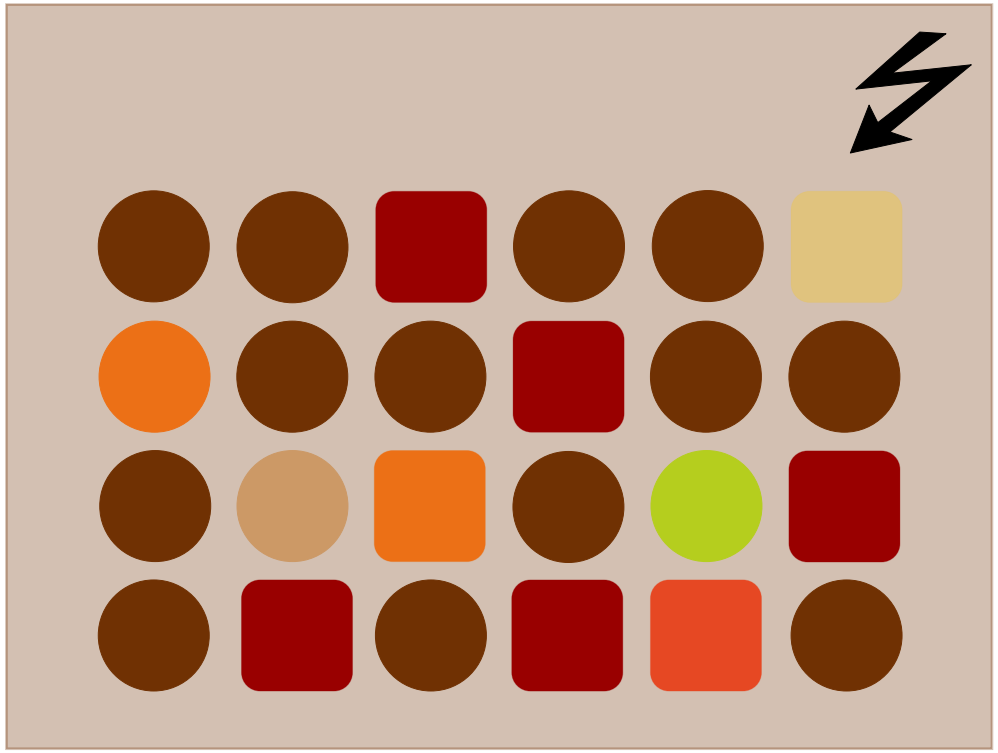

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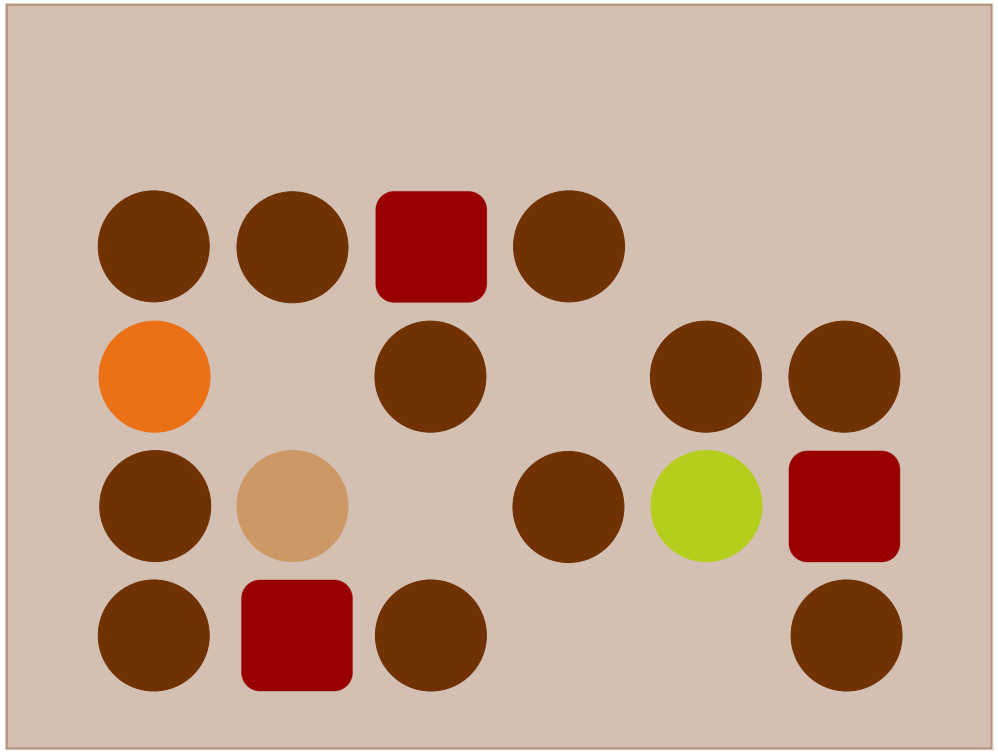

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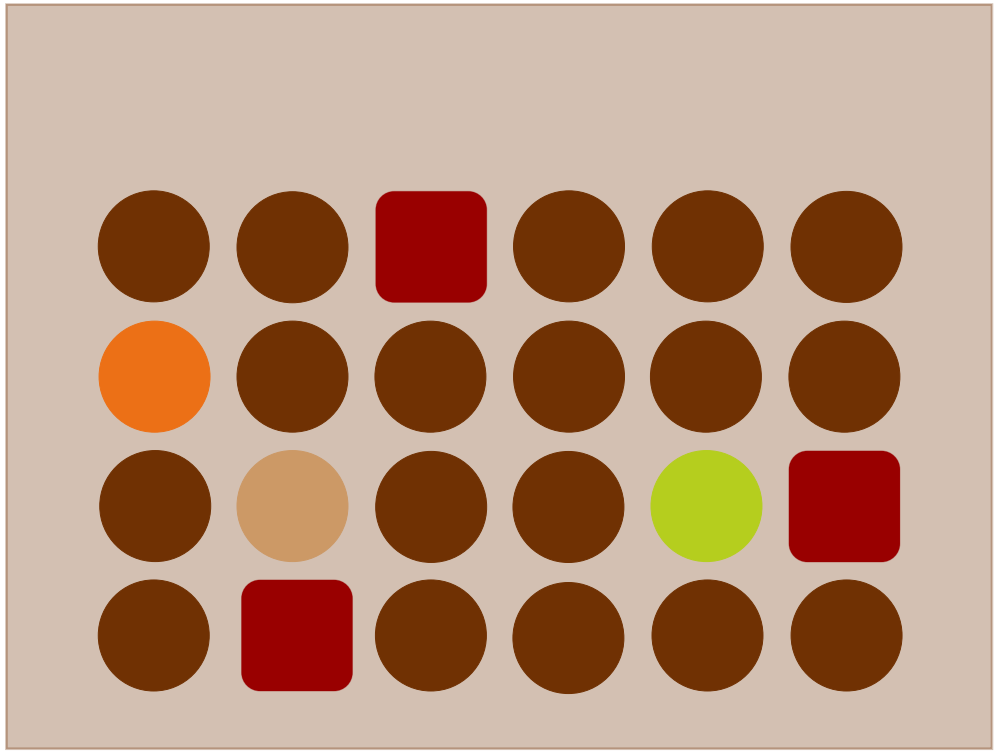

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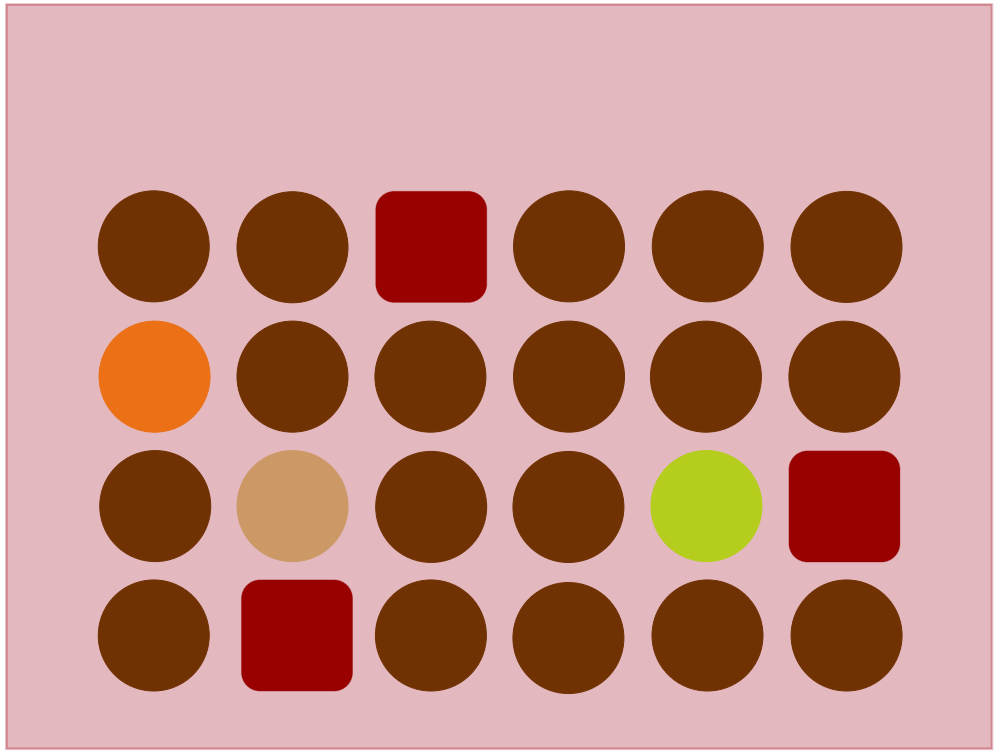

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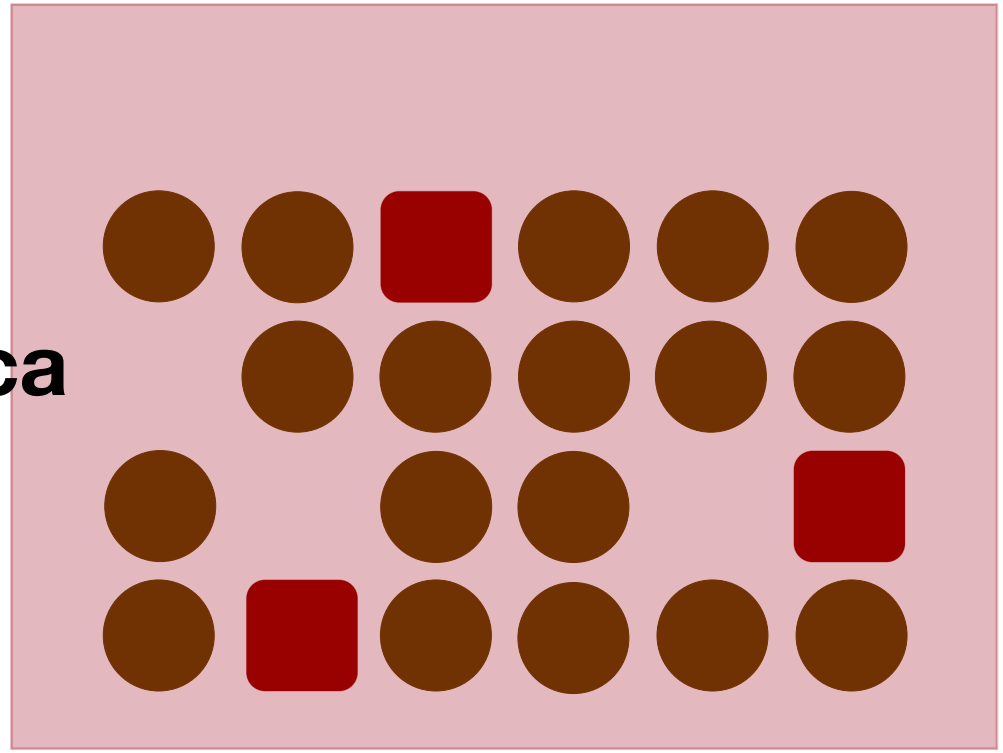

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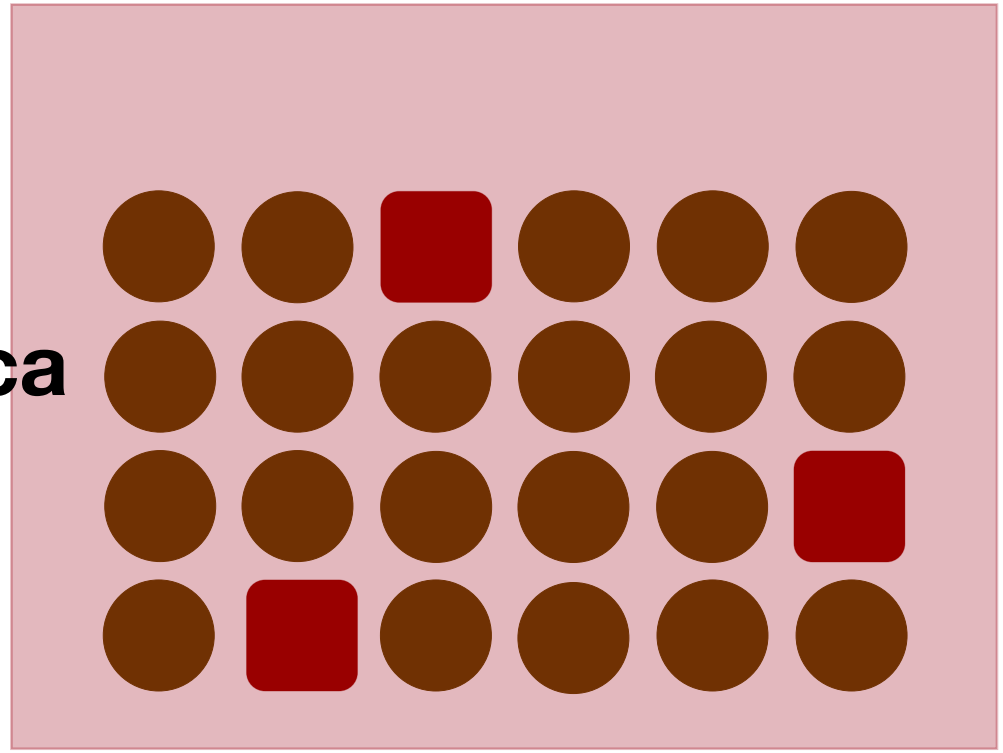

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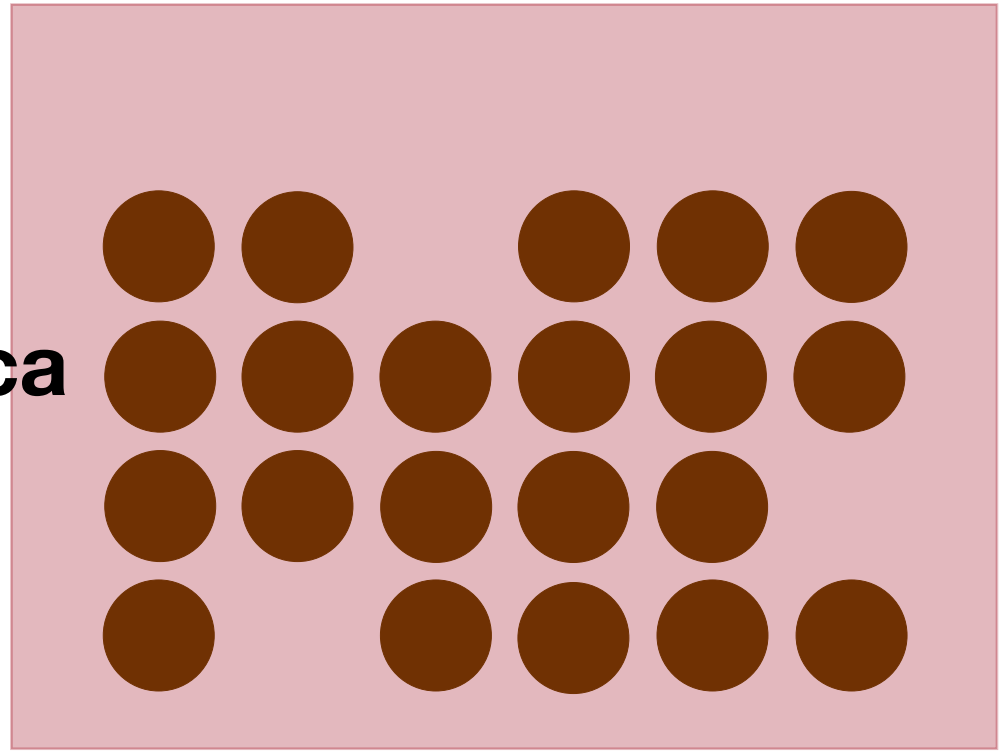

dinâmica ecológica

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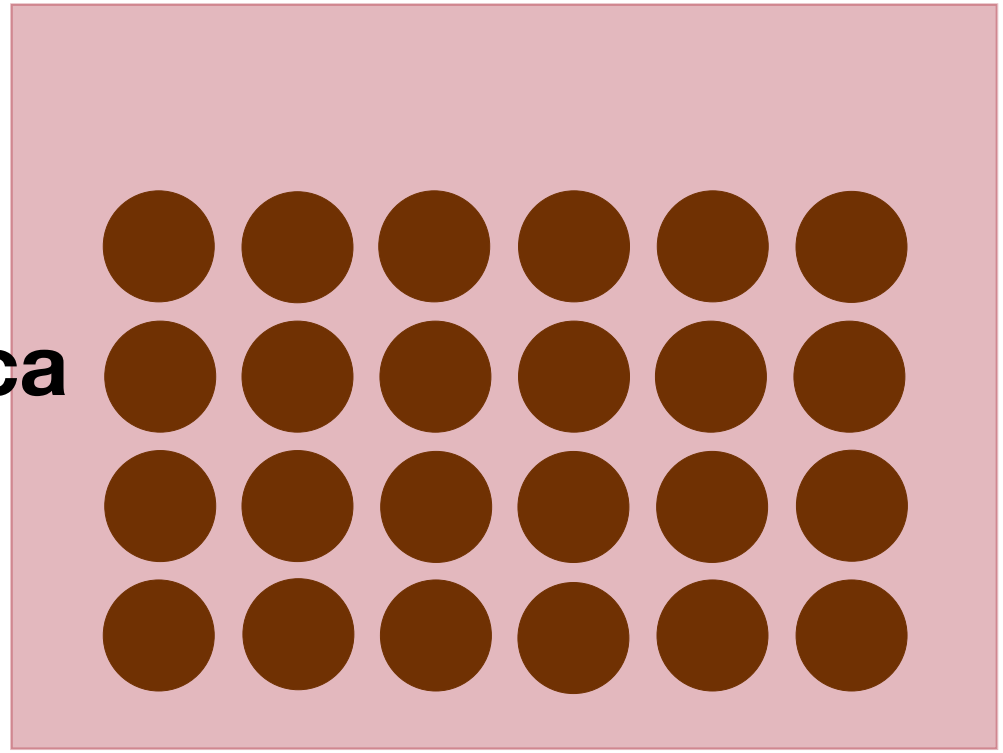
- migração
- especiação

distúrbio

- abundância
- recurso

dinâmica evolutiva

- **seleção**
- **deriva genética**
- fluxo gênico
- mutação



dinâmica ecológica

- **filtragem**
- **deriva ecológica**
- migração
- especiação

distúrbio

Biologia Evolutiva

- população
- adaptação

Ecologia de Comunidades

- comunidade
- exclusão competitiva de populações

porém…

dinâmica evolutiva ⟷ dinâmica ecológica

porém…

dinâmica
eco-evolutiva

dinâmica
evolutiva

dinâmica
ecológica

porém…

dinâmica
eco-evolutiva

dinâmica
evolutiva

dinâmica
ecológica

- contextos multiespecíficos
- espécies sob evolução

logo…

dinâmica
eco-evolutiva

dinâmica
evolutiva

dinâmica
ecológica

logo…

dinâmica
eco-evolutiva

dinâmica
evolutiva

dinâmica
ecológica

distúrbio

logo…

dinâmica
eco-evolutiva

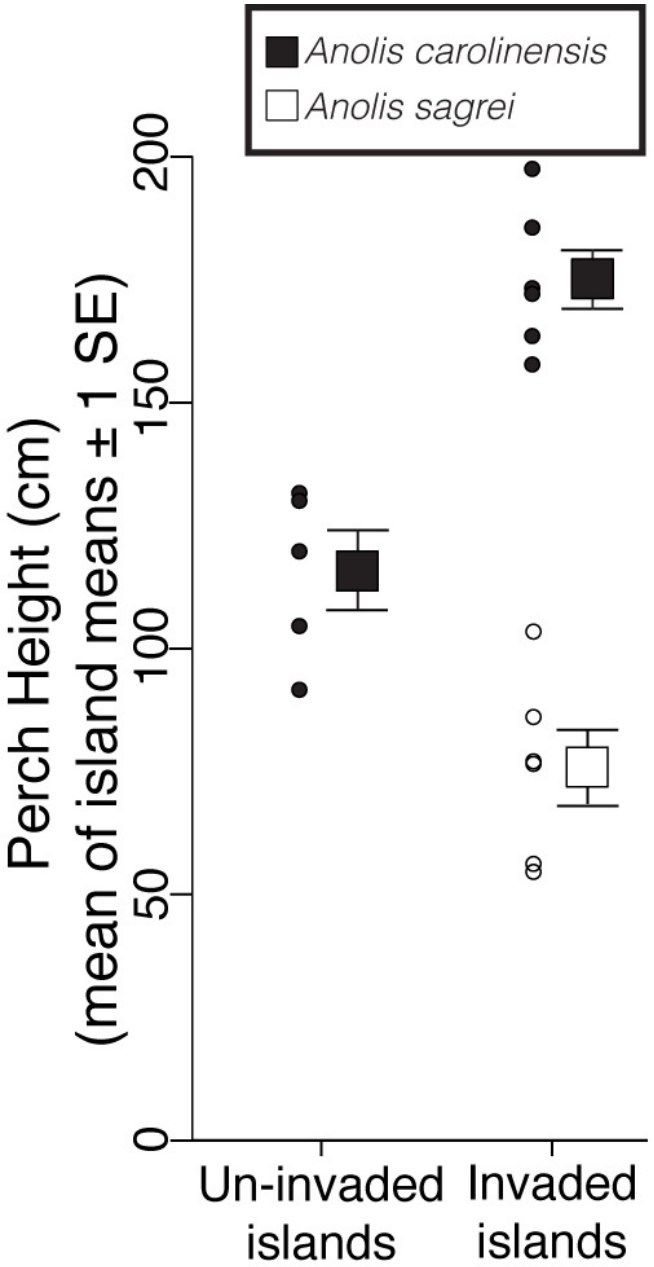
dinâmica
evolutiva

dinâmica
ecológica

distúrbio

predições
distintas e imprecisas

logo…


Anolis carolinensis
Anolis sagrei
Perch Height (cm)
(mean of island means ± 1 SE)
0
50
100
150
200
Un-invaded islands
Invaded islands

Como o **distúrbio** determina

Como o **distúrbio** determina

as **estratégias de vida** presentes

em populações e comunidades sob **dinâmicas**

Como o **distúrbio** determina

as **estratégias de vida** presentes

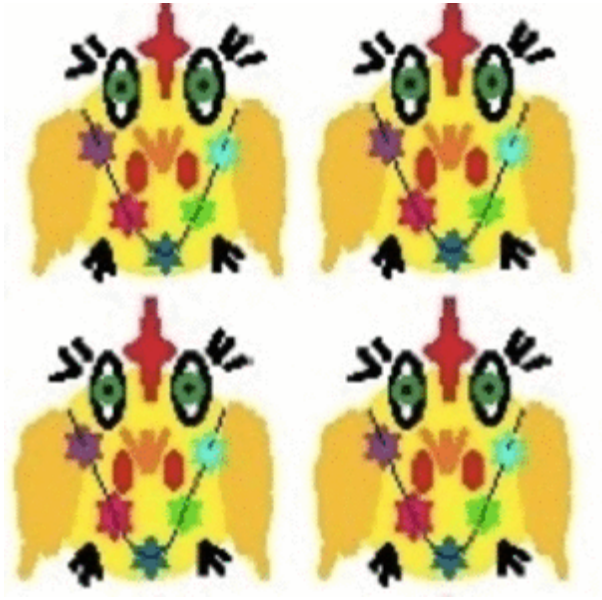
em populações e comunidades sob **dinâmicas**

evolutivas, **ecológicas** e **eco-evolutivas**?

modelo baseado em indivíduo

modelo baseado em indivíduo

modelo baseado em indivíduo



modelo baseado em indivíduo

parâmetros

modelo baseado em indivíduo

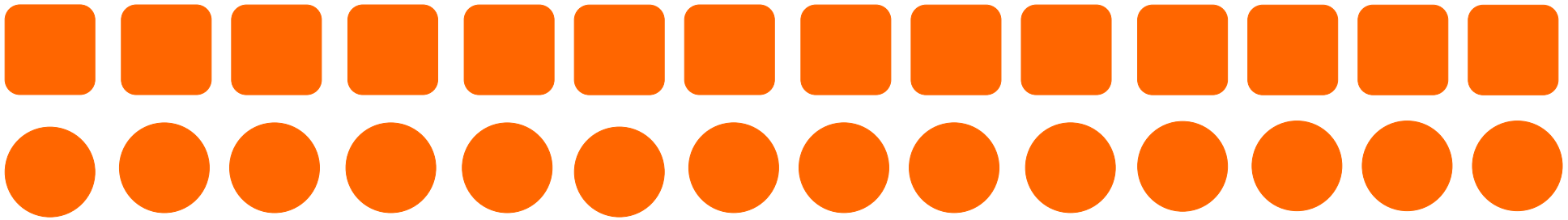
parâmetros

modelo baseado em indivíduo

parâmetros

riqueza t0

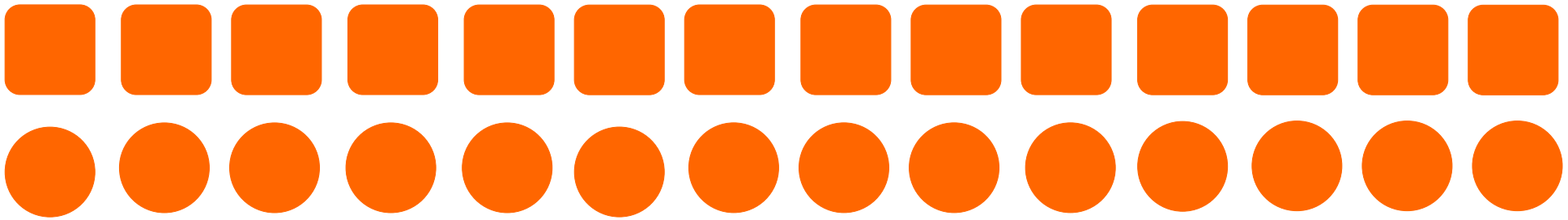
modelo baseado em indivíduo



parâmetros

riqueza t0

modelo baseado em indivíduo

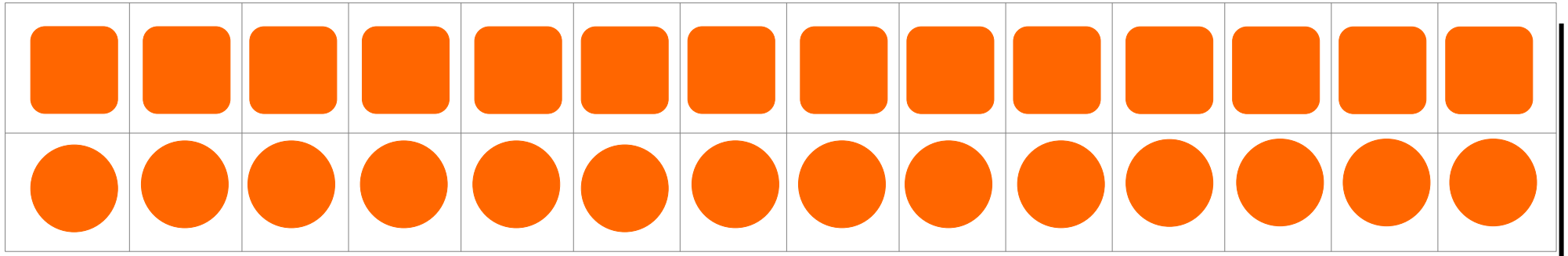


parâmetros

riqueza t0

abundância t0

modelo baseado em indivíduo

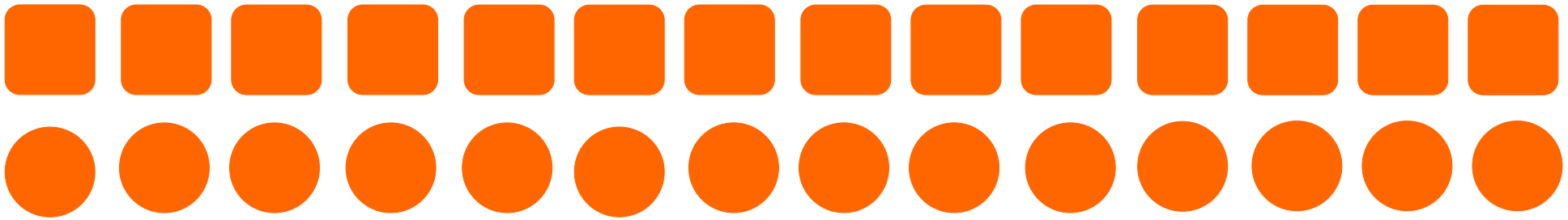


parâmetros

riqueza t0

abundância t0

modelo baseado em indivíduo

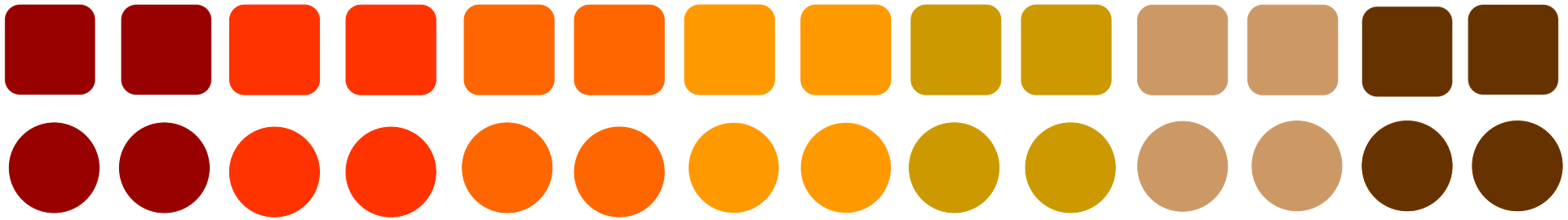


parâmetros

riqueza t0

abundância t0

modelo baseado em indivíduo

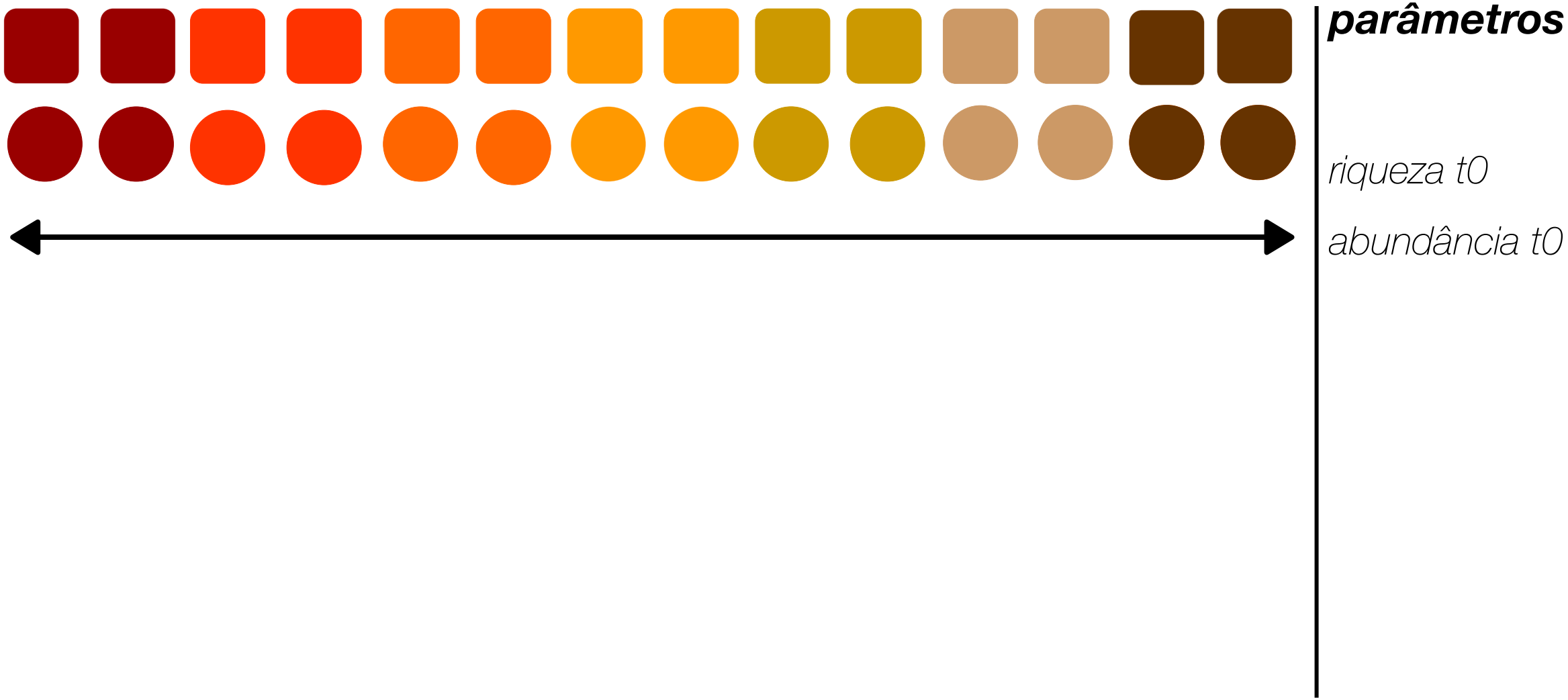


parâmetros

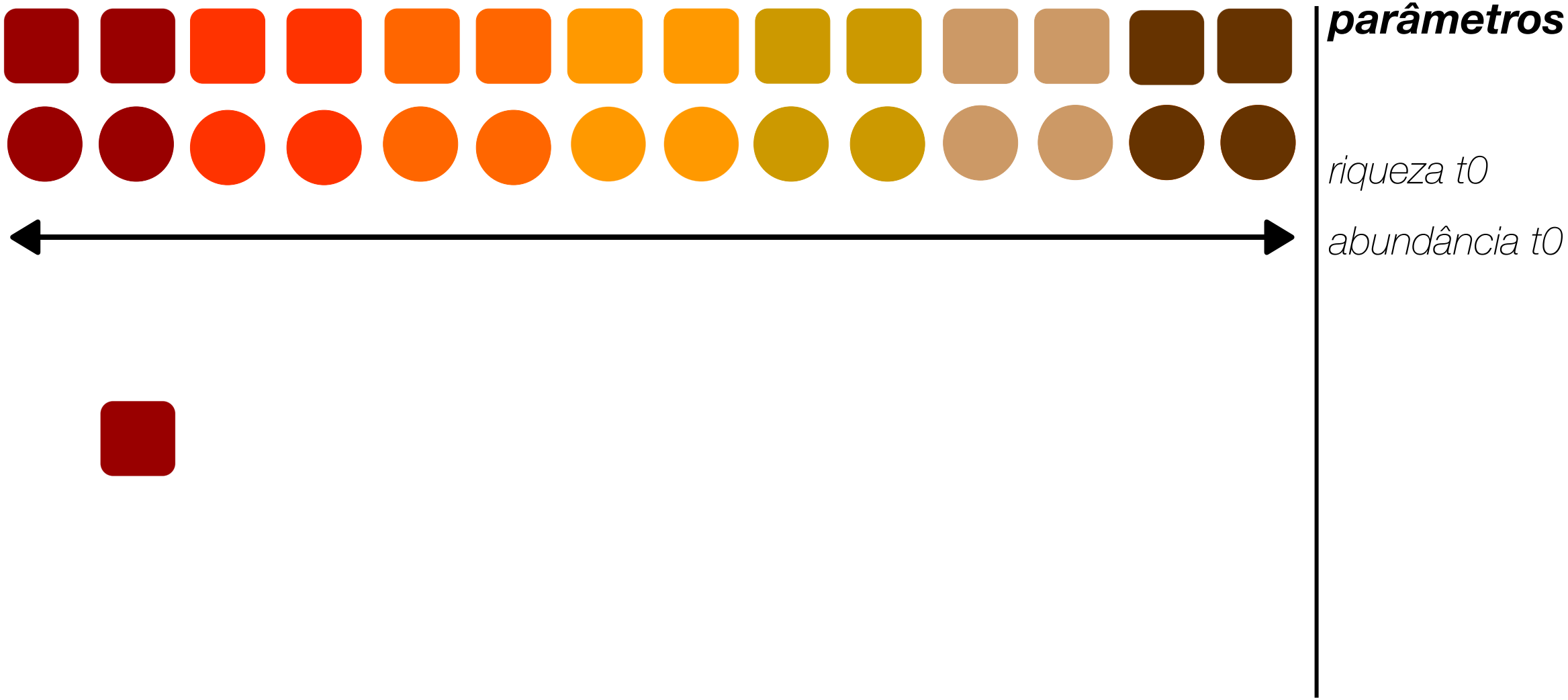
riqueza t0

abundância t0

modelo baseado em indivíduo



modelo baseado em indivíduo



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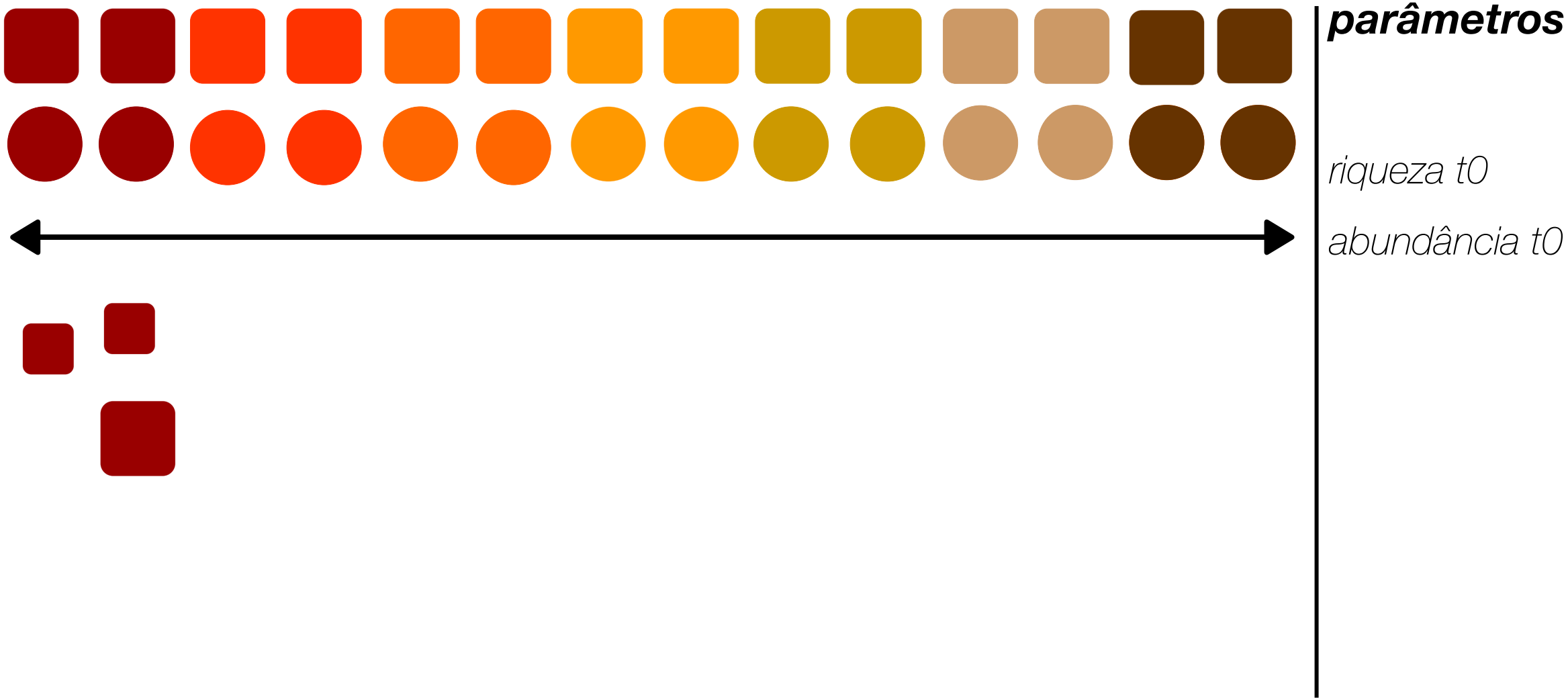

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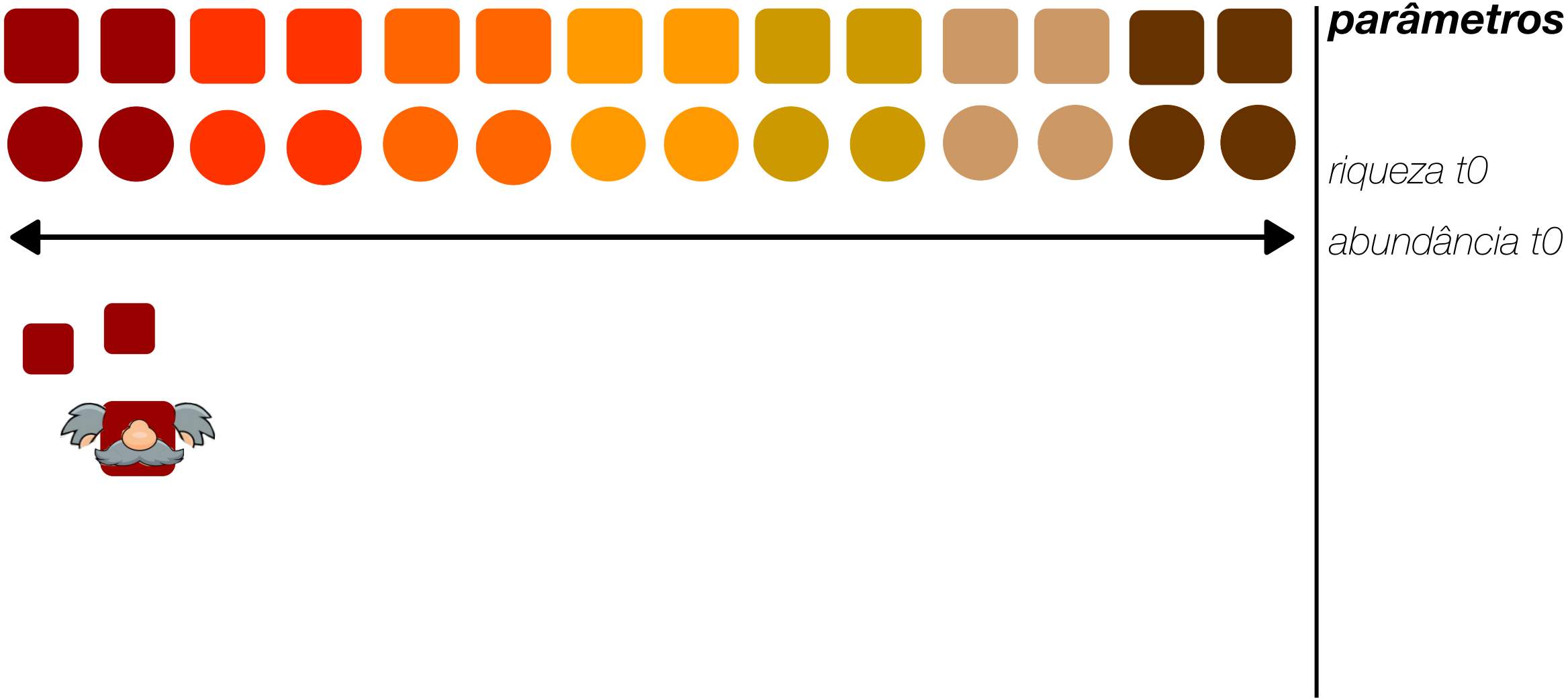
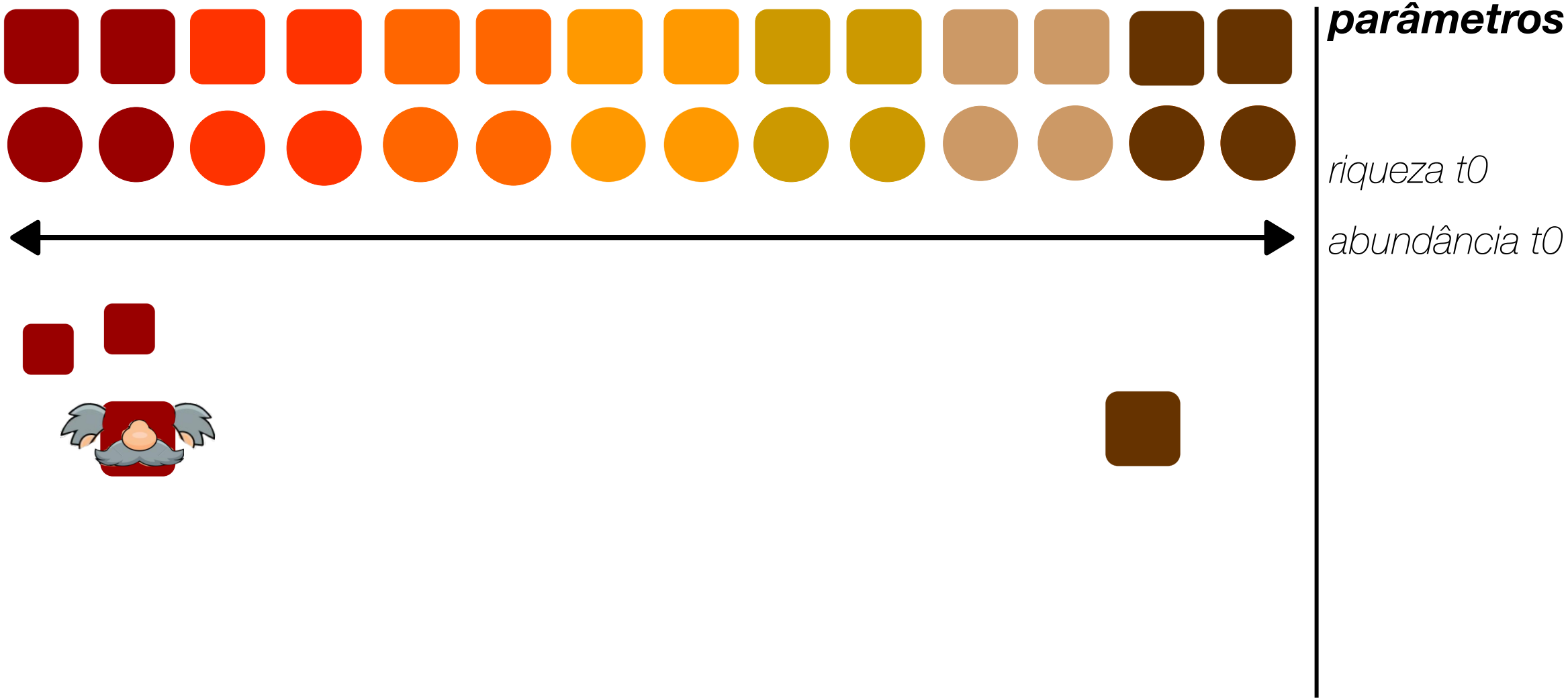
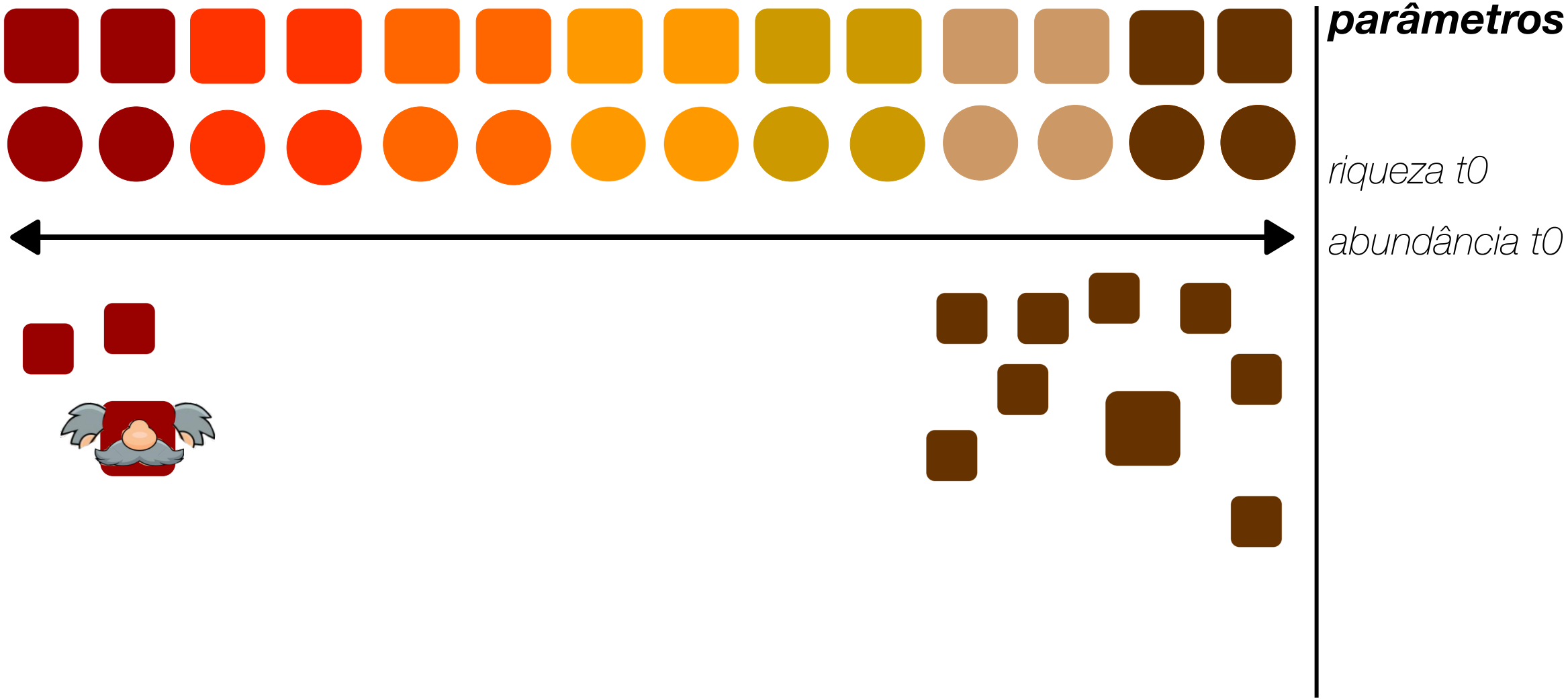


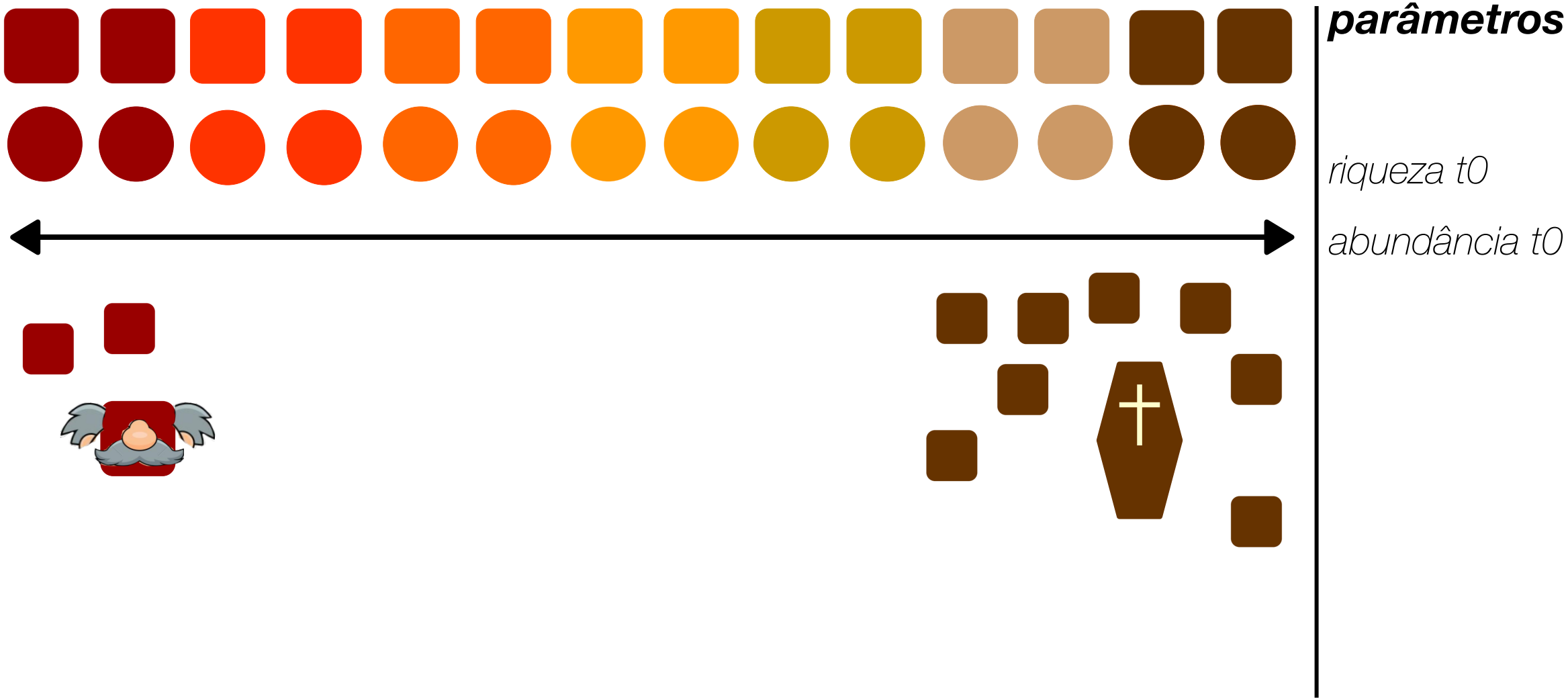
modelo baseado em indivíduo



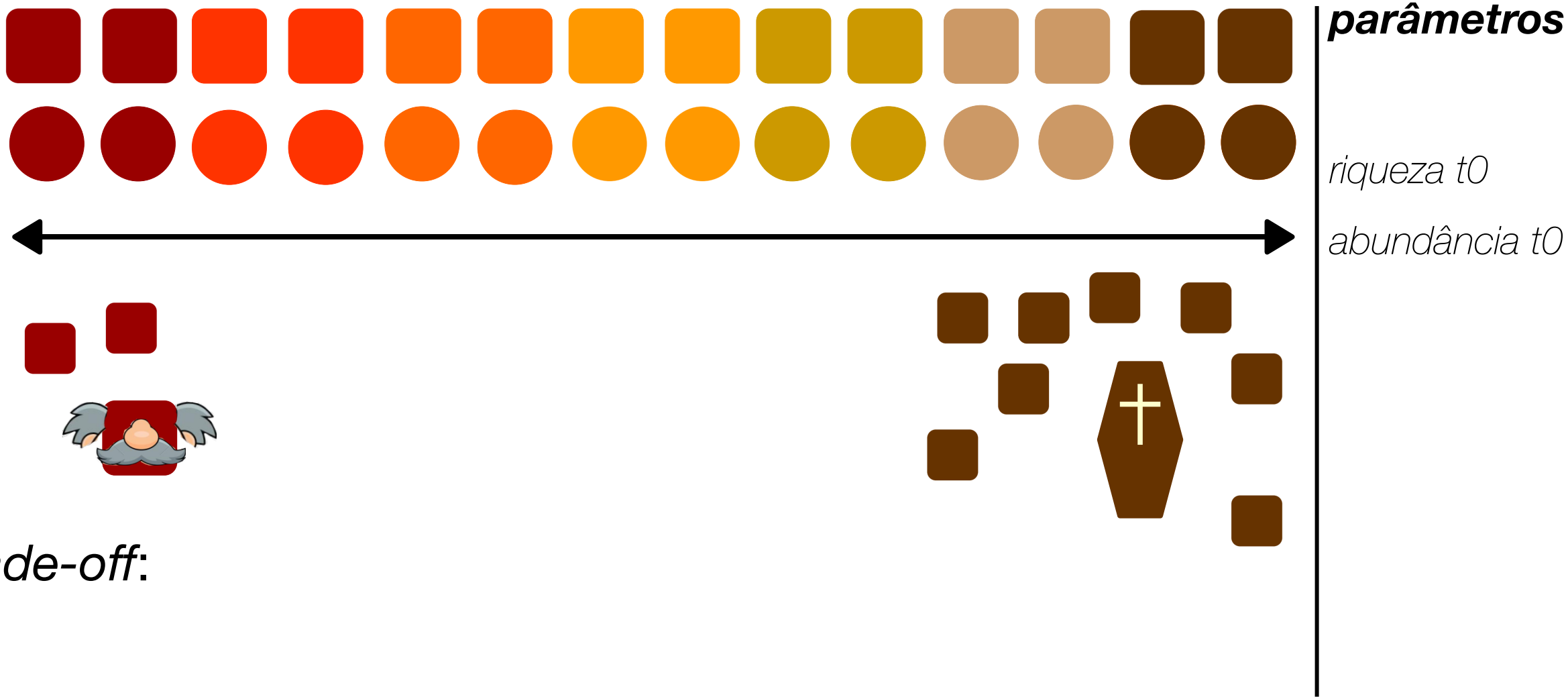
modelo baseado em indivíduo



modelo baseado em indivíduo

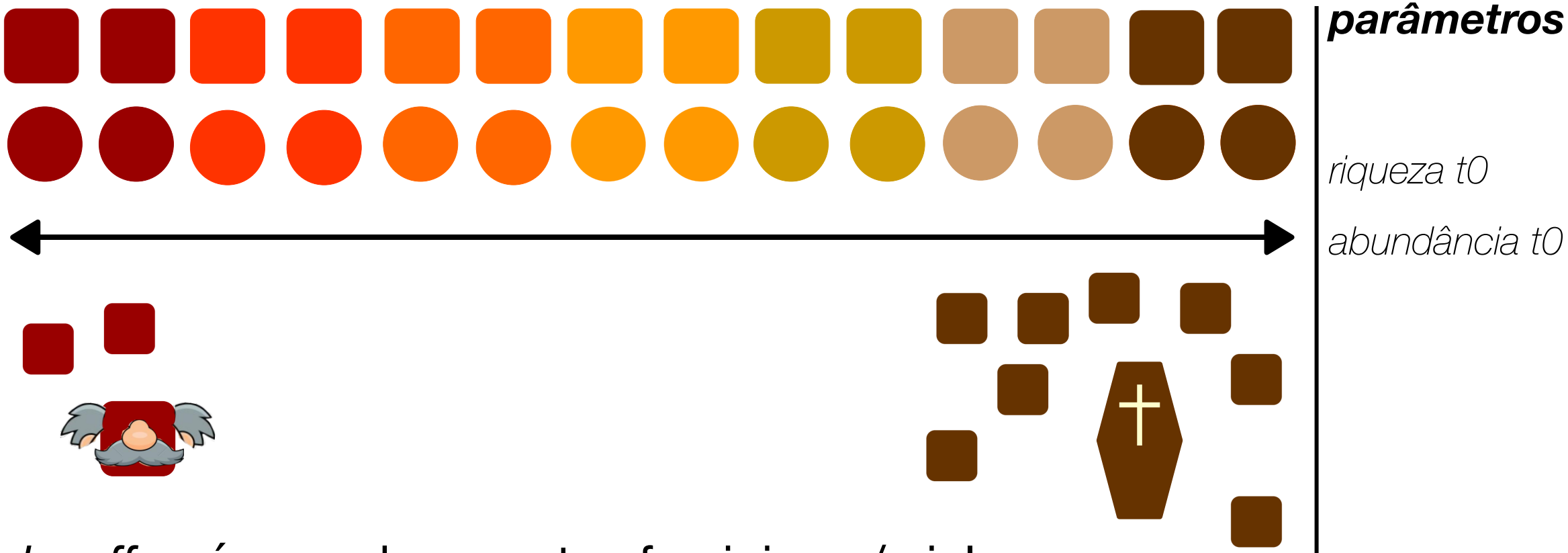


modelo baseado em indivíduo



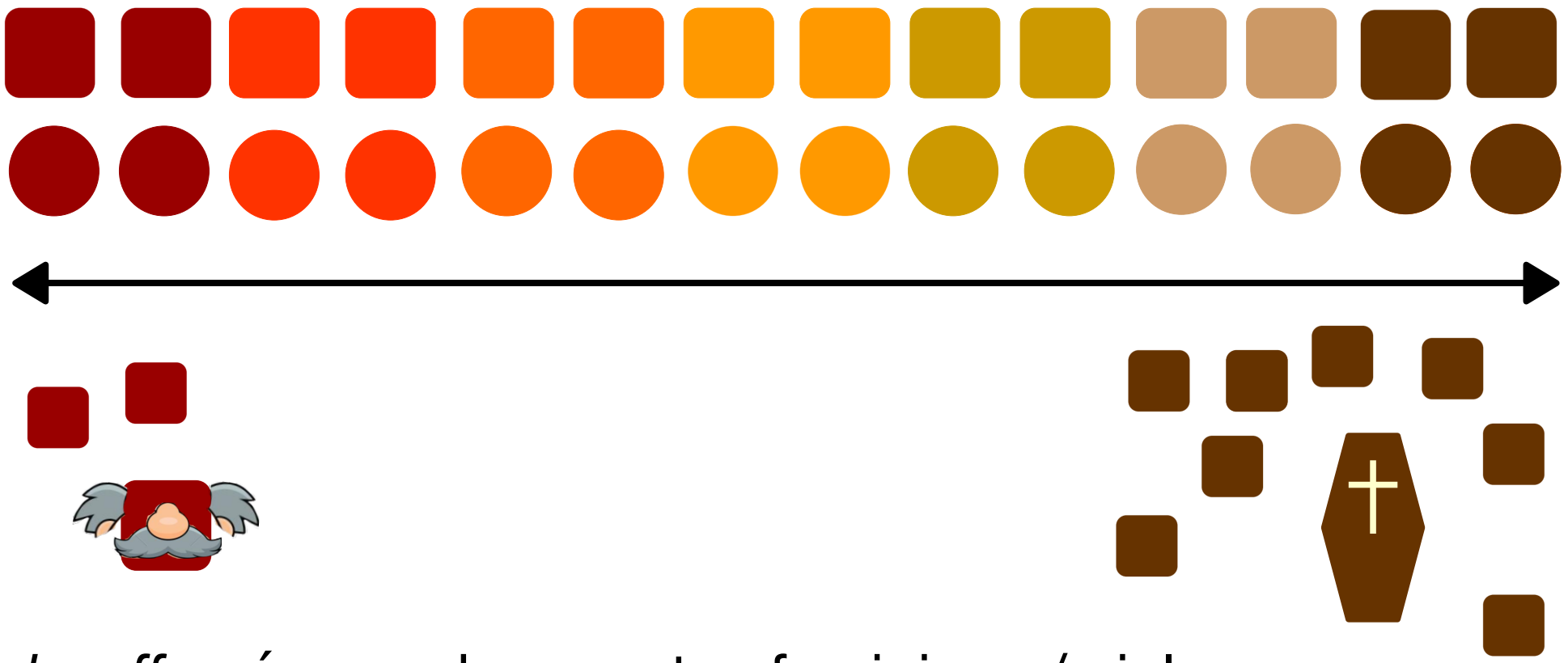
trade-off:

modelo baseado em indivíduo



trade-off: $\dfrac{\text{número de gametas femininos / ciclo}}{\text{probabilidade de morte / ciclo}}$

modelo baseado em indivíduo



parâmetros

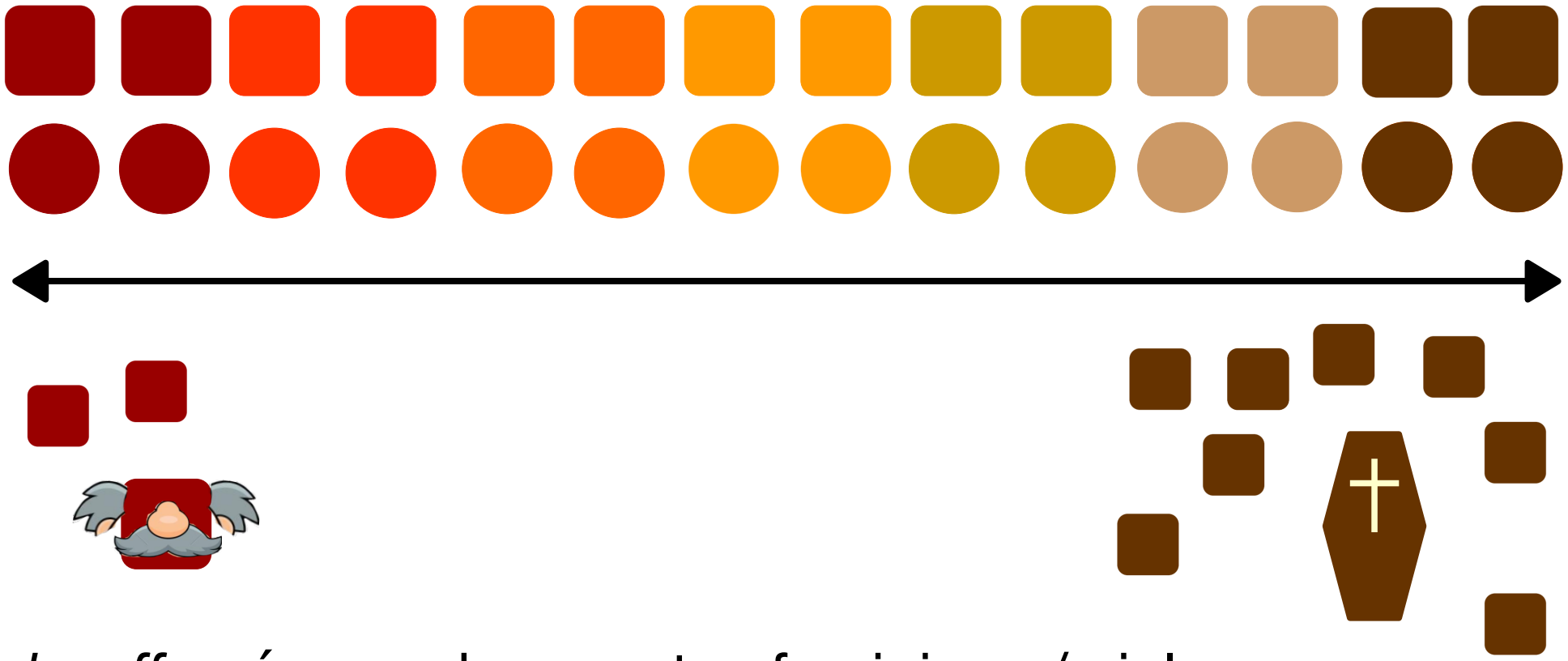
riqueza t0

abundância t0

no gametas♀/ciclo

trade-off: $\dfrac{\text{número de gametas femininos / ciclo}}{\text{probabilidade de morte / ciclo}}$

modelo baseado em indivíduo



parâmetros

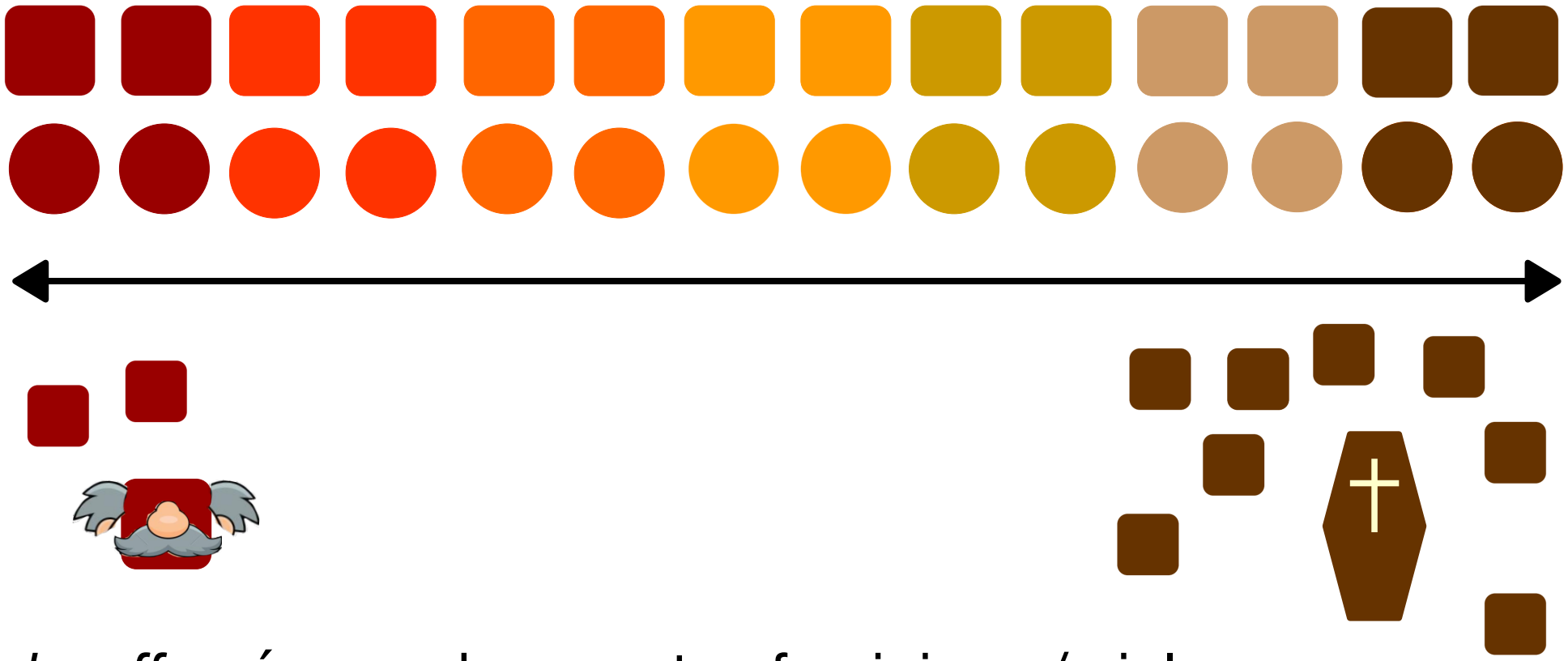
riqueza t0

abundância t0

no gametas ♀/ciclo

trade-off: $\dfrac{\text{número de gametas femininos / ciclo}}{\text{probabilidade de morte / ciclo}} = \text{constante}$

modelo baseado em indivíduo



parâmetros

riqueza t0

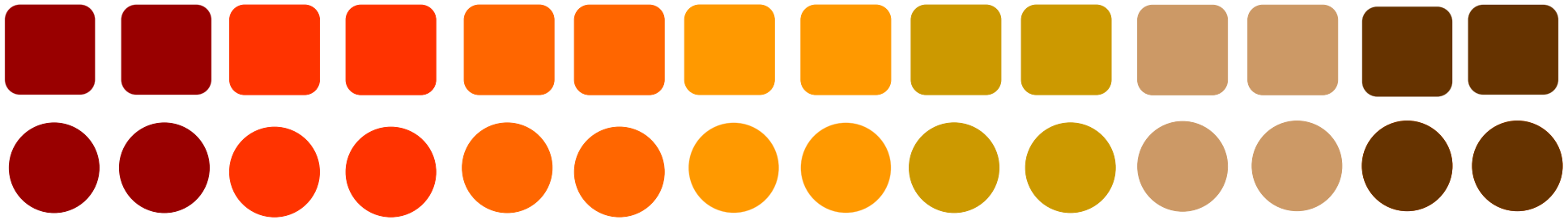
abundância t0

no gametas♀/ciclo

constante

trade-off: $\dfrac{\text{número de gametas femininos / ciclo}}{\text{probabilidade de morte / ciclo}} = \text{constante}$

modelo baseado em indivíduo



parâmetros

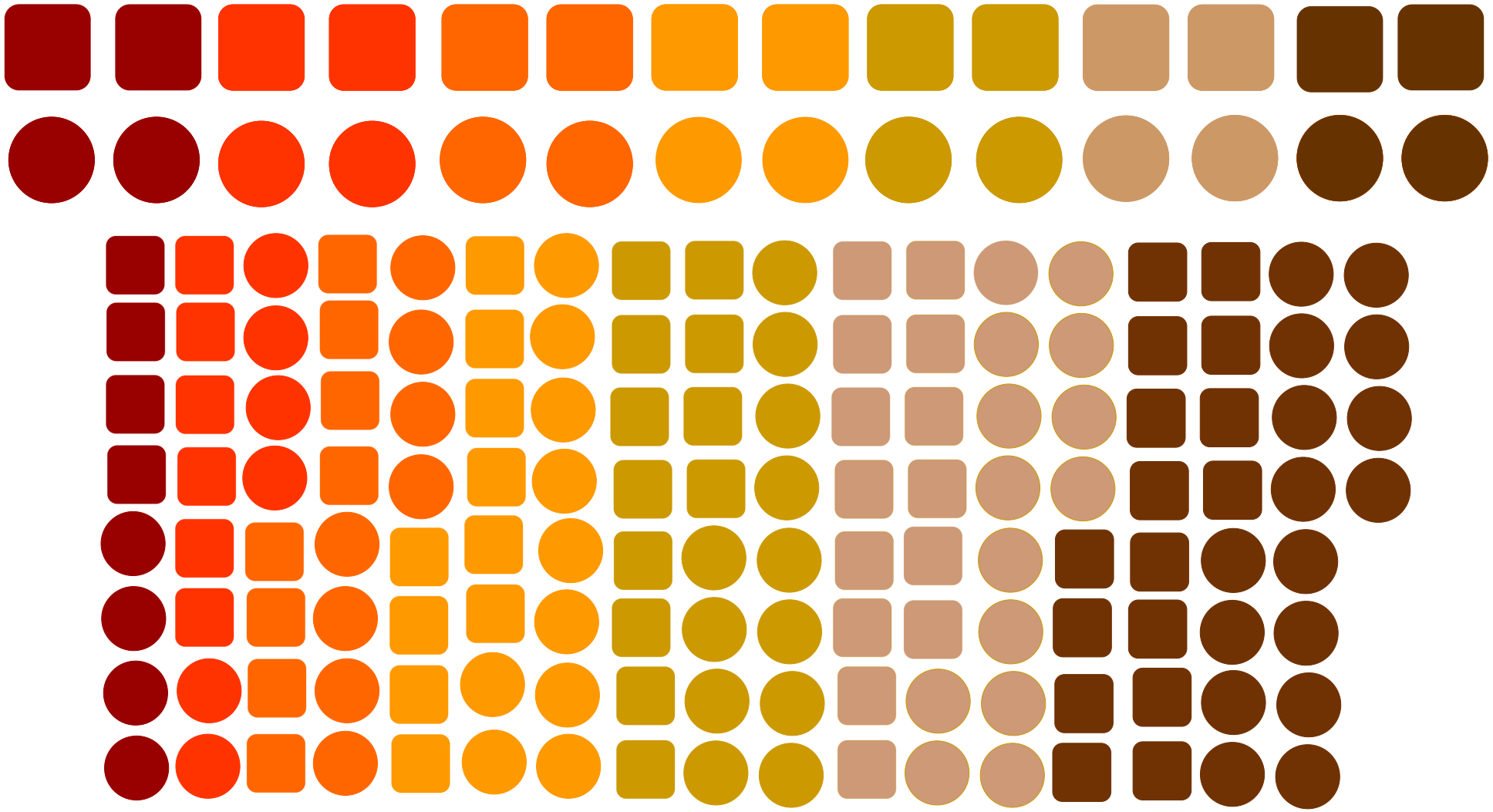
riqueza t0

abundância t0

no gametas♀/ciclo

constante

modelo baseado em indivíduo



parâmetros

riqueza t0

abundância t0

no gametas♀/ciclo

constante

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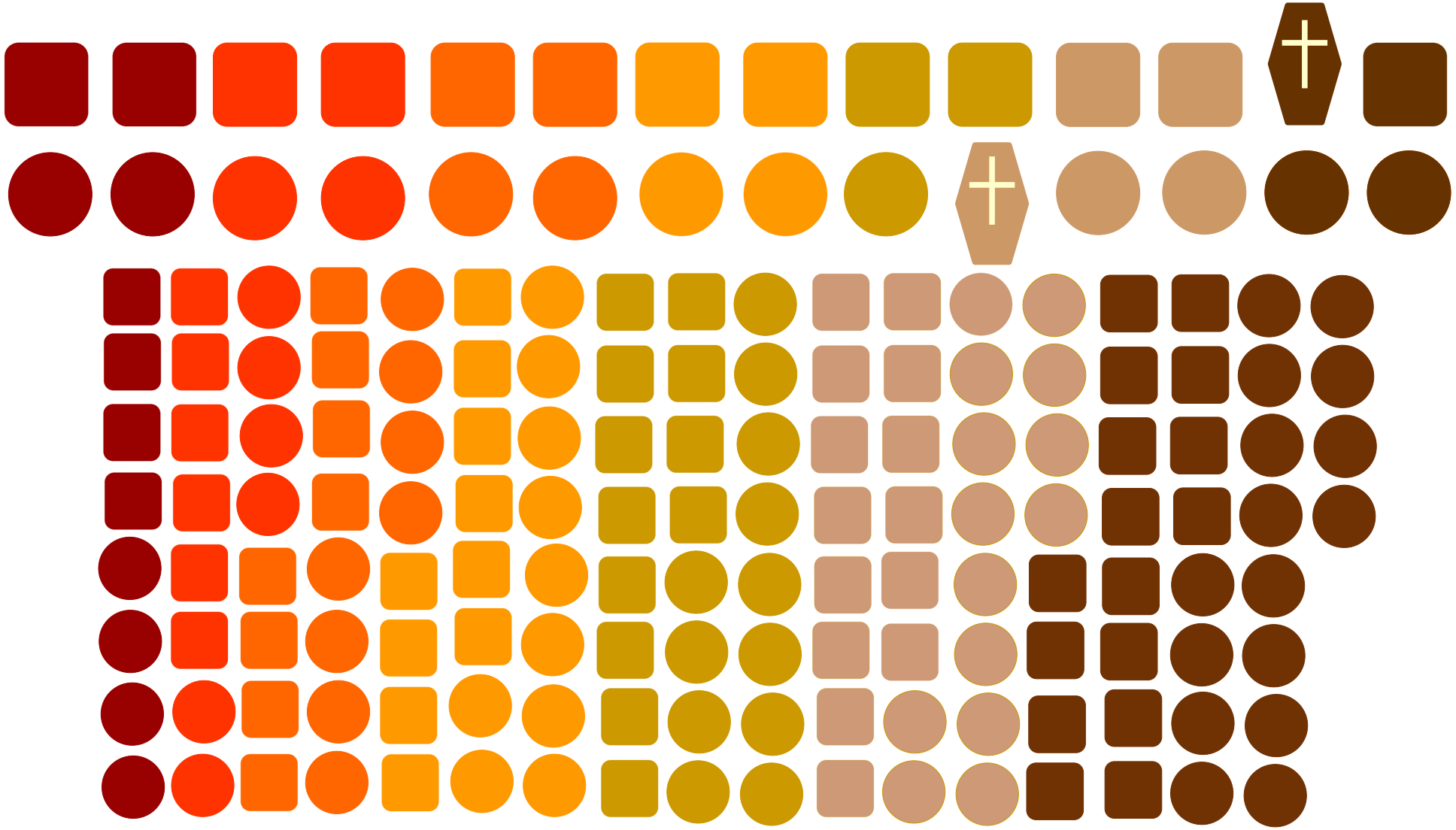

parâmetros

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constante

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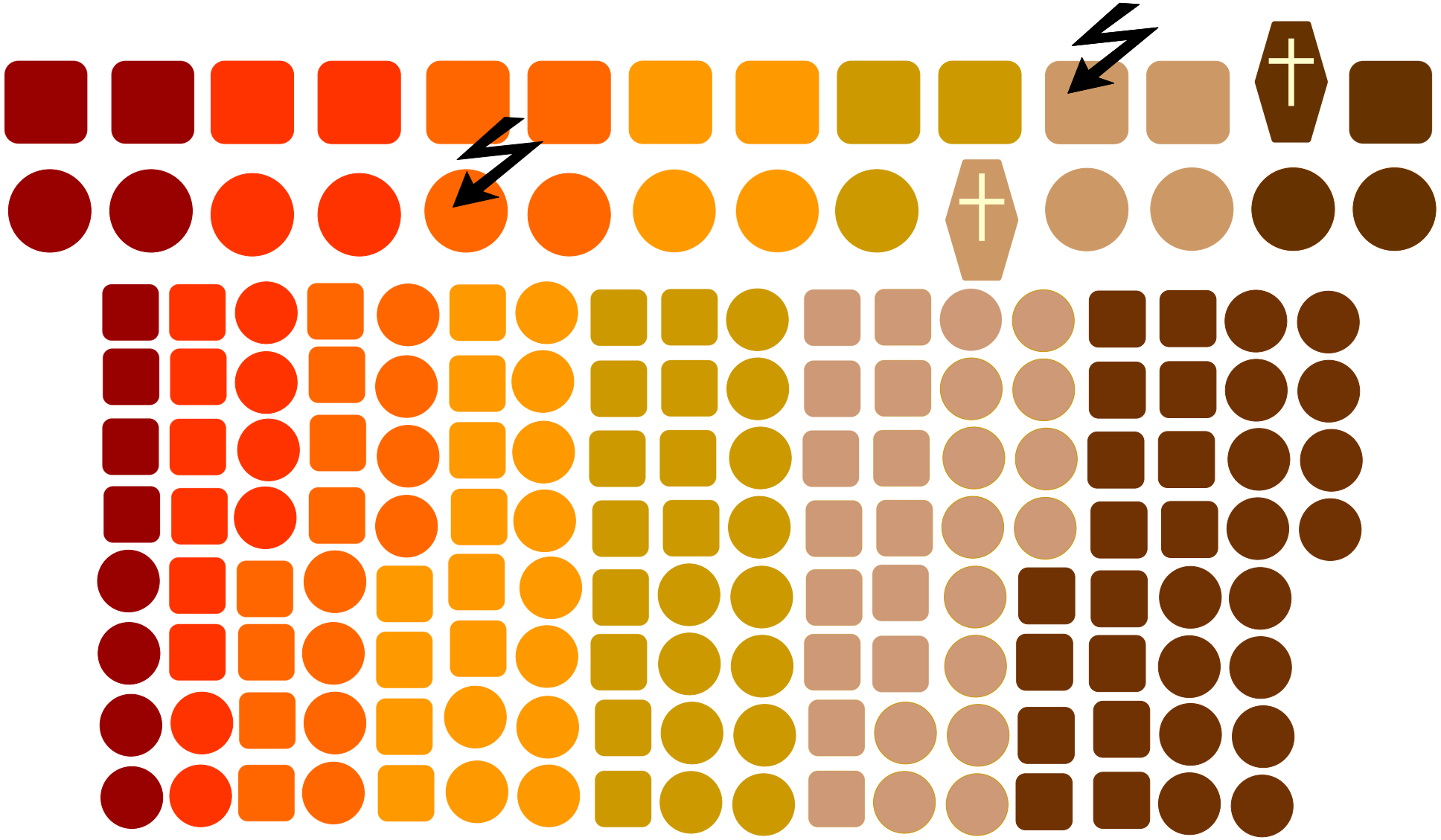

parâmetros

riqueza t0

abundância t0

no gametas♀/ciclo

constante

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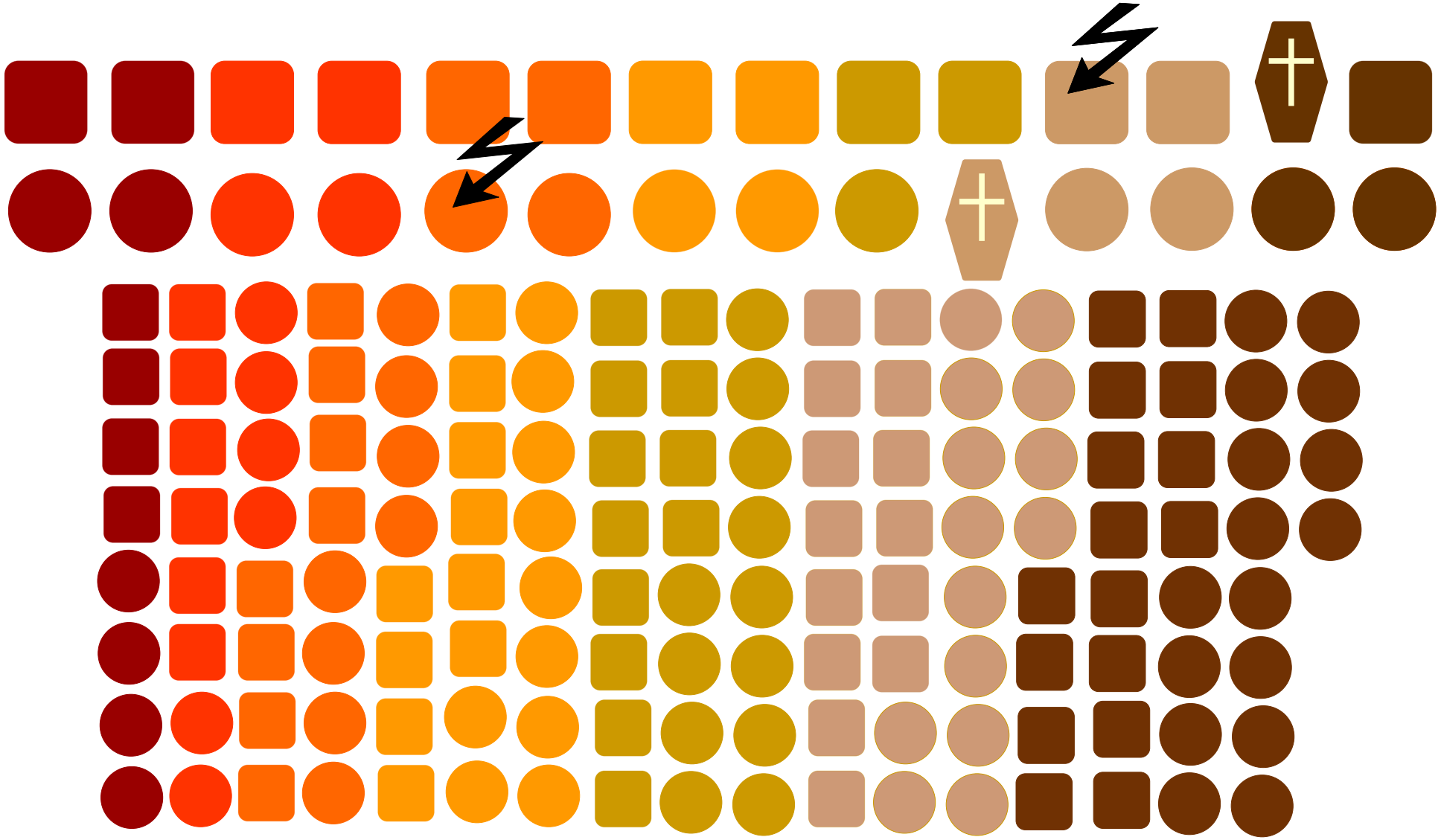


parâmetros

riqueza t0

abundância t0

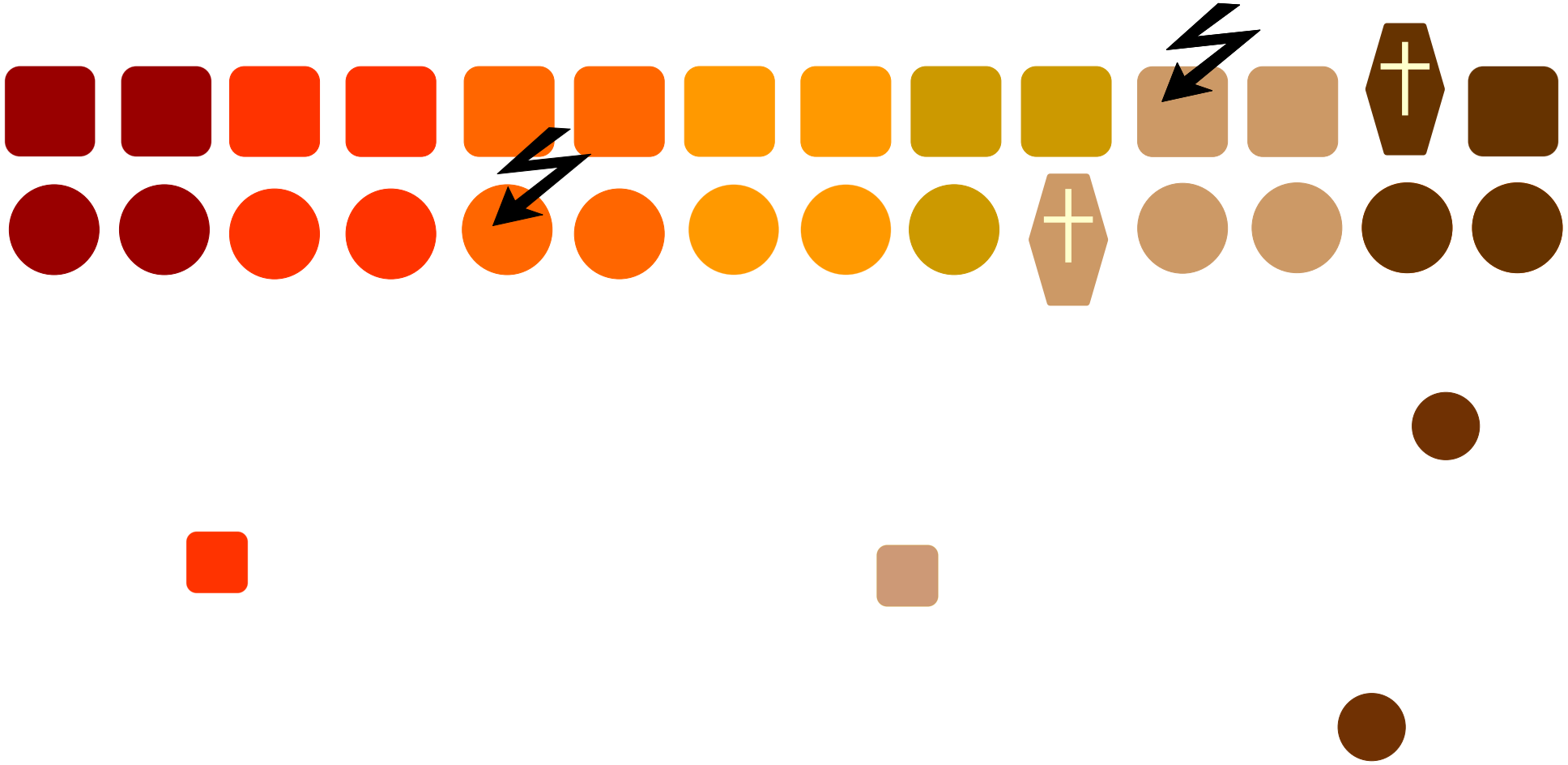
no gametas♀/ciclo

constante

no distúrbios

% morta/distúrbio

modelo baseado em indivíduo



parâmetros

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abundância t0

no gametas♀/ciclo

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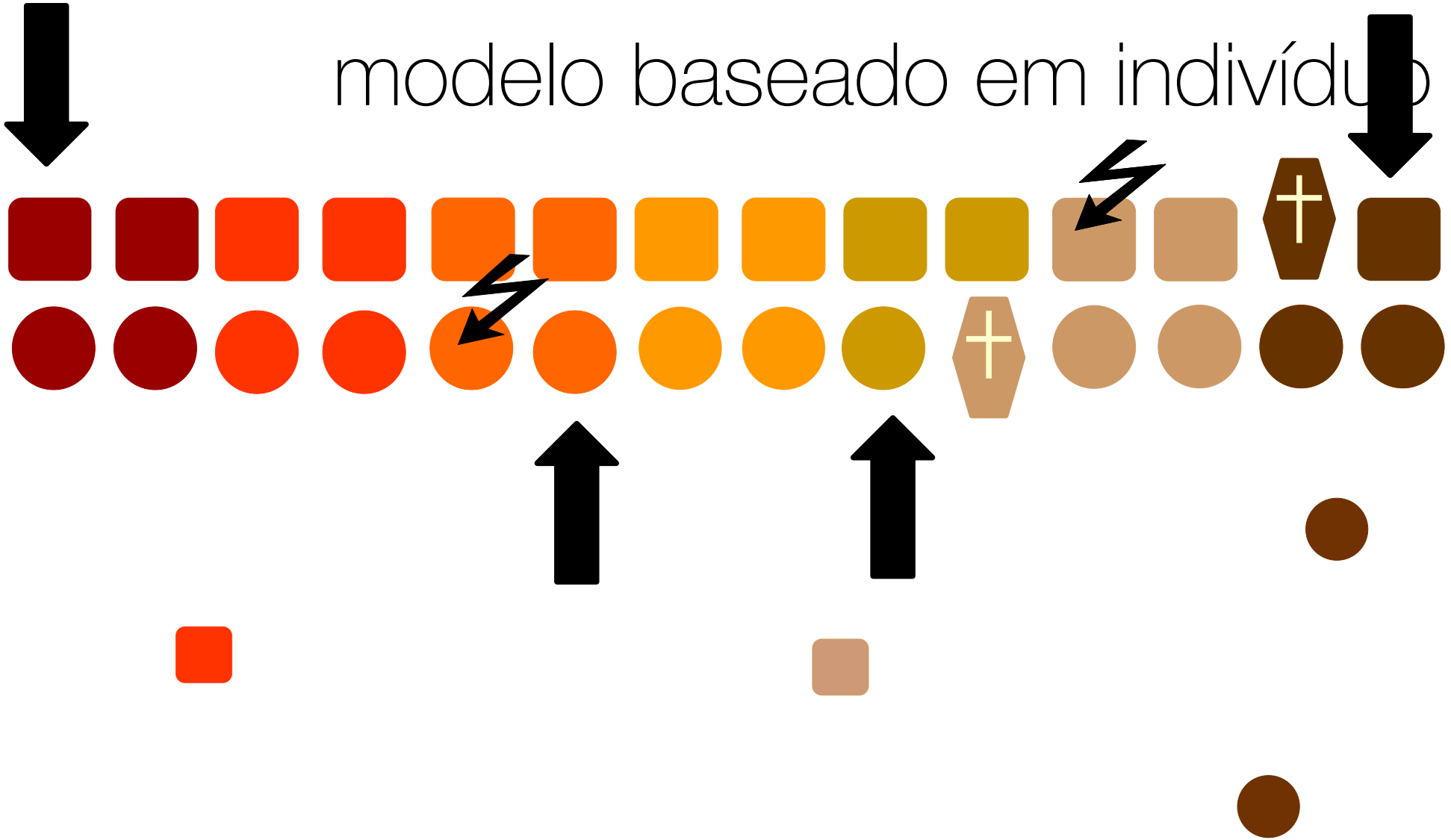

parâmetros

riqueza t0

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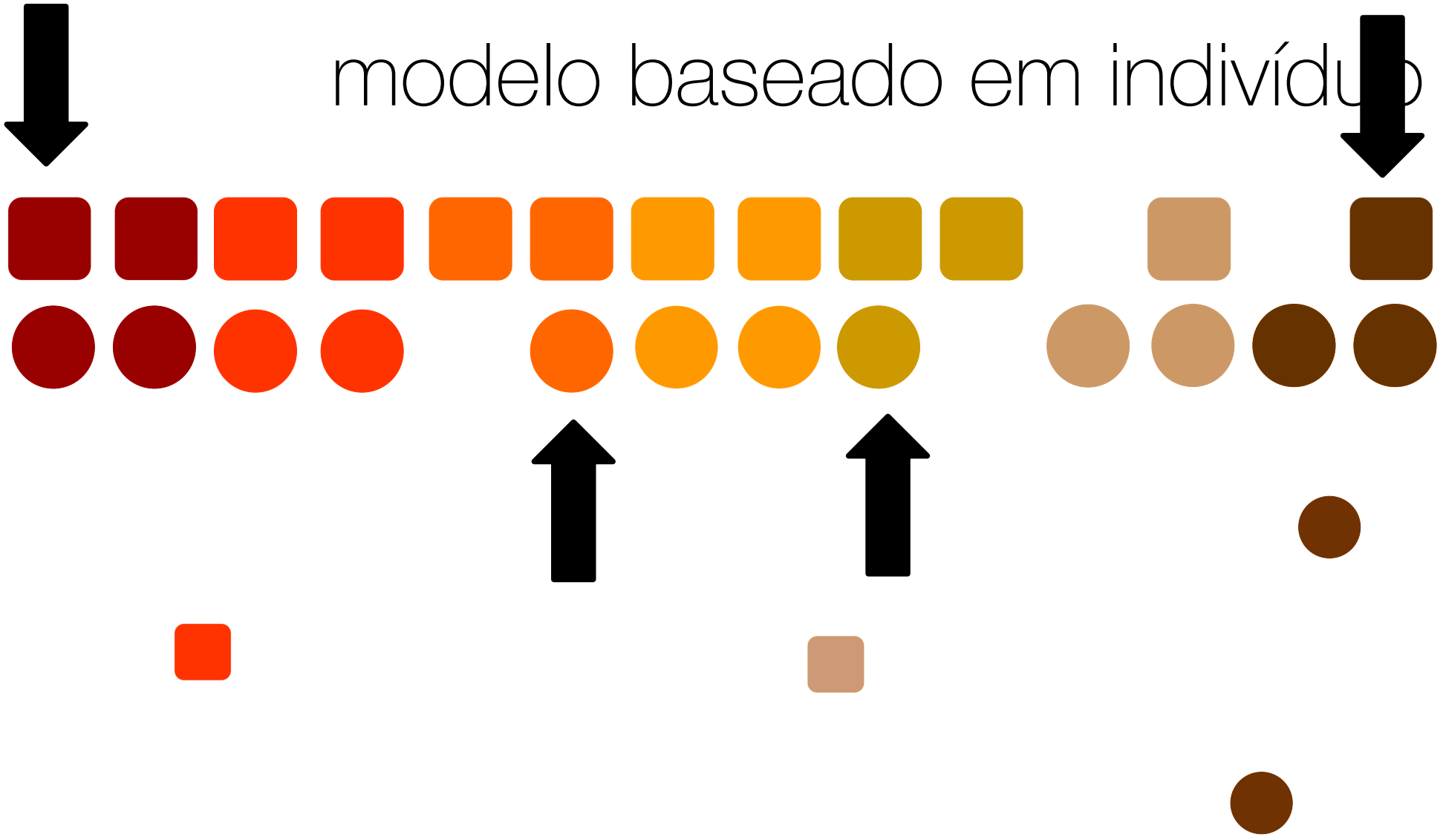

parâmetros

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abundância t0

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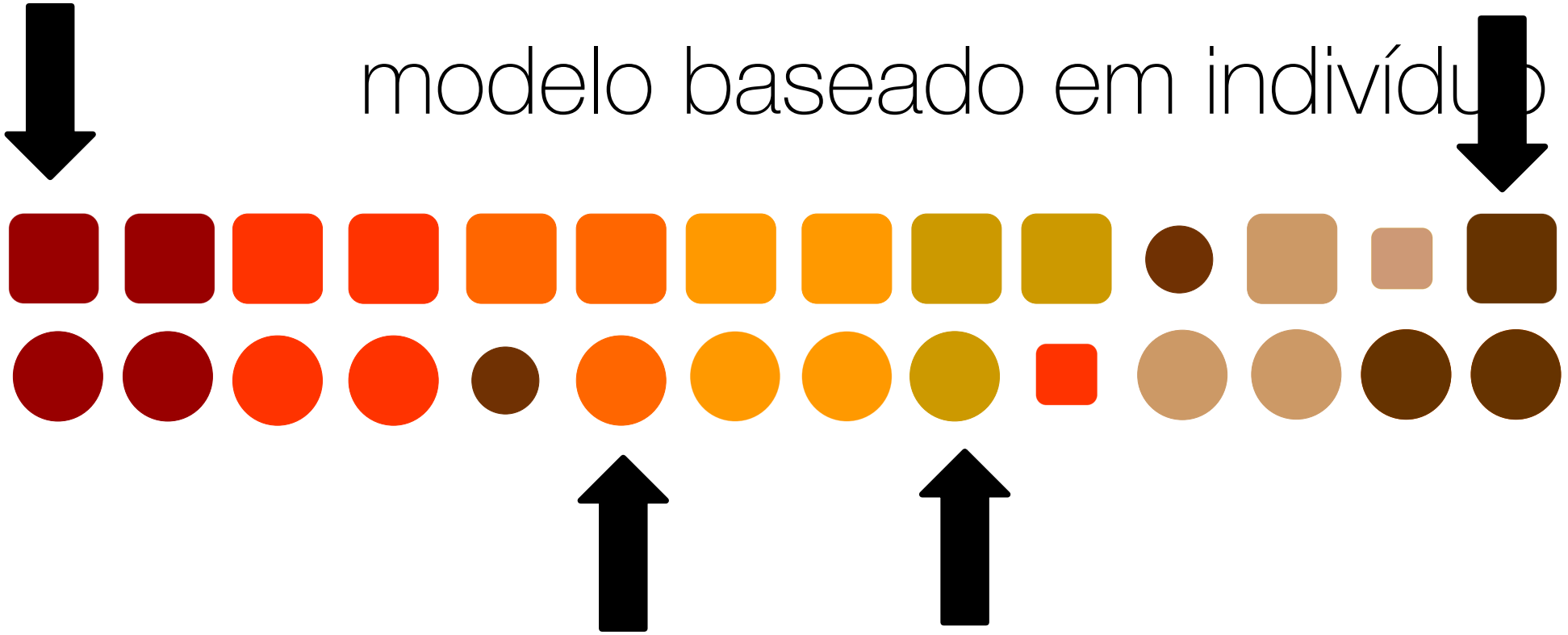

parâmetros

riqueza t0

abundância t0

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no distúrbios

% morta/distúrbio

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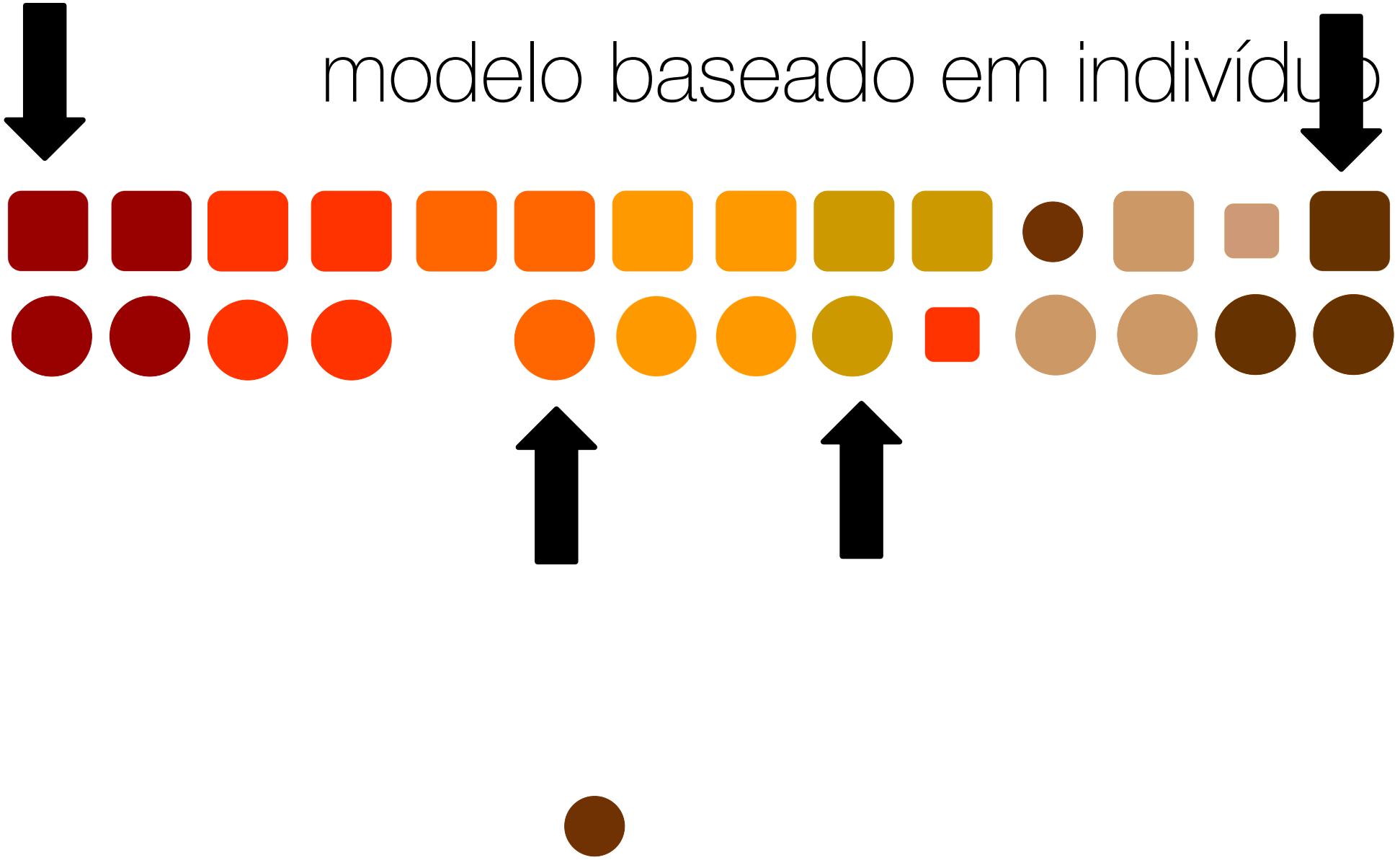

parâmetros

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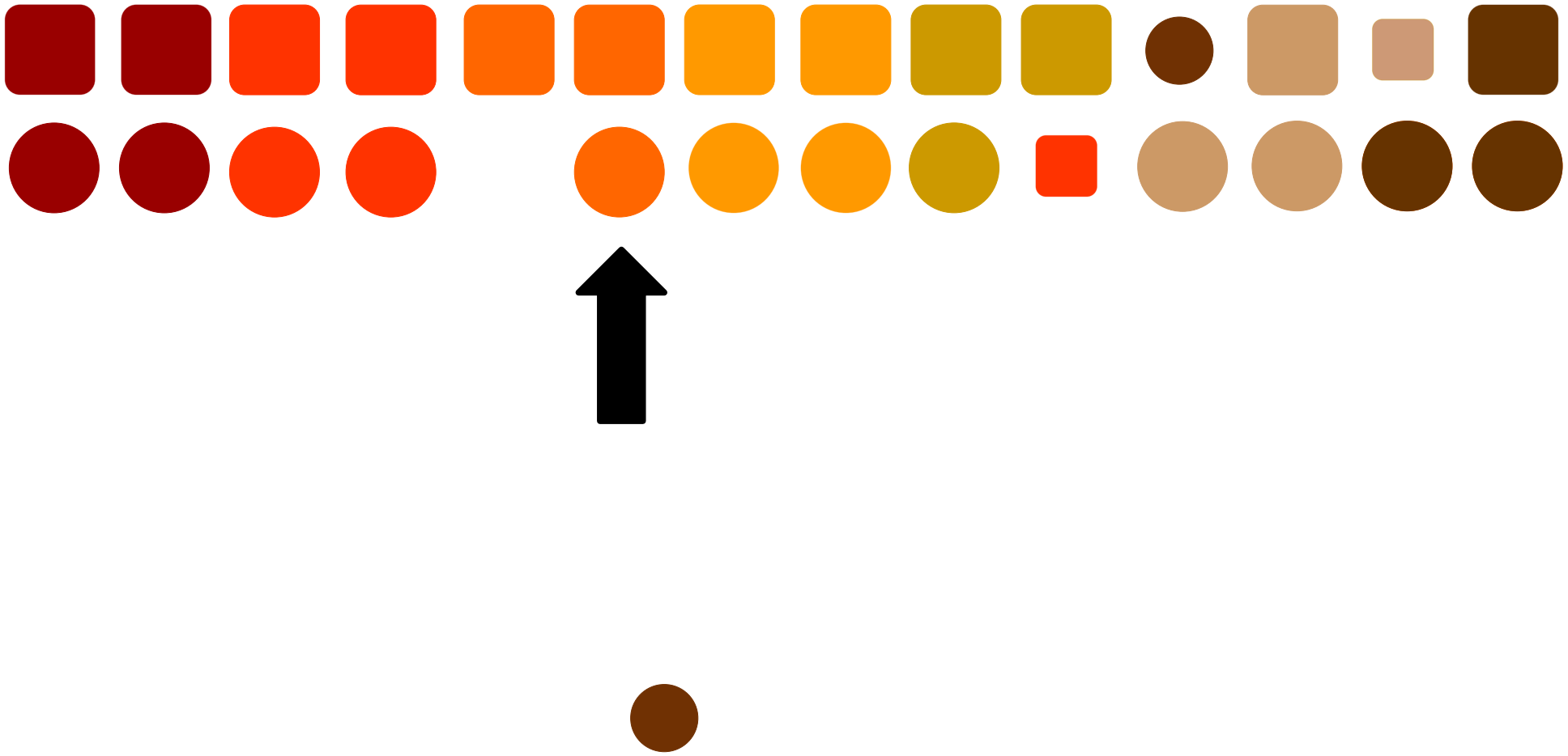

parâmetros

riqueza t0

abundância t0

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constante

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modelo baseado em indivíduo

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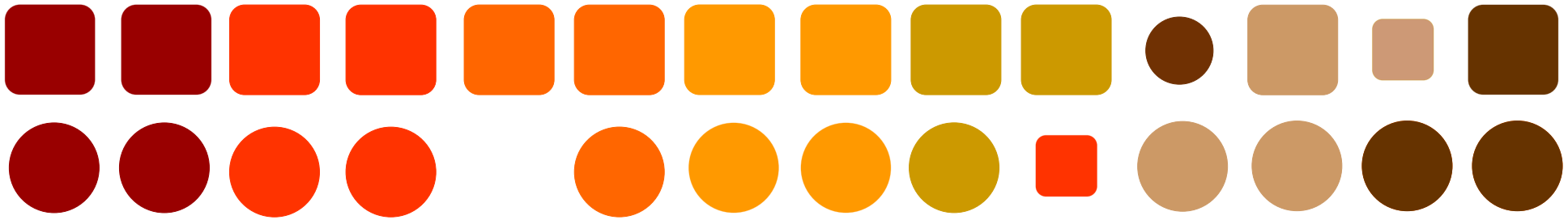

parâmetros

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abundância t0

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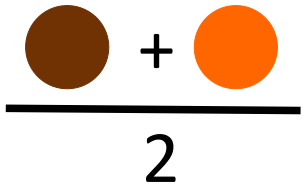
constante

no distúrbios

% morta/distúrbio



modelo baseado em indivíduo

parâmetros

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no gametas♀/ciclo

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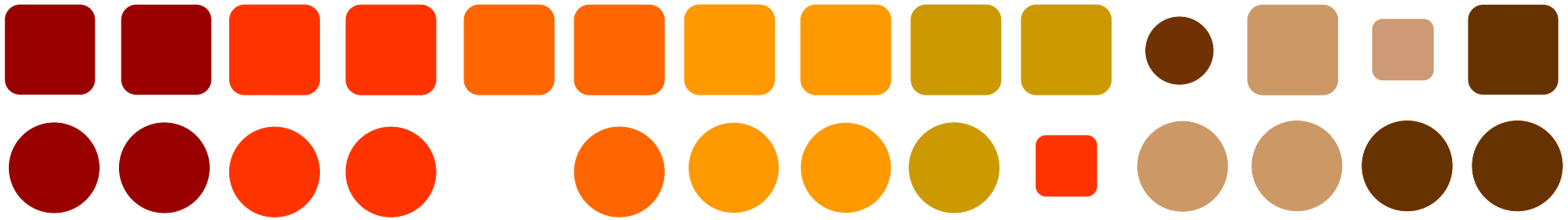

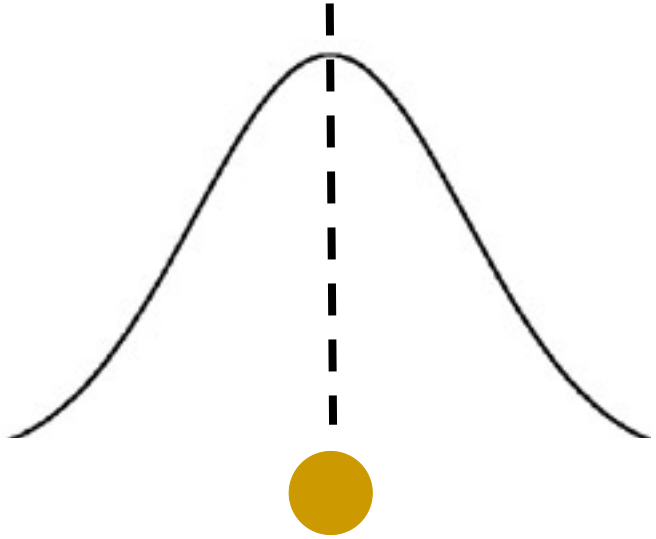

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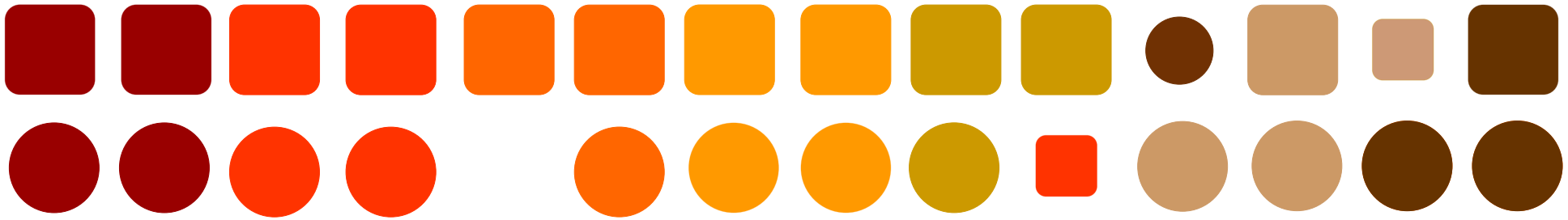
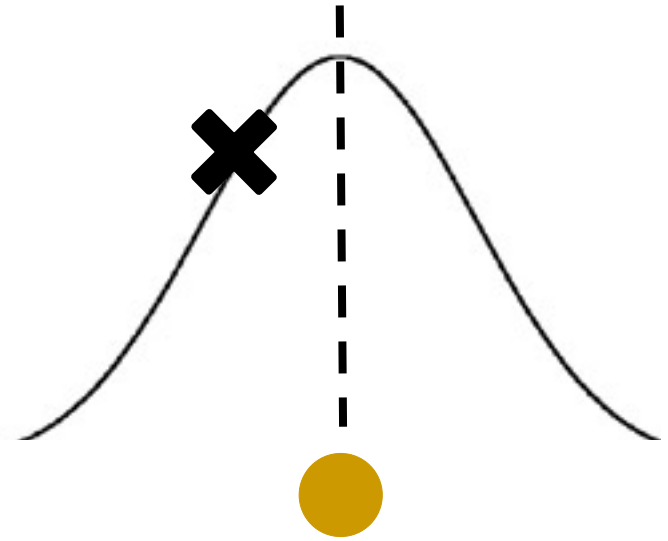




parâmetros

riqueza t0

abundância t0

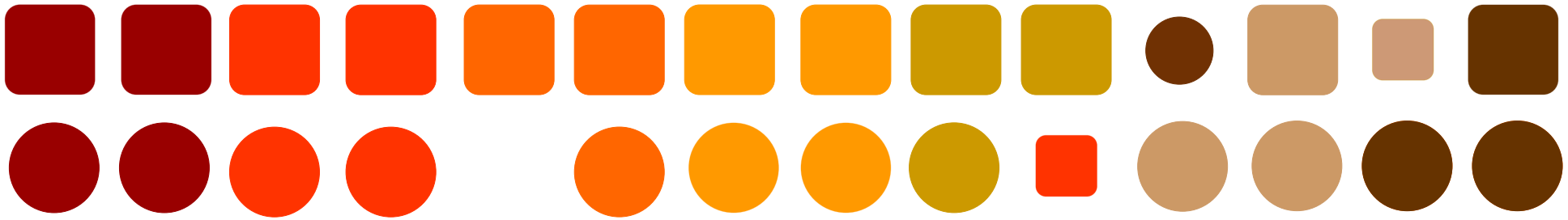
no gametas♀/ciclo

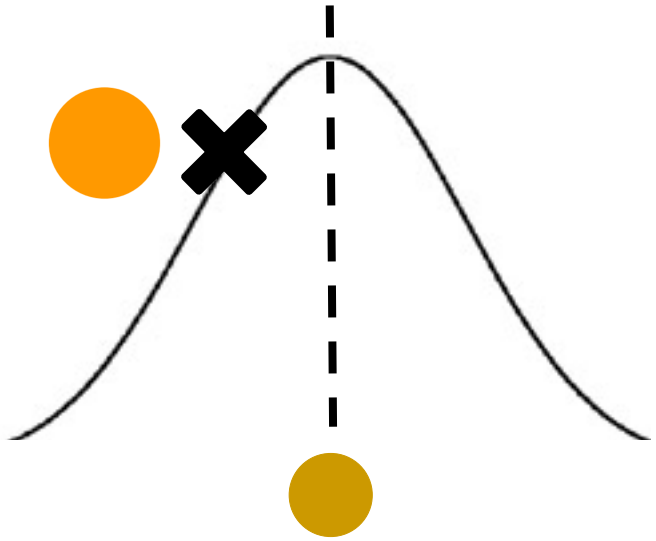
constante

no distúrbios

% morta/distúrbio

modelo baseado em indivíduo





parâmetros

riqueza t0

abundância t0

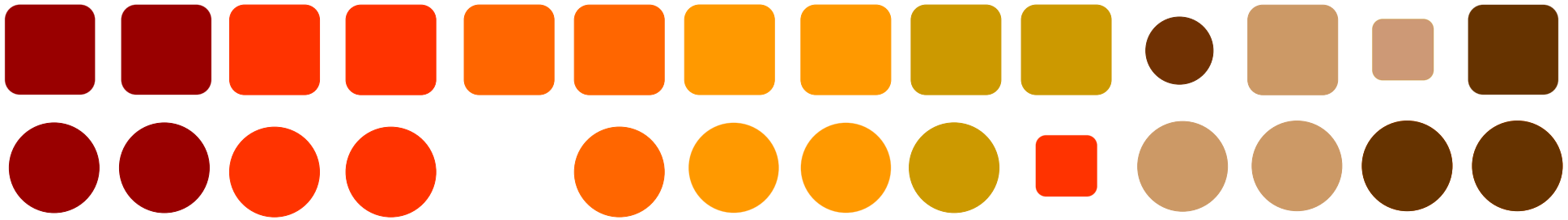
no gametas♀/ciclo

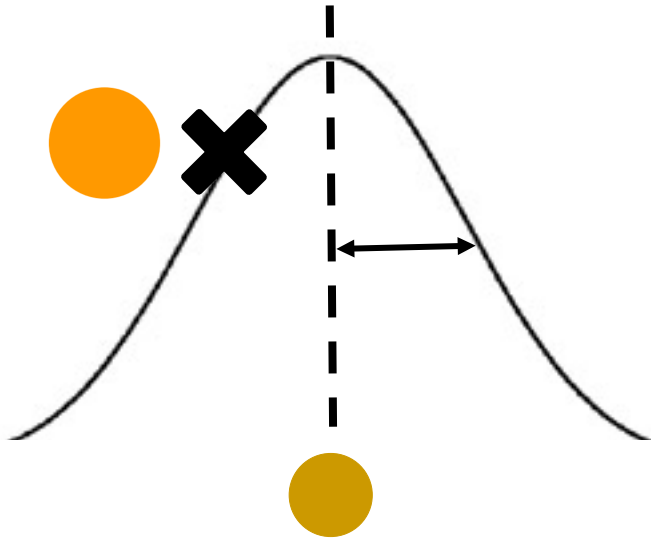
constante

no distúrbios

% morta/distúrbio

modelo baseado em indivíduo





parâmetros

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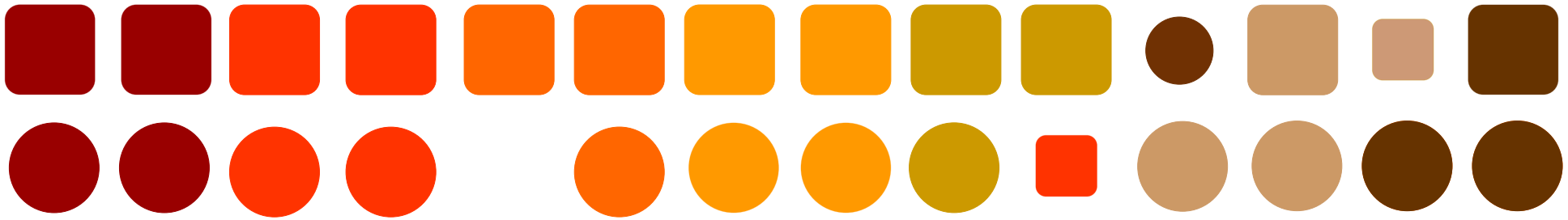
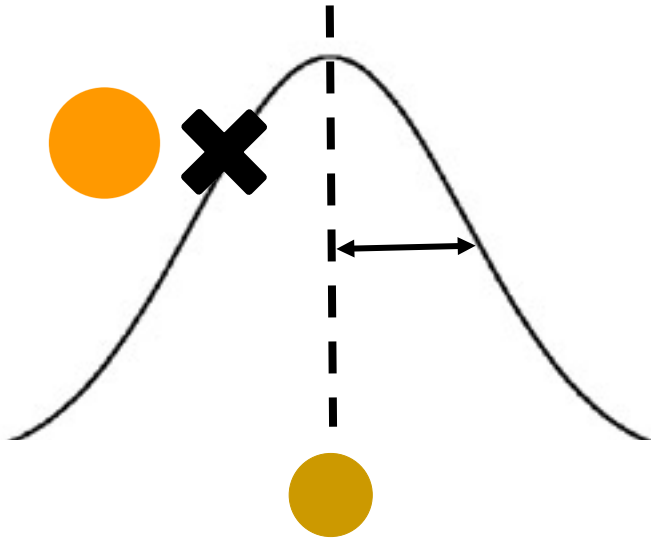
no distúrbios

% morta/distúrbio

modelo baseado em indivíduo





parâmetros

riqueza t0

abundância t0

no gametas♀/ciclo

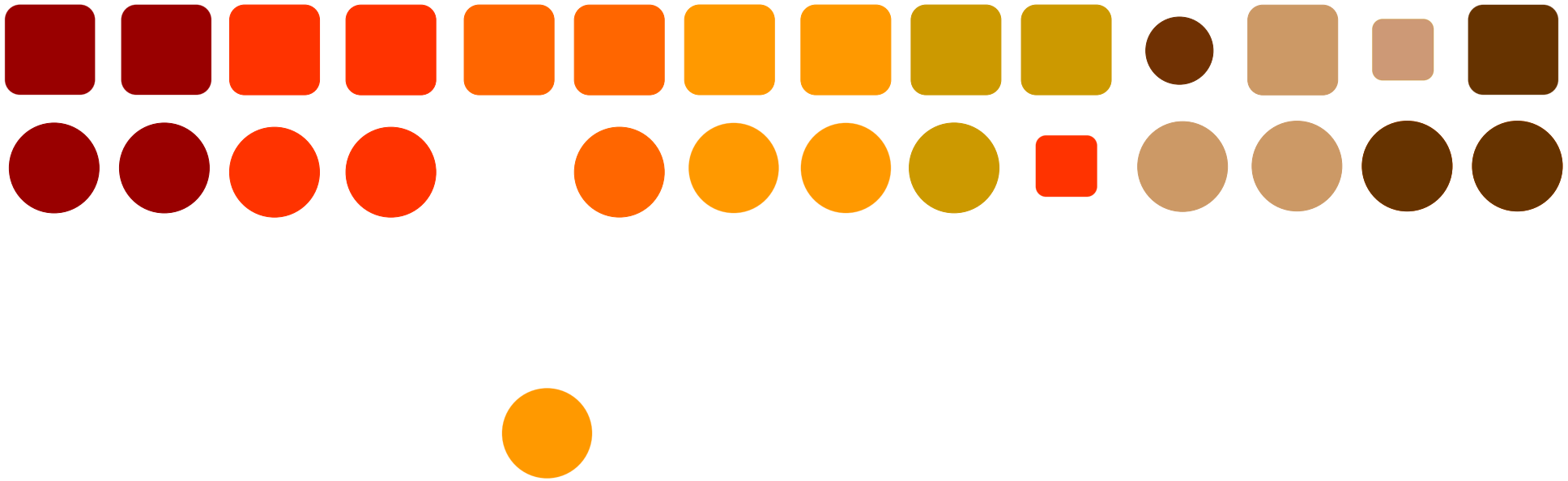
constante

no distúrbios

% morta/distúrbio

taxa de mutação

modelo baseado em indivíduo



parâmetros

riqueza t0

abundância t0

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constante

no distúrbios

% morta/distúrbio

taxa de mutação

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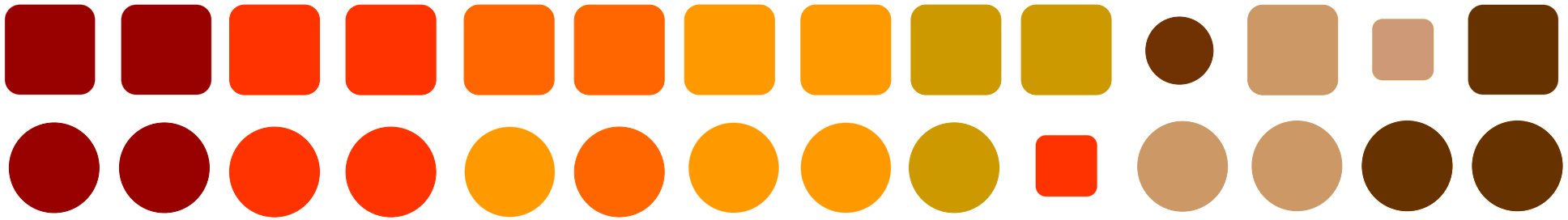


parâmetros

riqueza t0

abundância t0

no gametas♀/ciclo

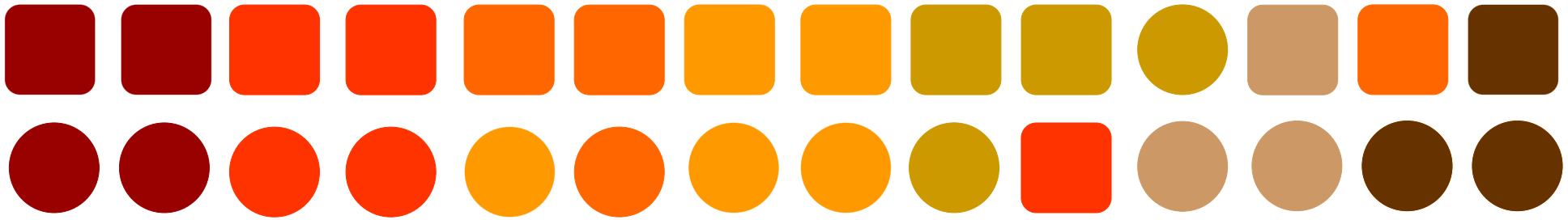
constante

no distúrbios

% morta/distúrbio

taxa de mutação

modelo baseado em indivíduo



parâmetros

riqueza t0

abundância t0

no gametas♀/ciclo

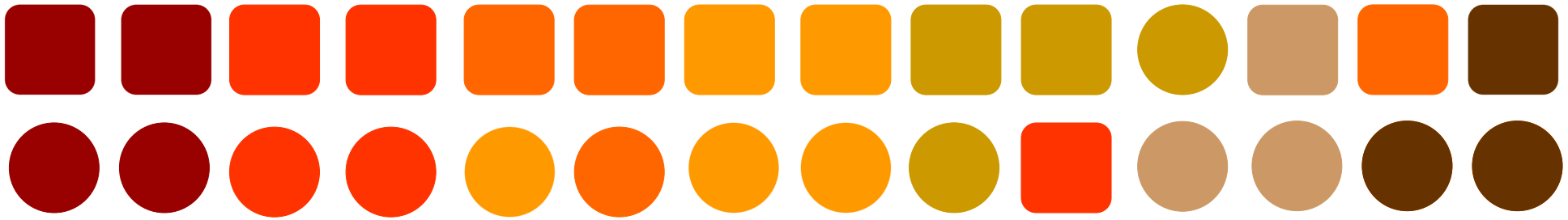
constante

no distúrbios

% morta/distúrbio

taxa de mutação

modelo baseado em indivíduo



parâmetros

riqueza t0

abundância t0

no gametas♀/ciclo

constante

no distúrbios

% morta/distúrbio

taxa de mutação

no tempos

cenários simulados

cenários simulados

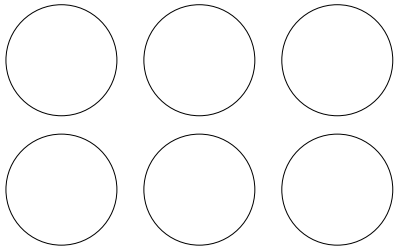
evolutivo

ecológico

eco-evolutivo

cenários simulados

evolutivo

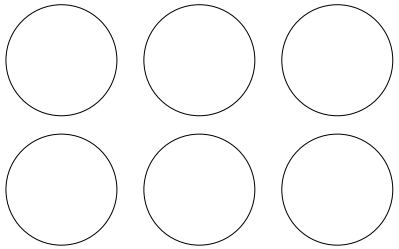


ecológico

eco-evolutivo

cenários simulados

evolutivo



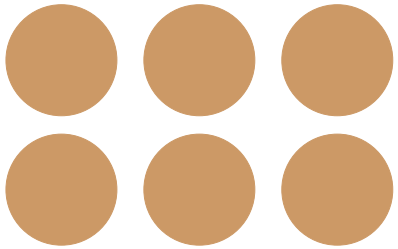
1 espécie

ecológico

eco-evolutivo

cenários simulados

evolutivo



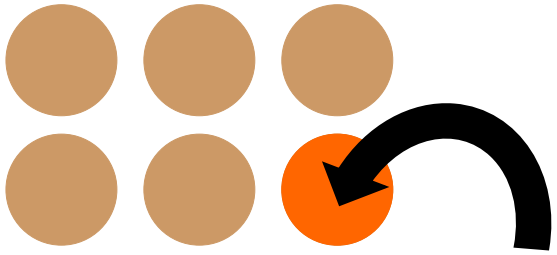
1 espécie

ecológico

eco-evolutivo

cenários simulados

evolutivo



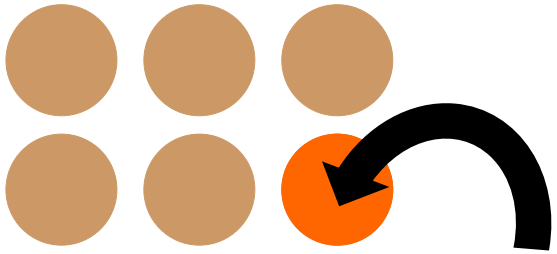
1 espécie

ecológico

eco-evolutivo

cenários simulados

evolutivo



1 espécie

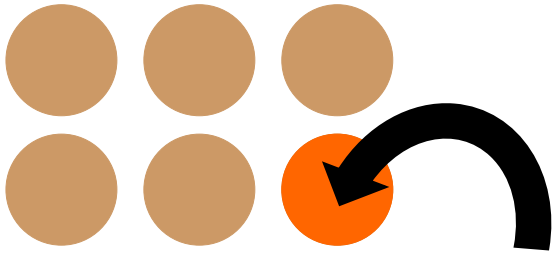
mutação > 0

ecológico

eco-evolutivo

cenários simulados

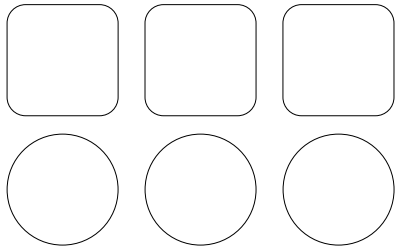
evolutivo



1 espécie

mutação > 0

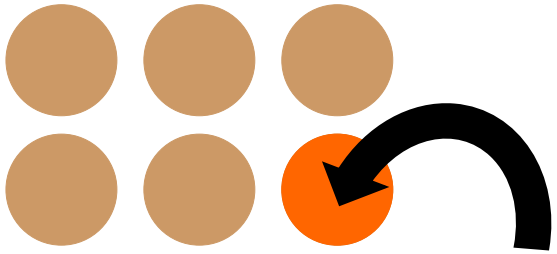
ecológico



eco-evolutivo

cenários simulados

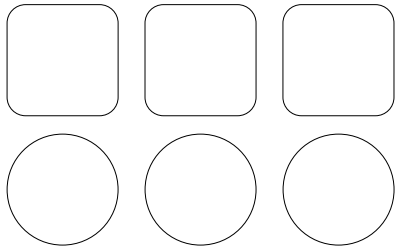
evolutivo



1 espécie

mutação > 0

ecológico

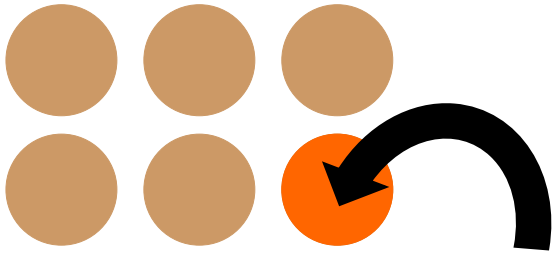


+ 1 espécie

eco-evolutivo

cenários simulados

evolutivo



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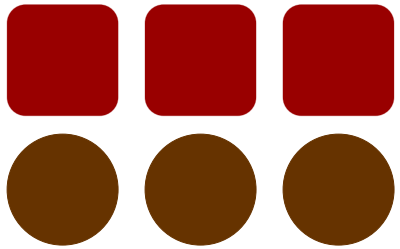
mutação > 0

ecológico



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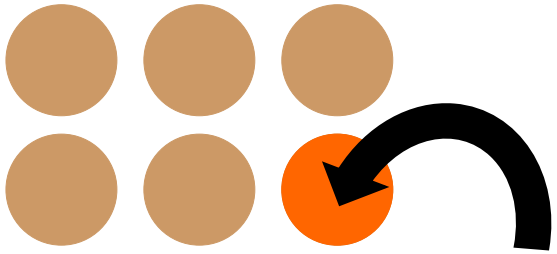
eco-evolutivo

cenários simulados

evolutivo



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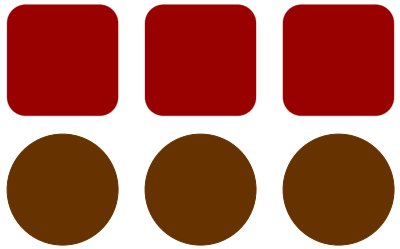


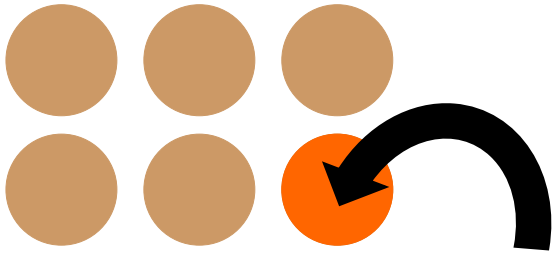
+ 1 espécie

mutação = 0

eco-evolutivo

cenários simulados

evolutivo



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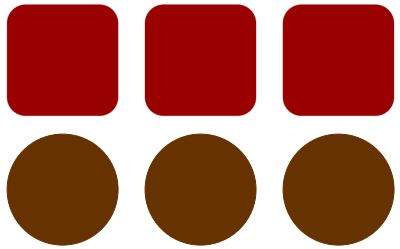

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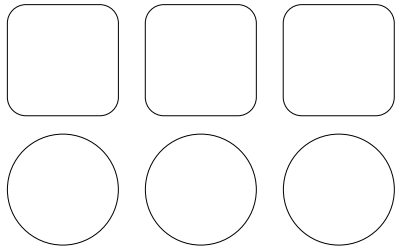
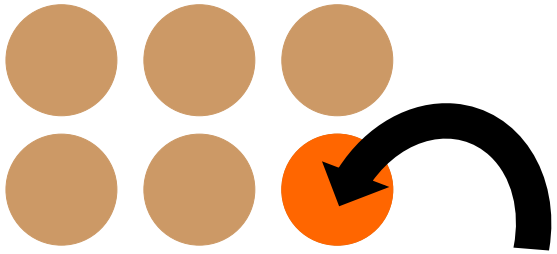


cenários simulados

evolutivo



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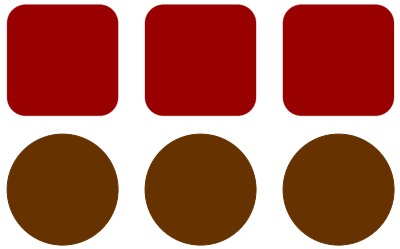

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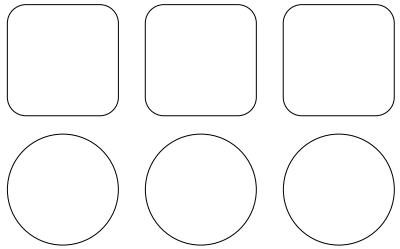

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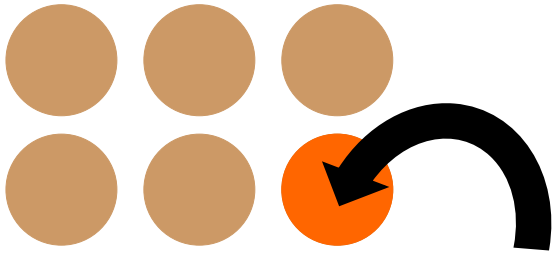
cenários simulados

evolutivo



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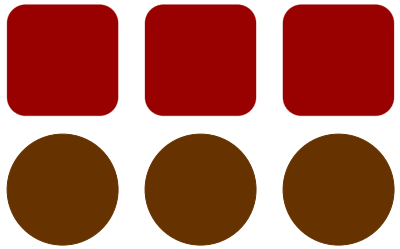

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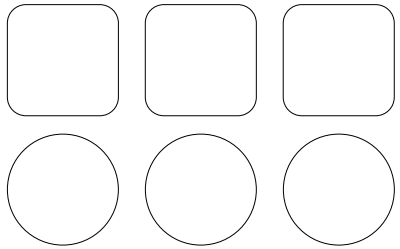

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cenários simulados

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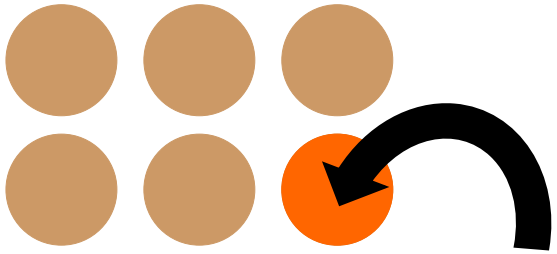

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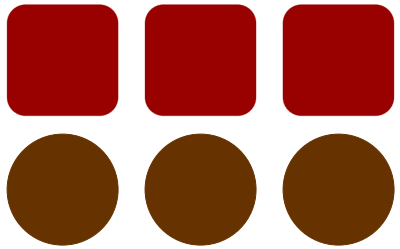

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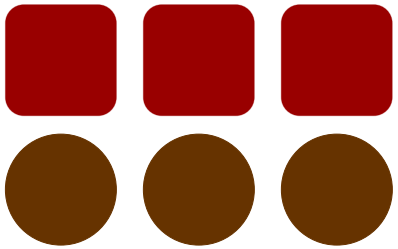

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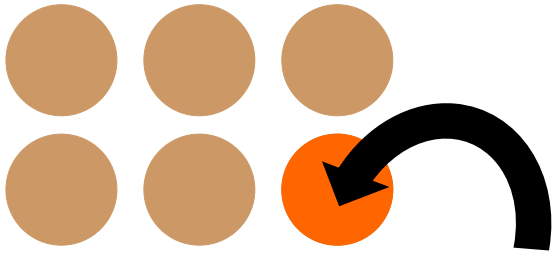

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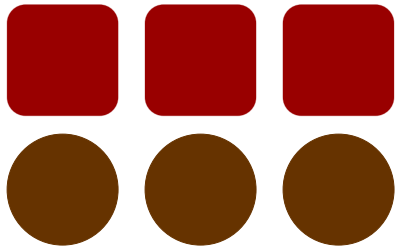

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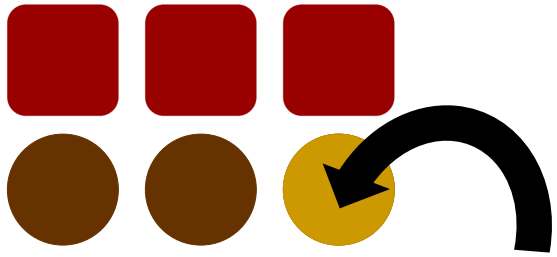

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cenários simulados

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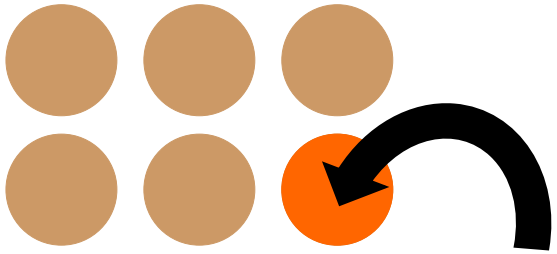

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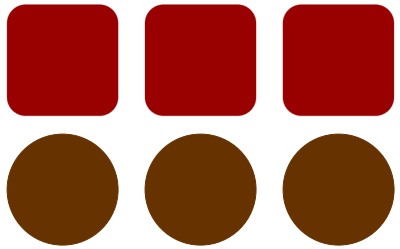

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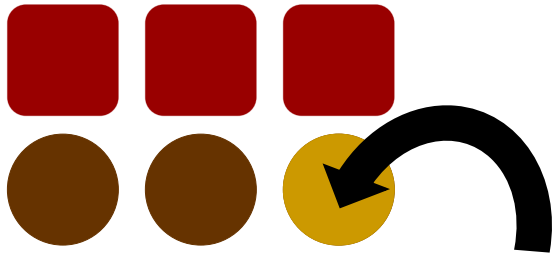

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cenários simulados

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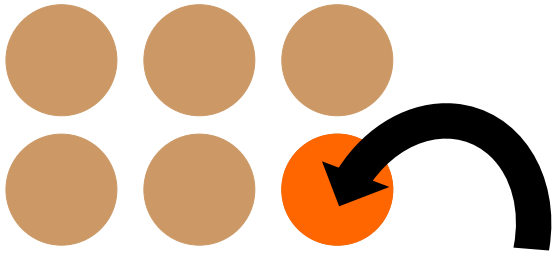

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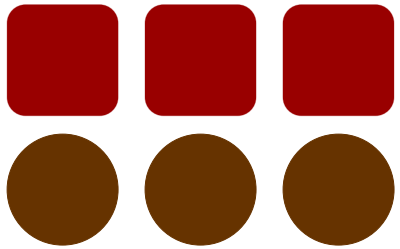

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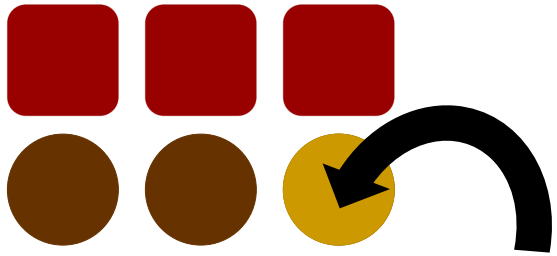

+ 1 espécie

mutação > 0

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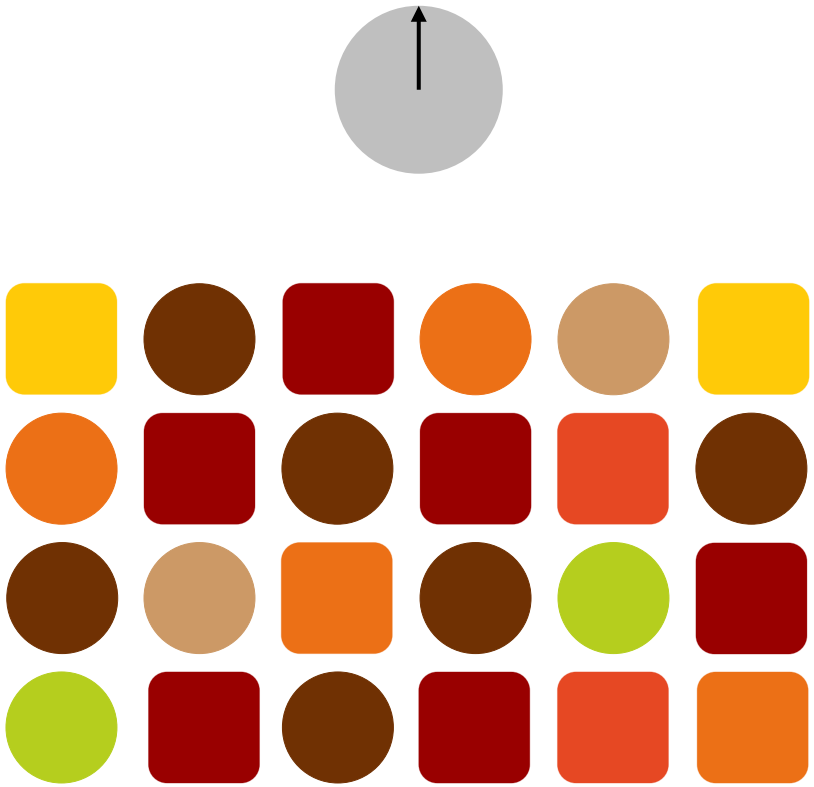

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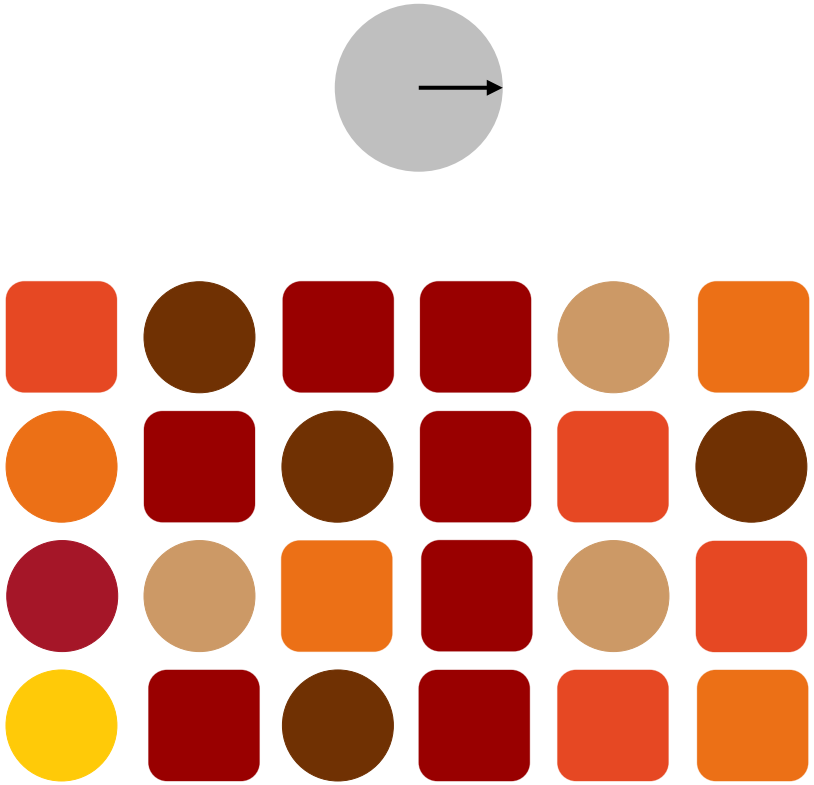

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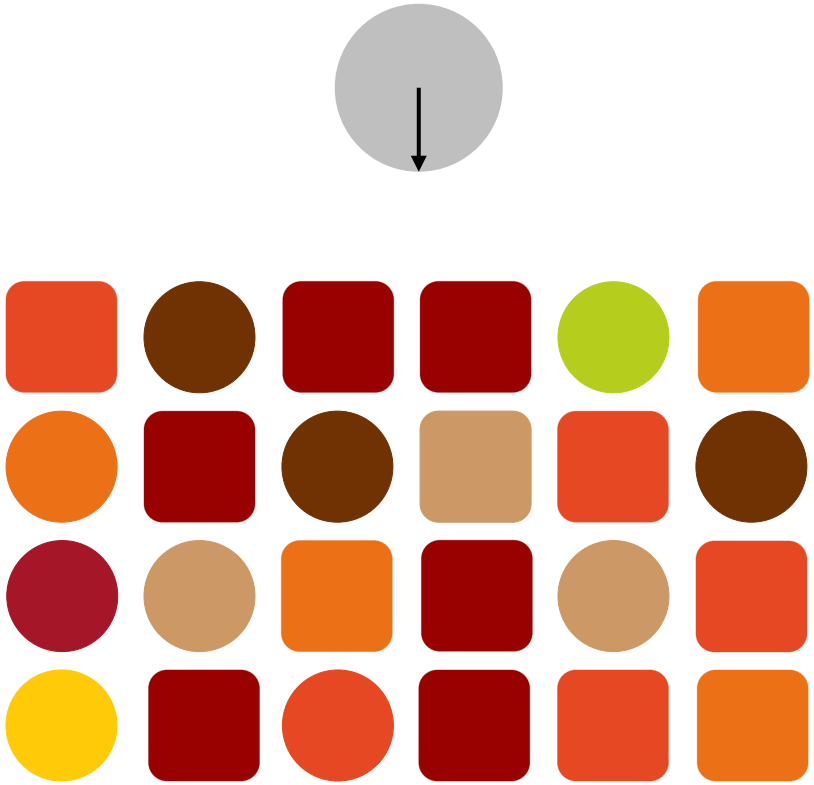

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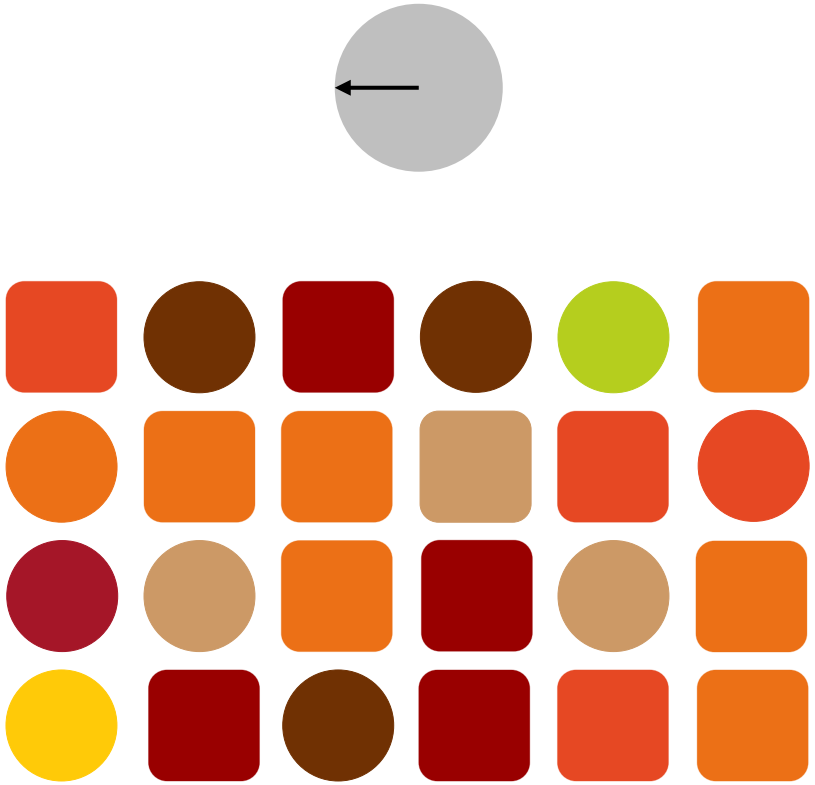

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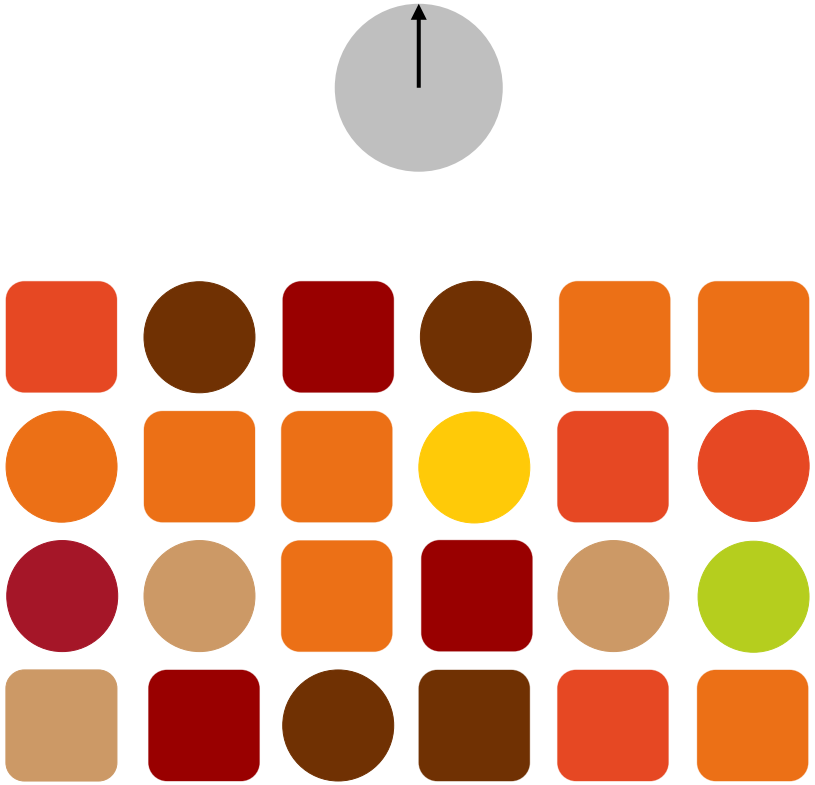

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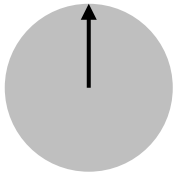

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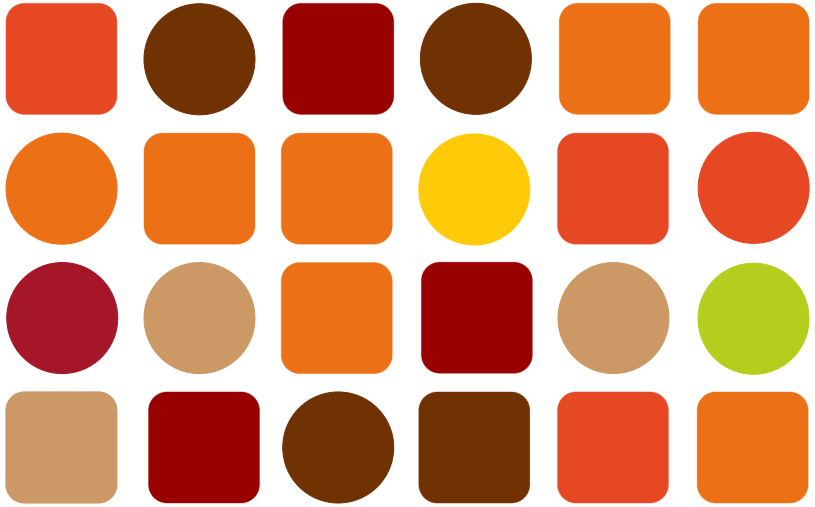

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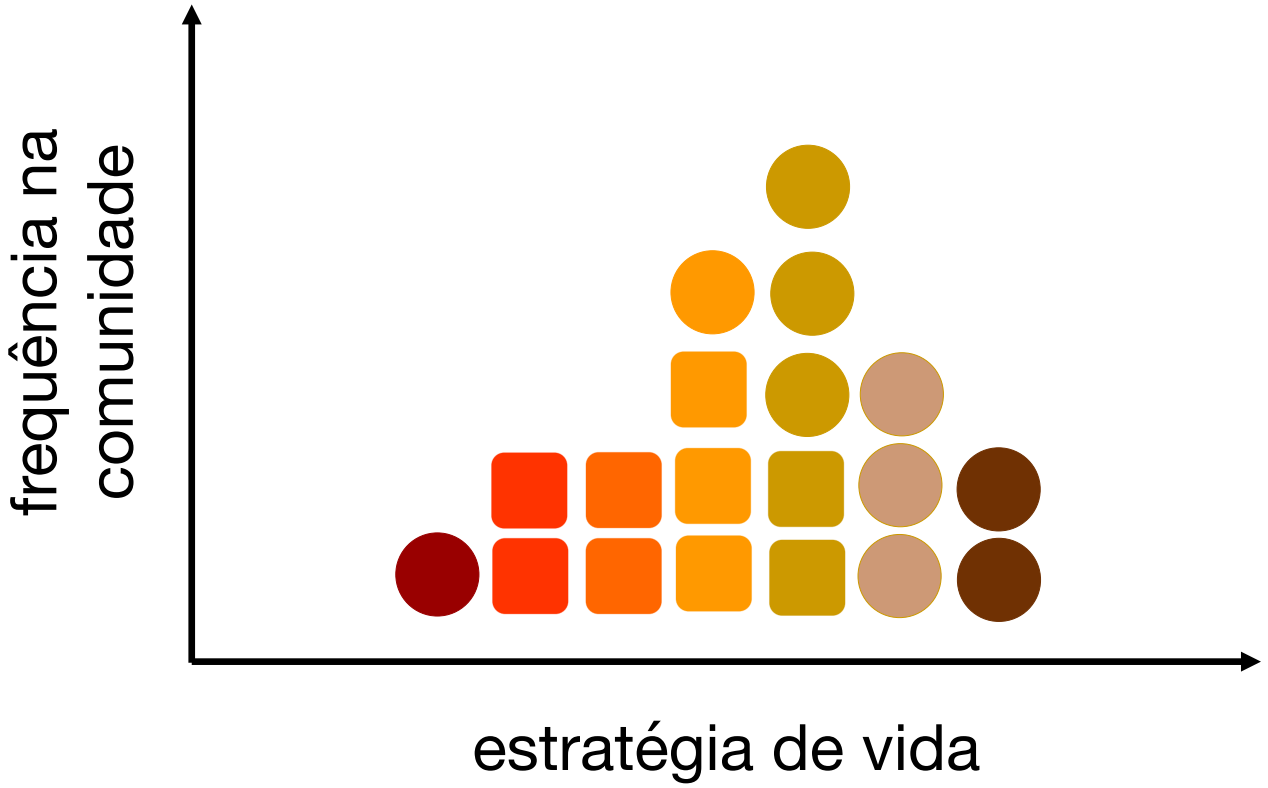

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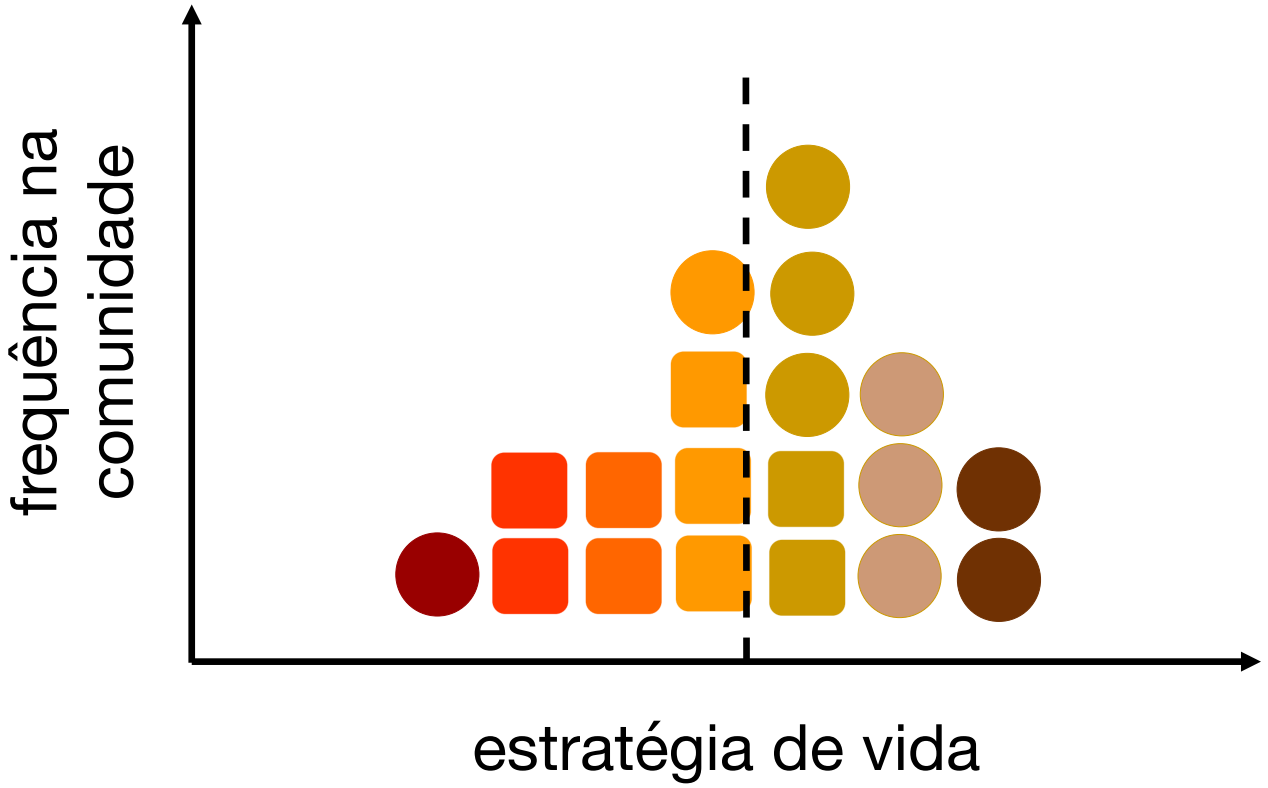
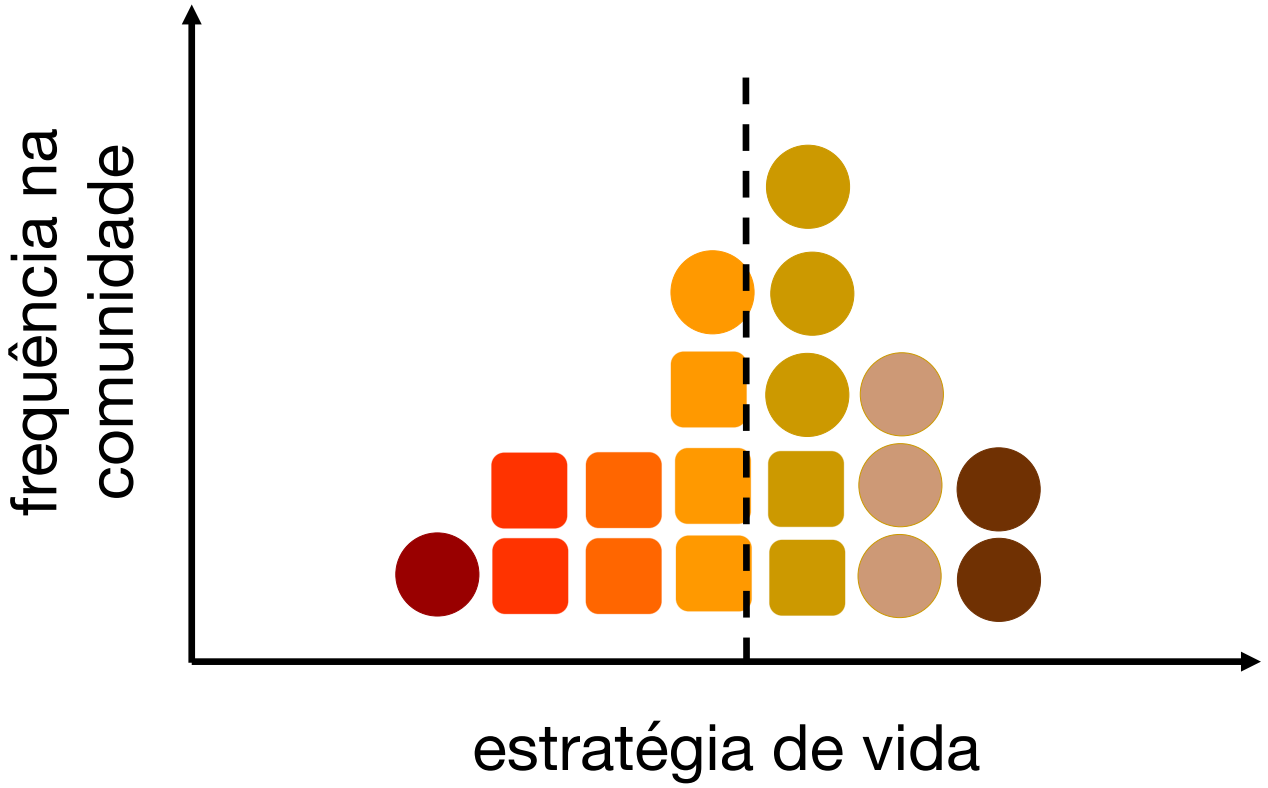


variáveis de interesse



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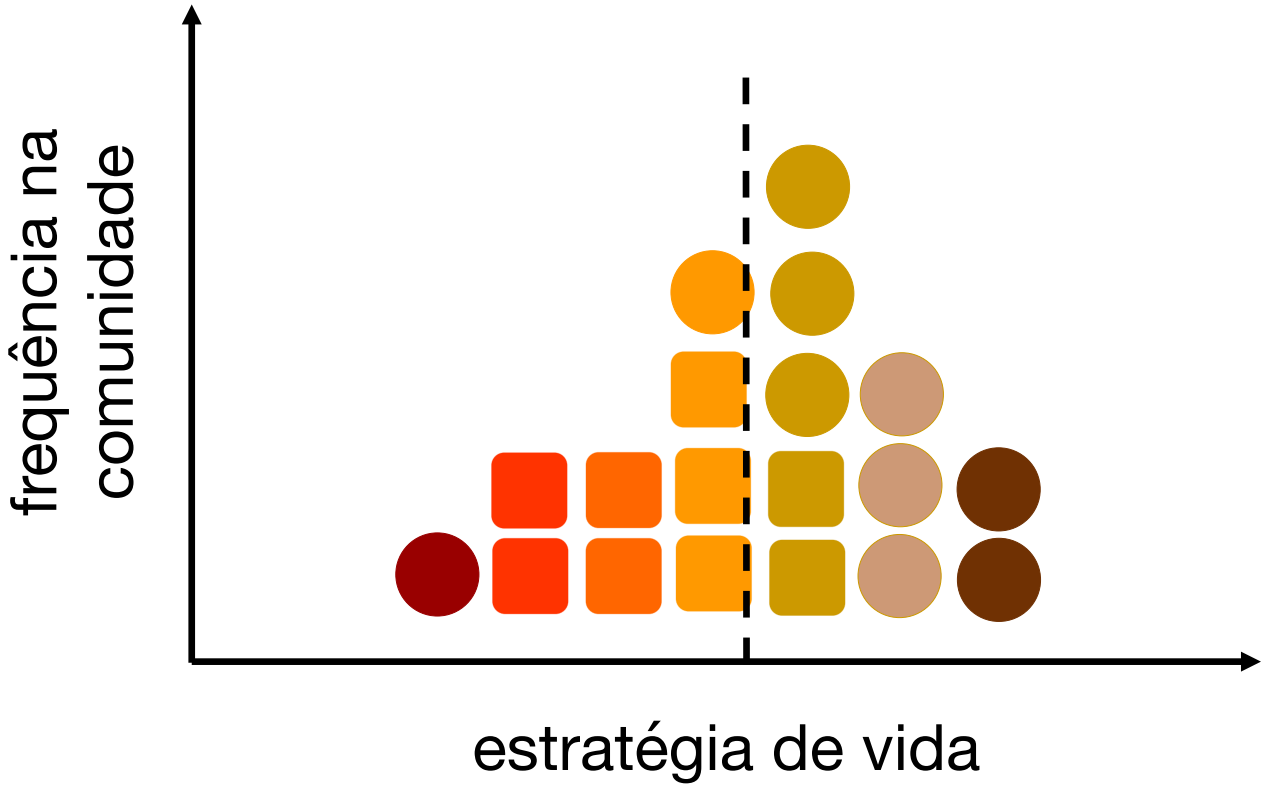
variáveis de interesse



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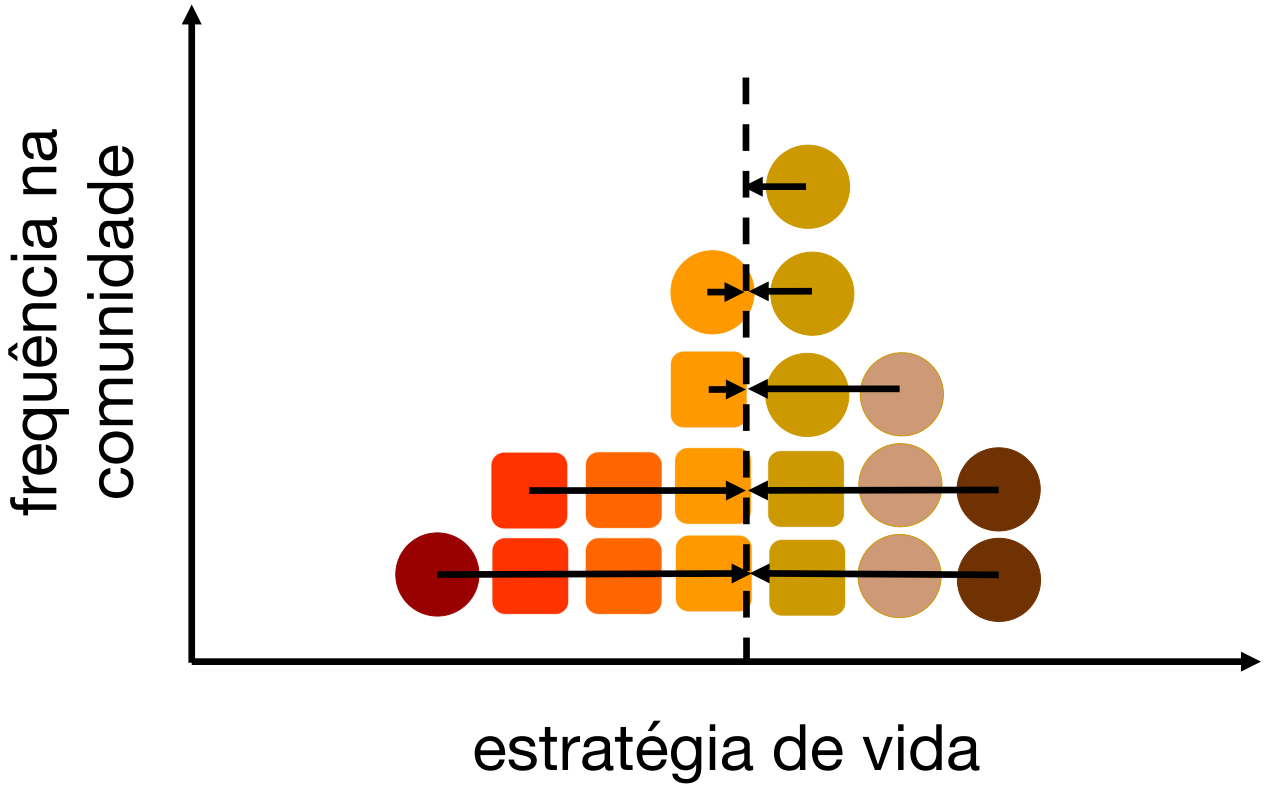

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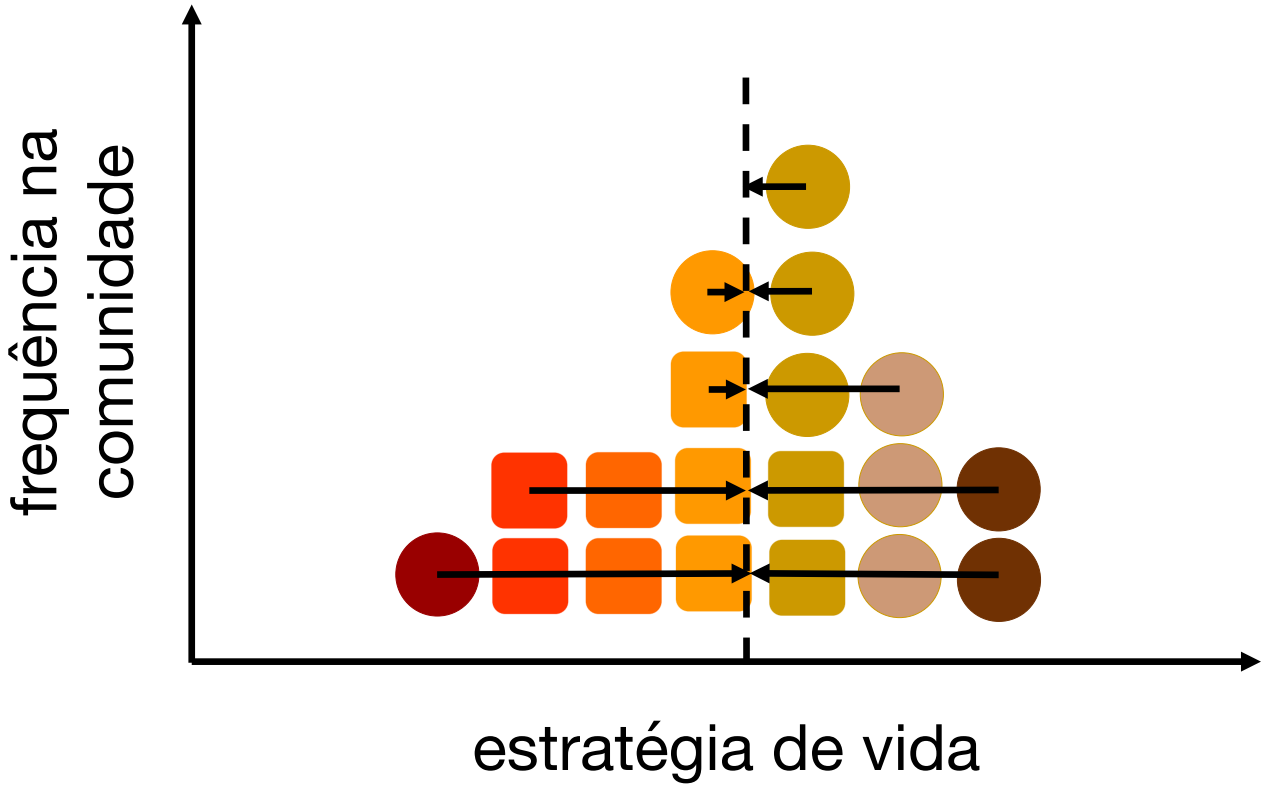

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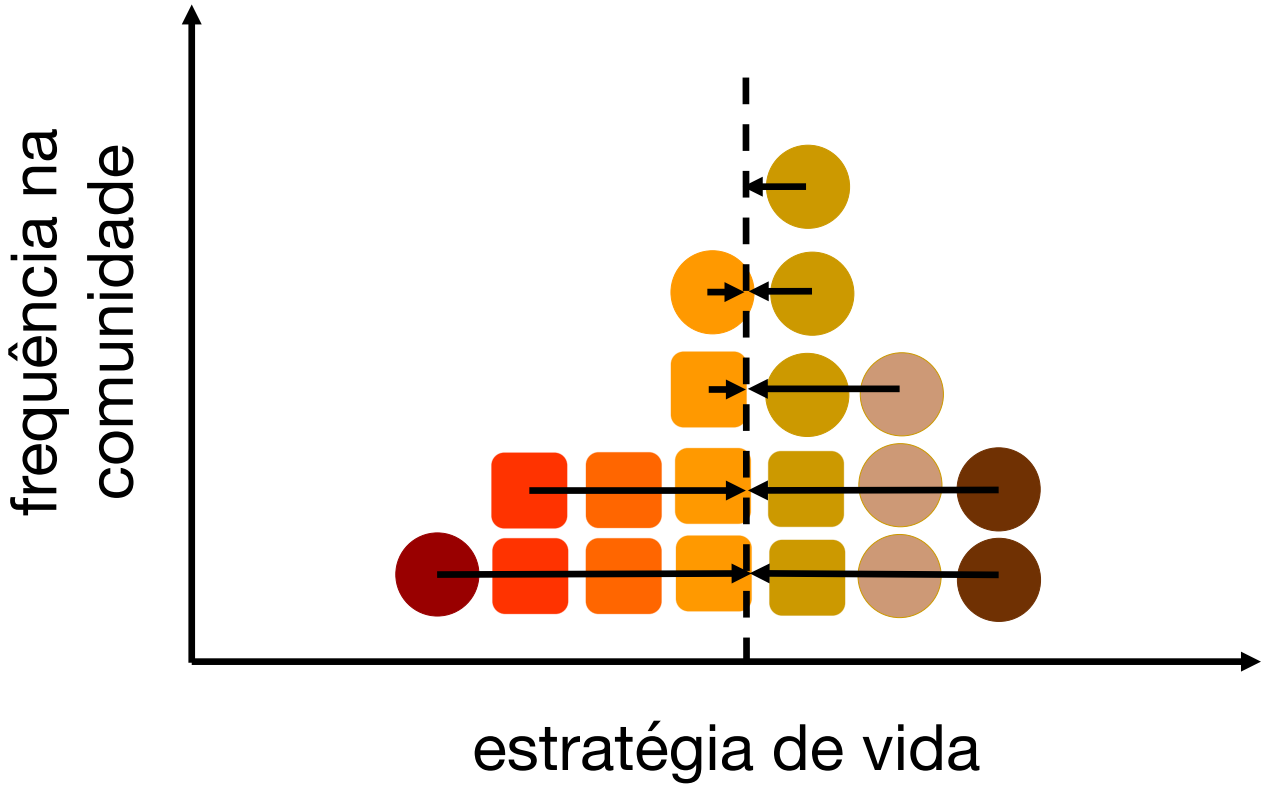
variáveis de interesse



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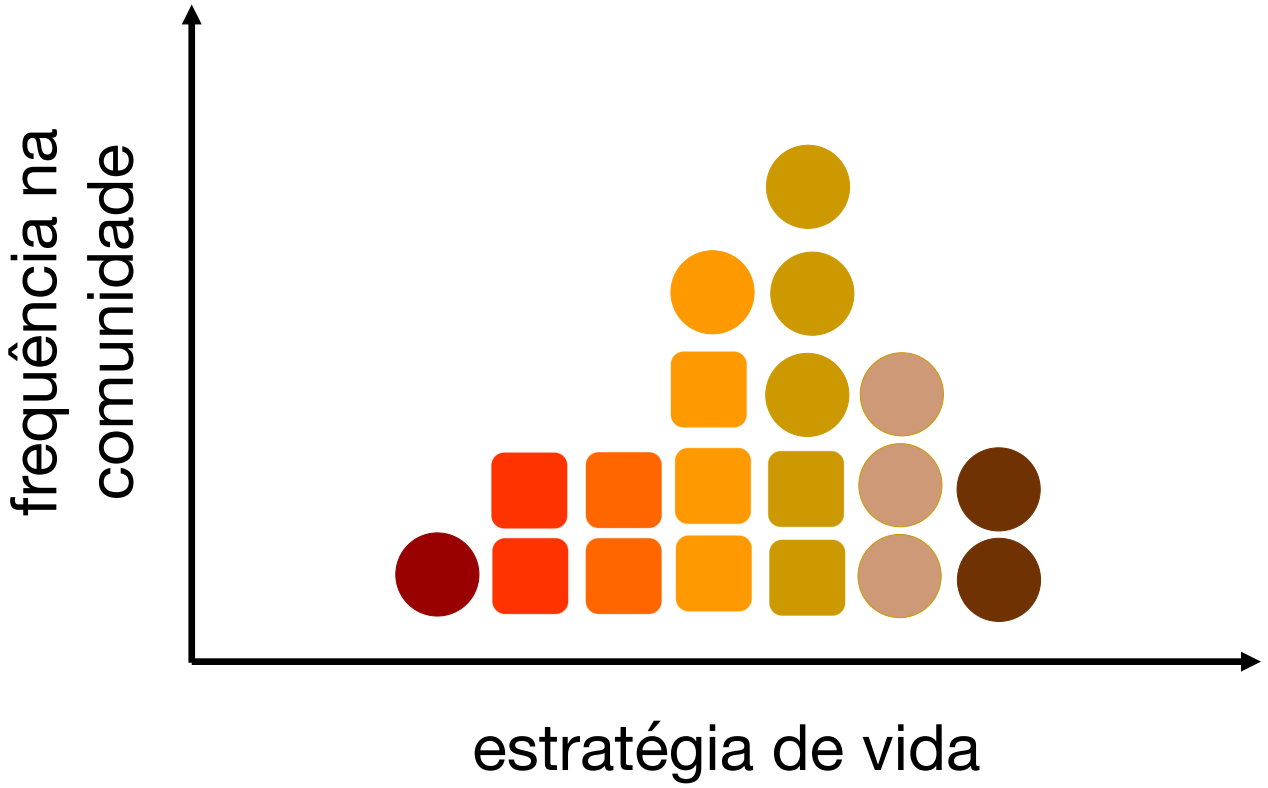
variância total da estratégia

diversidade de estratégias

variáveis de interesse



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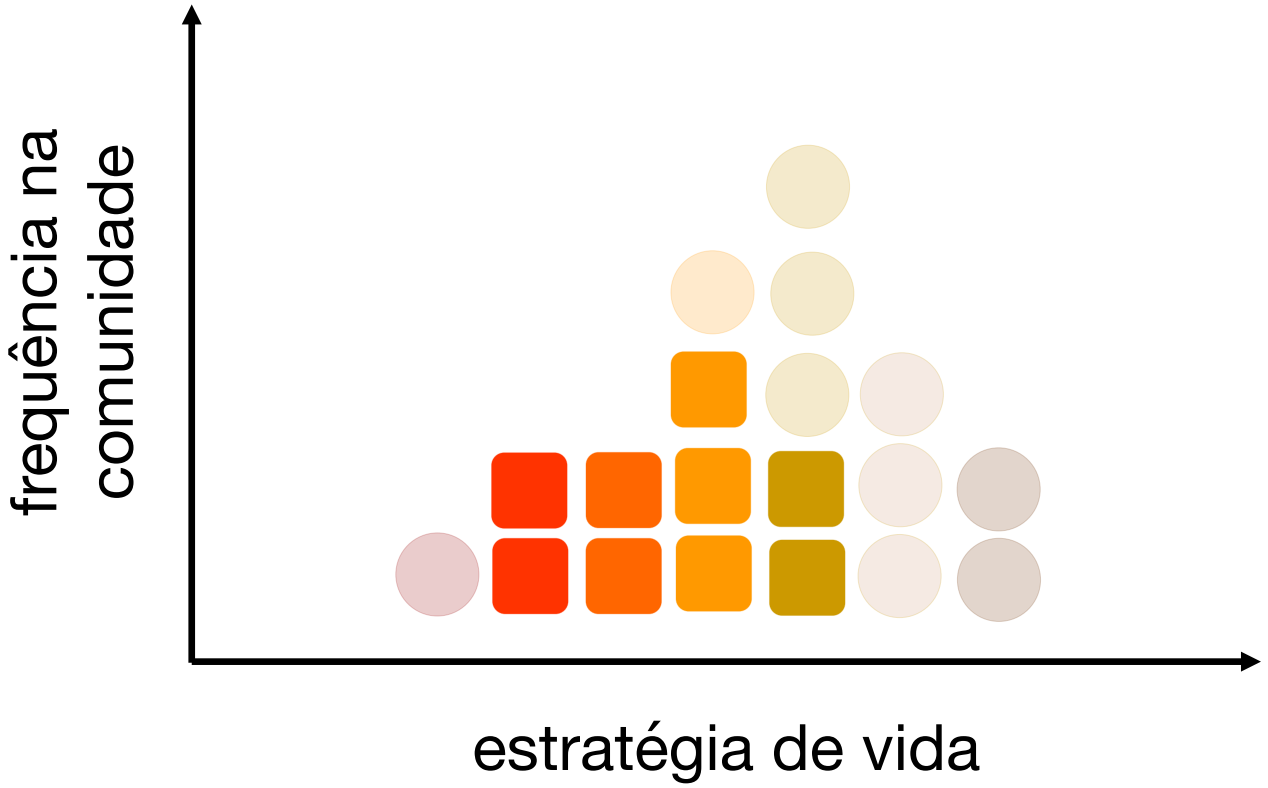
diversidade de estratégias

variáveis de interesse



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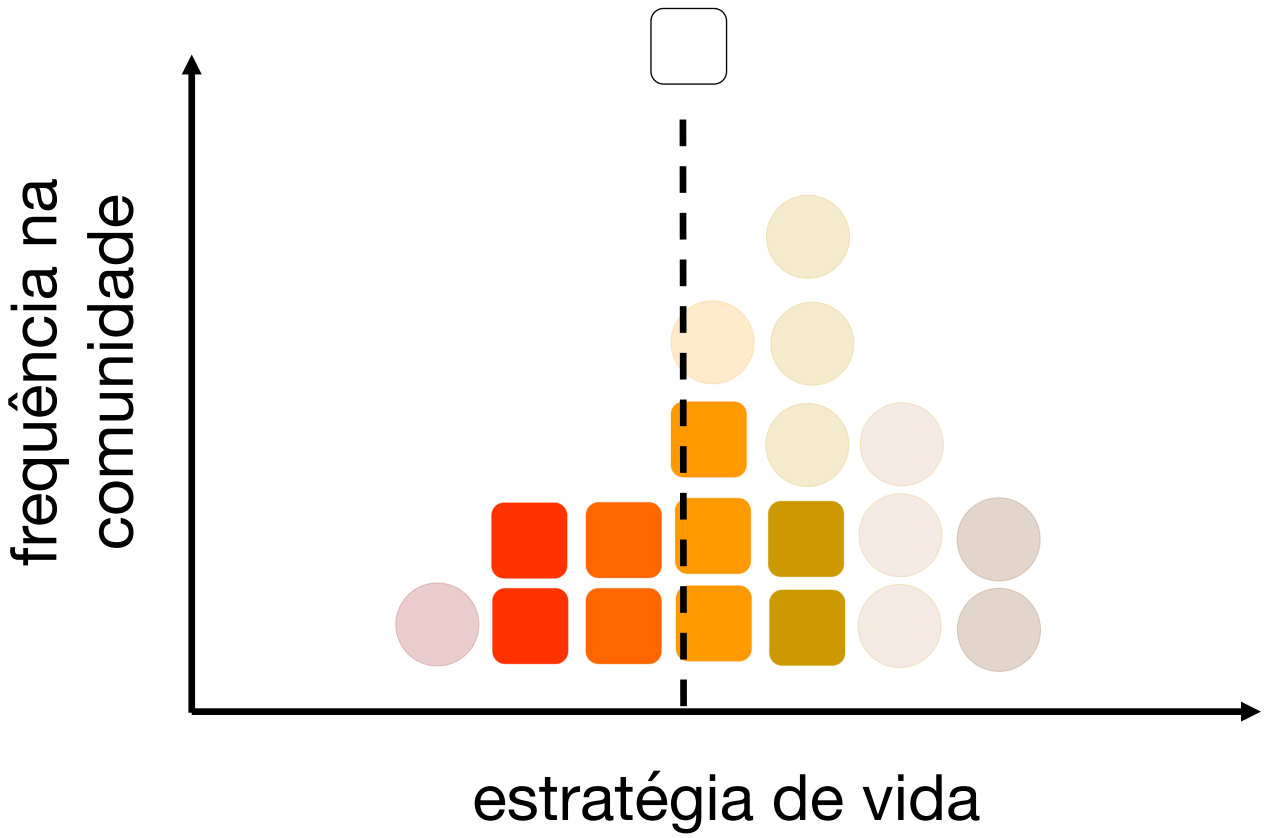

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diversidade de estratégias

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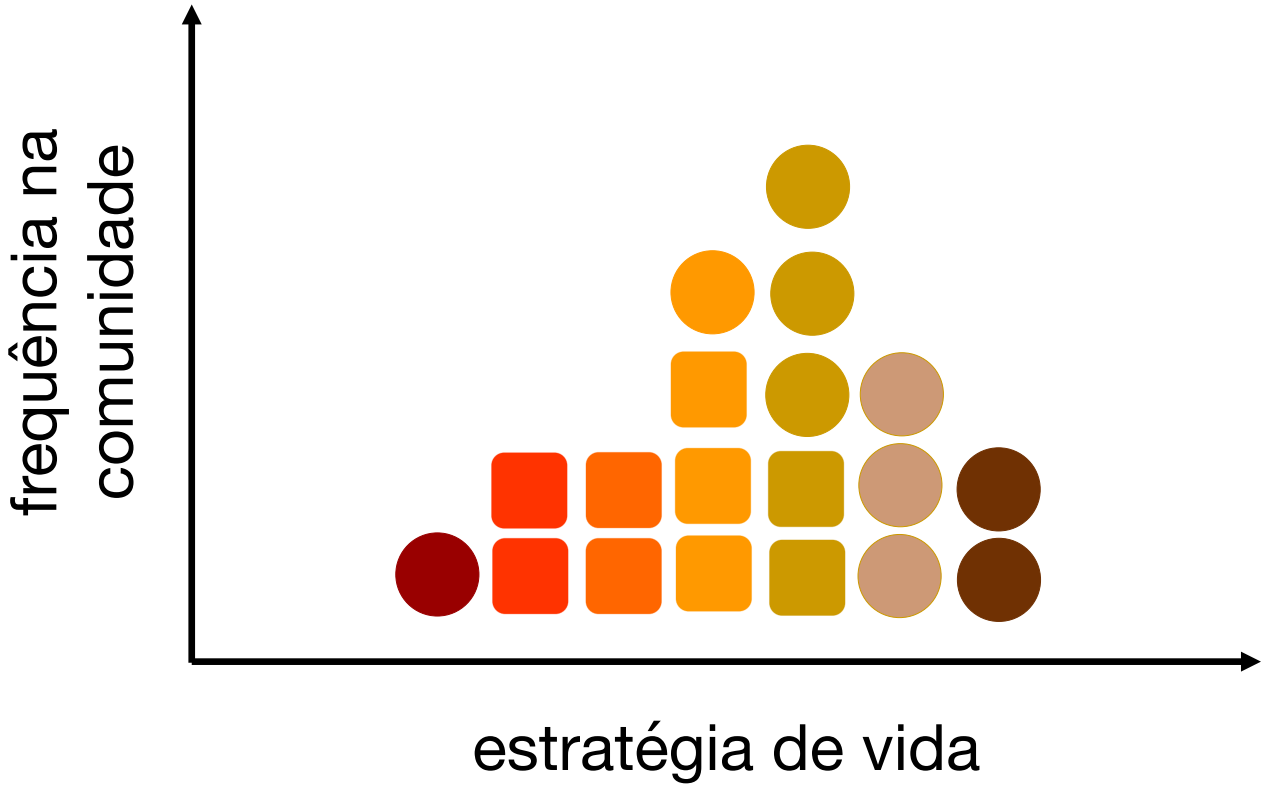

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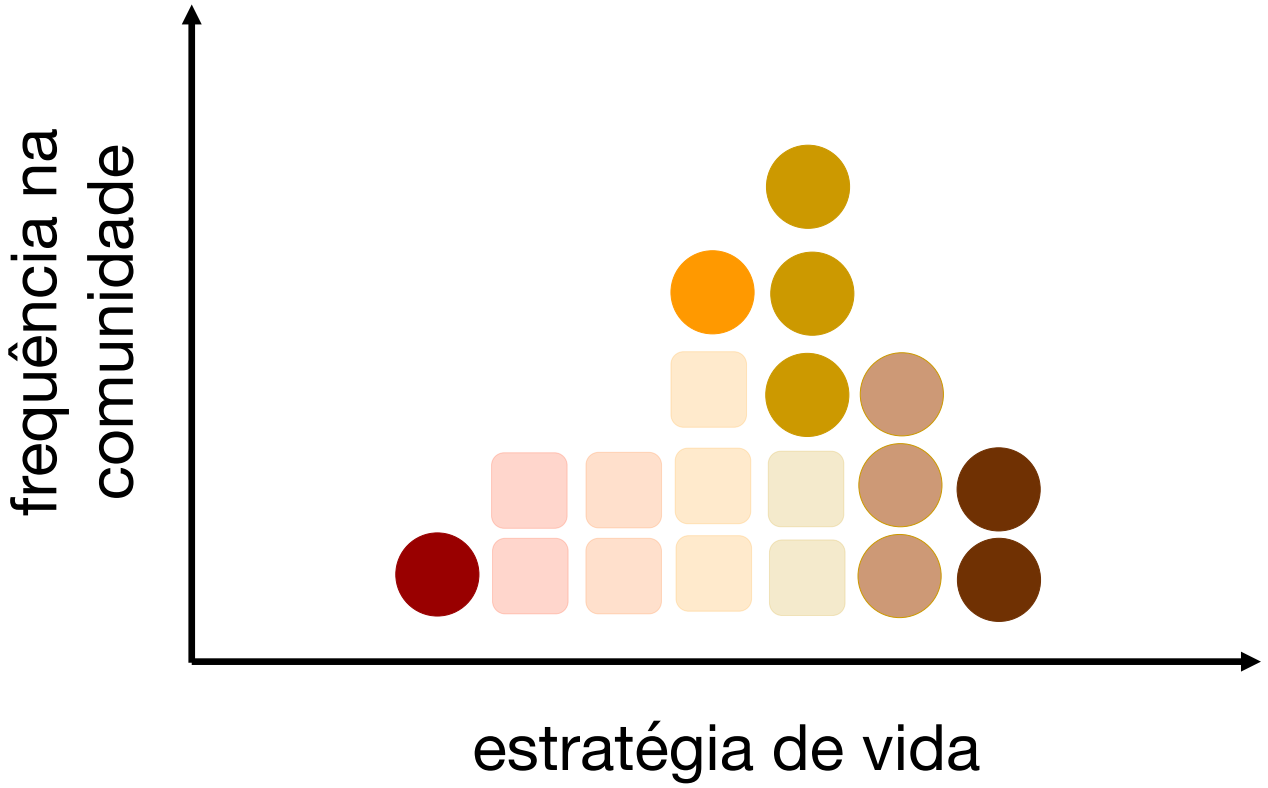

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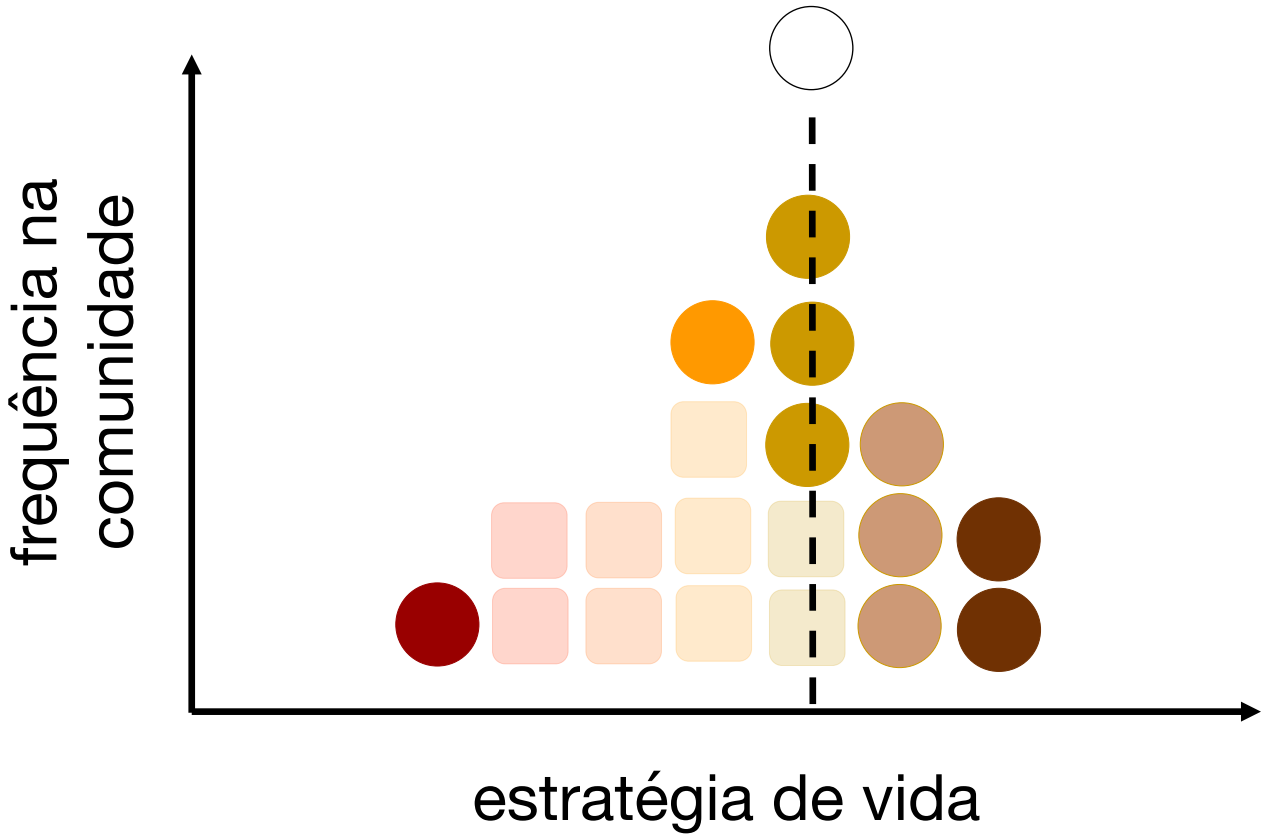

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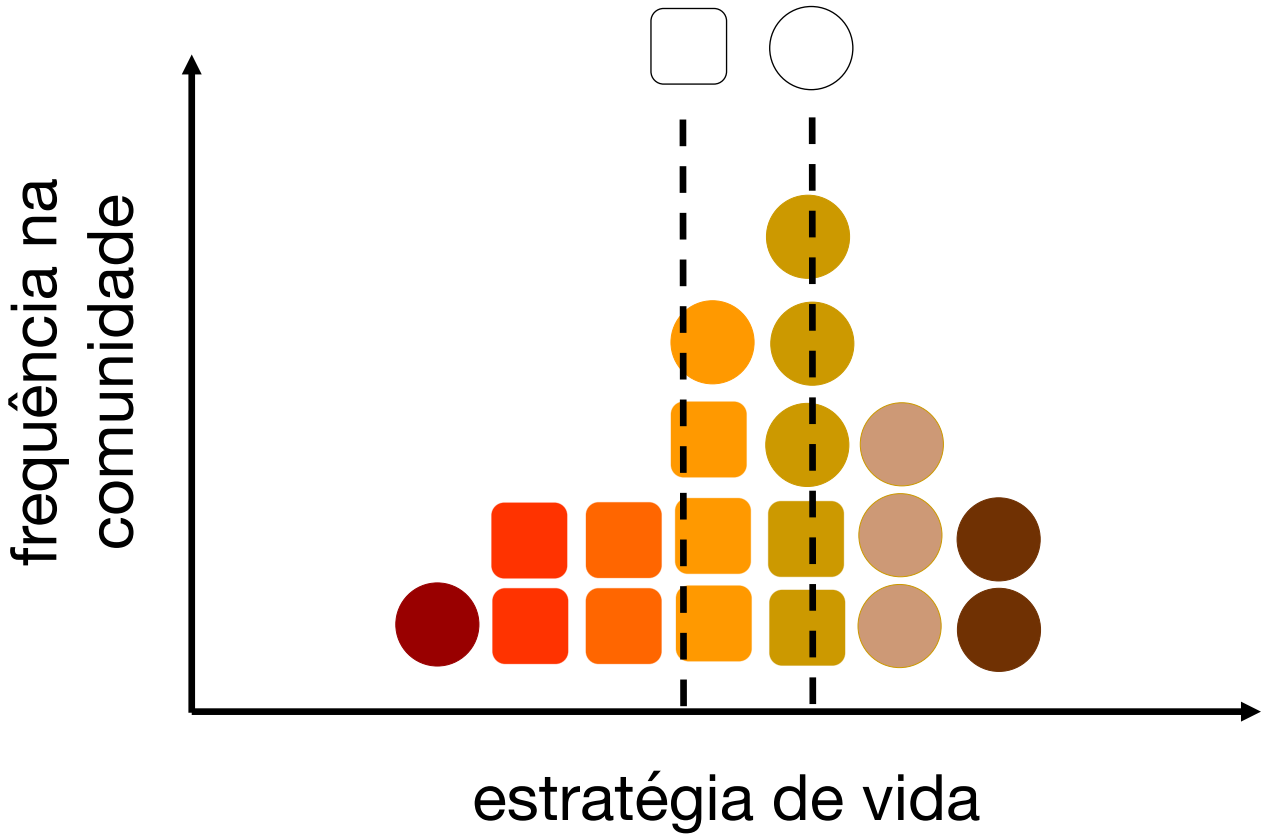

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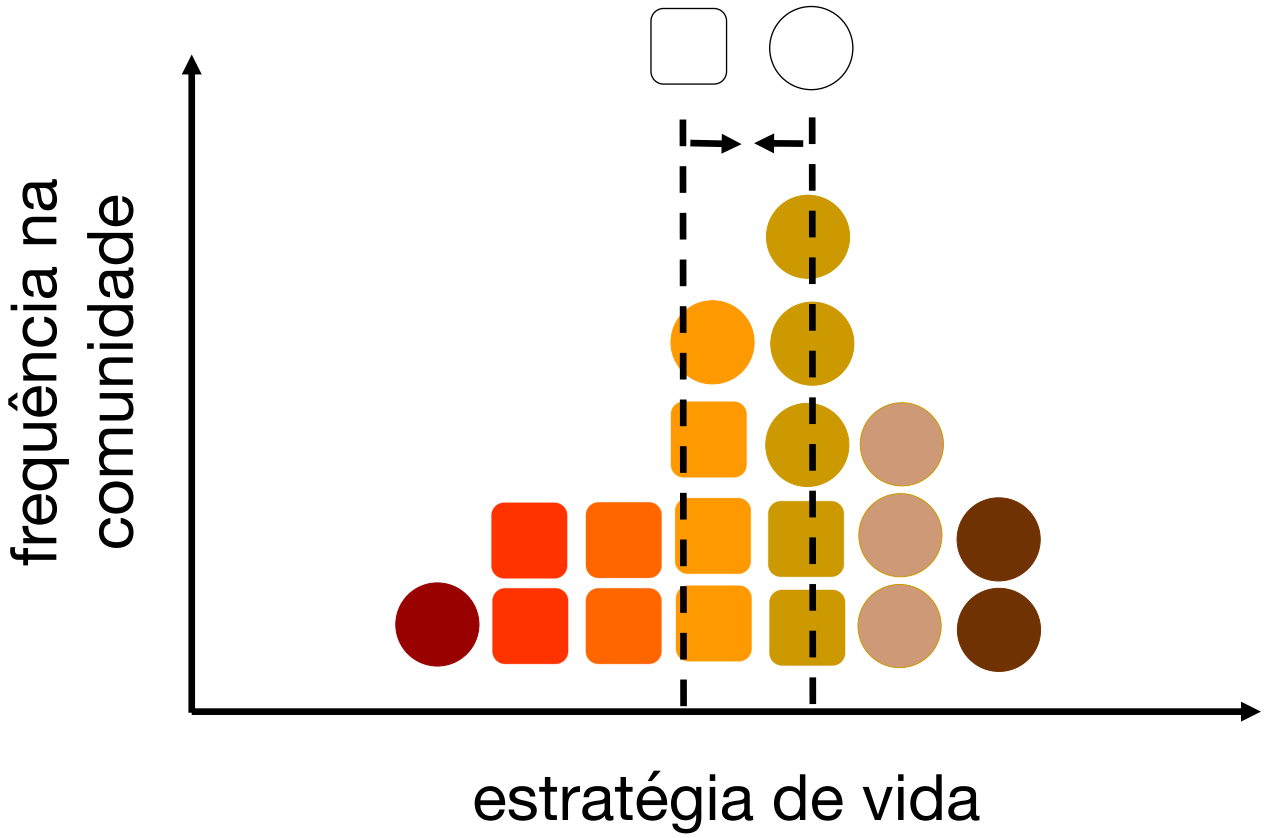

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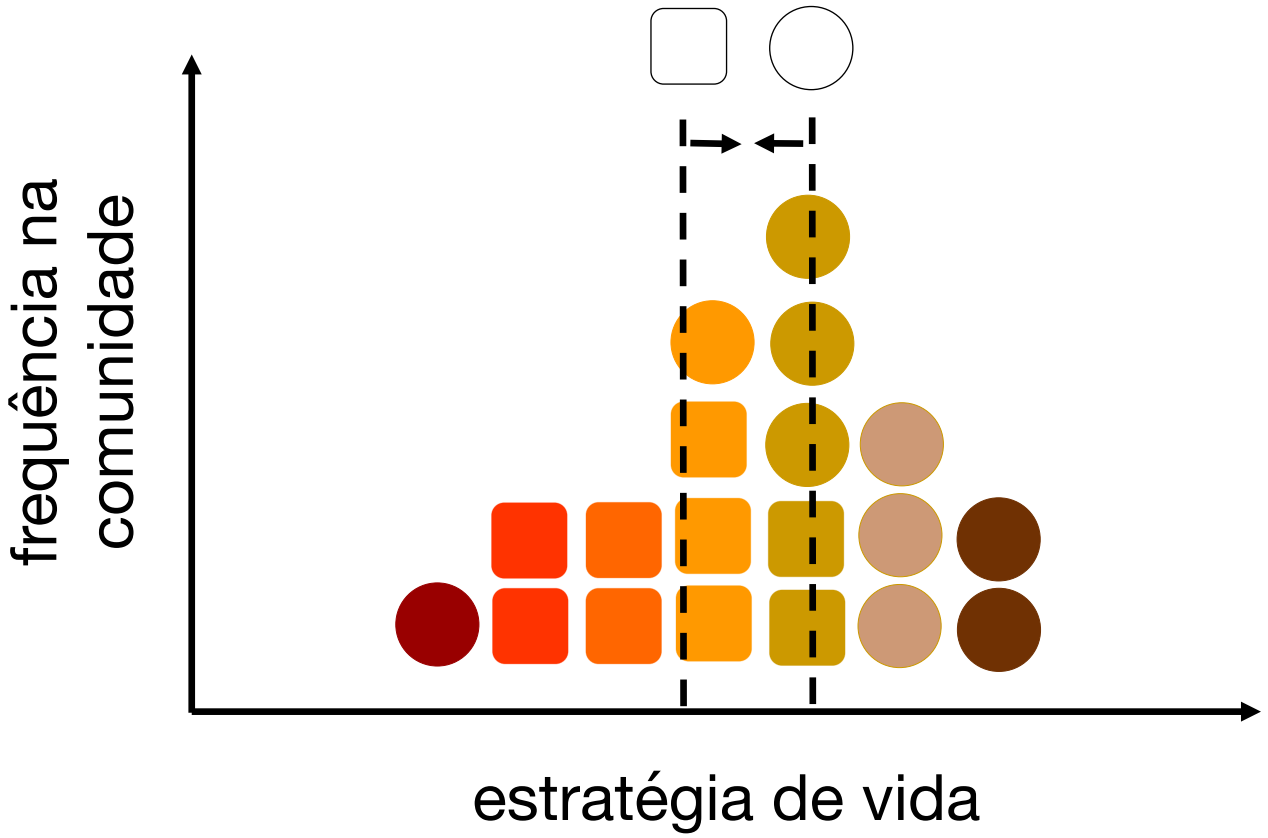
variáveis de interesse



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estratégia média

variância total da estratégia

diversidade de estratégias

variância interespecífica da estratégia

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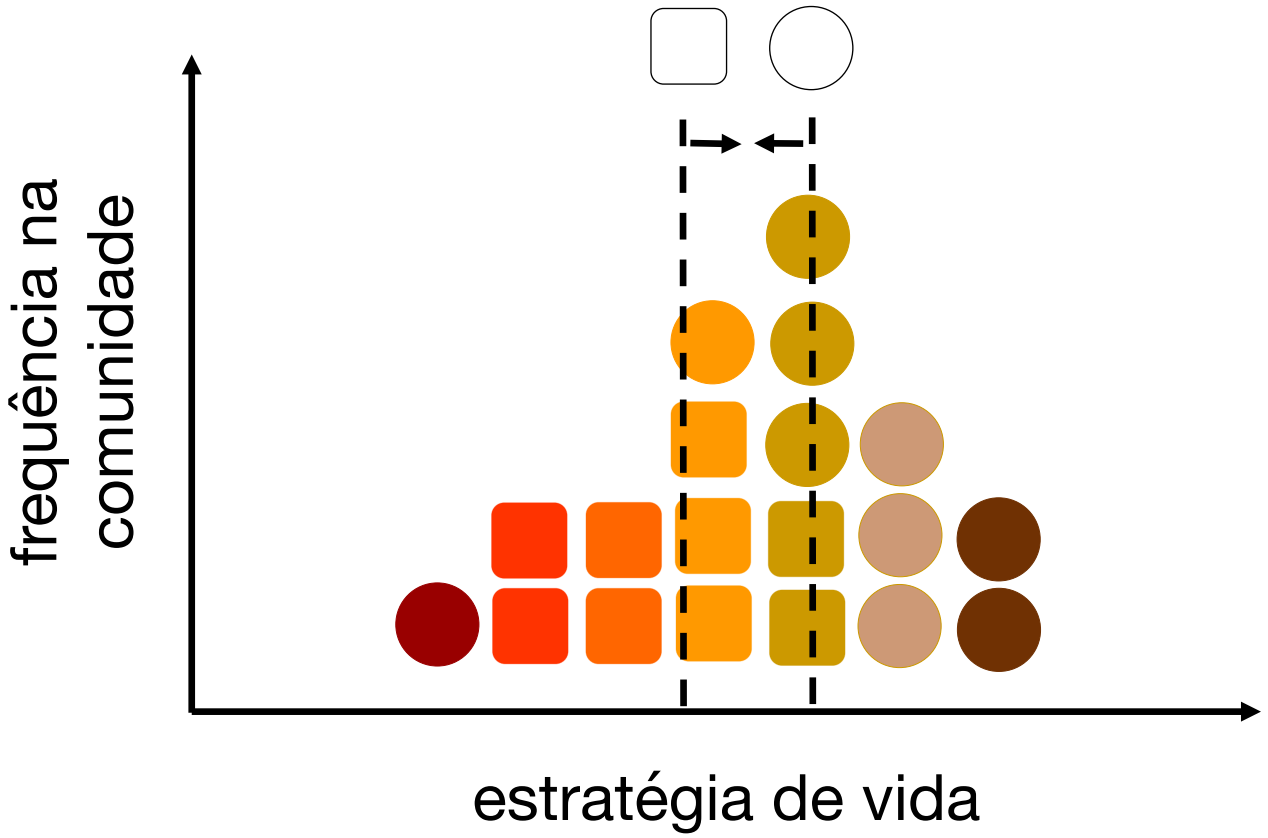


média da estratégia	**estratégia média**
variância total da estratégia	**diversidade de estratégias**
variância interespecífica da estratégia	**heterogeneidade interespecífica de estratégias**

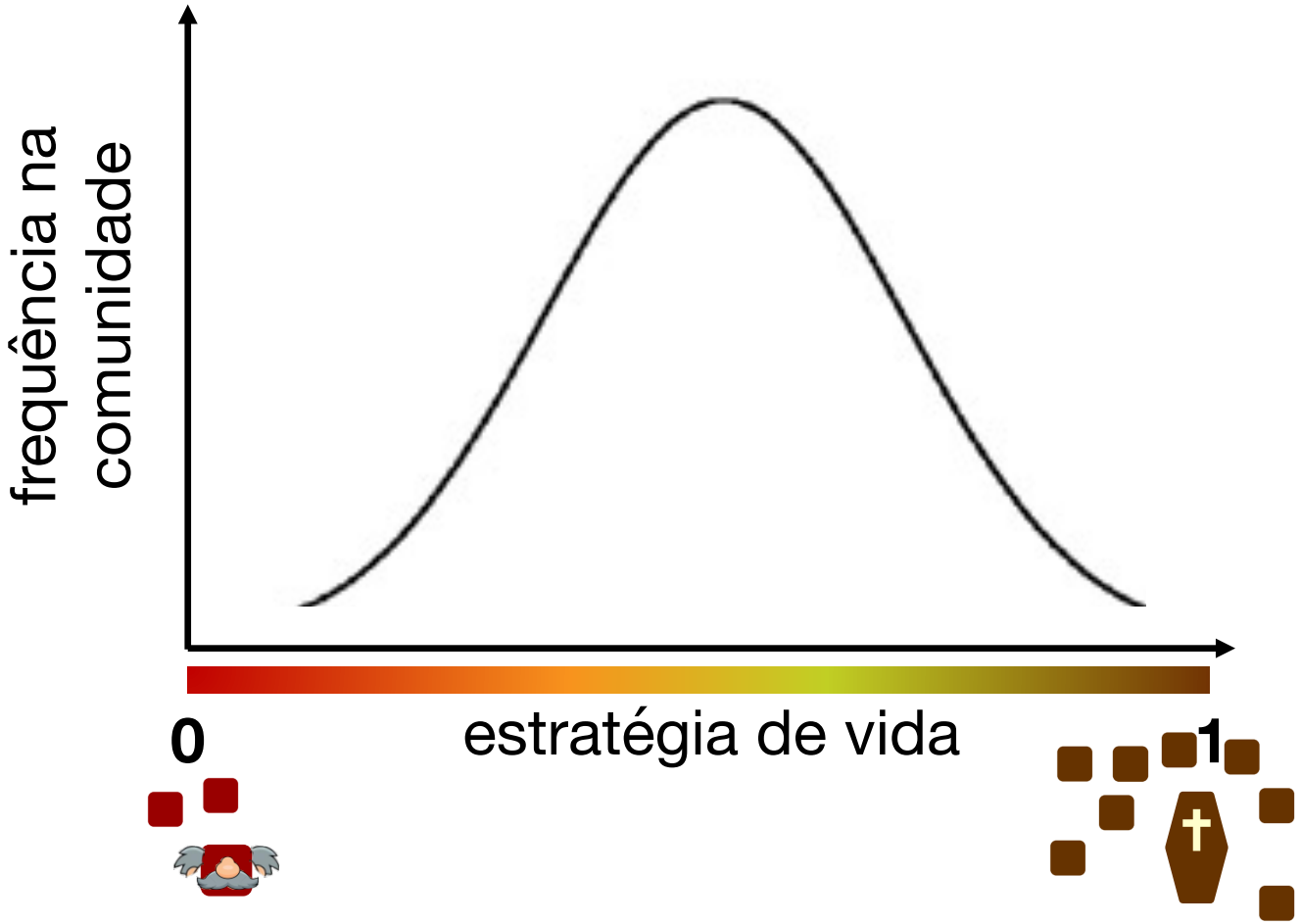
variáveis de interesse

média da estratégia	**estratégia média**
variância total da estratégia	**diversidade de estratégias**
variância interespecífica da estratégia	**heterogeneidade interespecífica de estratégias**

variáveis de interesse

média da estratégia	**estratégia média**
variância total da estratégia	**diversidade de estratégias**
variância interespecífica da estratégia	**heterogeneidade interespecífica de estratégias**

variáveis de interesse



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estratégia média

variância total da estratégia

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variância interespecífica da estratégia

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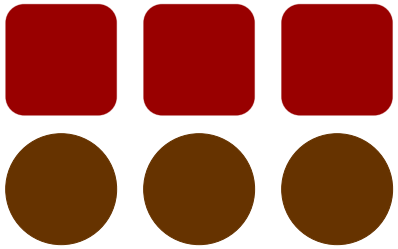
variável preditora



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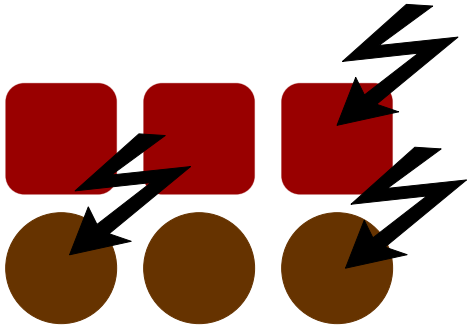

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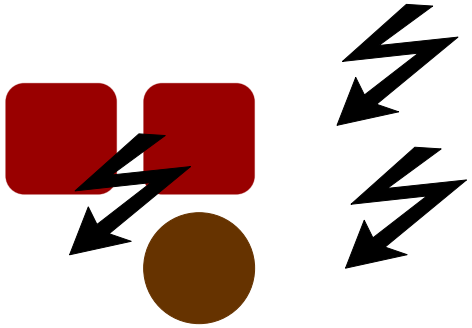

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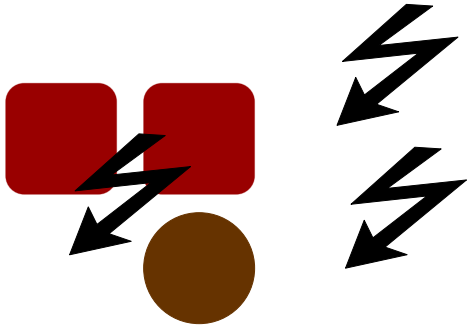

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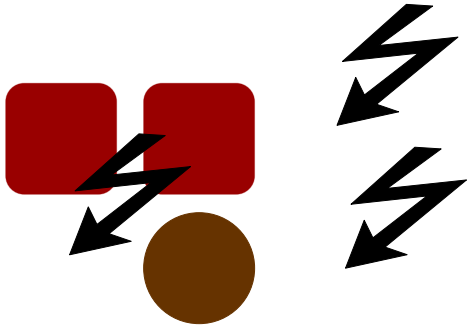

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intensidade do distúrbio

variável preditora

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intensidade do distúrbio

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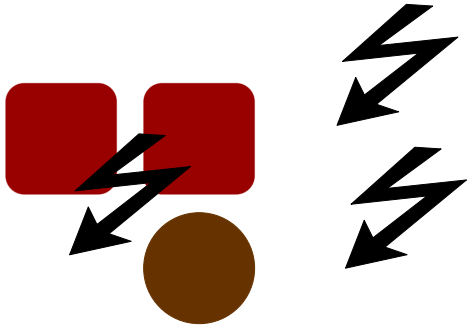

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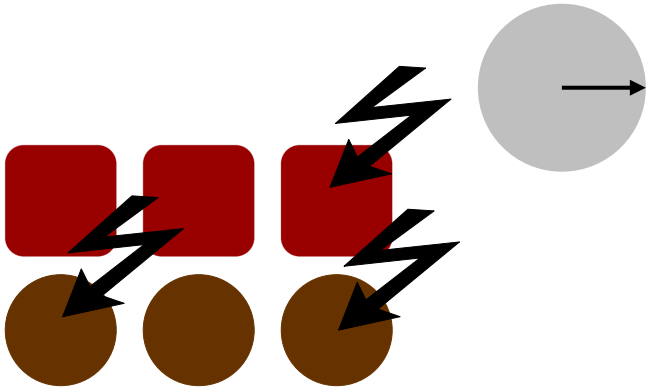

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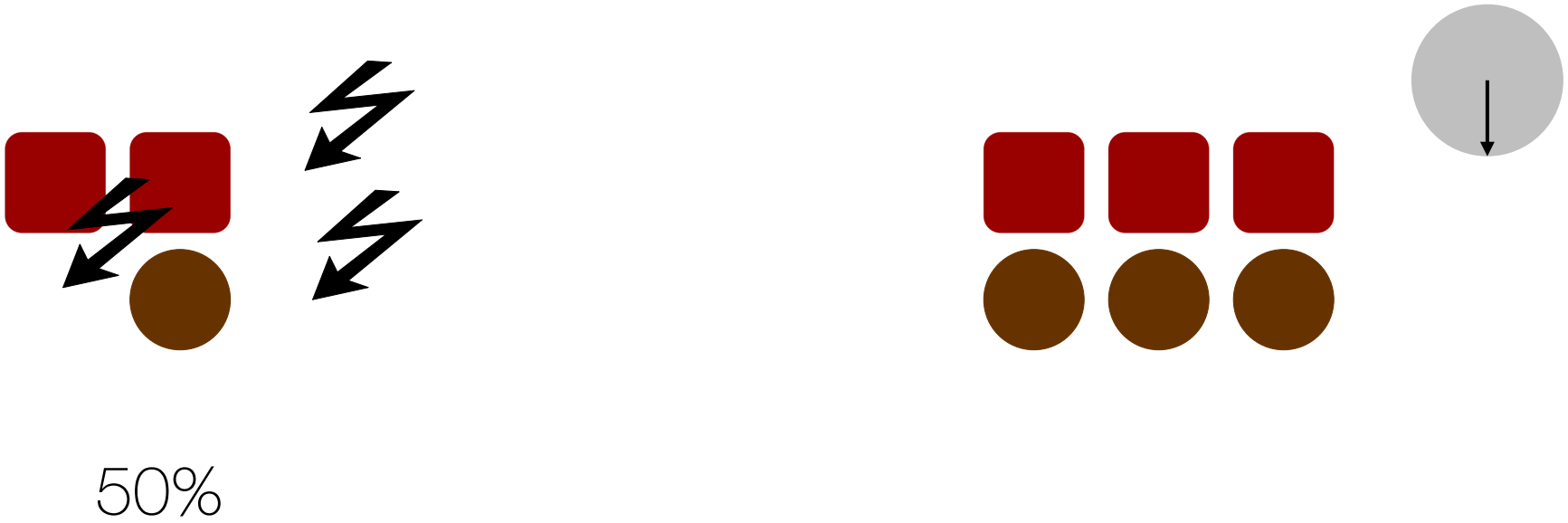

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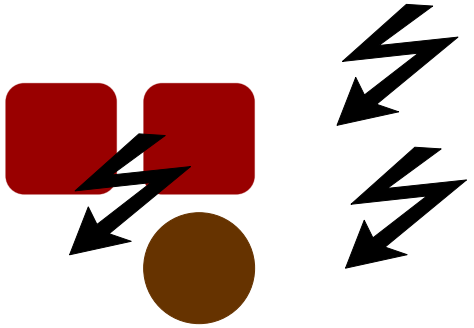

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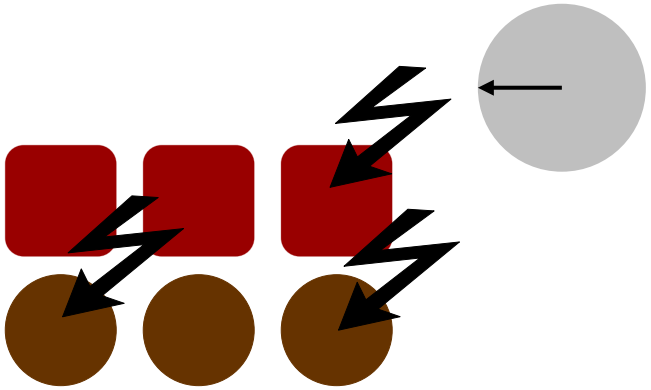

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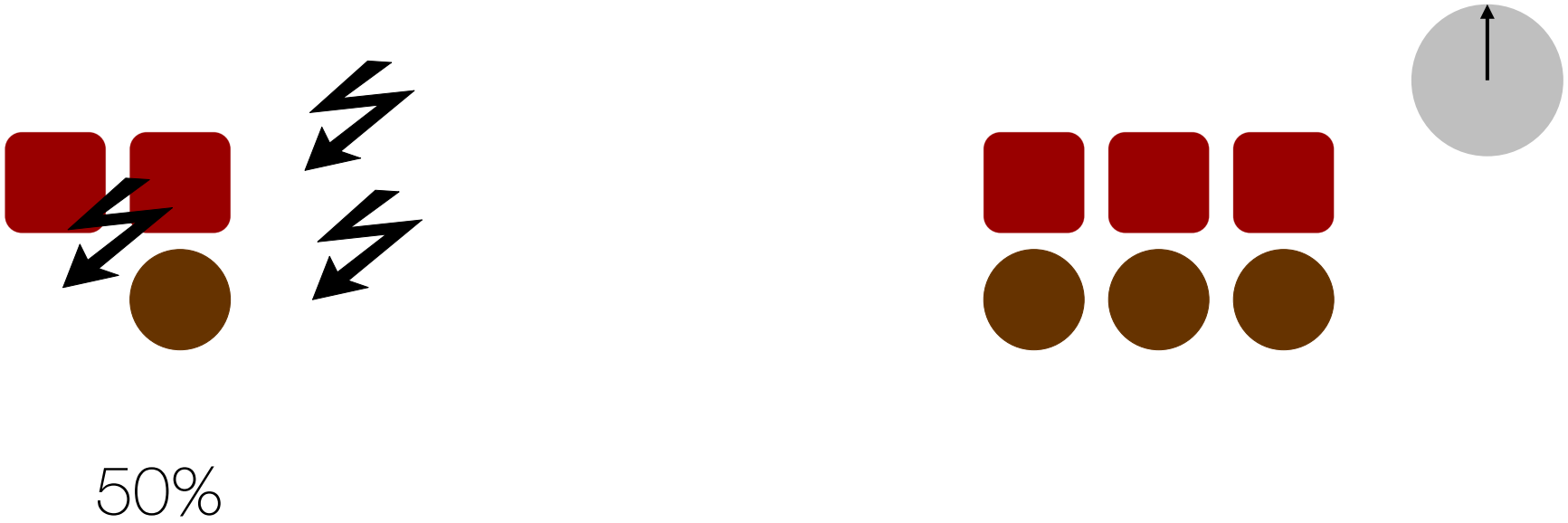

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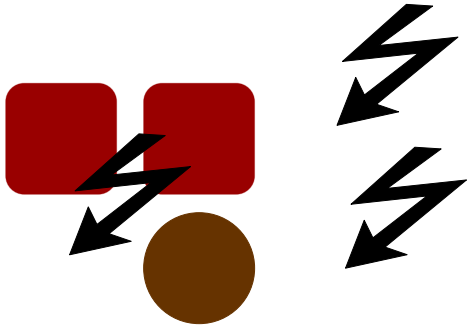

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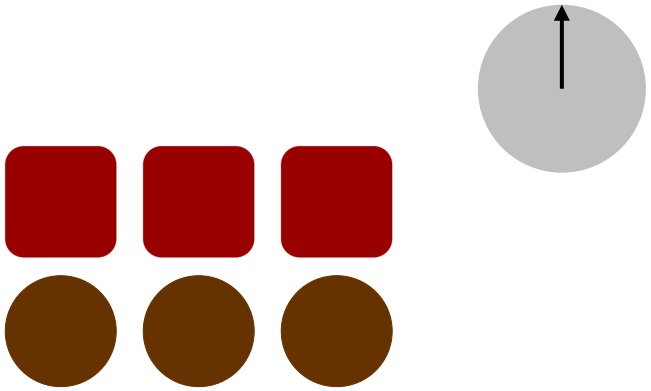

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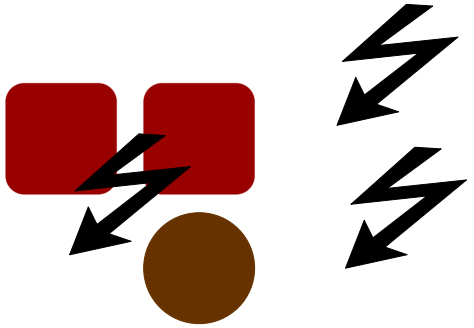
variável preditora



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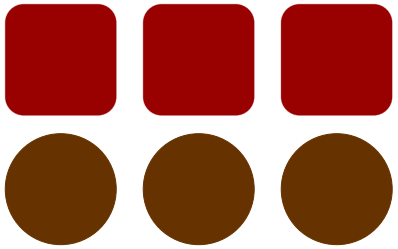
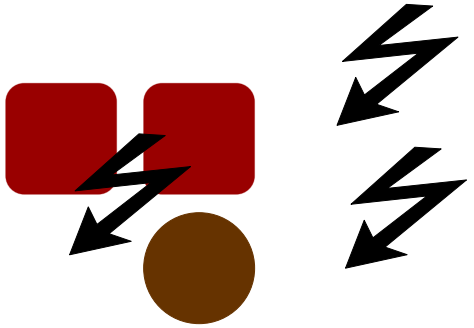


2 eventos

número de eventos de distúrbio

variável preditora



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intensidade do distúrbio

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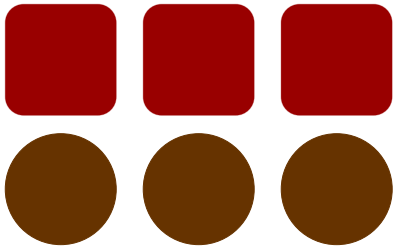


2 eventos

número de eventos de distúrbio

variável preditora

50%

2 eventos

=

variável preditora

50%

2 eventos

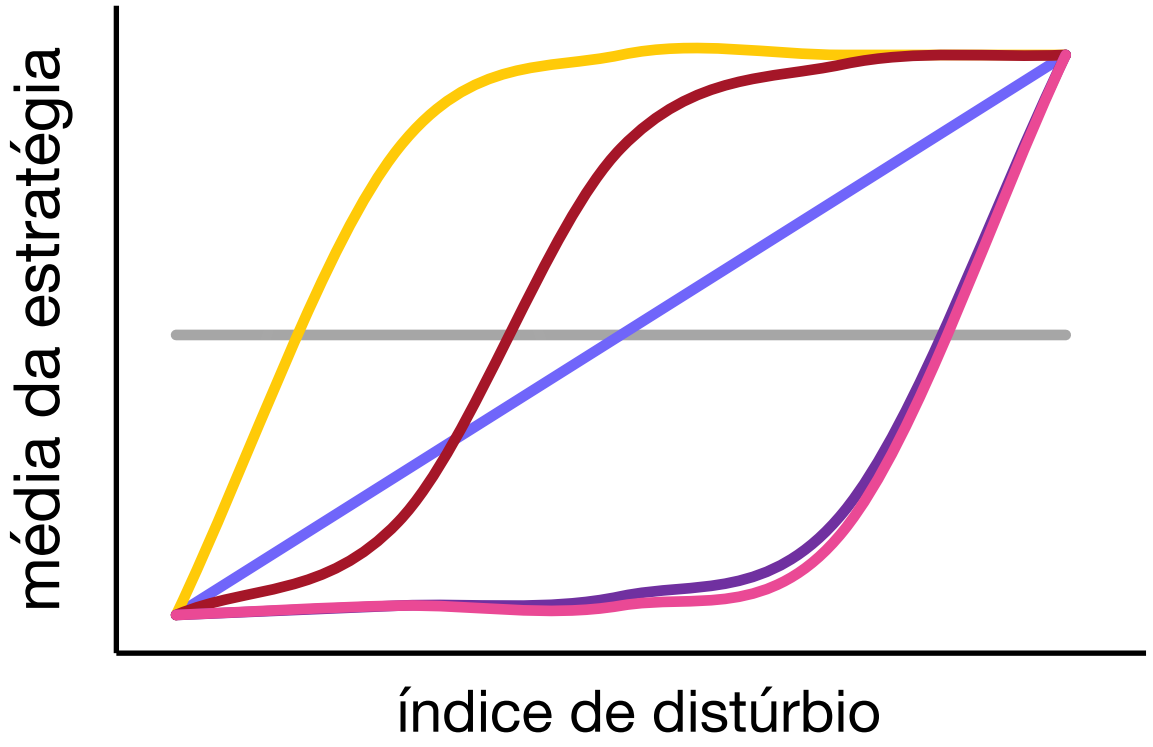
índice de distúrbio

análise dos dados

modelos

estratégia média ~ distúrbio

estratégia média ~ distúrbio



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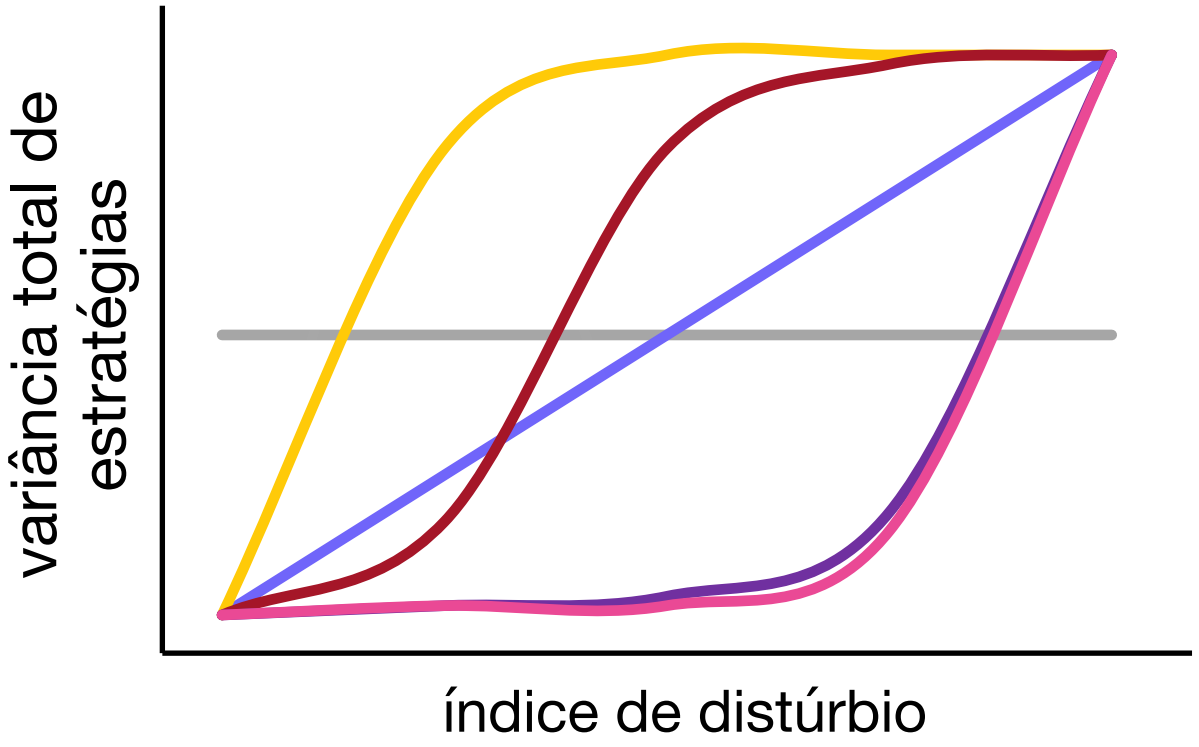

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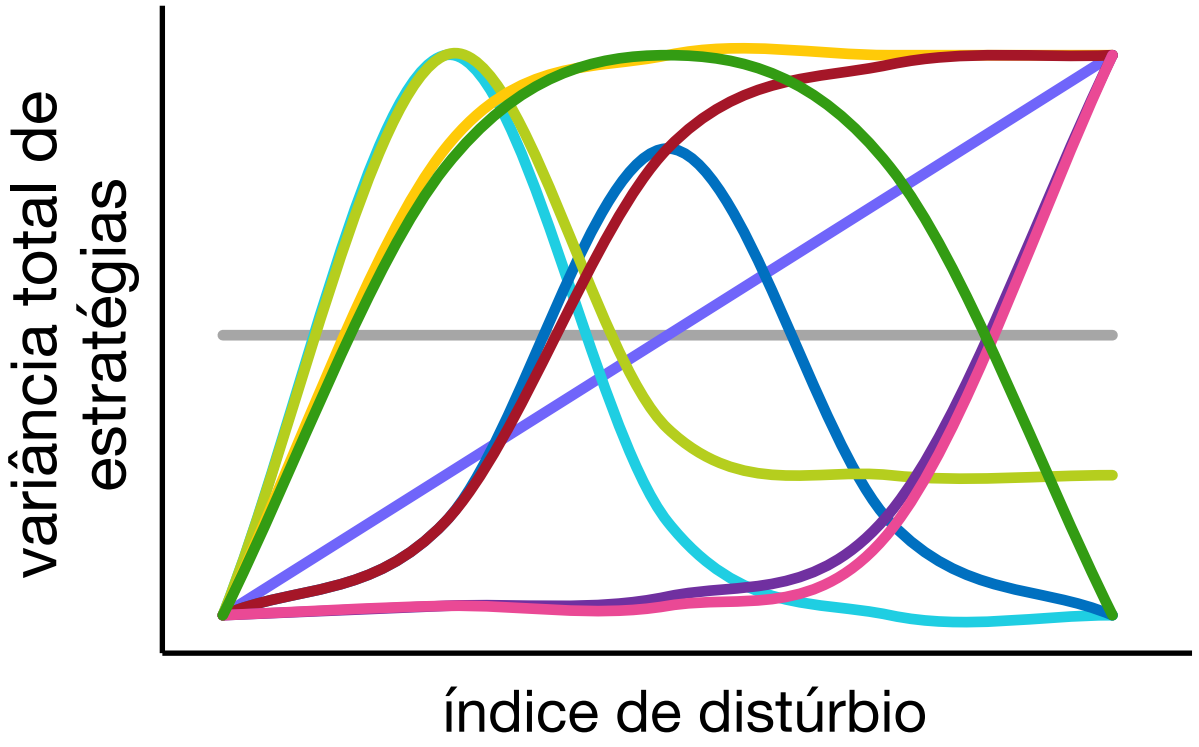

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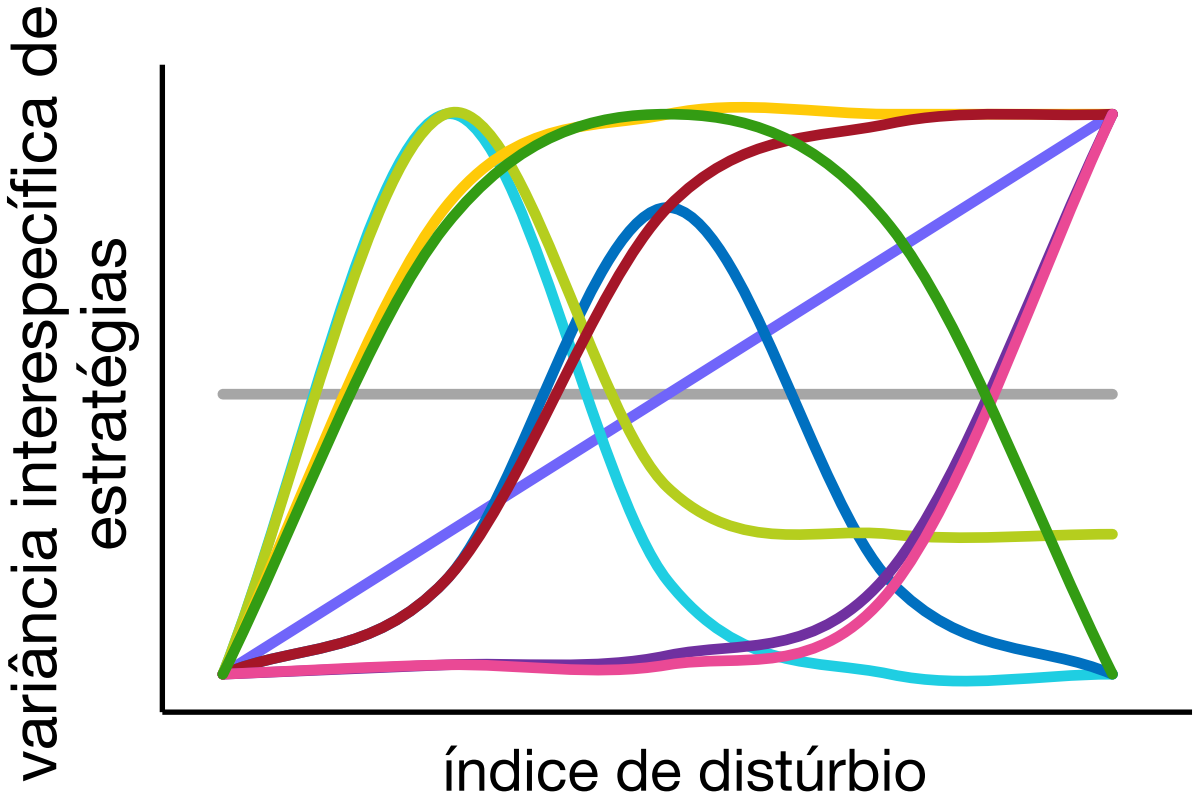

seleção de modelos

8 seleções de modelo

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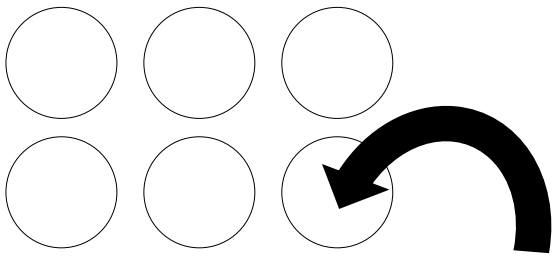
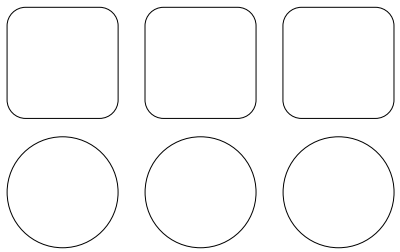
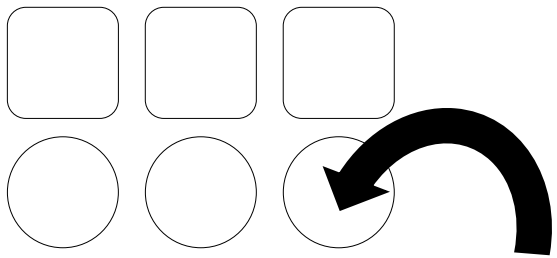
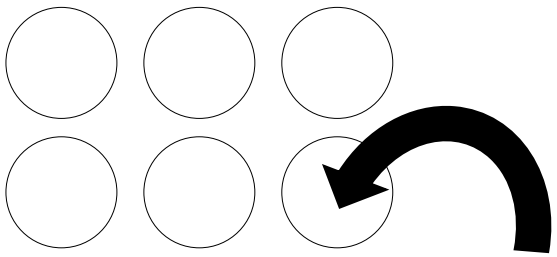
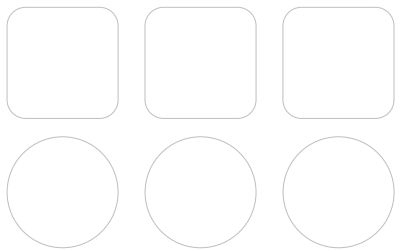
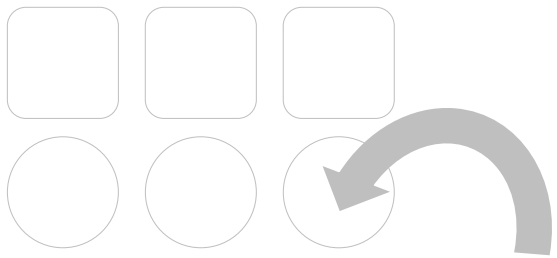
		
estratégia média	estratégia média	estratégia média
diversidade de estratégias	diversidade de estratégias	diversidade de estratégias
-	heterogeneidade interespecífica de estratégias	heterogeneidade interespecífica de estratégias

evolutivo	ecológico	eco-evolutivo
		
estratégia média	estratégia média	estratégia média
diversidade de estratégias	diversidade de estratégias	diversidade de estratégias
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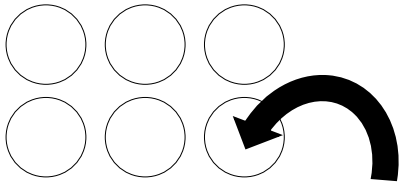
evolutivo

estratégia média



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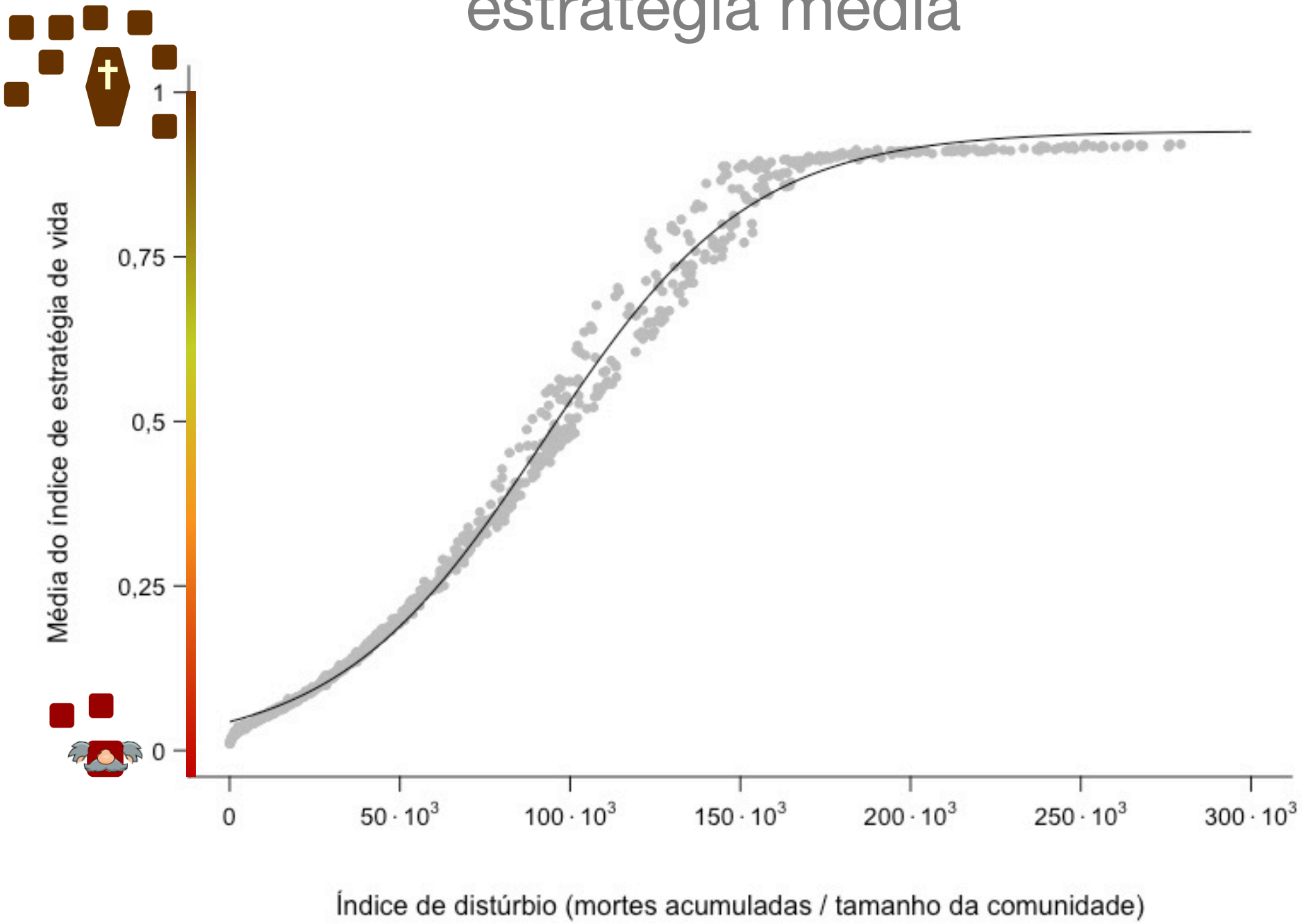
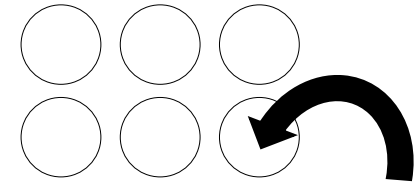
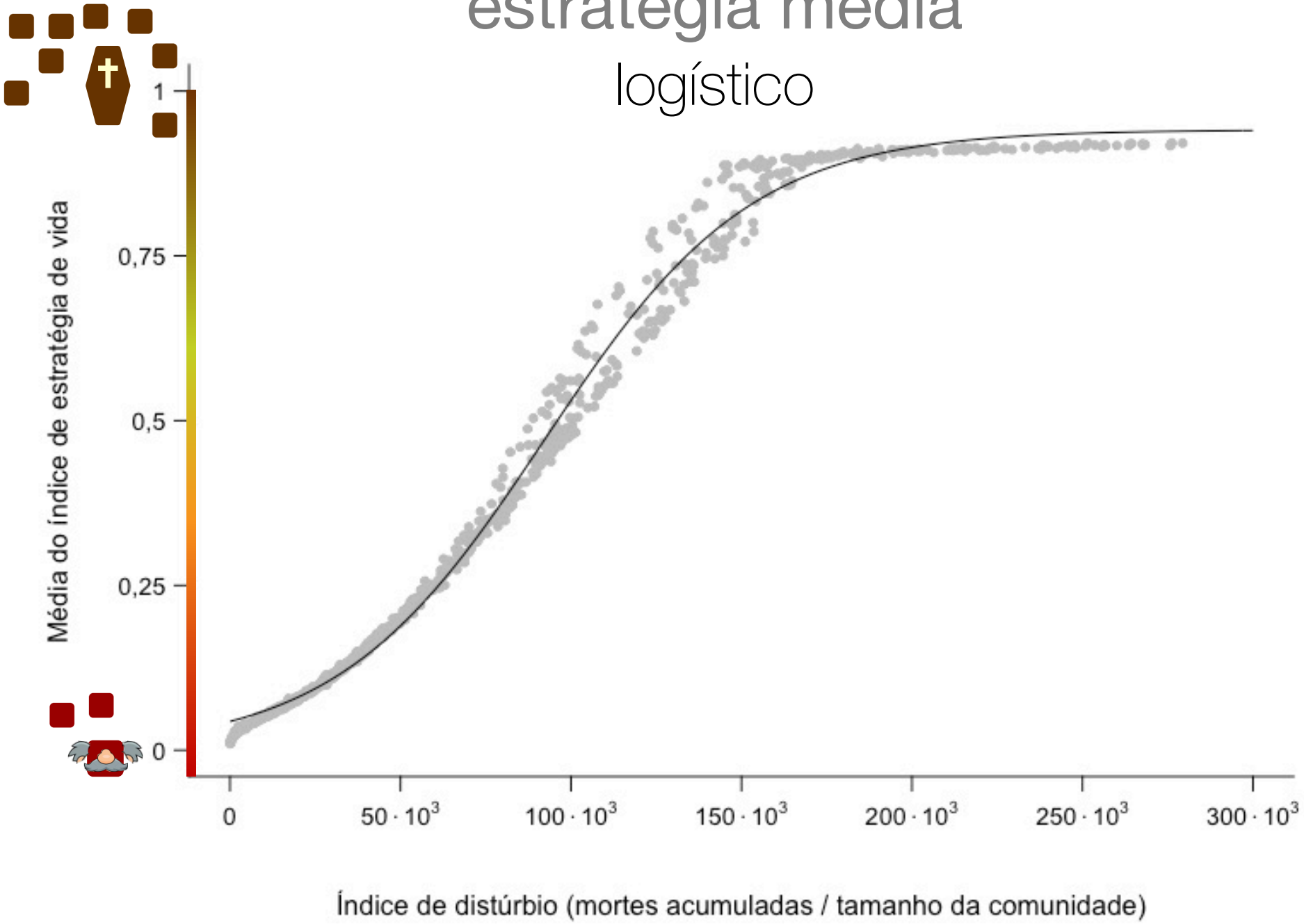


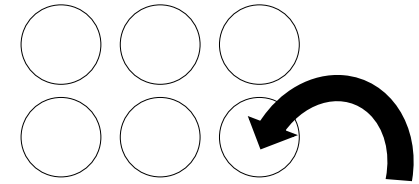


evolutivo

estratégia média

logístico





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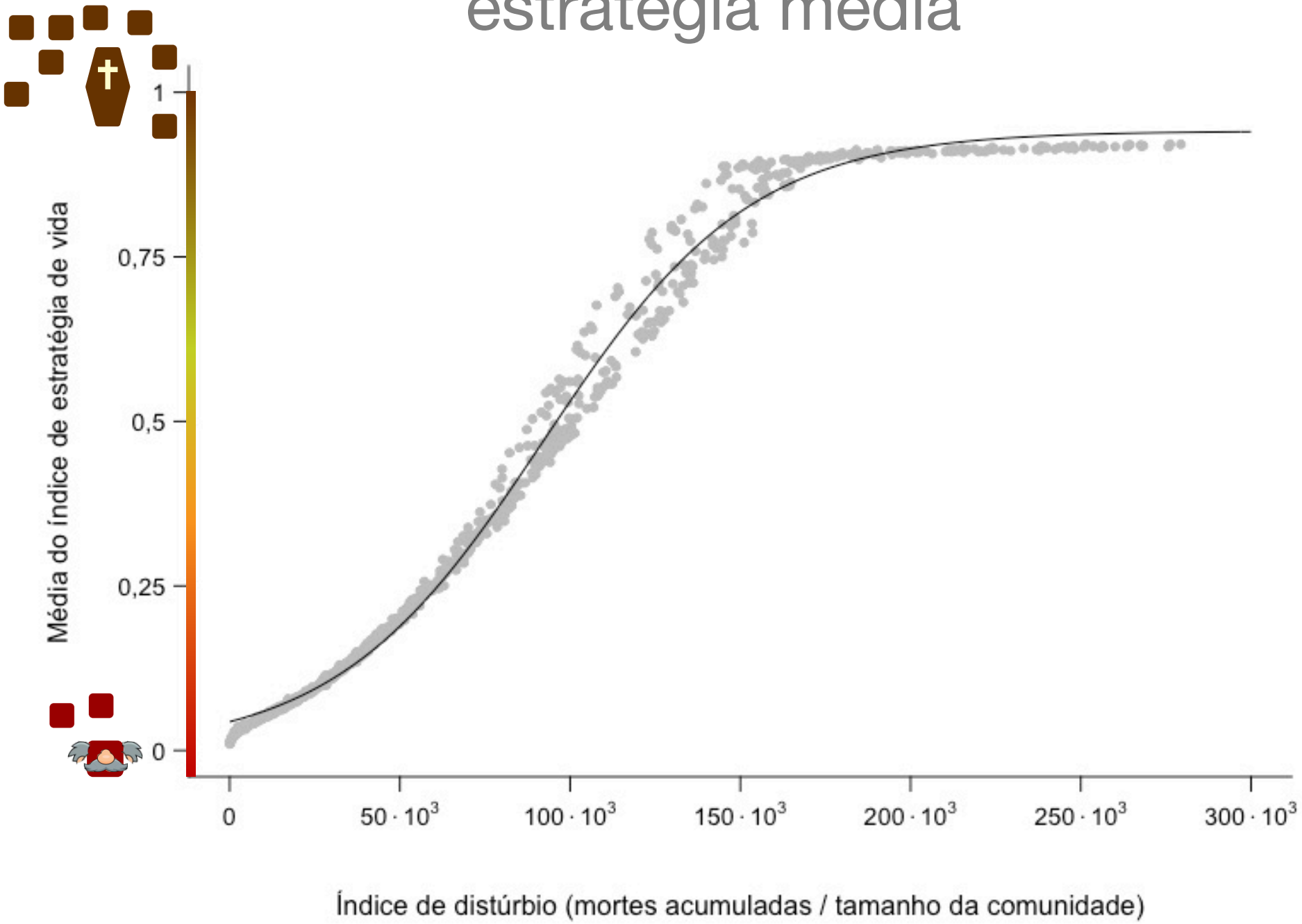
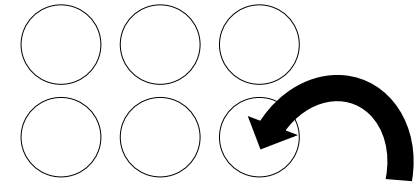
estratégia média





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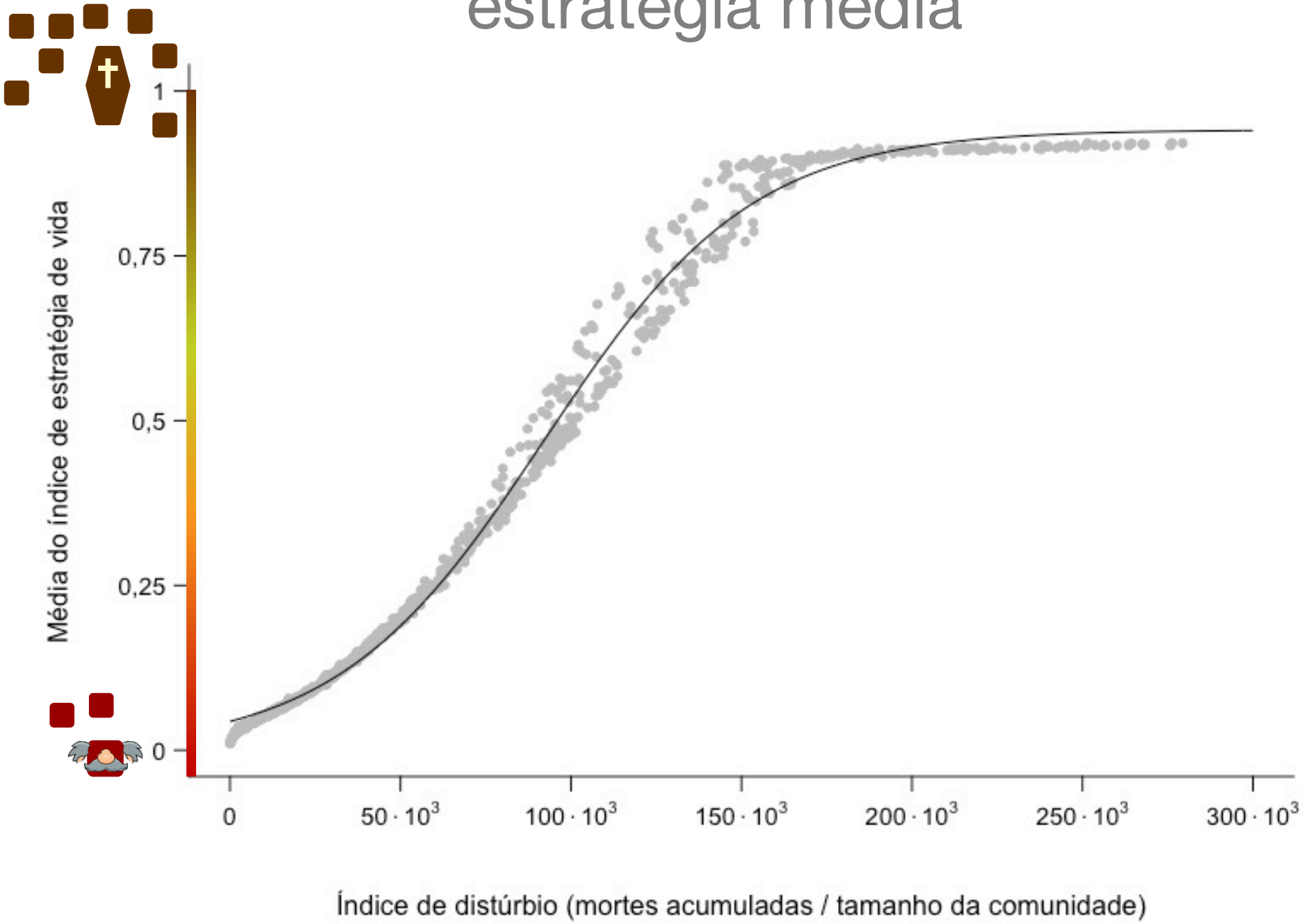

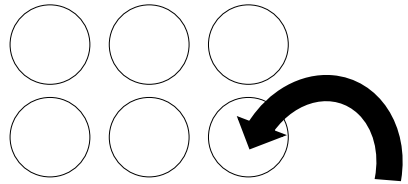

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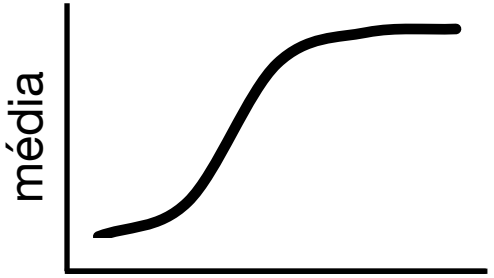

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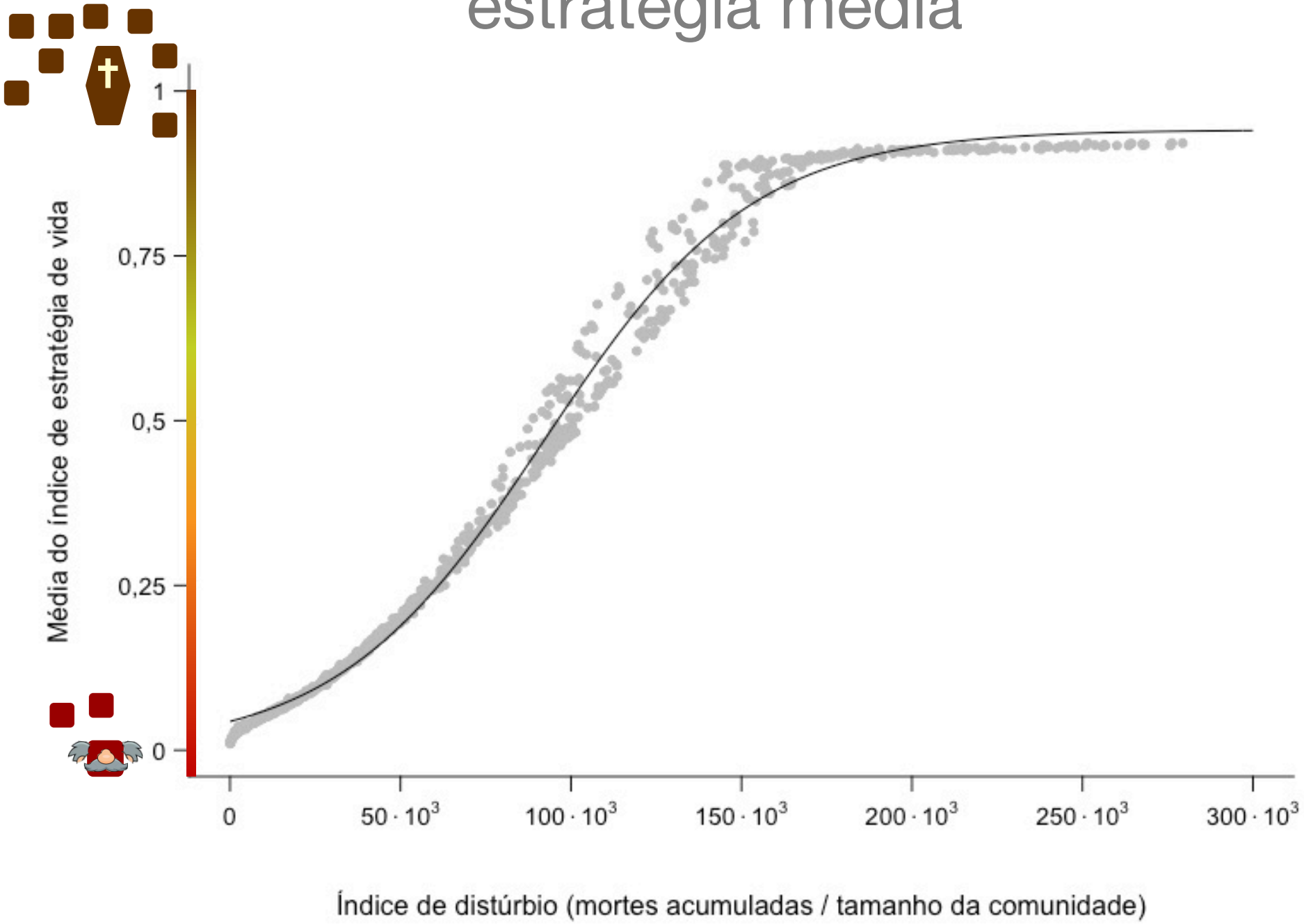

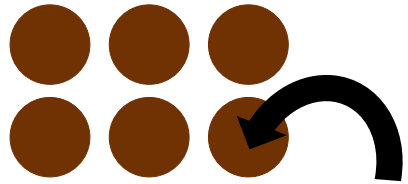

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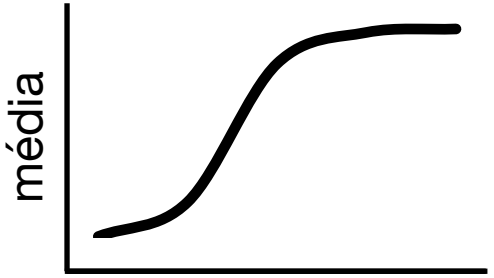
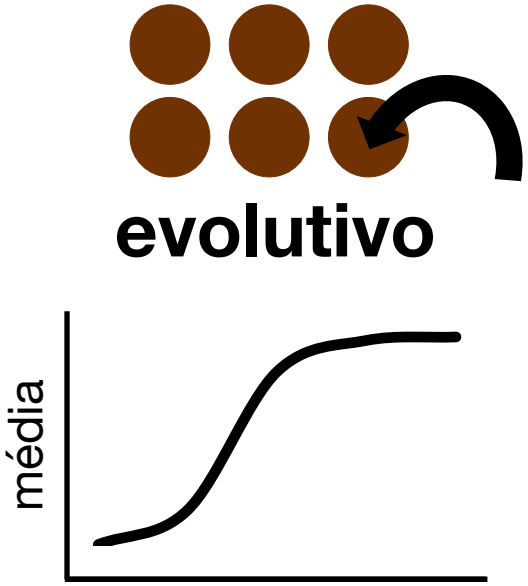


seleção natural

- variação herdável
- componente da aptidão



seleção natural

- variação herdável
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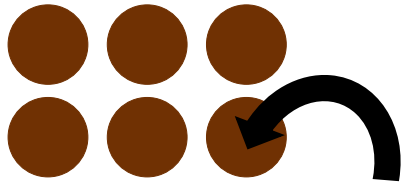

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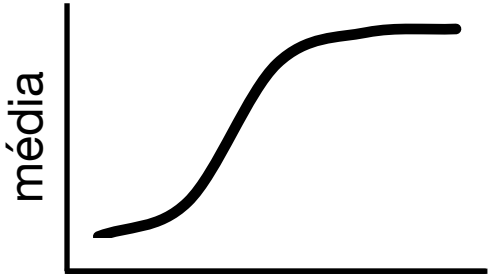
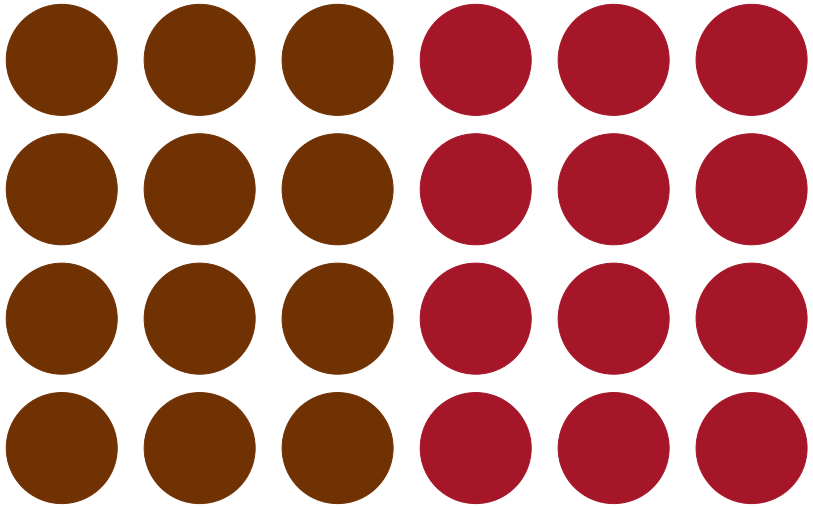


banco

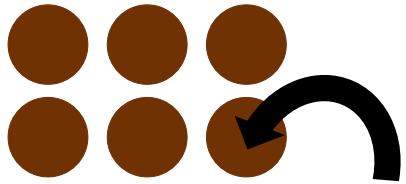
x 96

x 24



seleção natural

- variação herdável
- componente da aptidão



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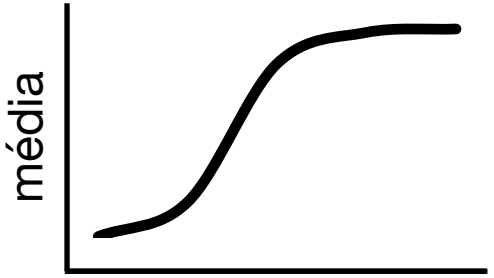

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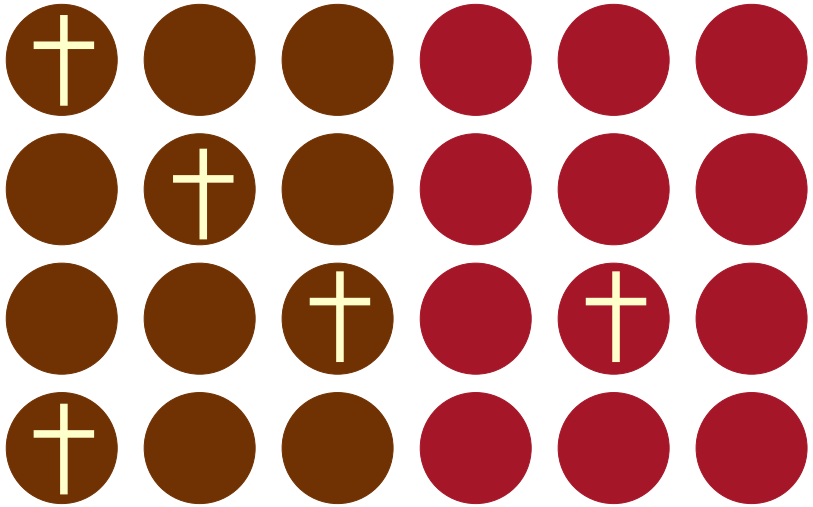

seleção natural

- variação herdável
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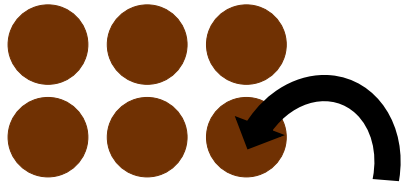

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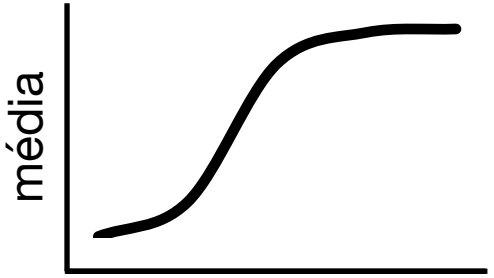

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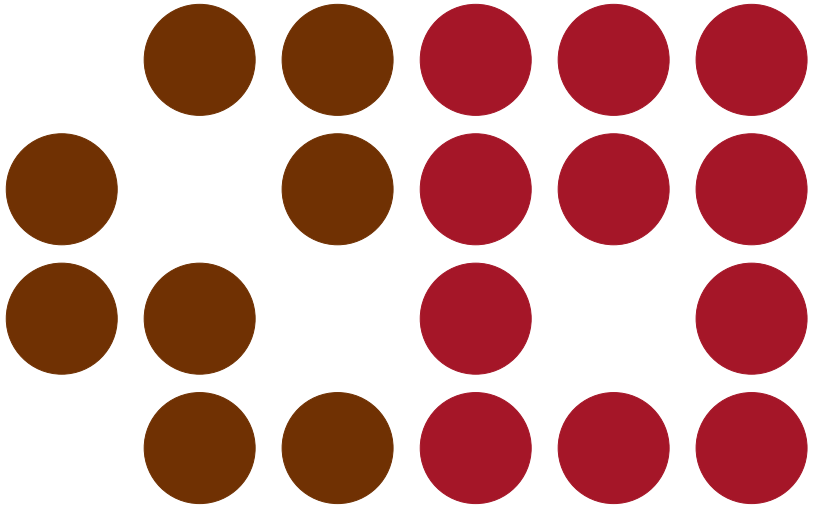
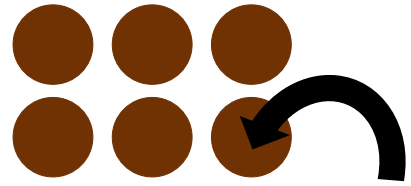


seleção natural

- variação herdável
- componente da aptidão



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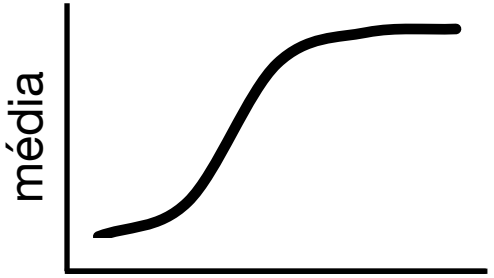

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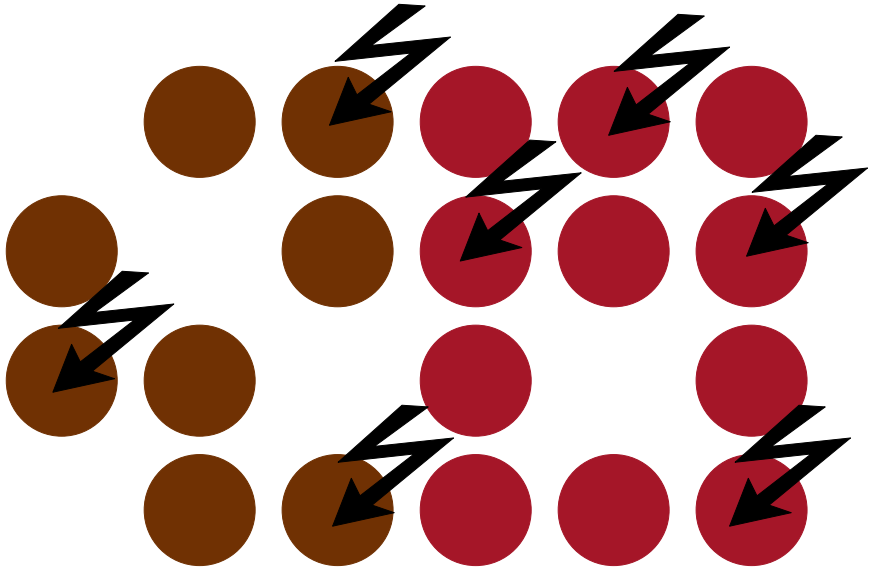

seleção natural

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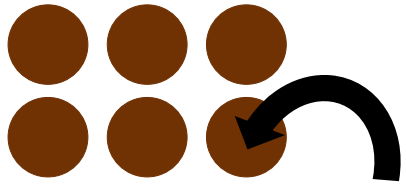

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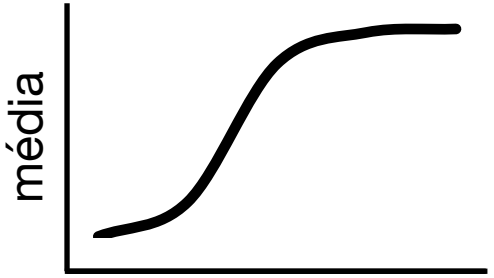

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x 96

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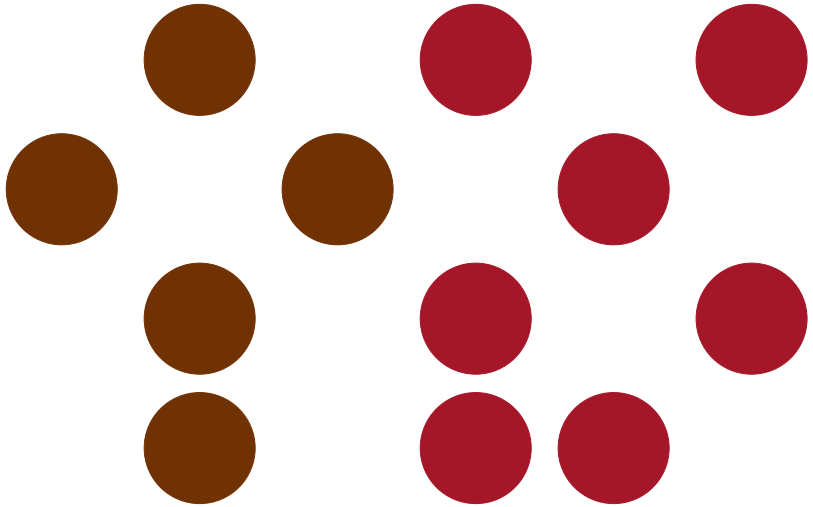
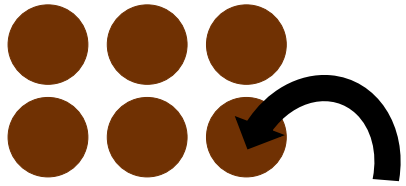


seleção natural

- variação herdável
- componente da aptidão



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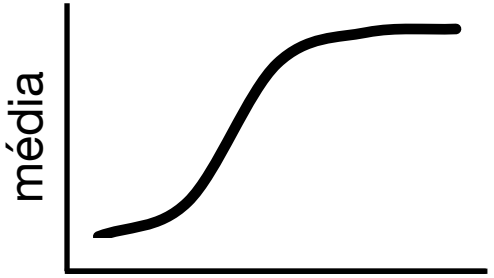

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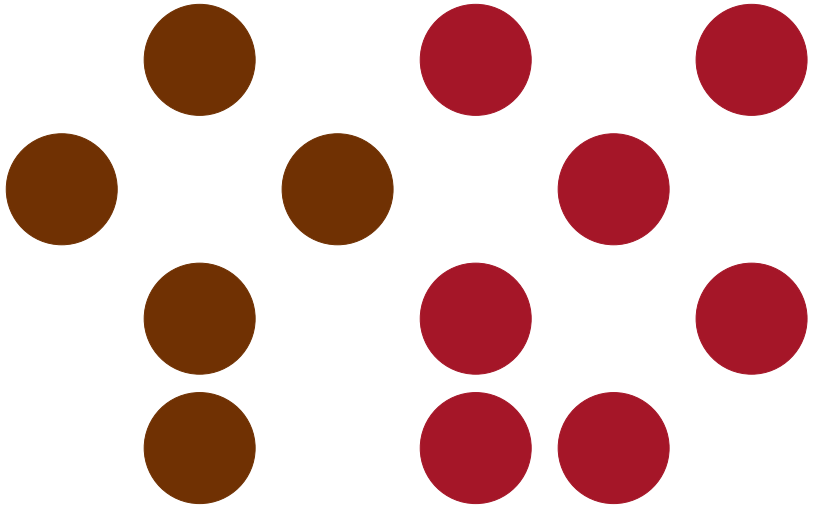

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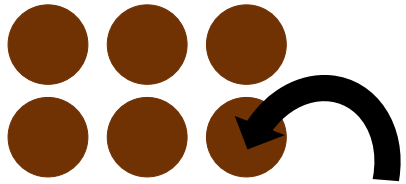

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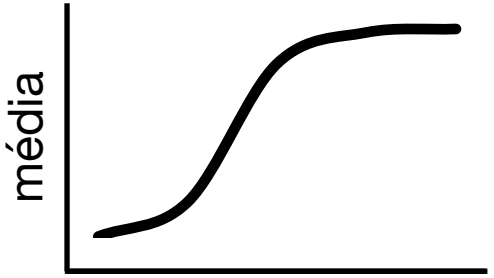

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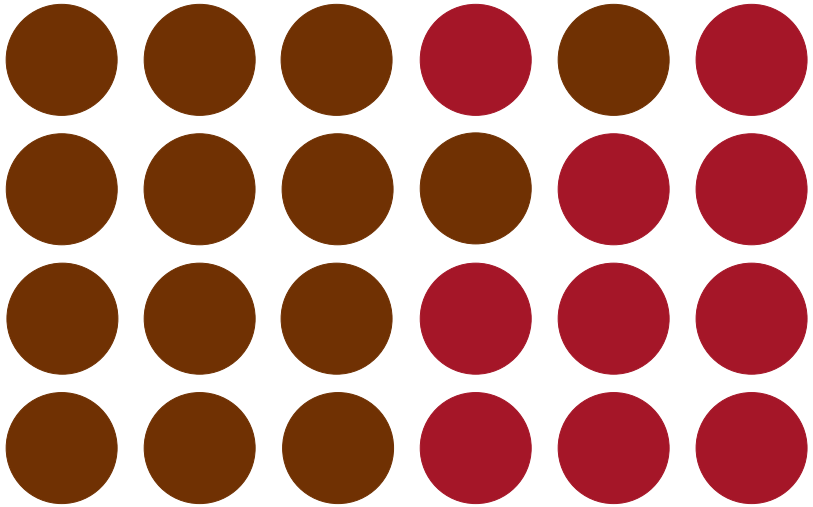
x 112

x 20



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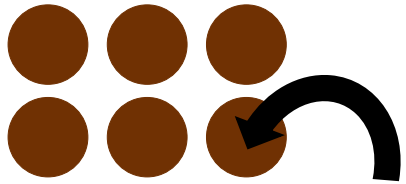
- variação herdável
- componente da aptidão



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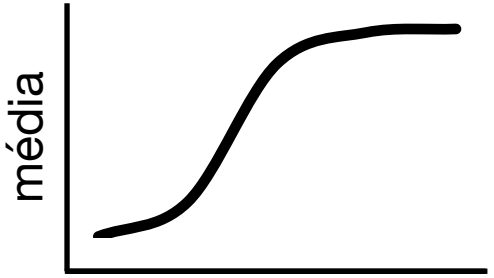

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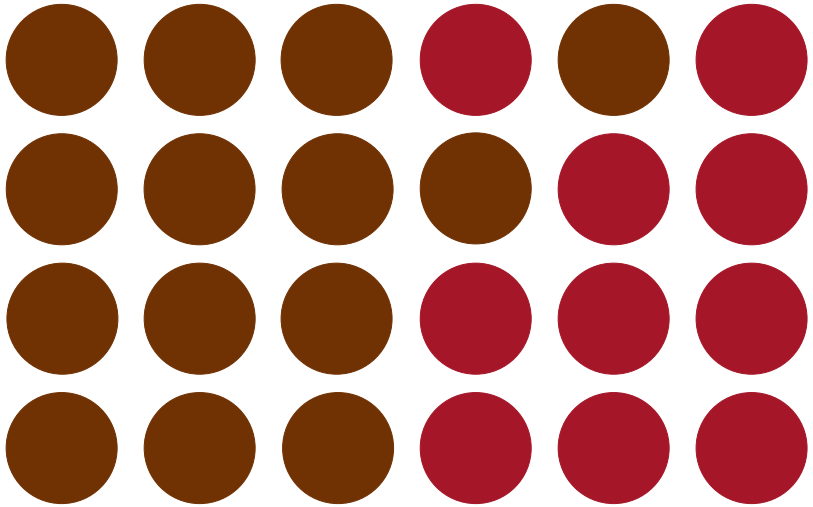
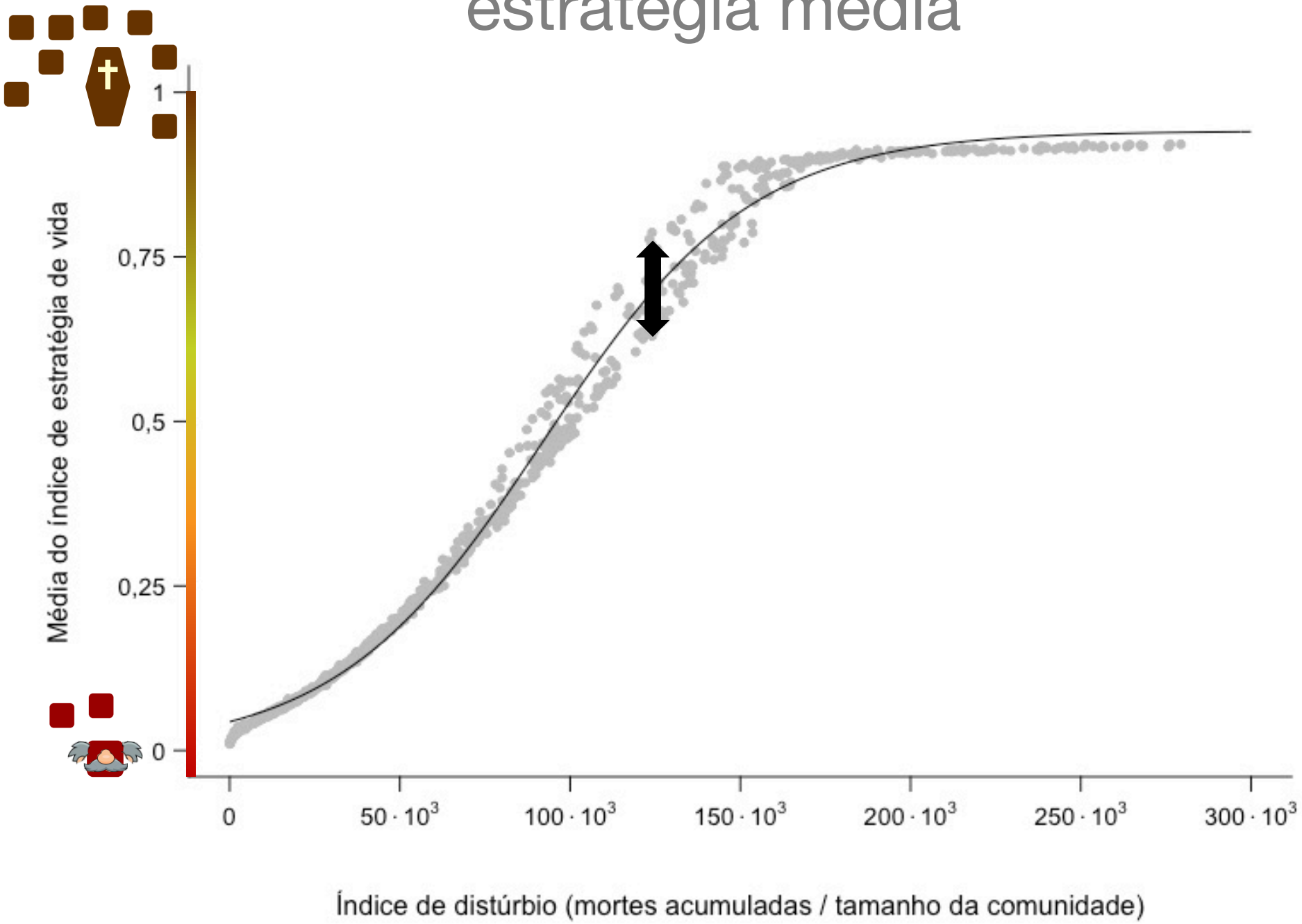
x 112

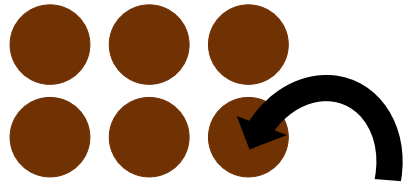
x 20



estratégia de maior fecundidade mais apta

estratégia média





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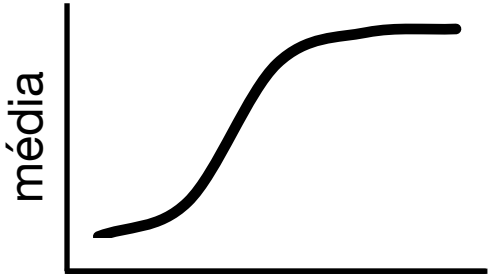

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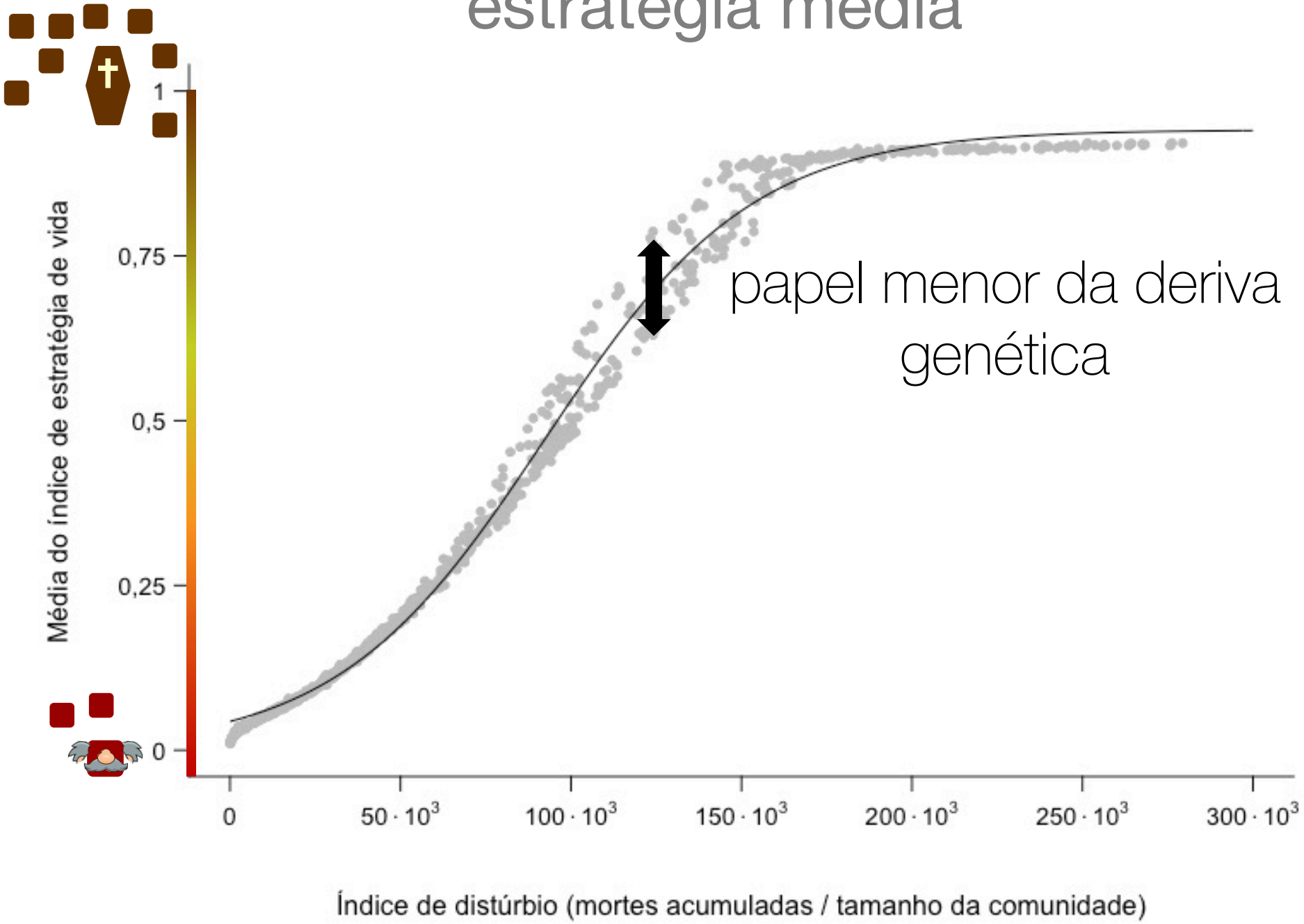
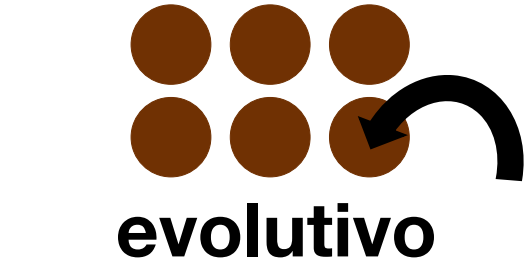
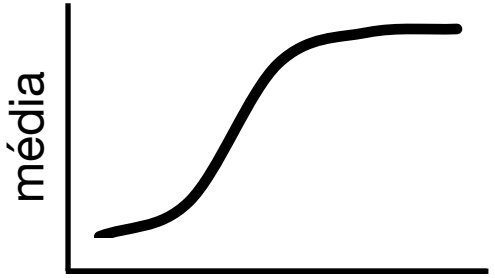
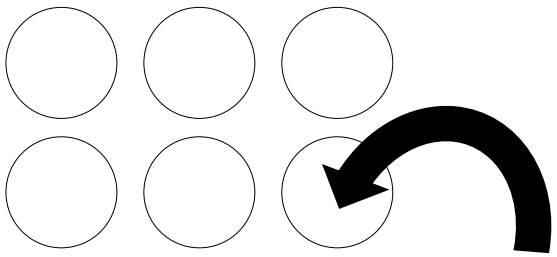
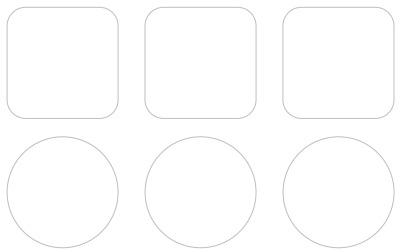
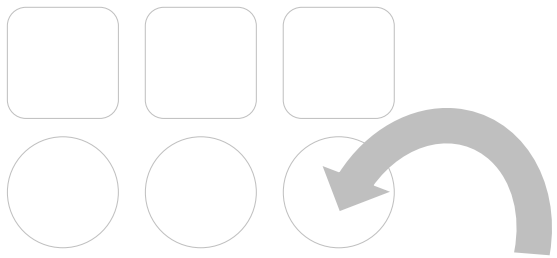






evolutivo	ecológico	eco-evolutivo
		
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diversidade de estratégias	diversidade de estratégias	diversidade de estratégias
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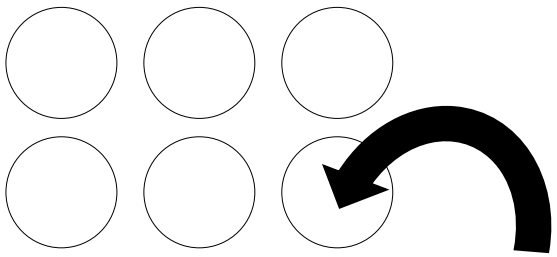
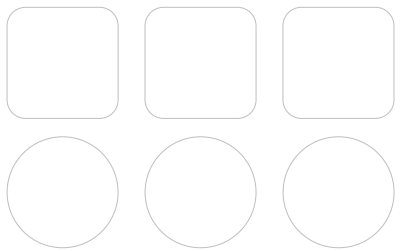
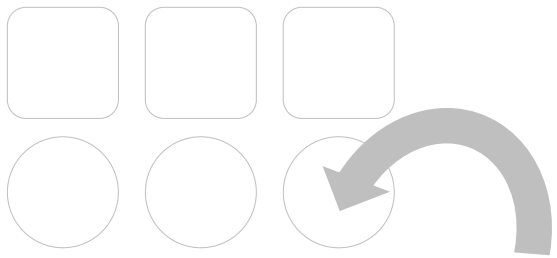
evolutivo	ecológico	eco-evolutivo
		
estratégia média	estratégia média	estratégia média
diversidade de estratégias	diversidade de estratégias	diversidade de estratégias
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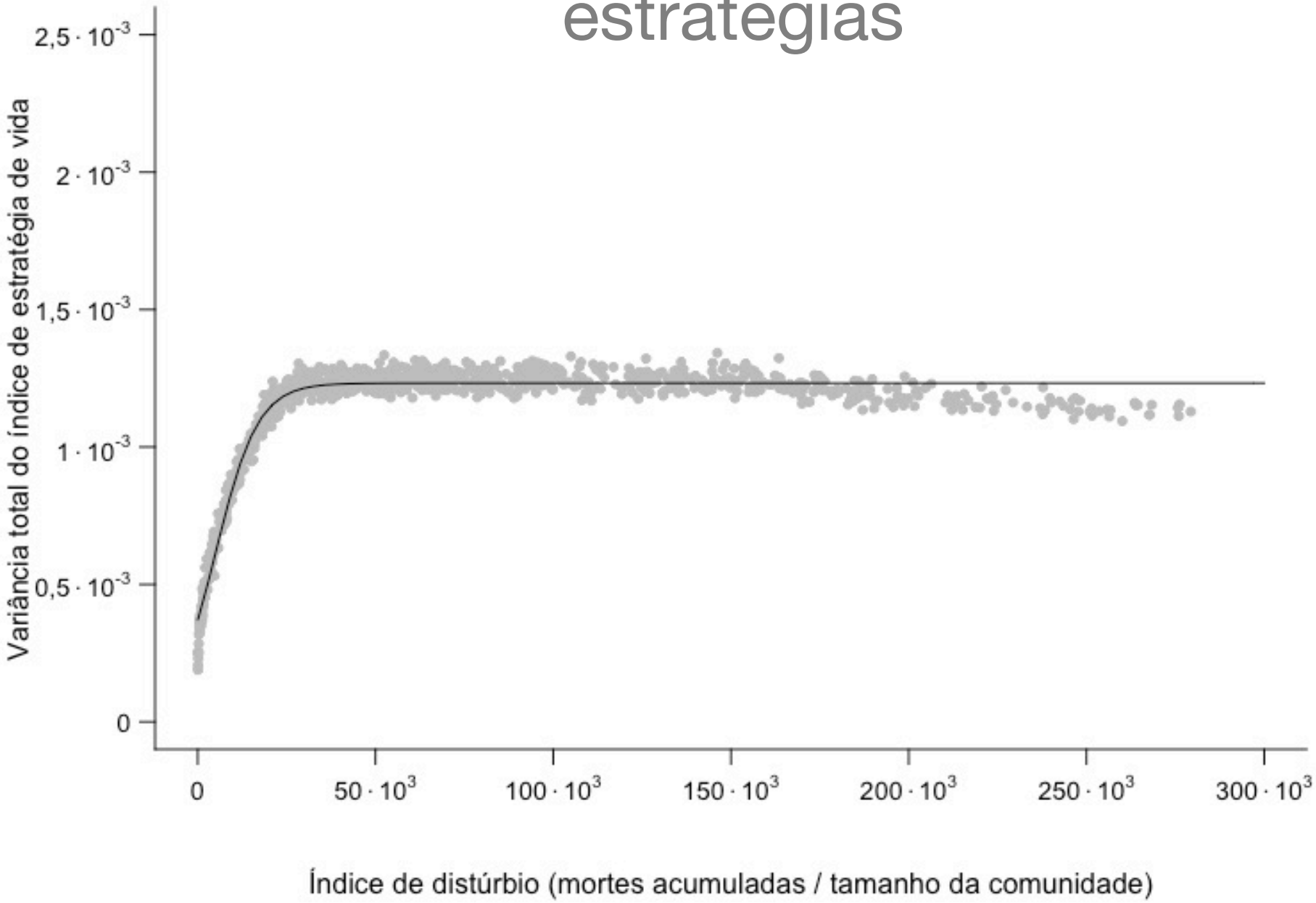
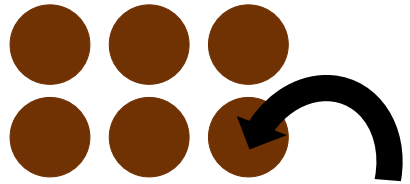
diversidade de estratégias





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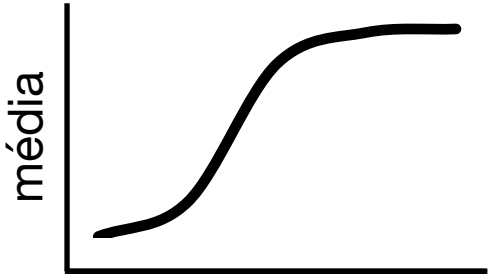
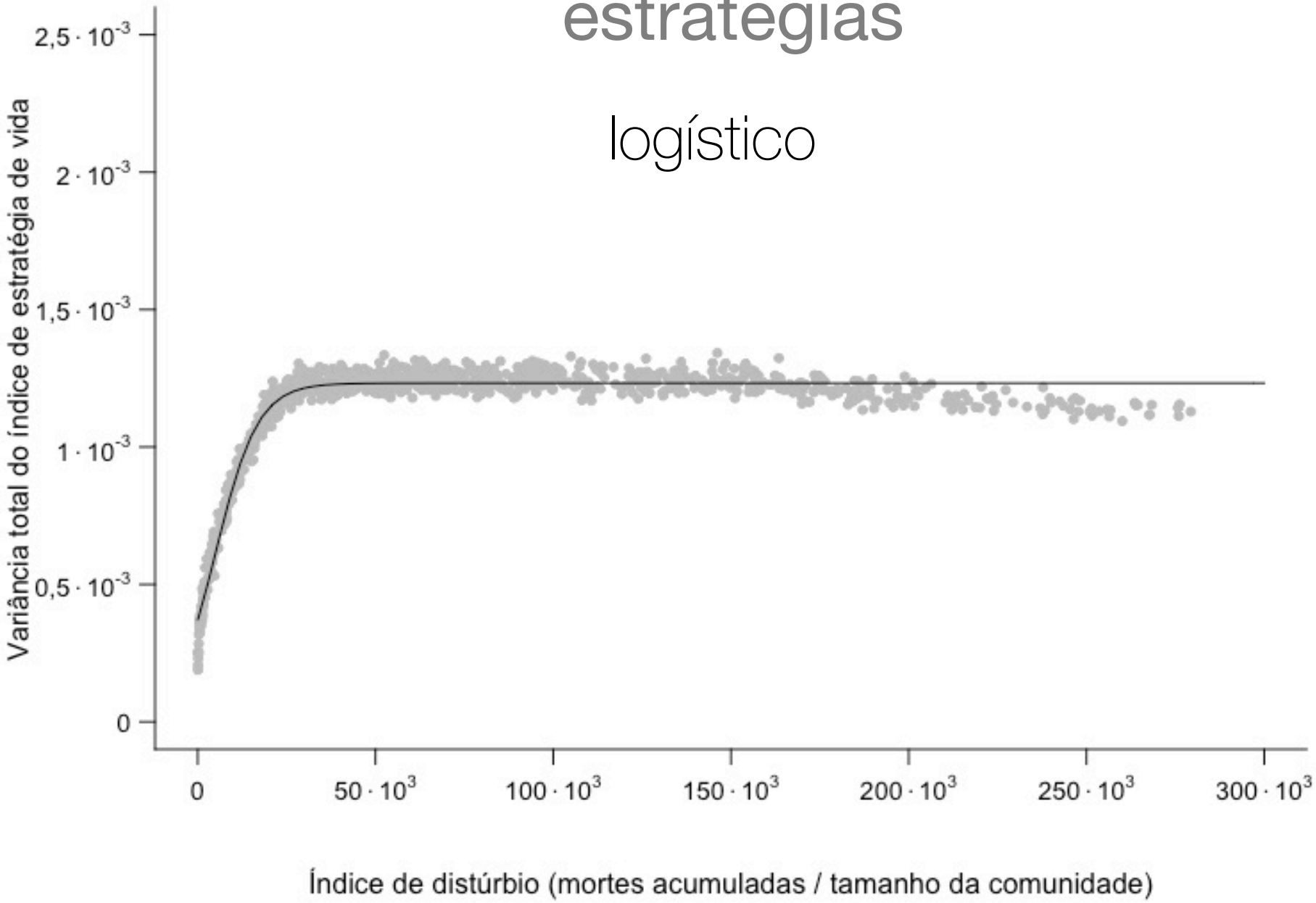
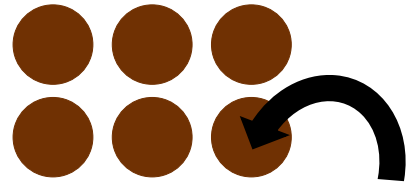


diversidade de estratégias

logístico





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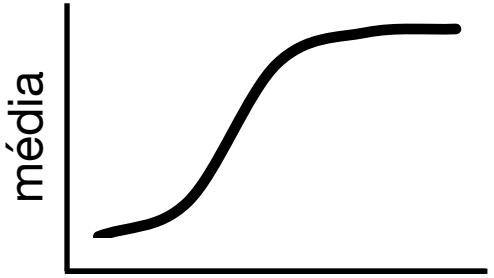
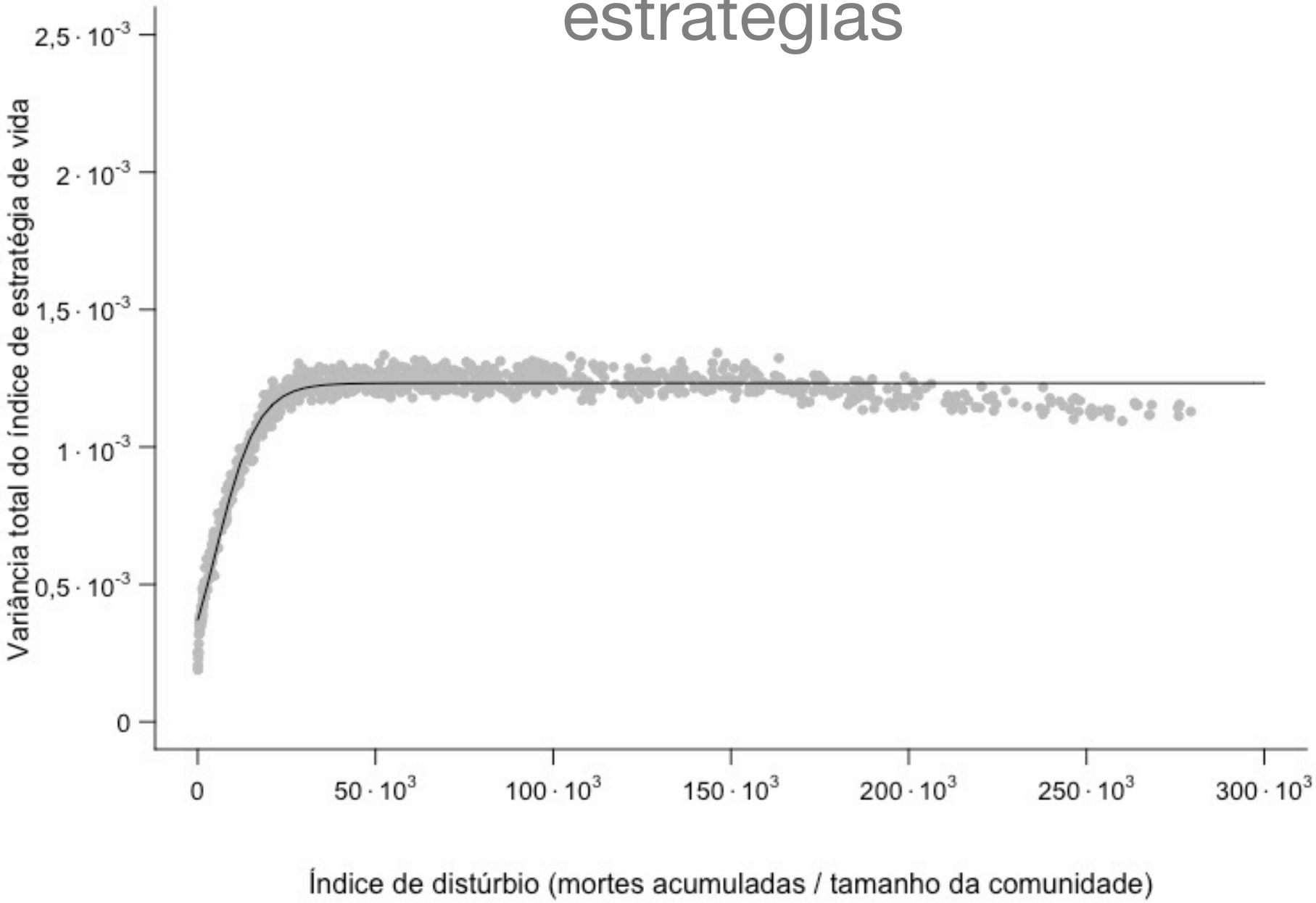
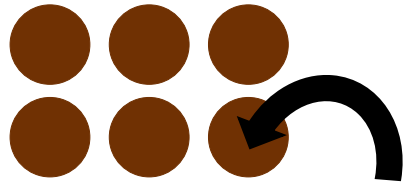


diversidade de estratégias





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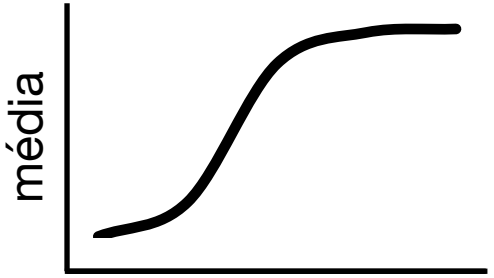

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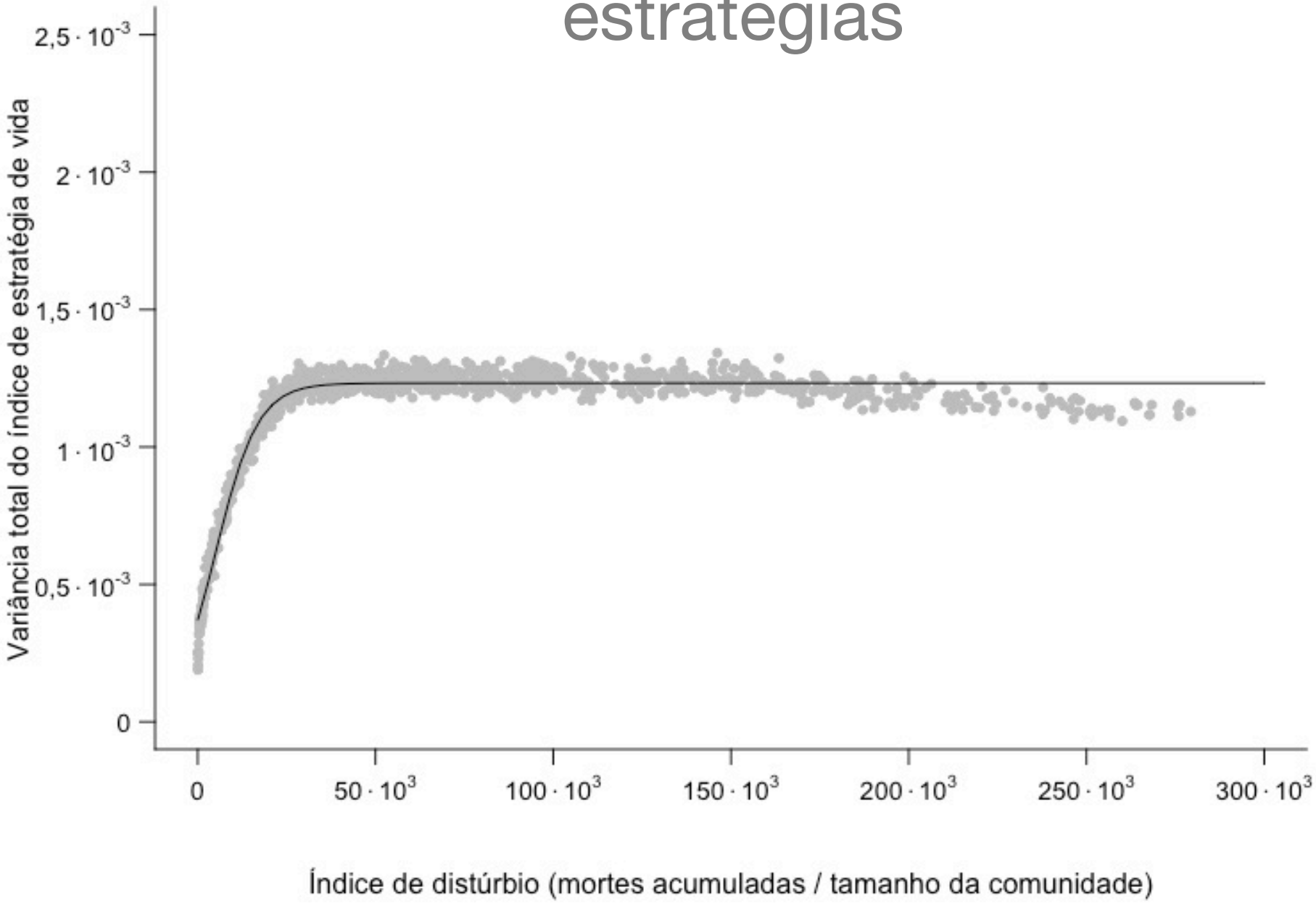

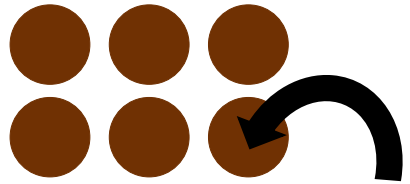

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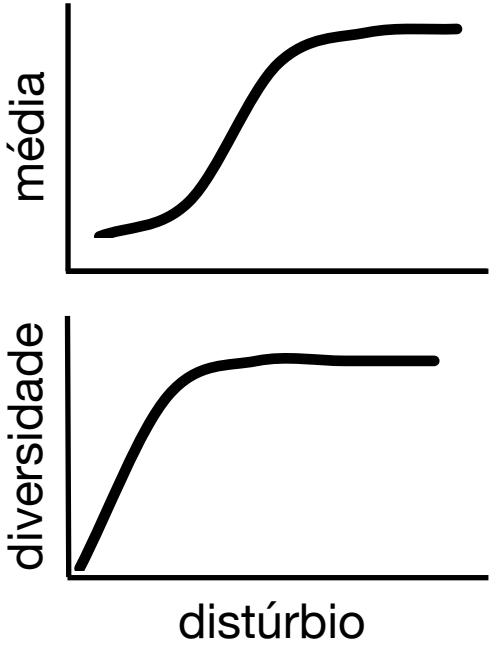

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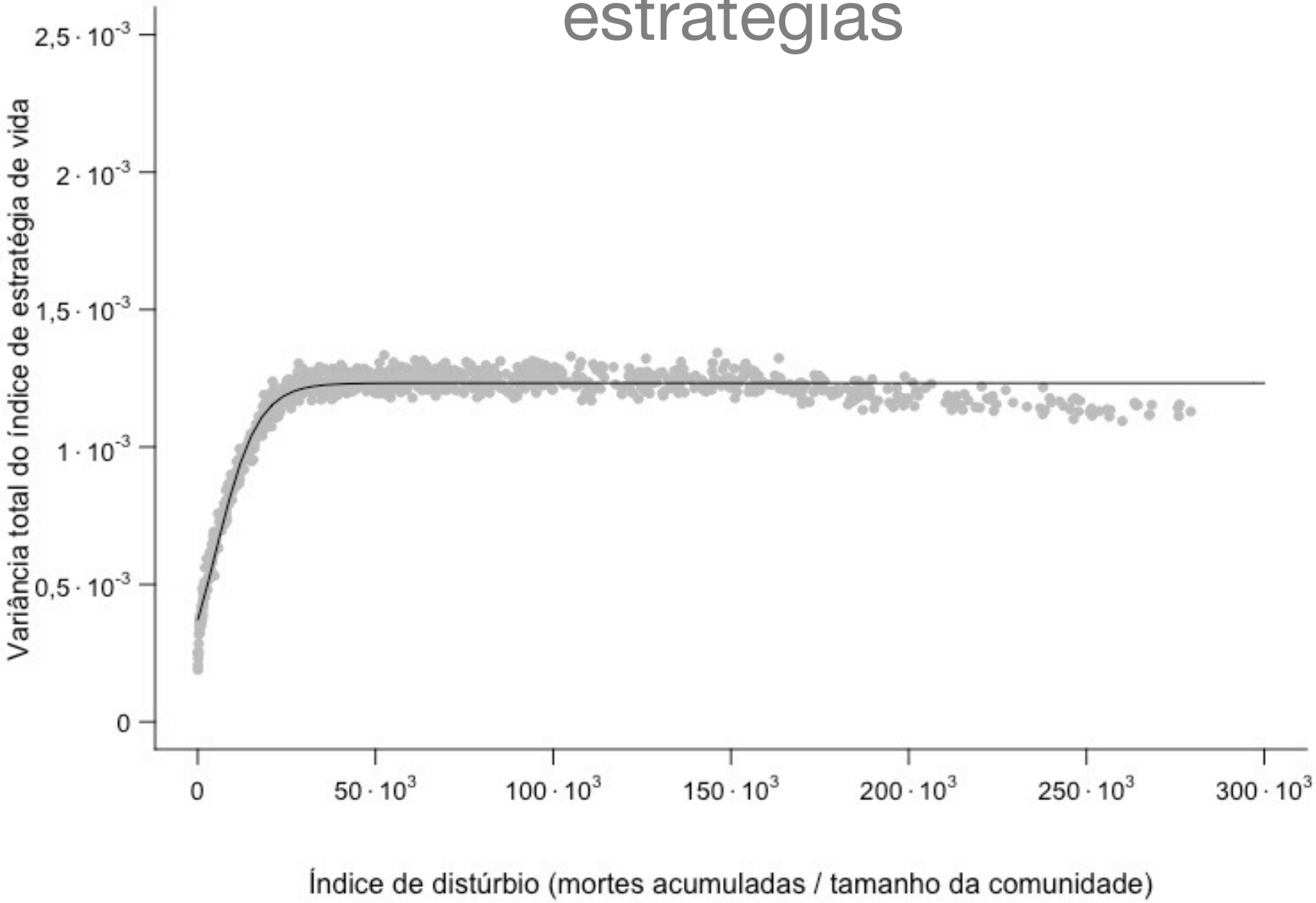

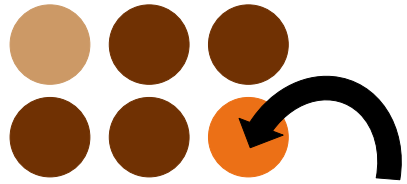

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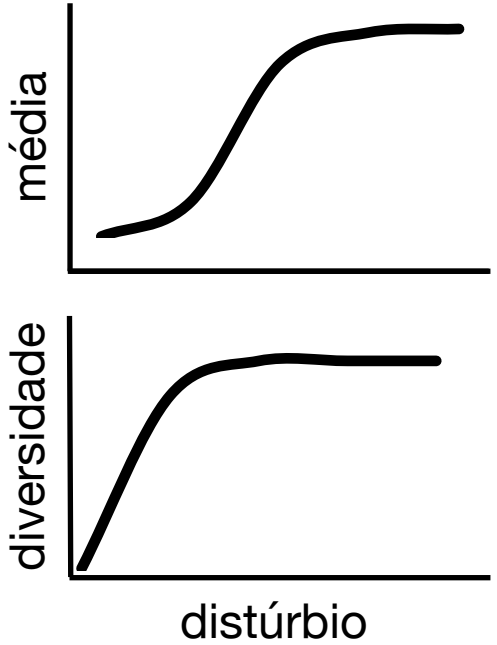

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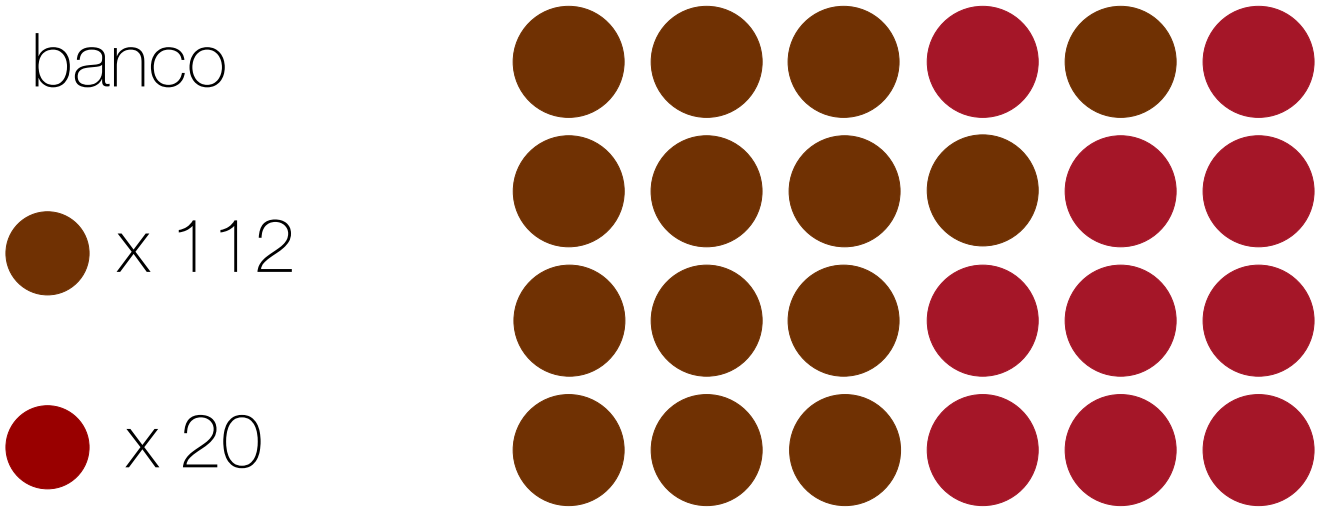

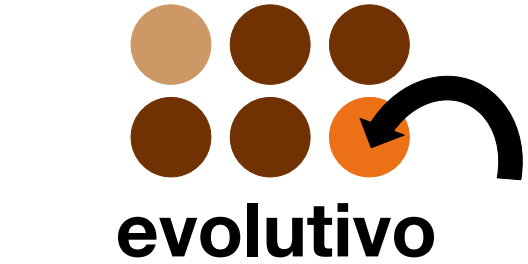

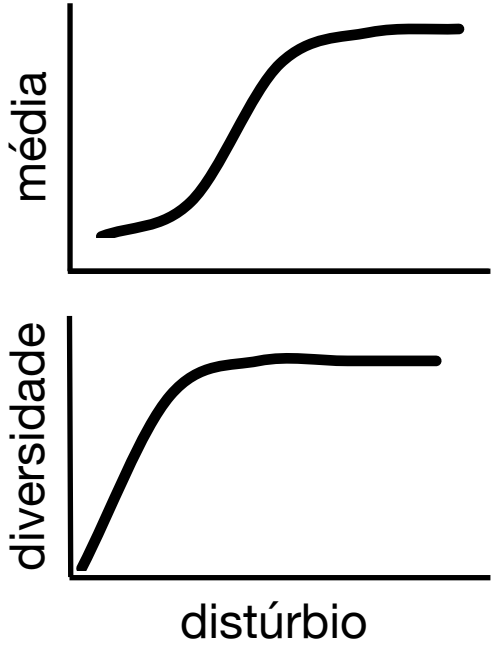

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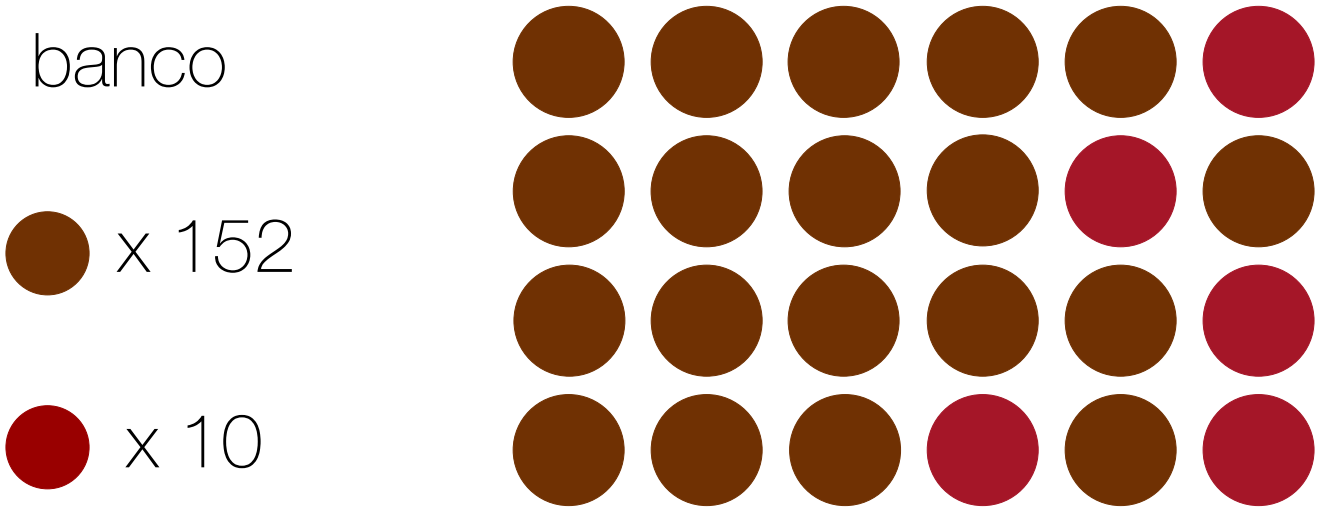

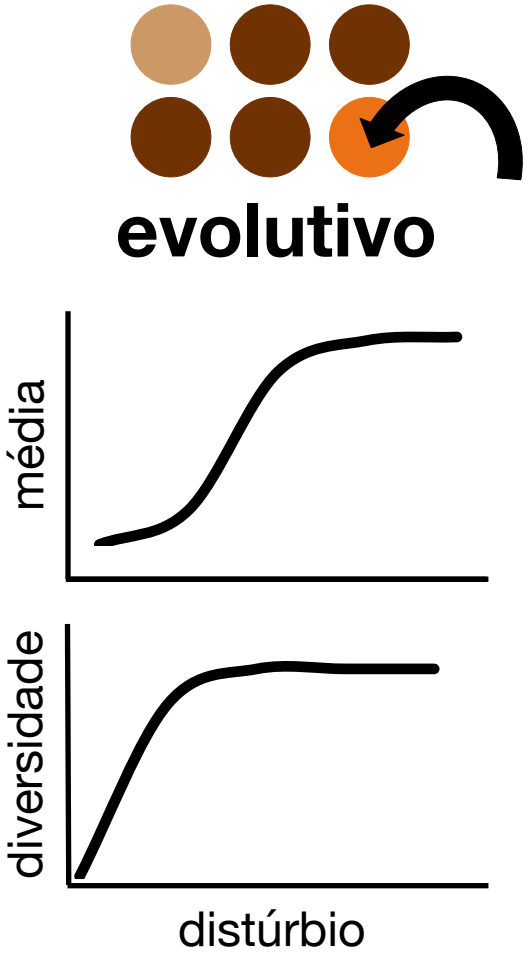

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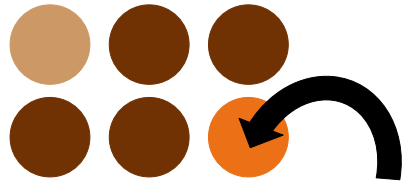

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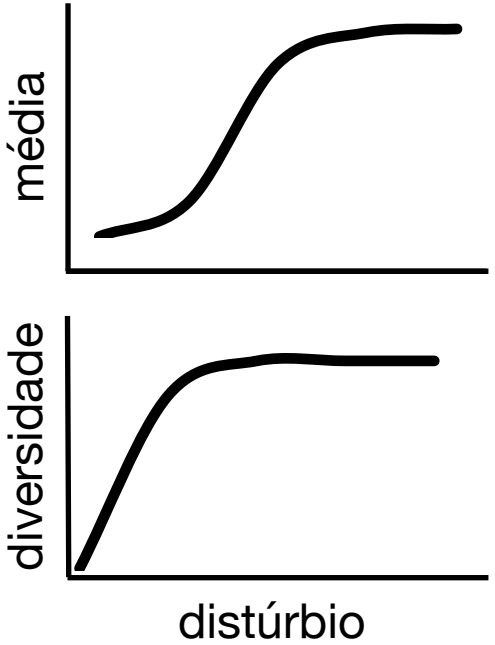

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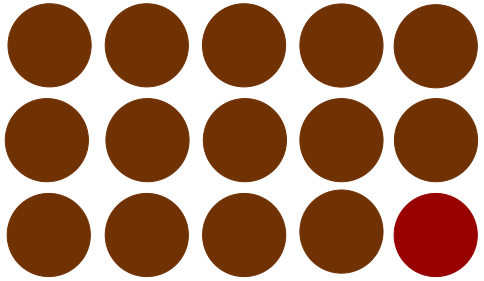

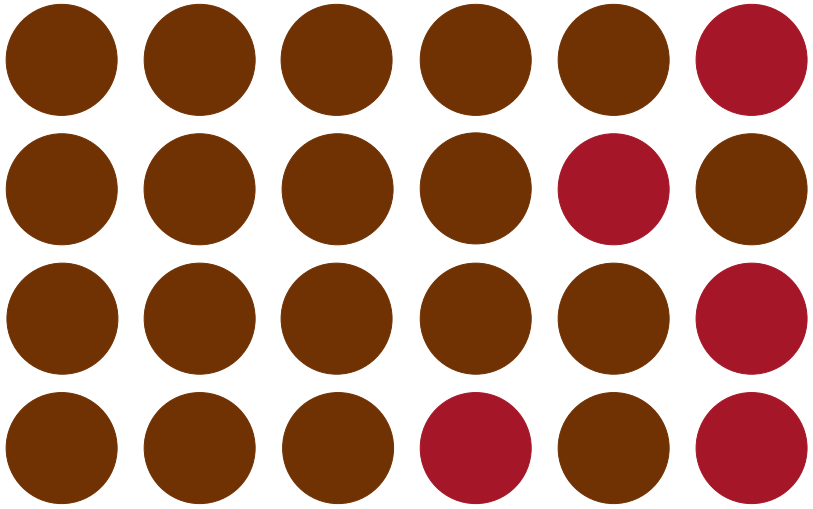

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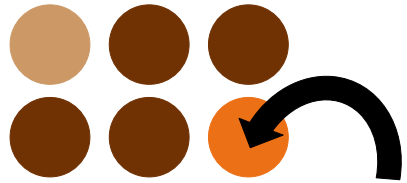

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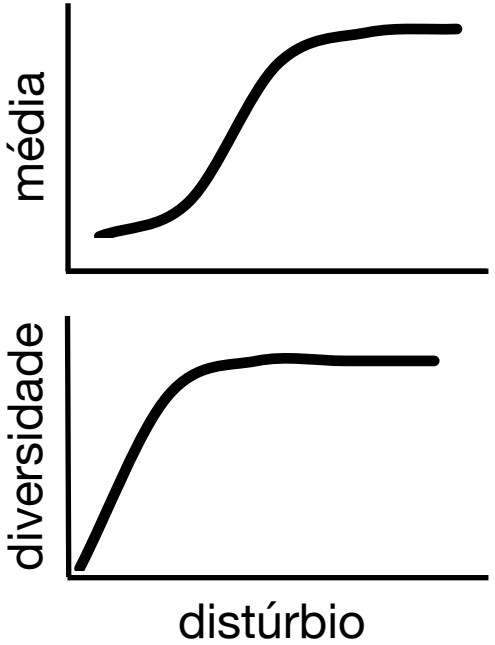

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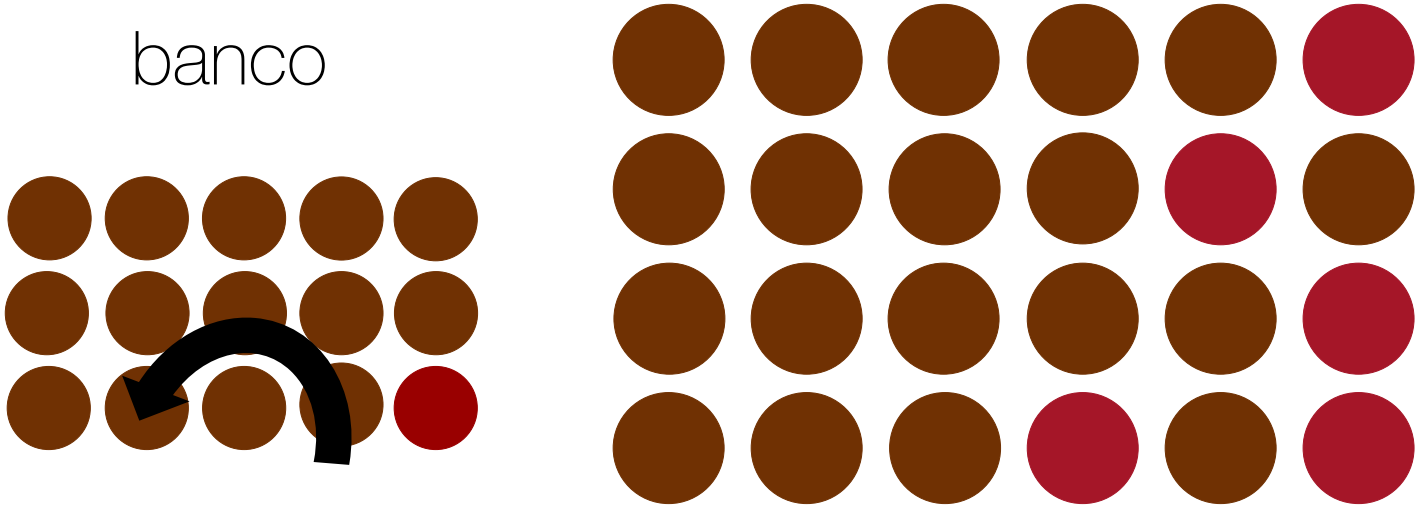

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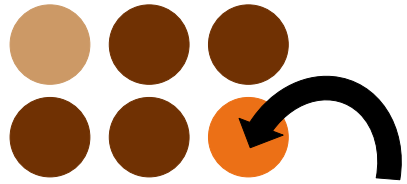

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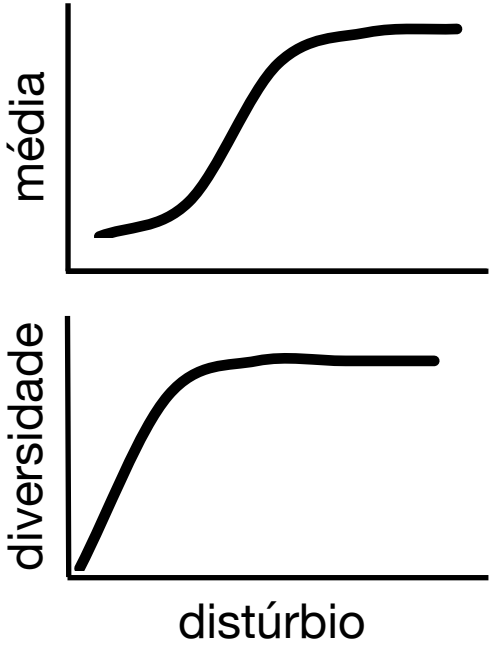

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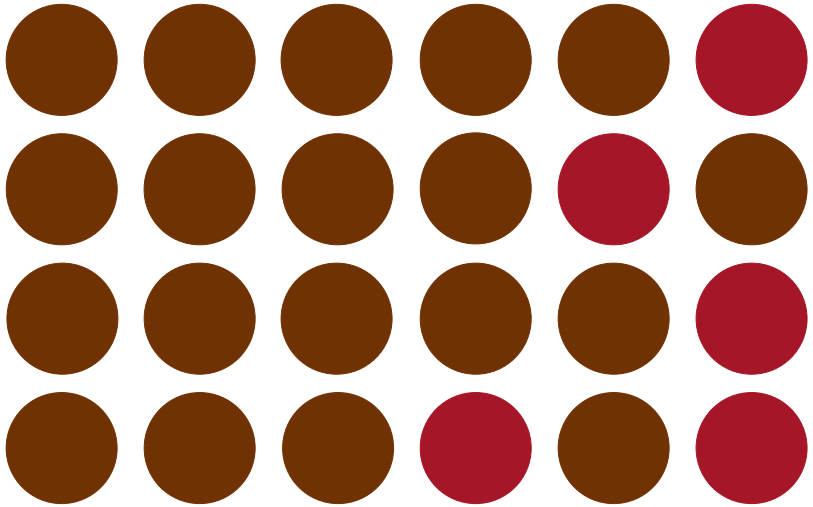

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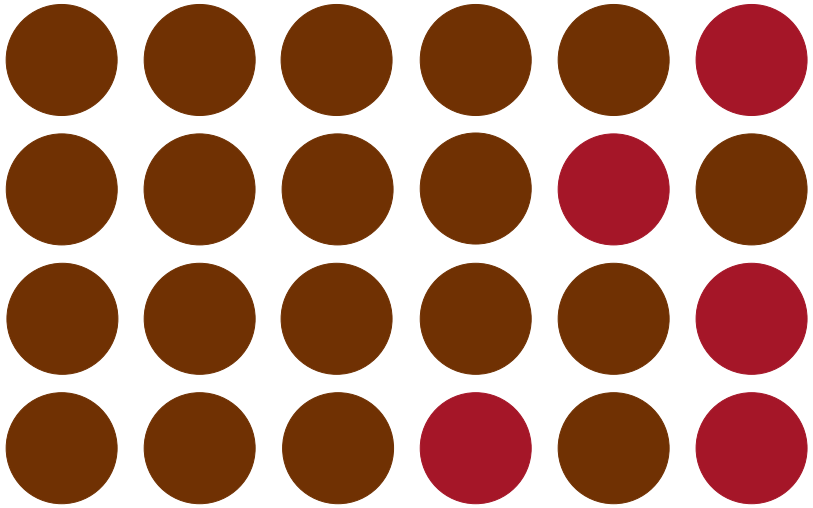

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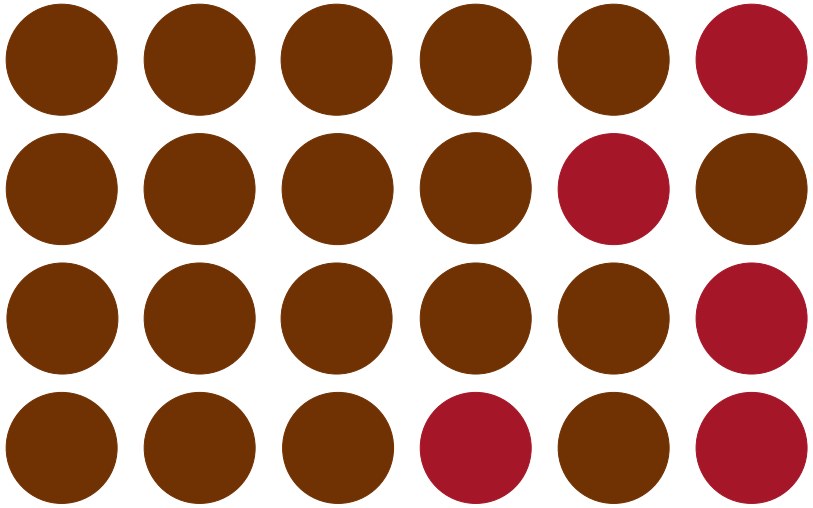

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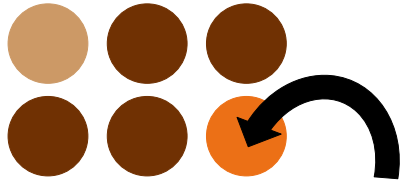

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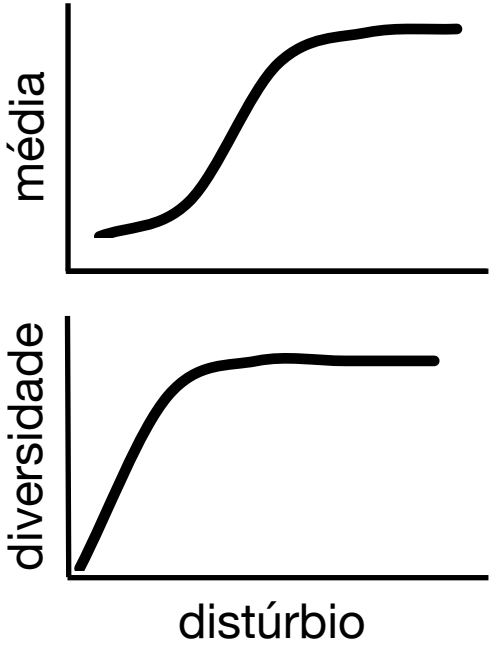

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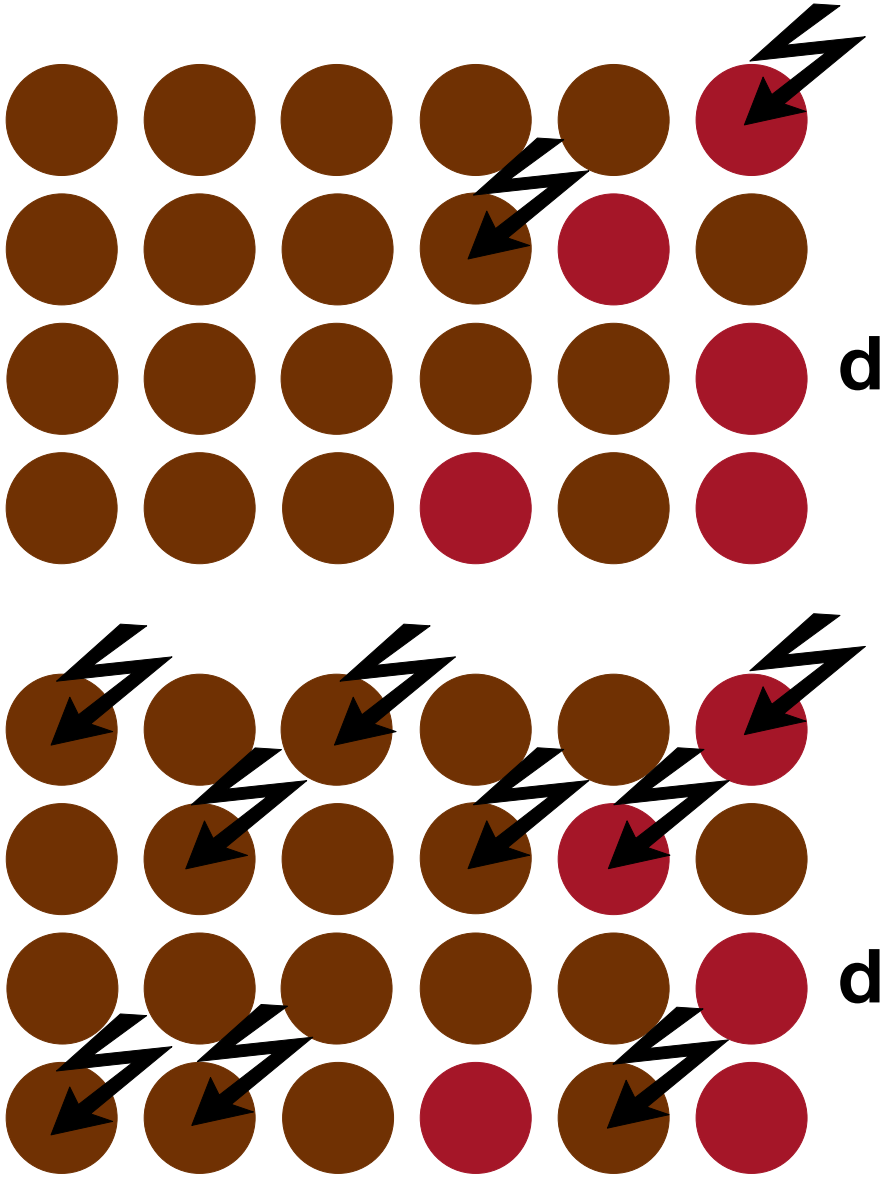

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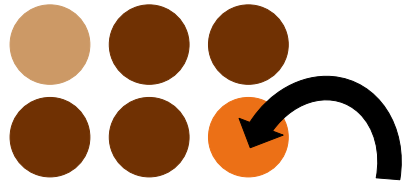

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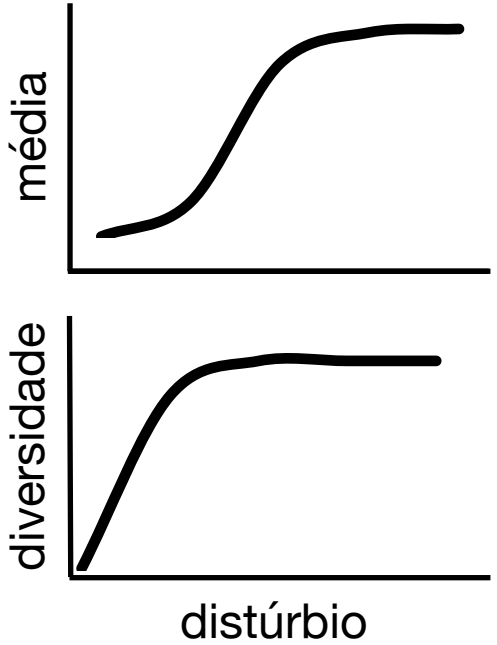

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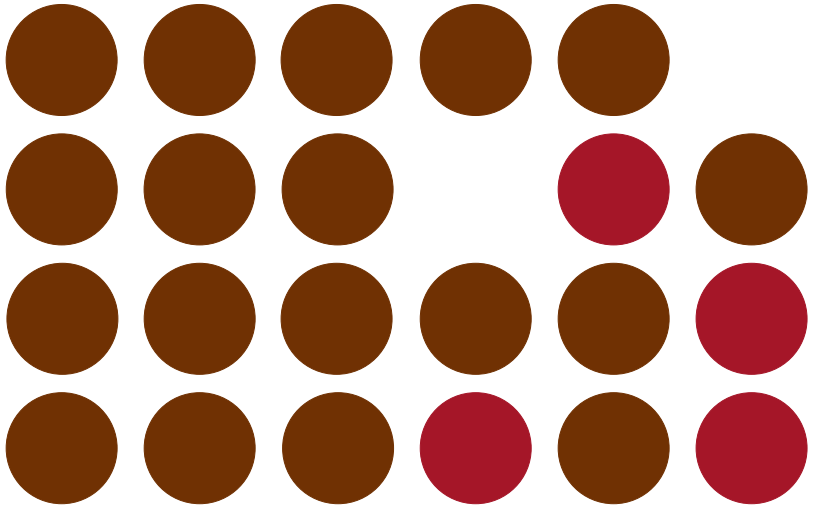

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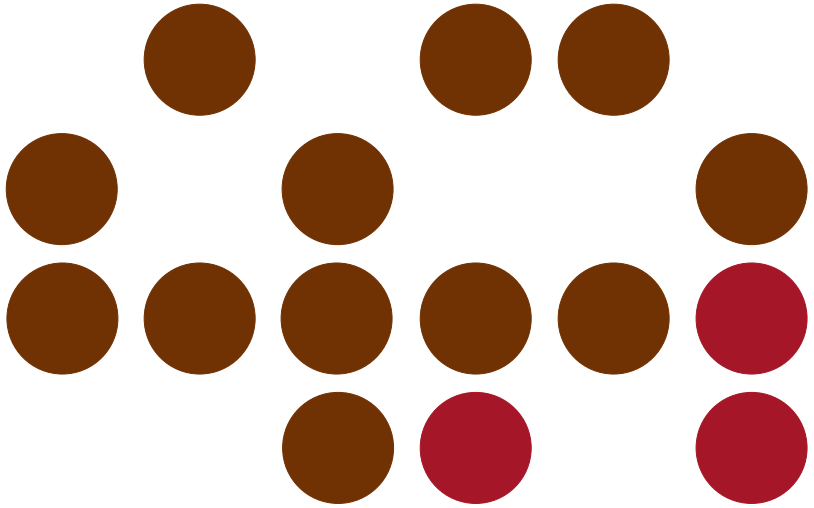

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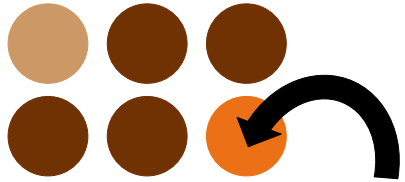

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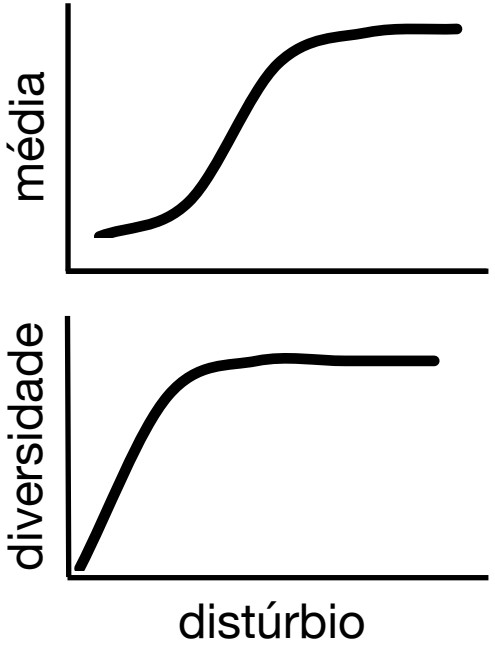

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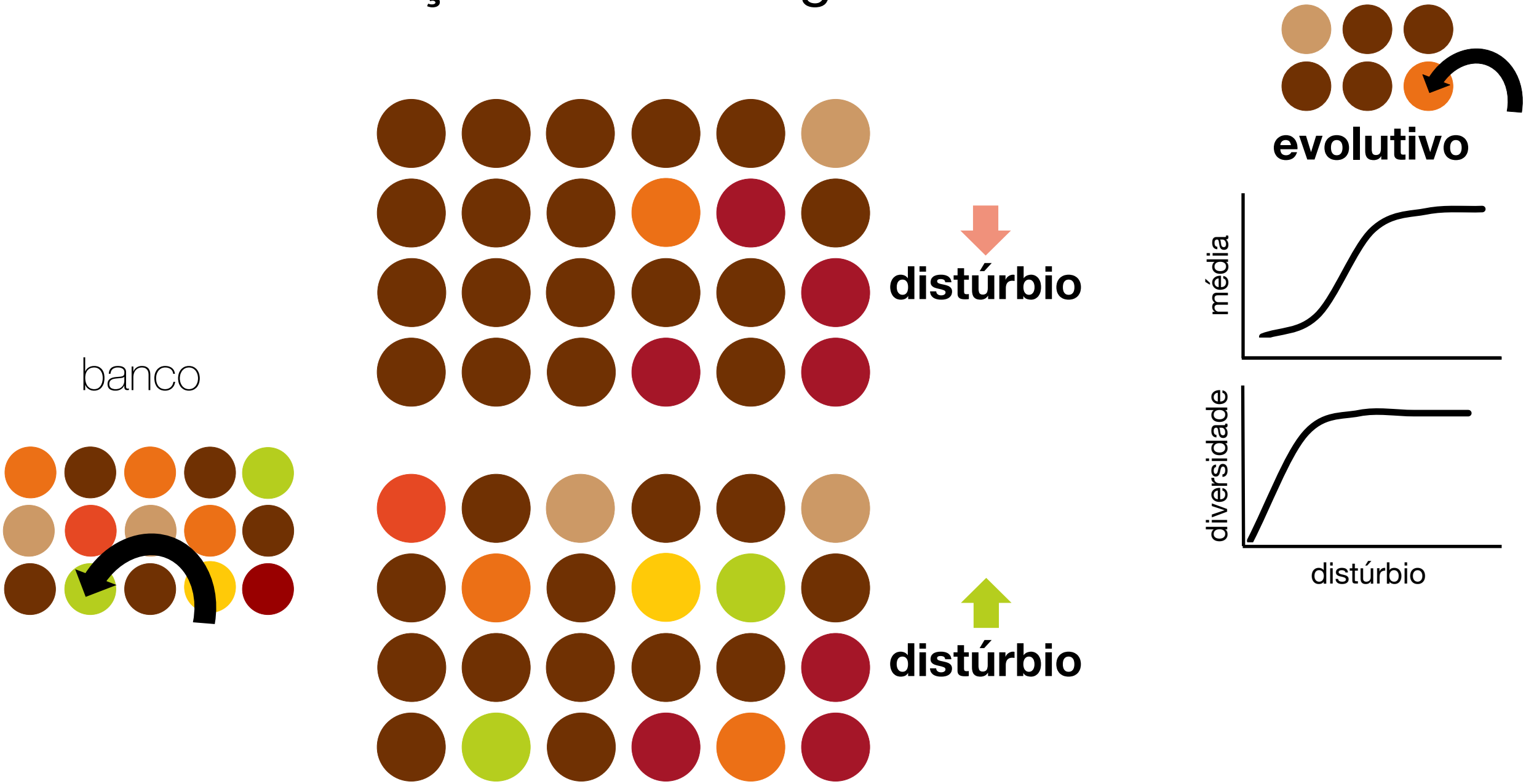

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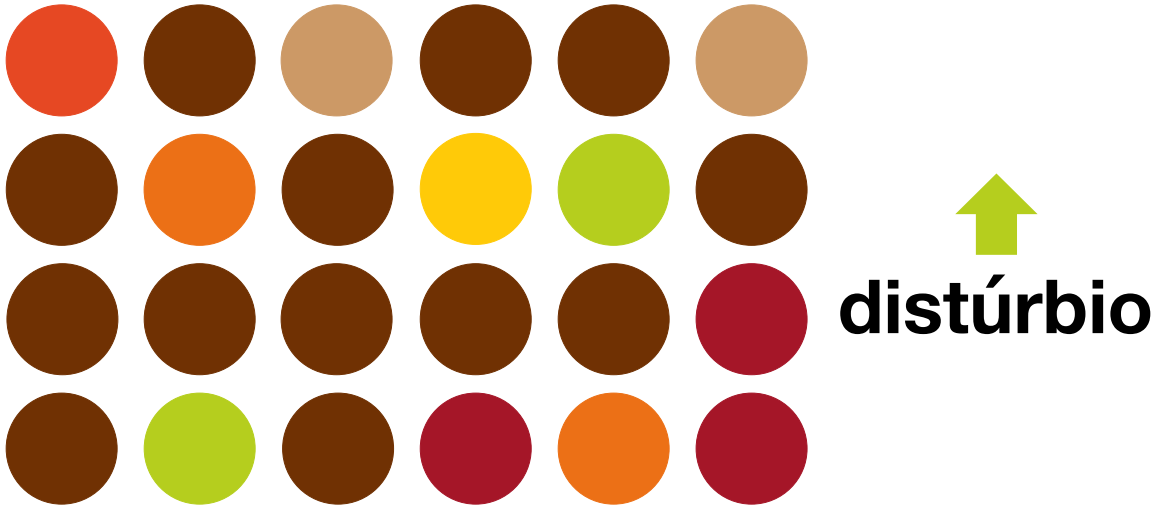

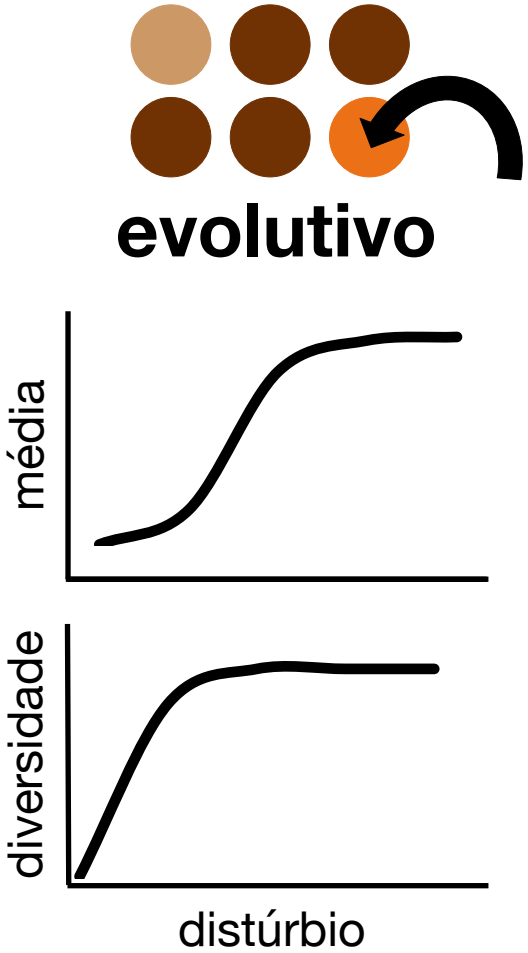

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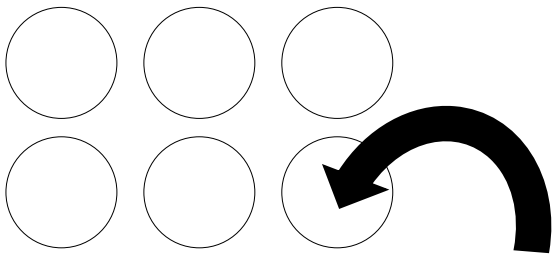	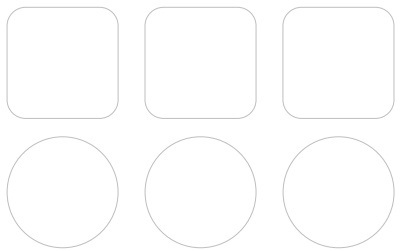	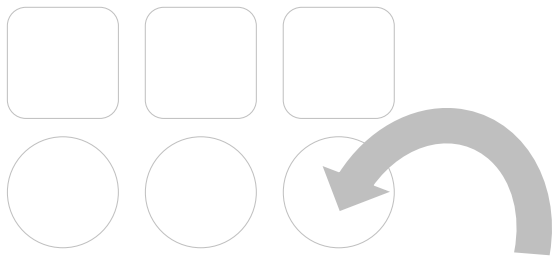
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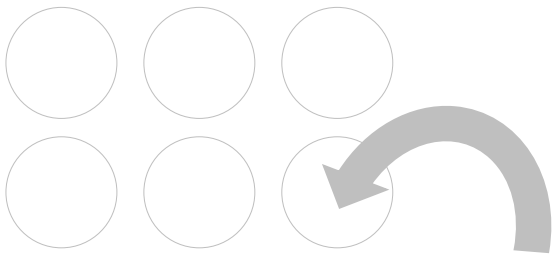	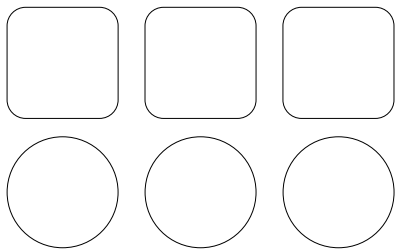	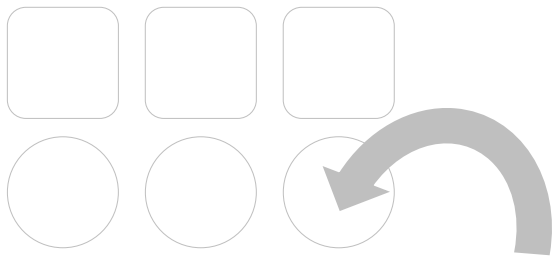
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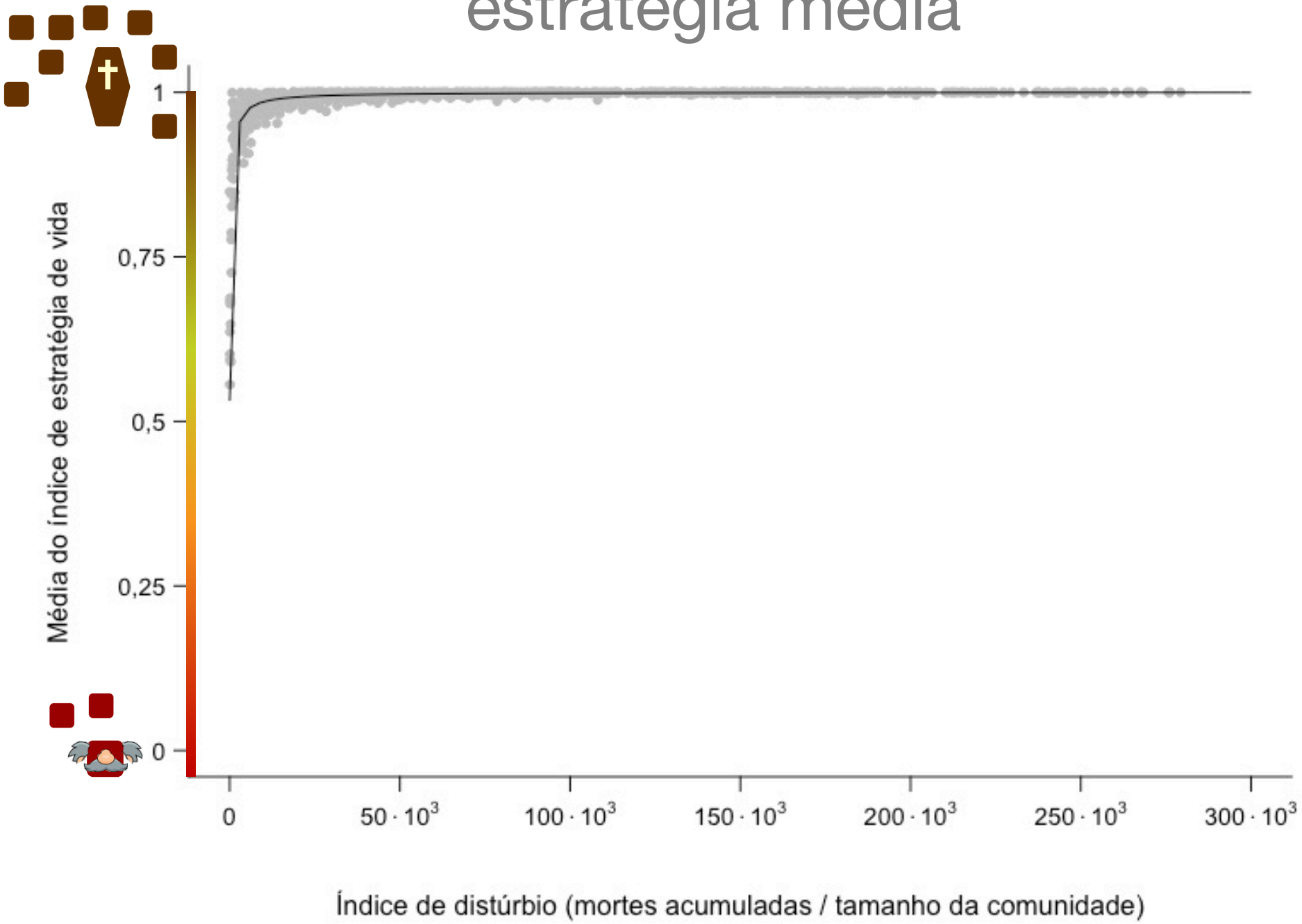
ecológico

estratégia média



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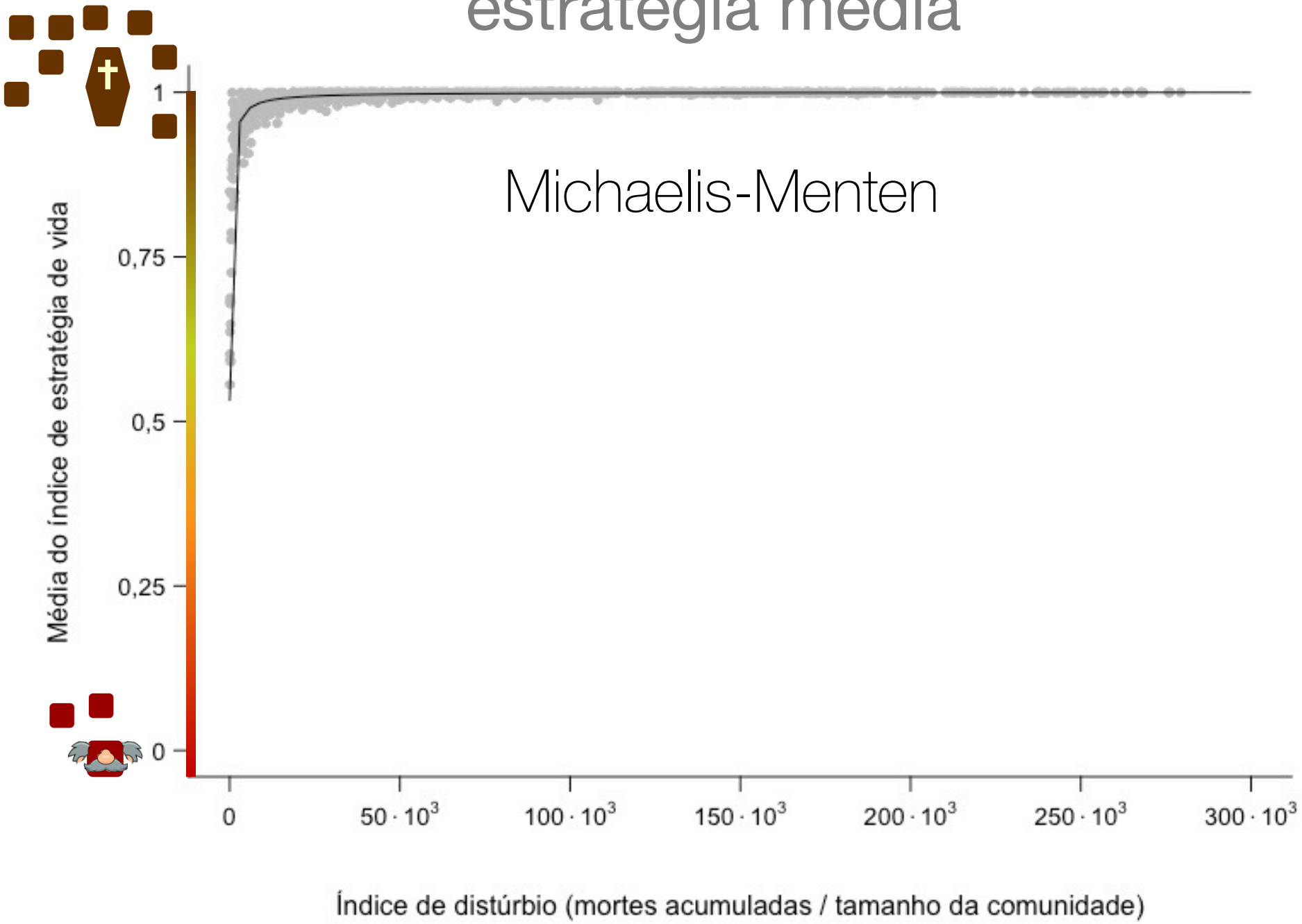

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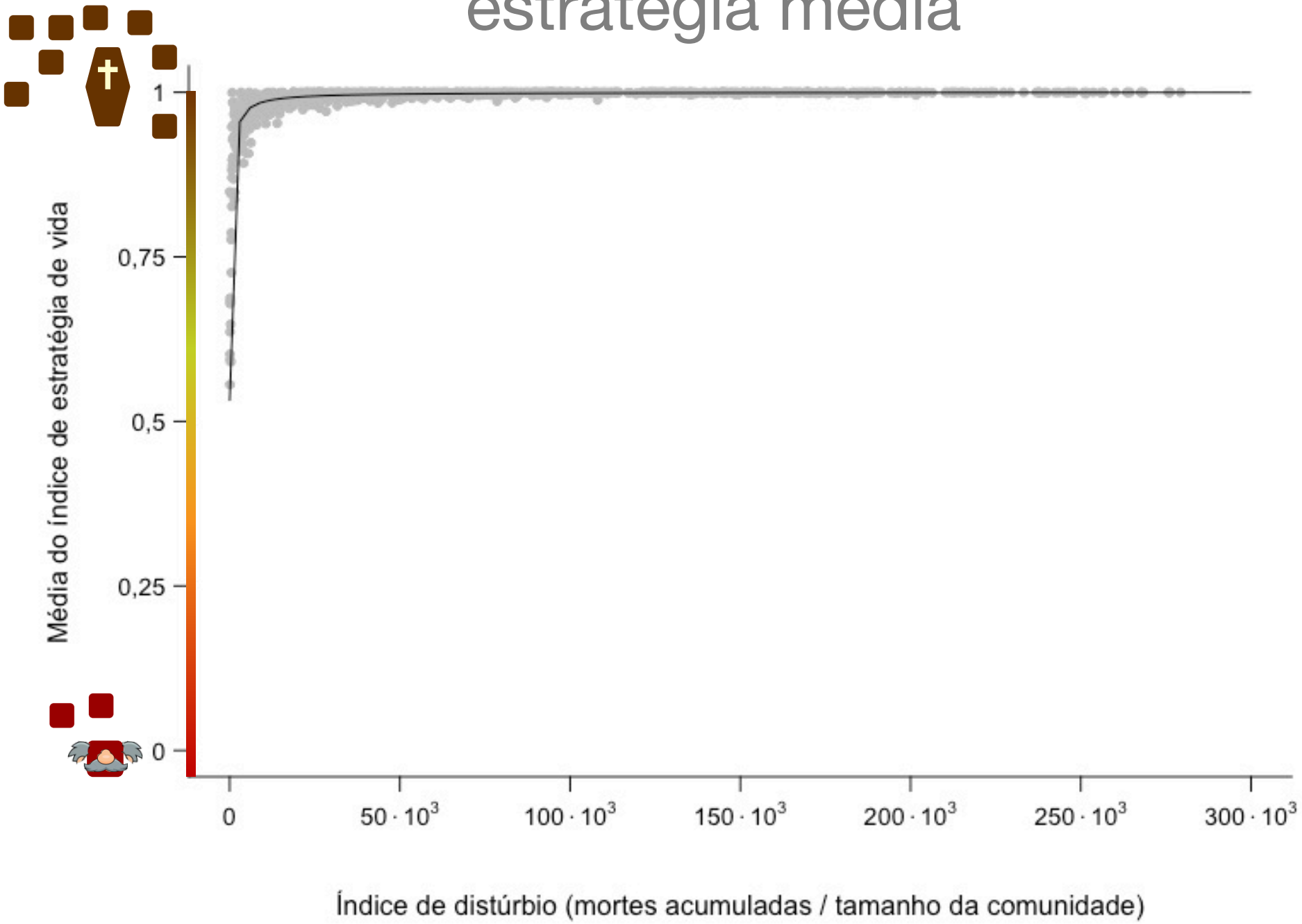

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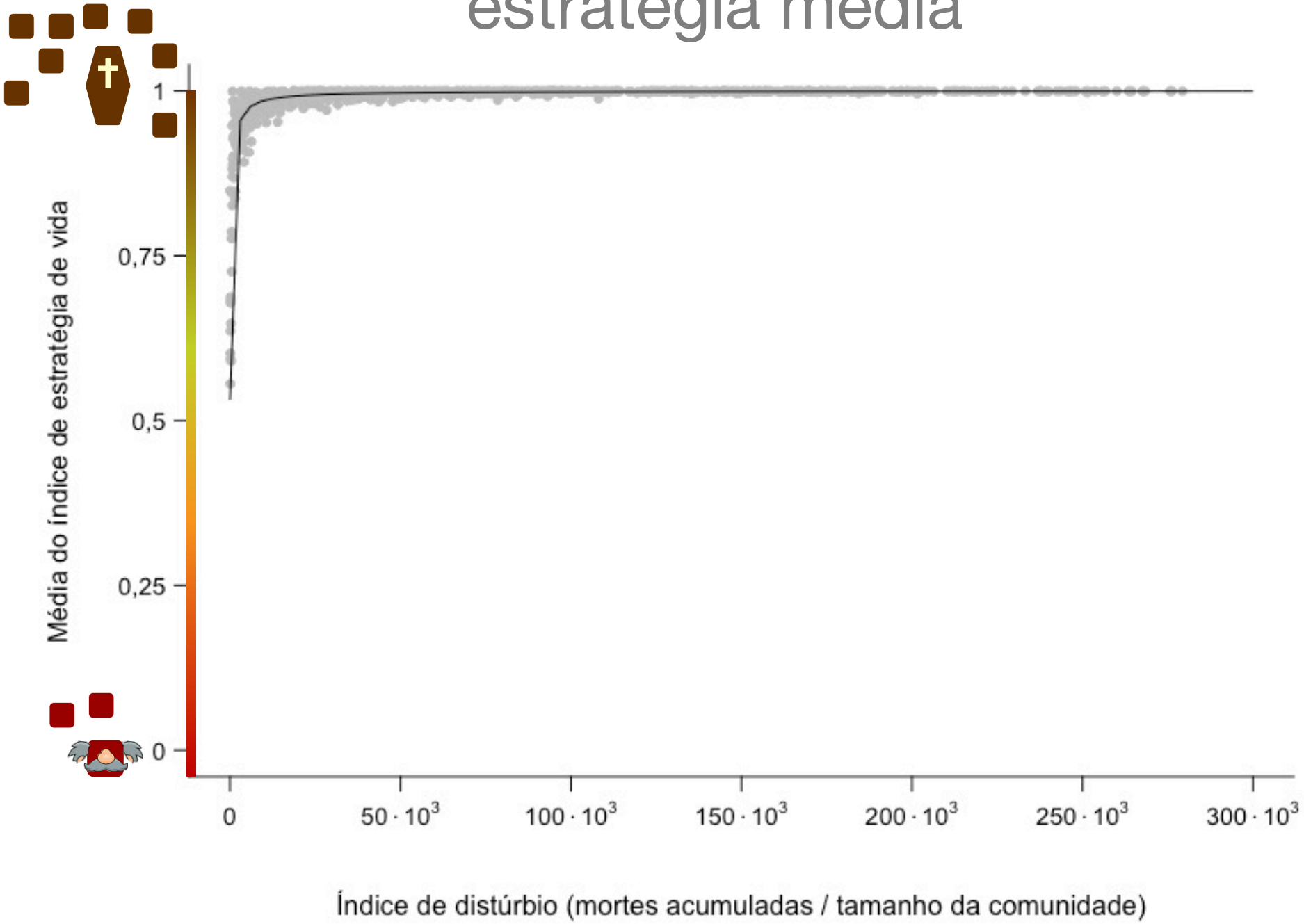

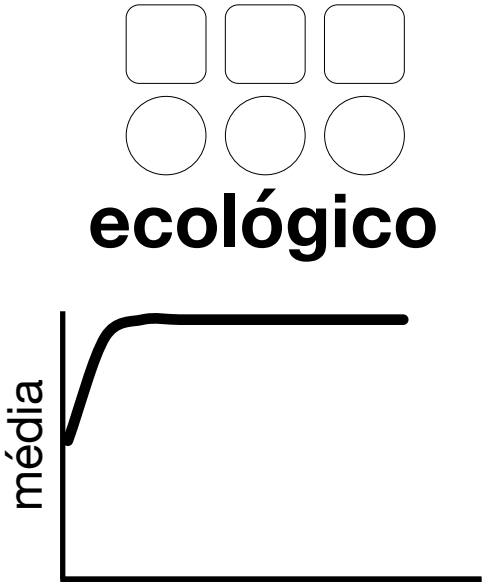

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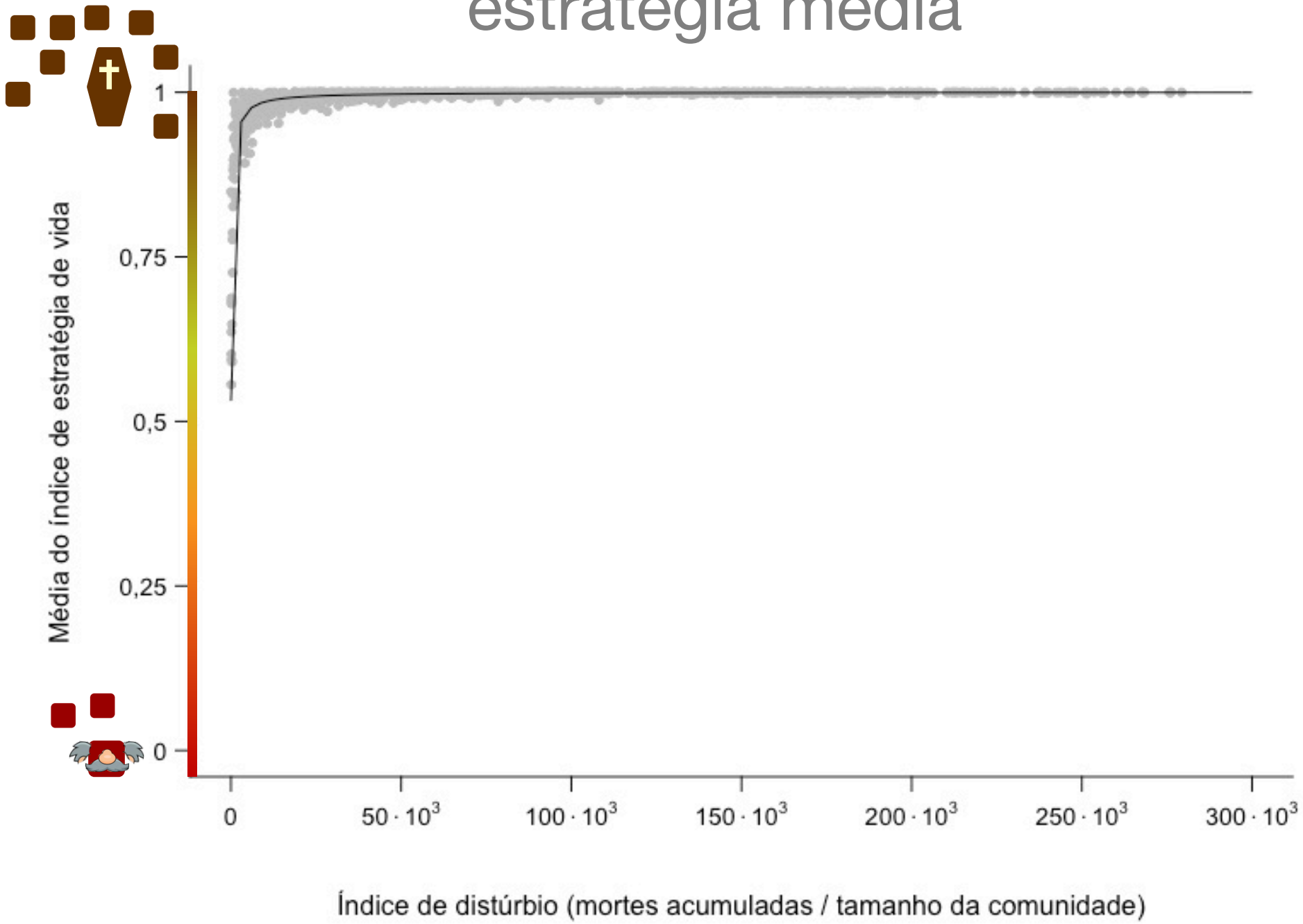

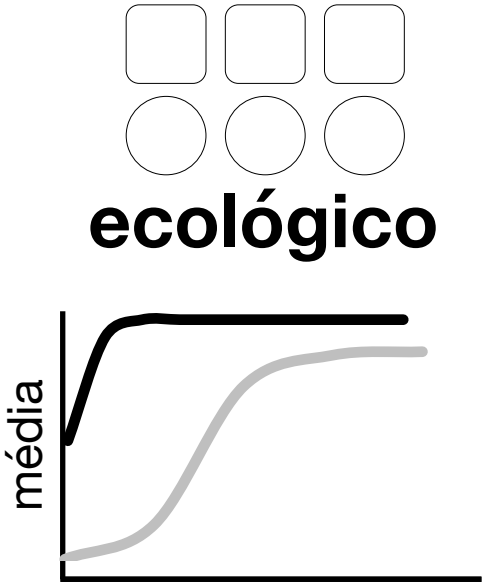

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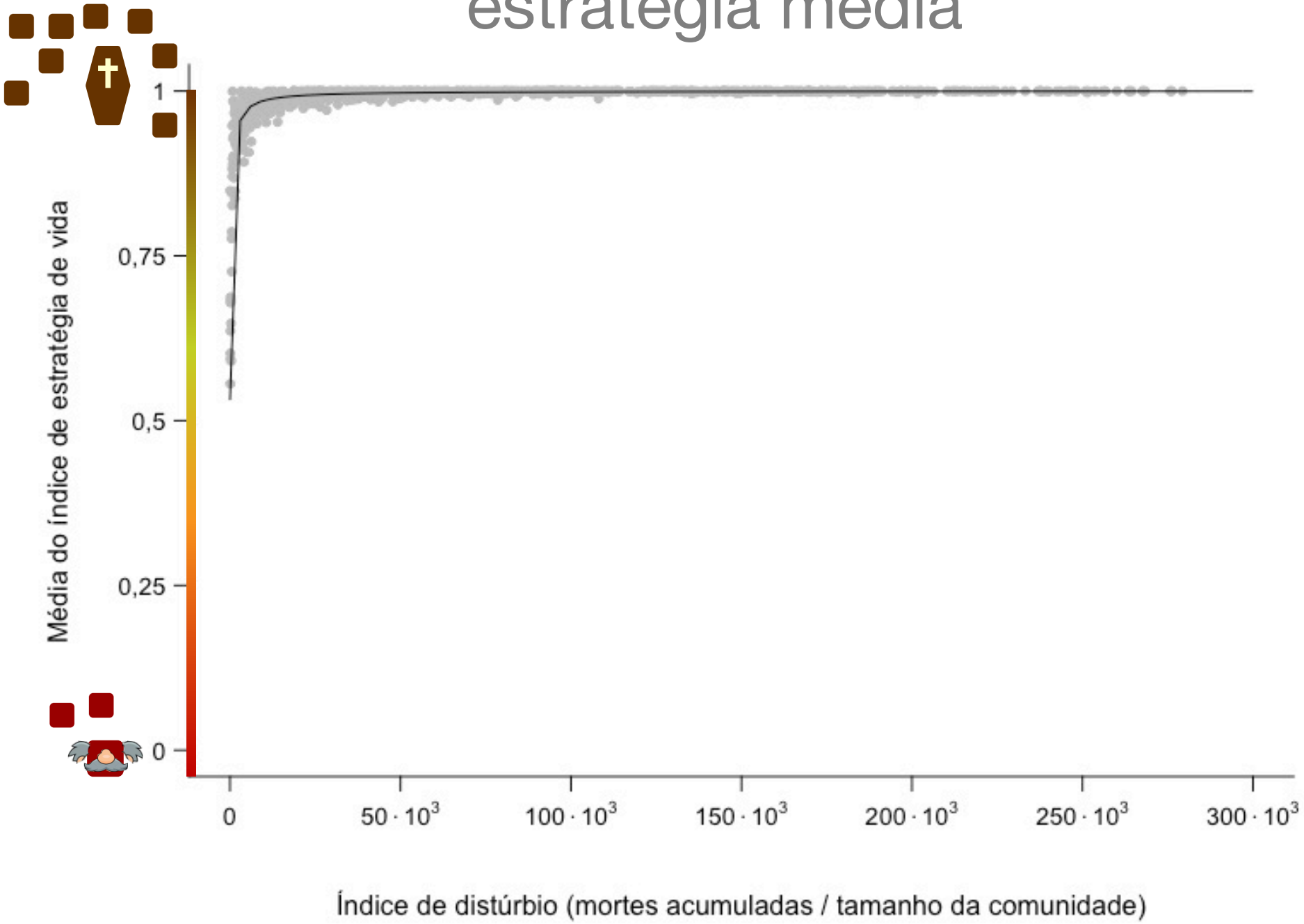

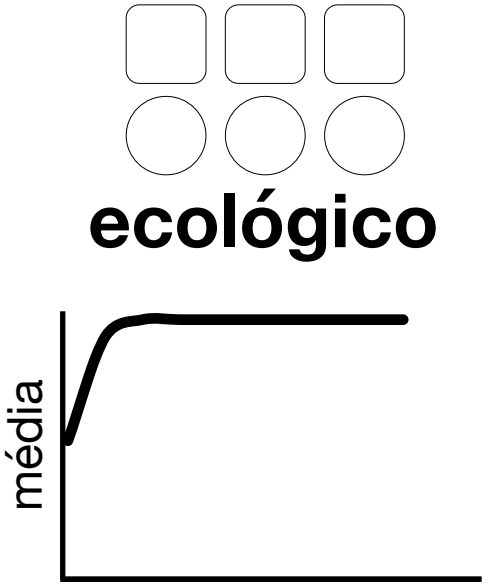

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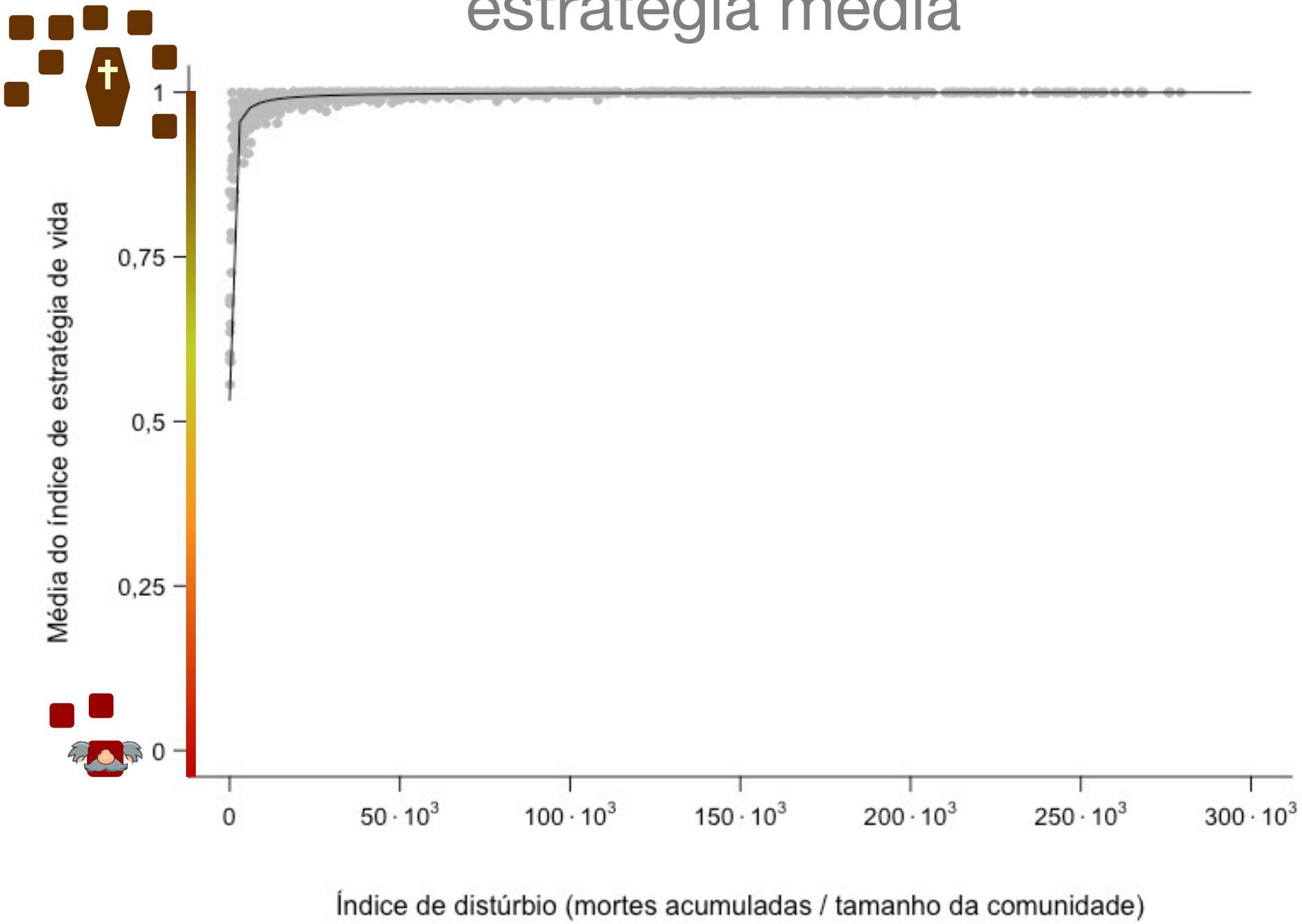

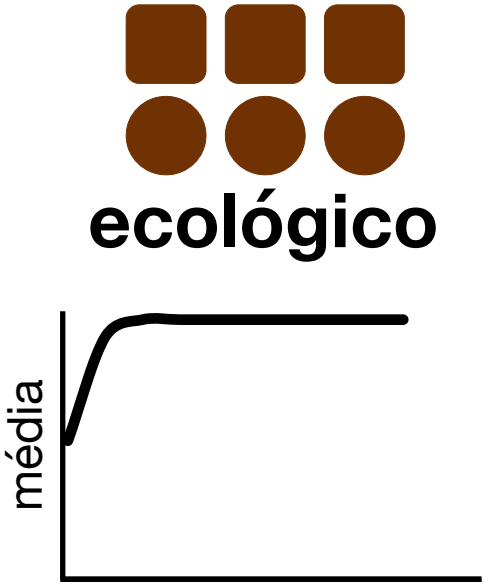

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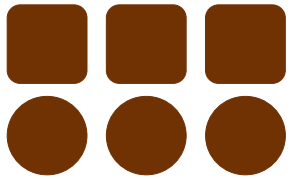

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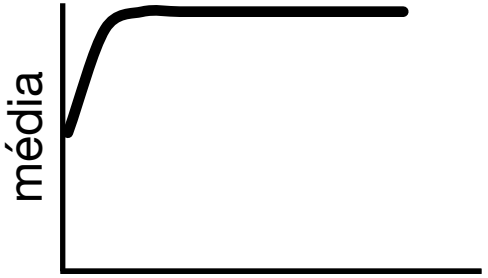
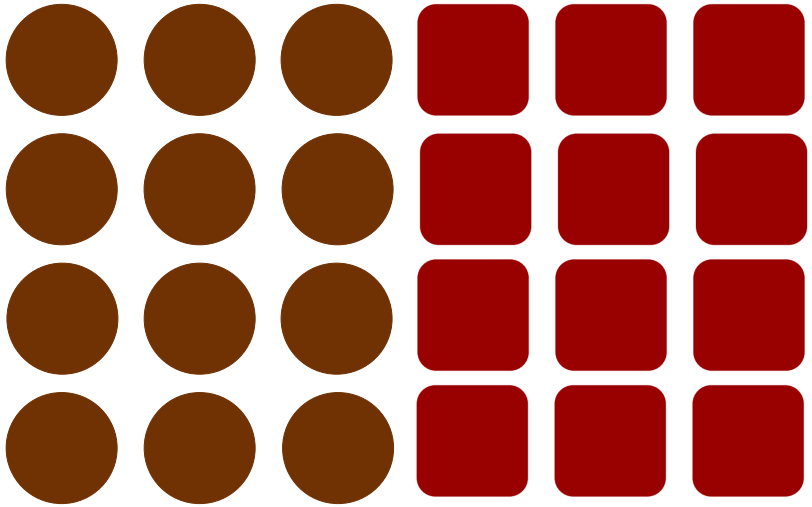


banco

x 96

x 24



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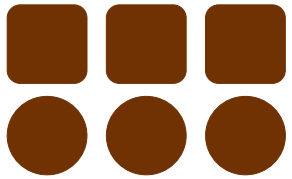

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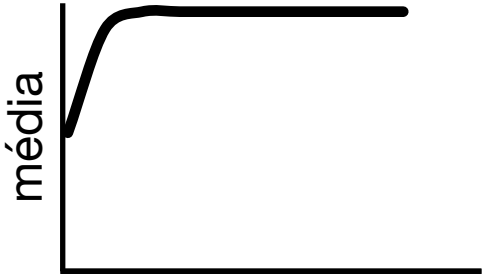

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x 152

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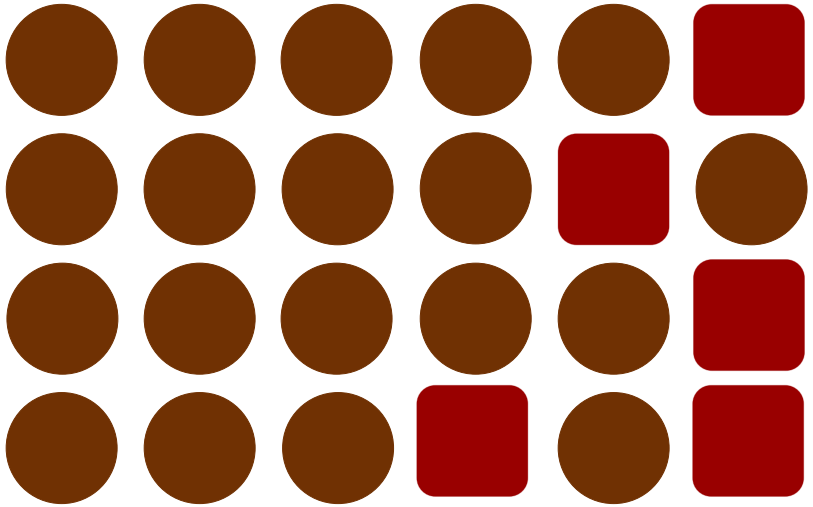

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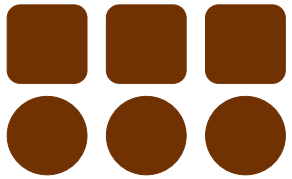

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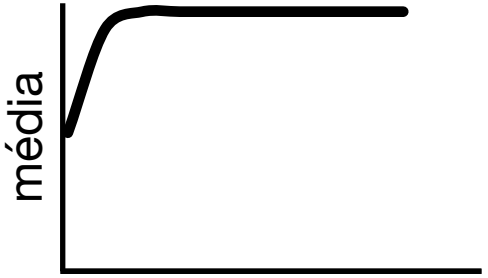

banco

x 176

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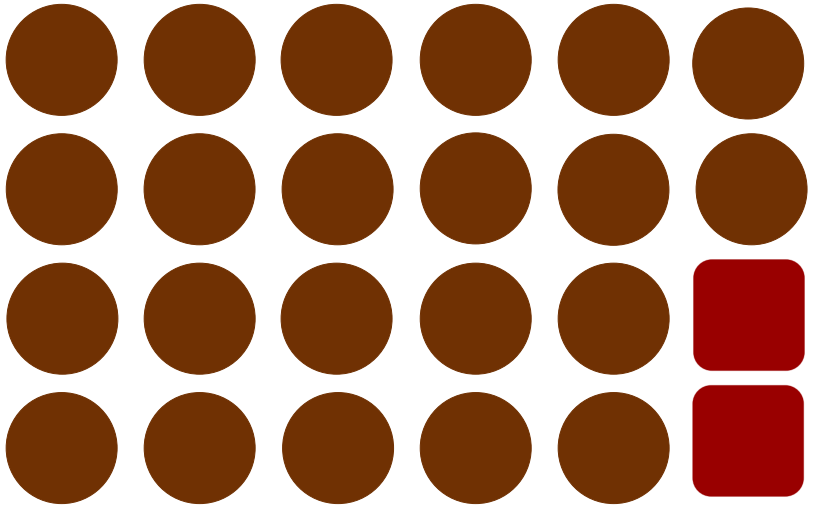

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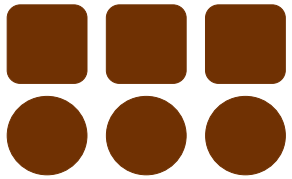

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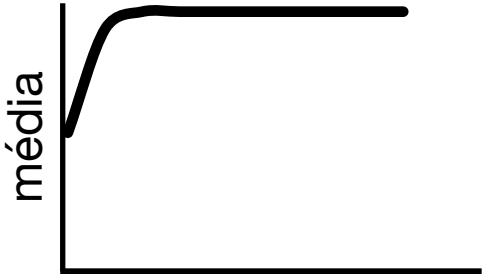

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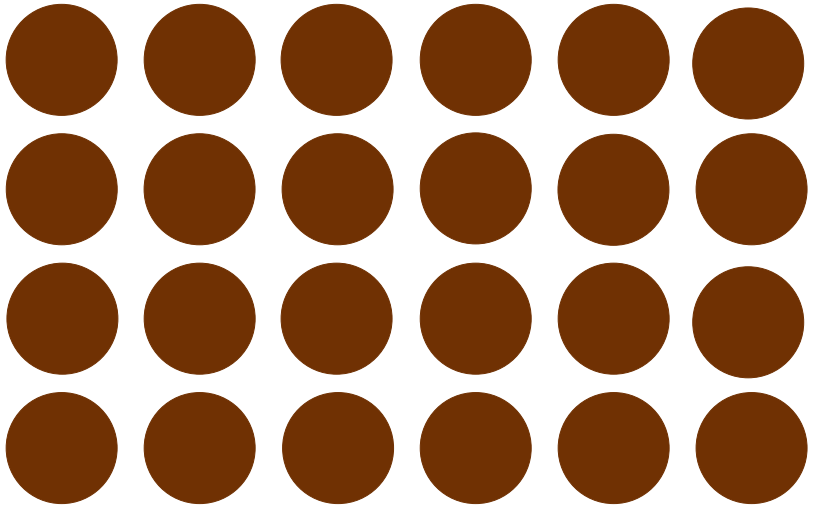
x 176



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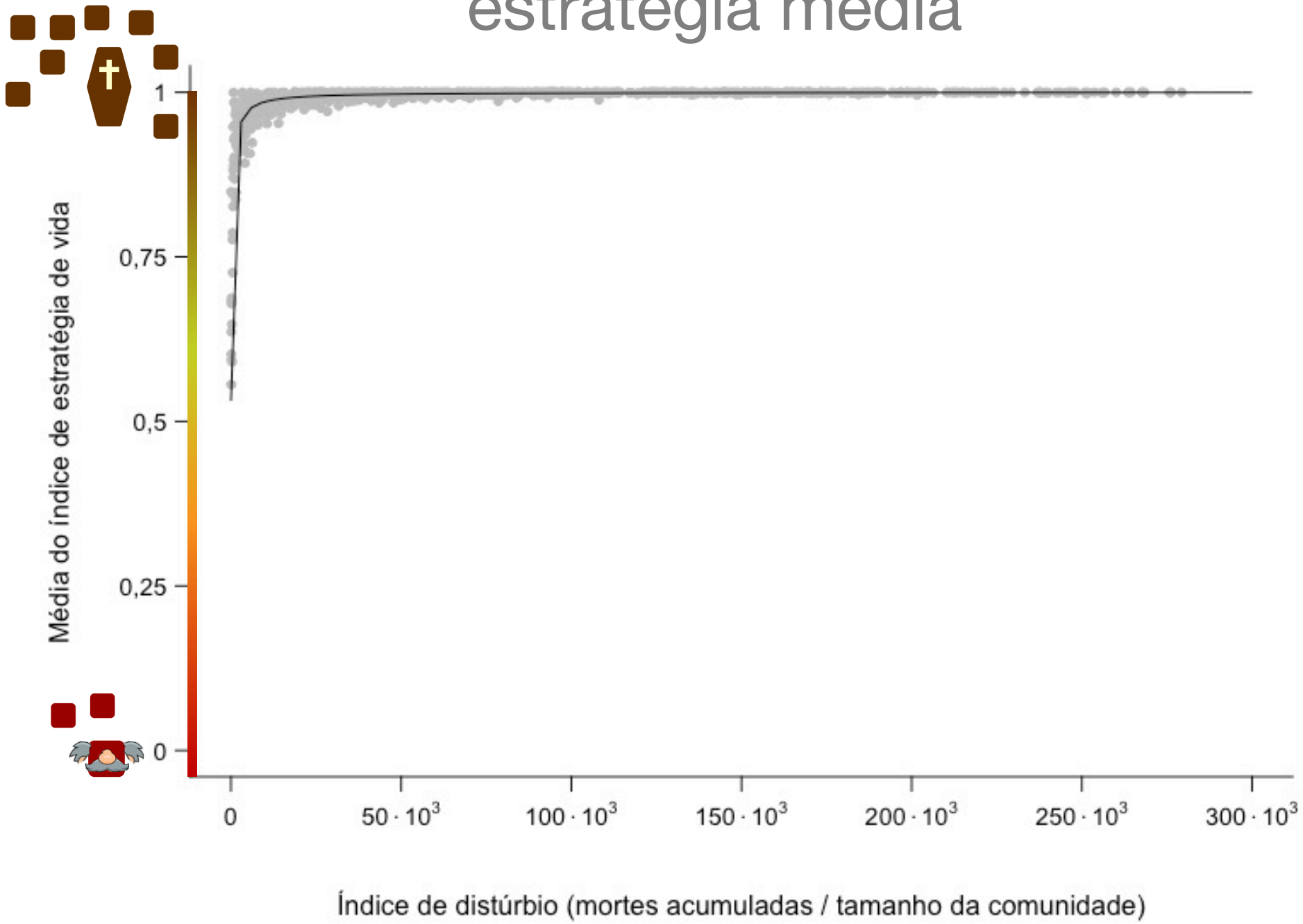

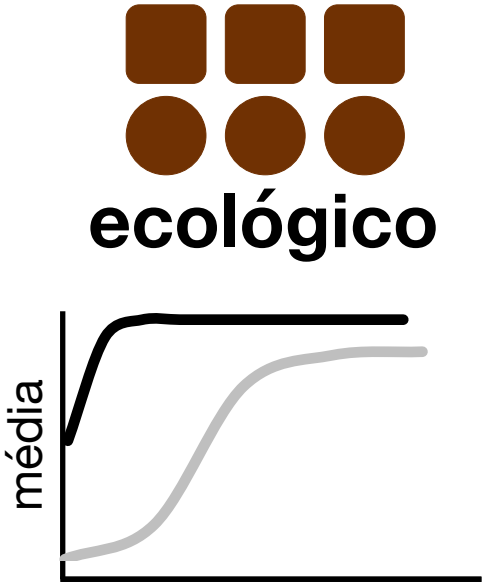

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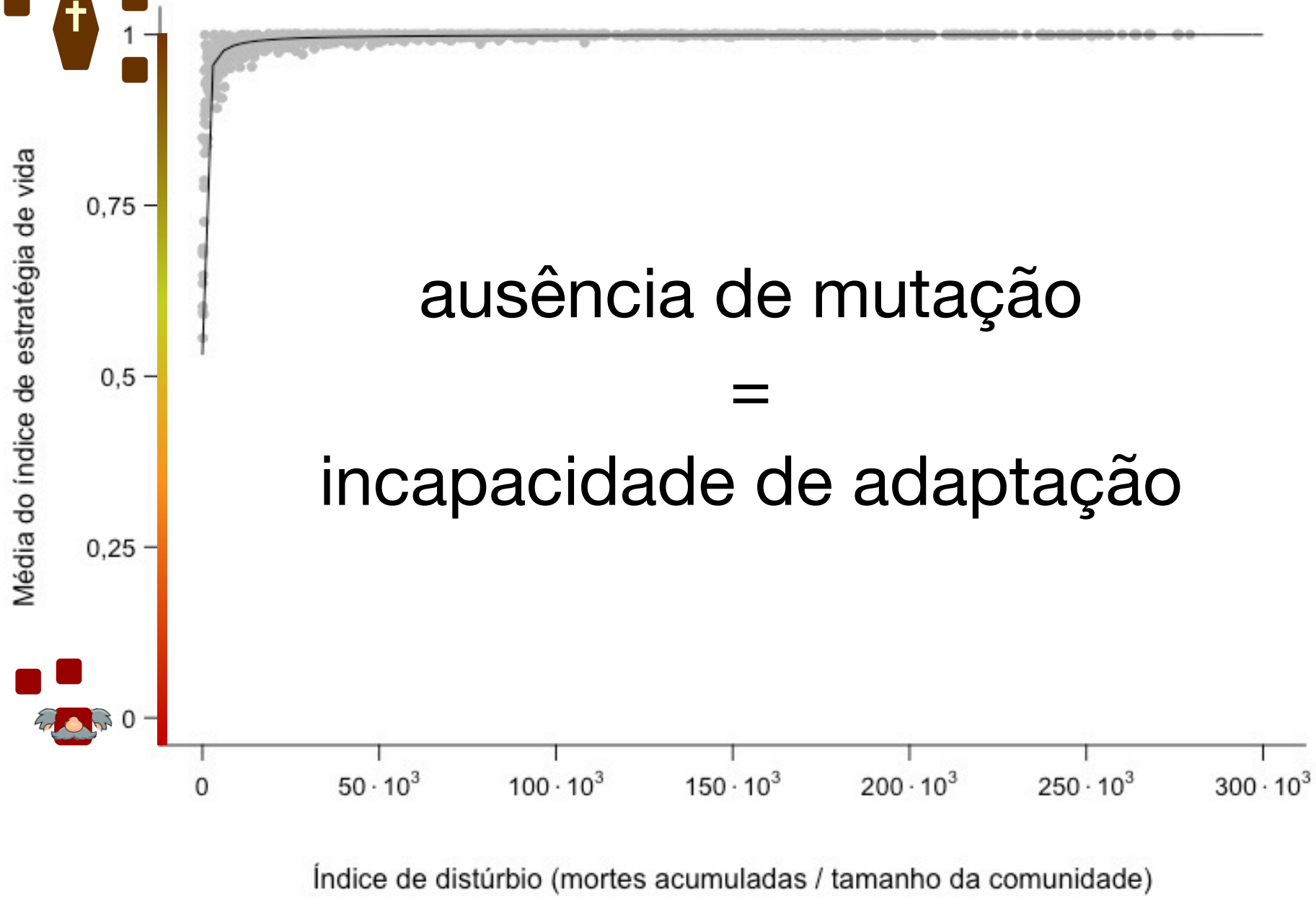

ausência de mutação

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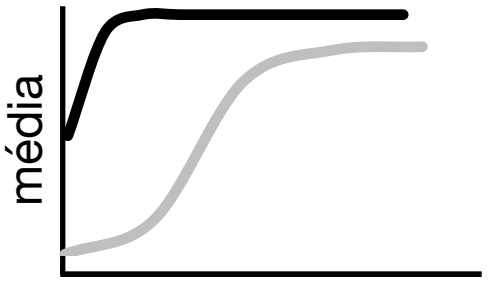
incapacidade de adaptação

ecológico



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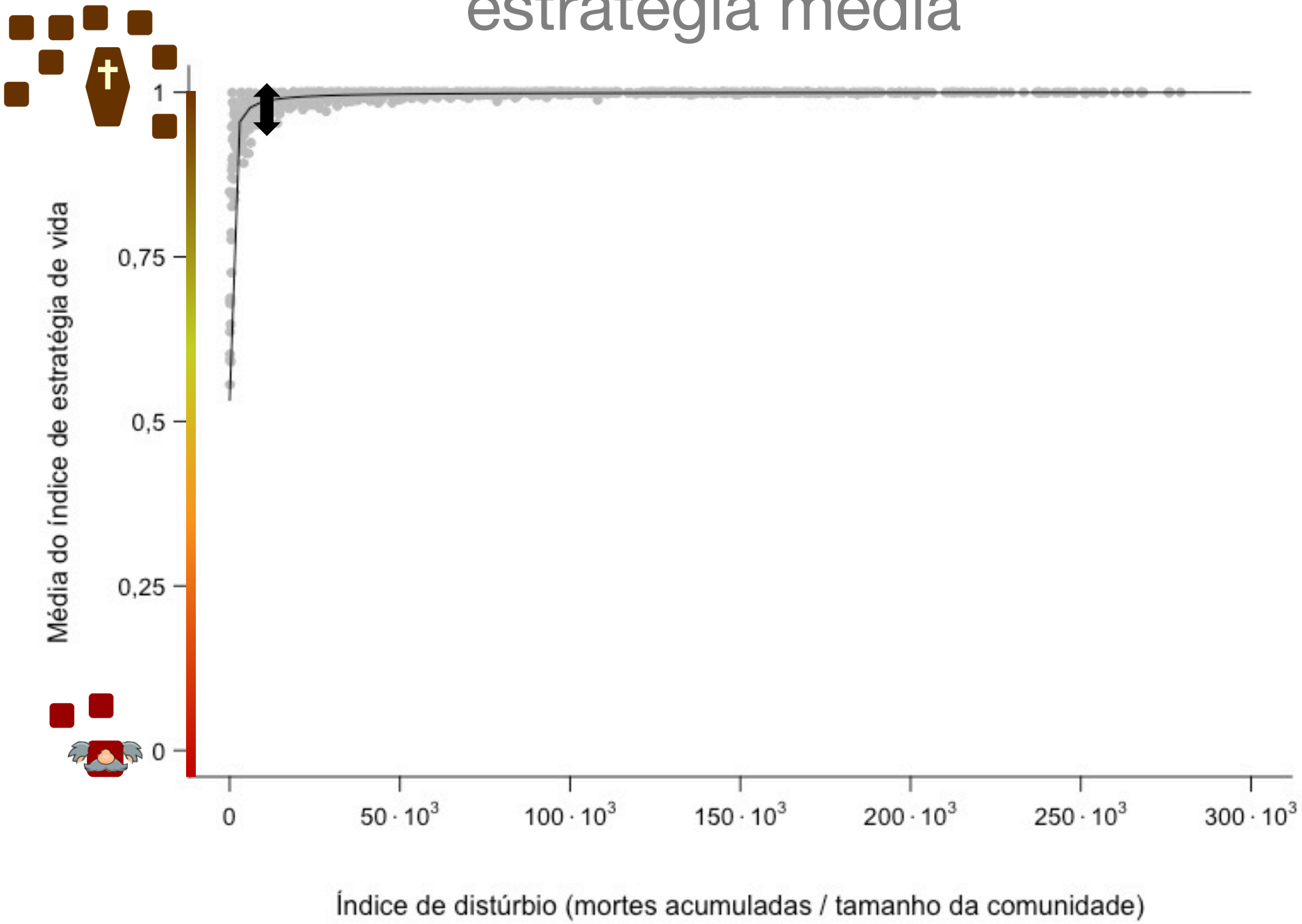

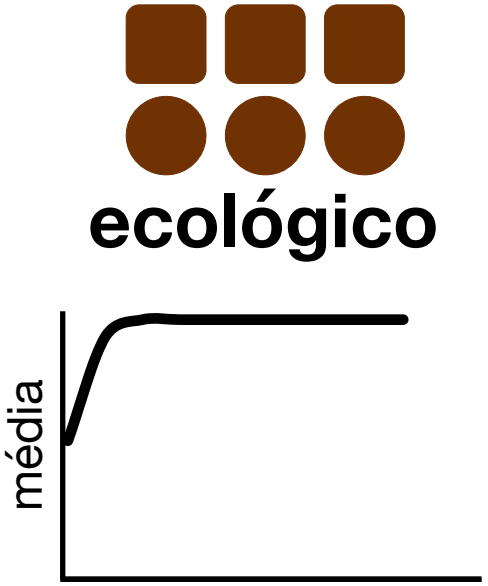

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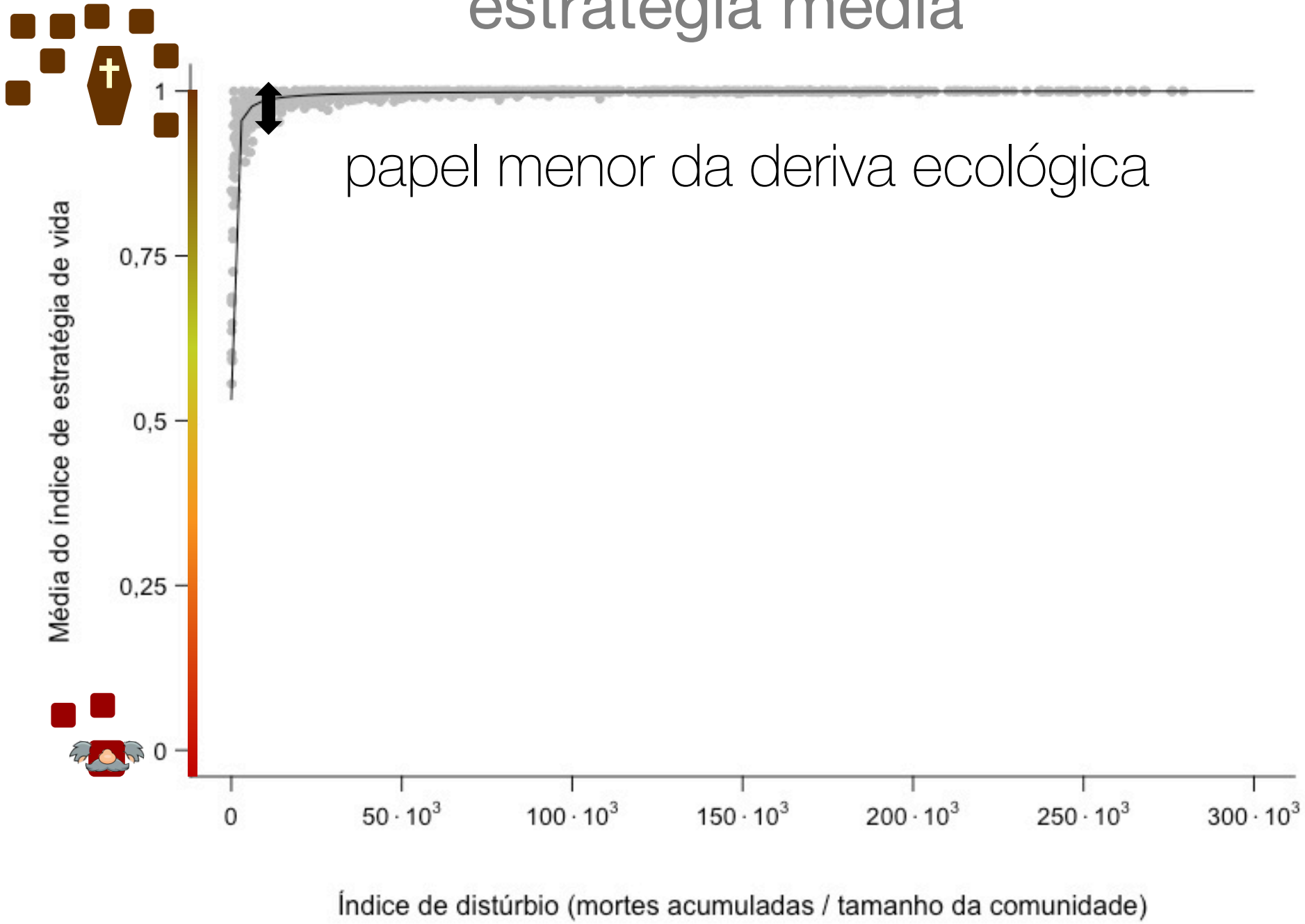
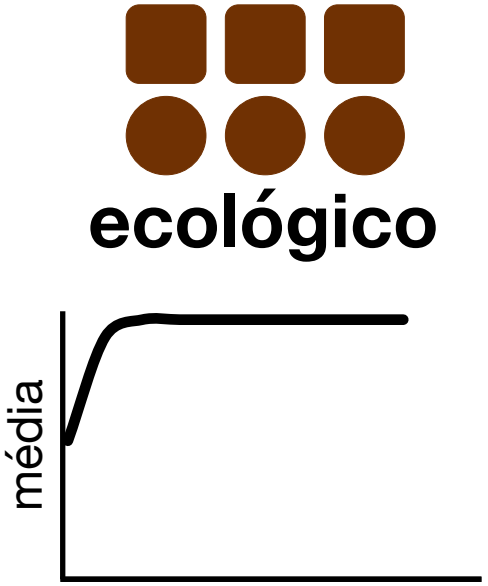
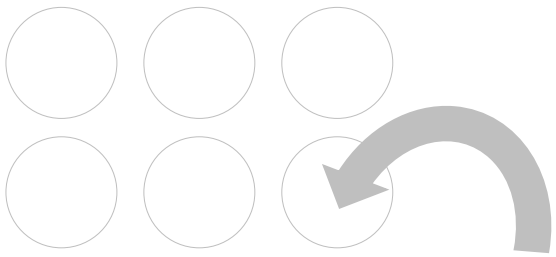
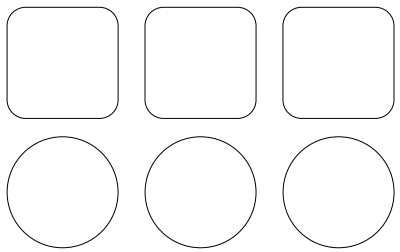
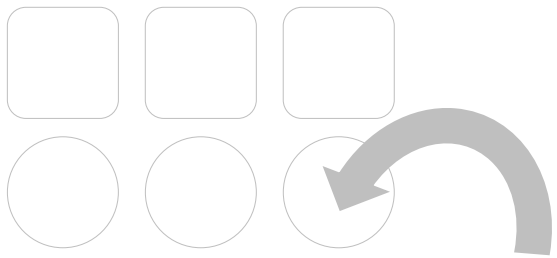
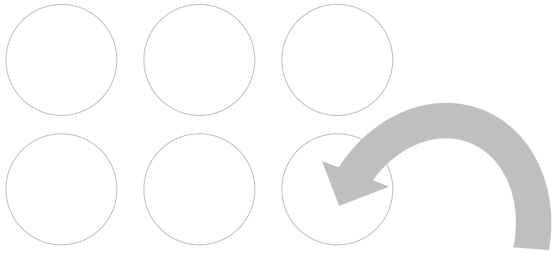
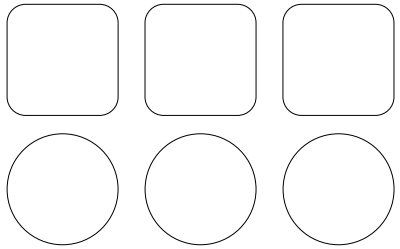
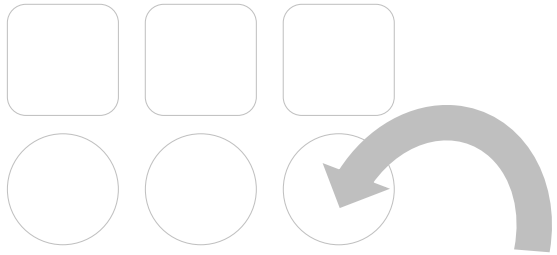




evolutivo	ecológico	eco-evolutivo
		
estratégia média	estratégia média	estratégia média
diversidade de estratégias	diversidade de estratégias	diversidade de estratégias
-	heterogeneidade interespecífica de estratégias	heterogeneidade interespecífica de estratégias

evolutivo	ecológico	eco-evolutivo
		
estratégia média	estratégia média	estratégia média
diversidade de estratégias	diversidade de estratégias	diversidade de estratégias
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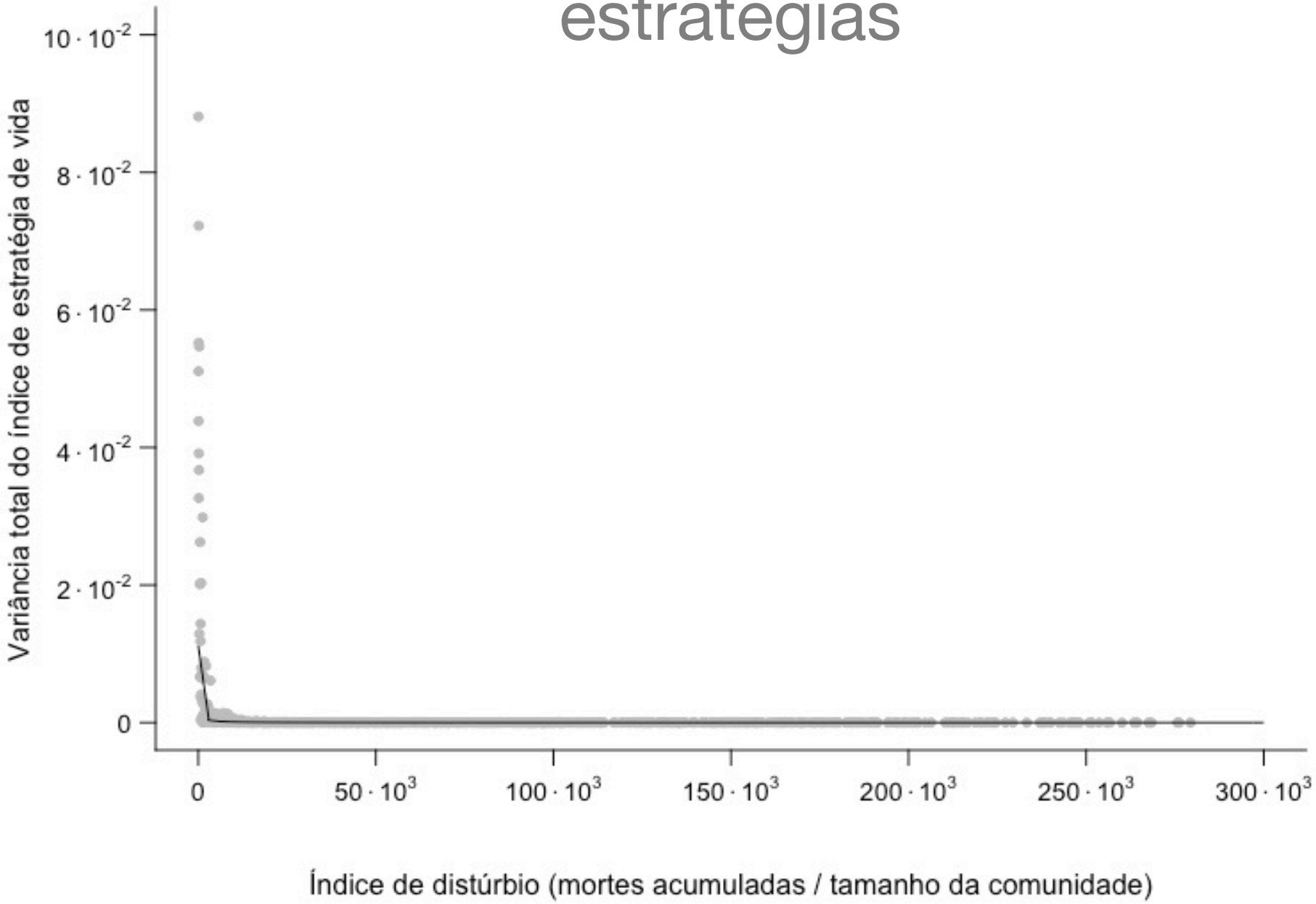
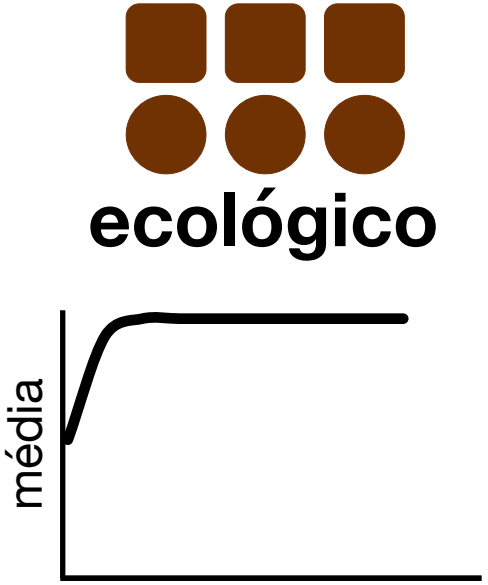
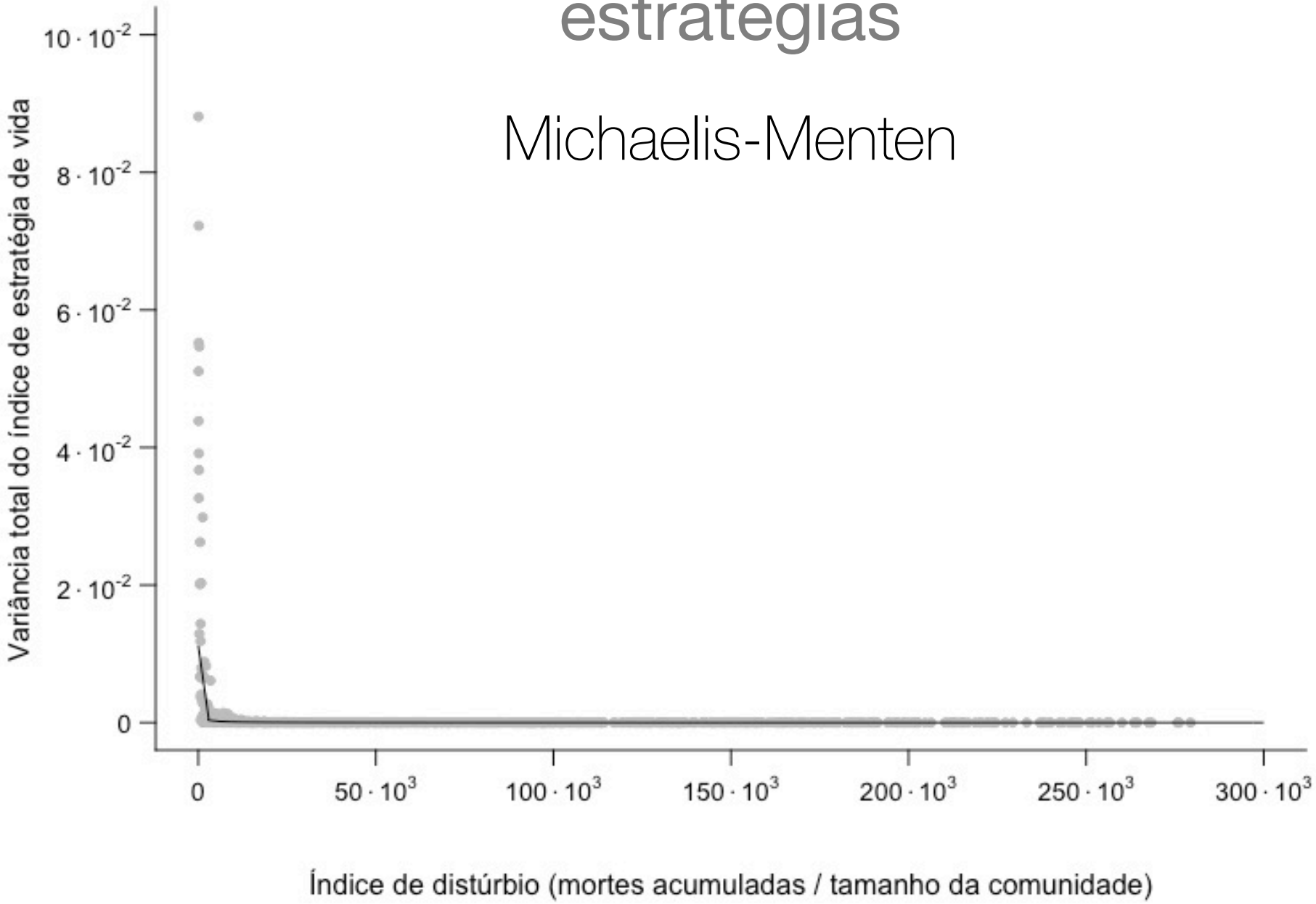
diversidade de estratégias



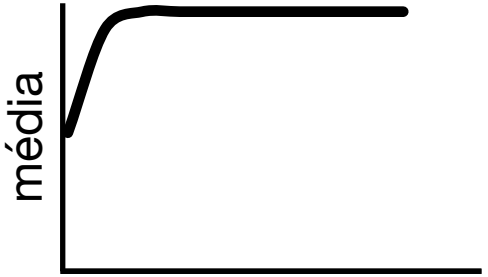


diversidade de estratégias

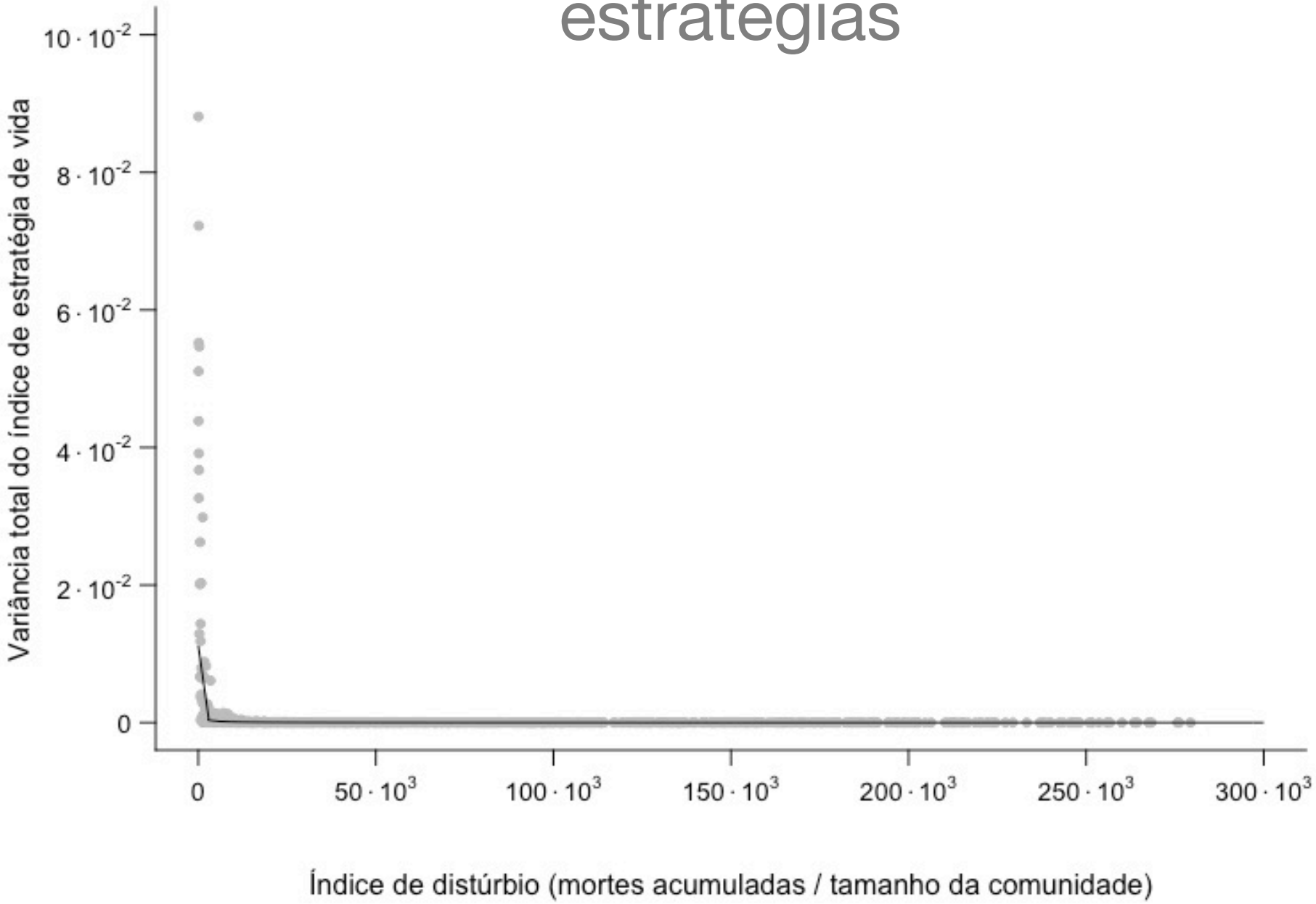
Michaelis-Menten

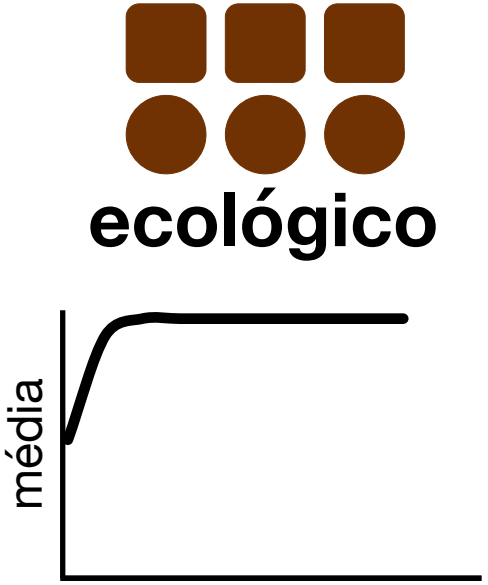


ecológico



diversidade de estratégias





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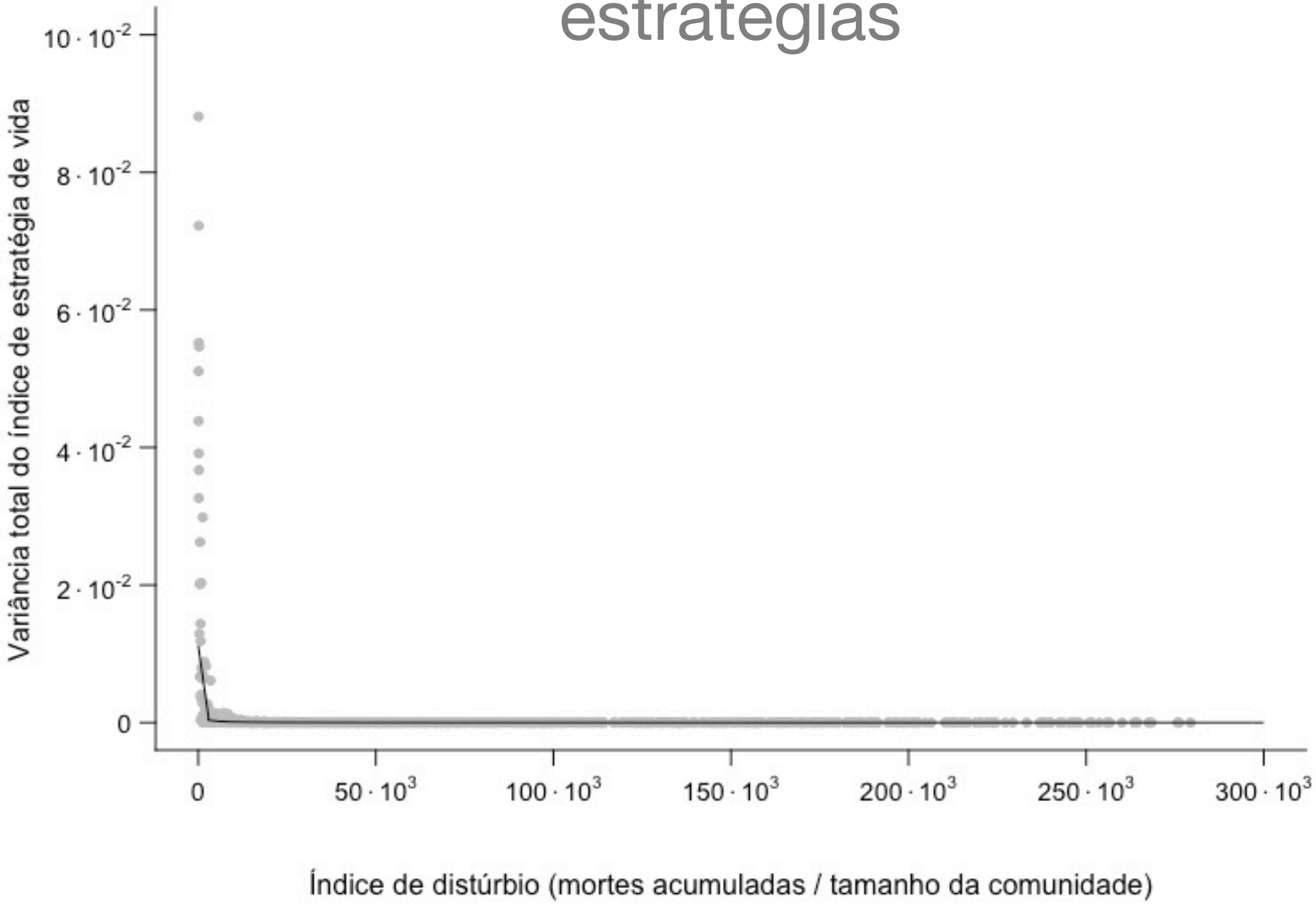

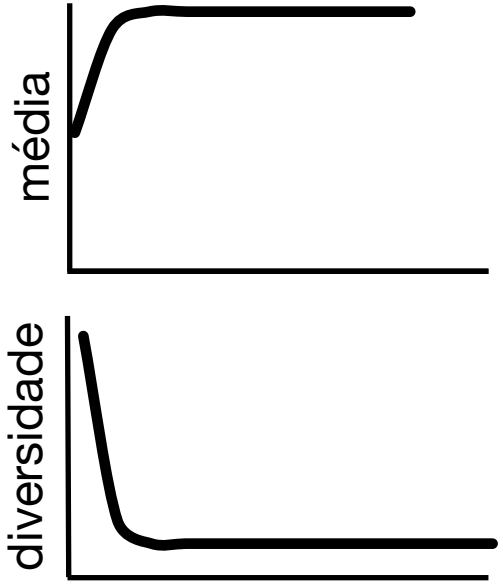

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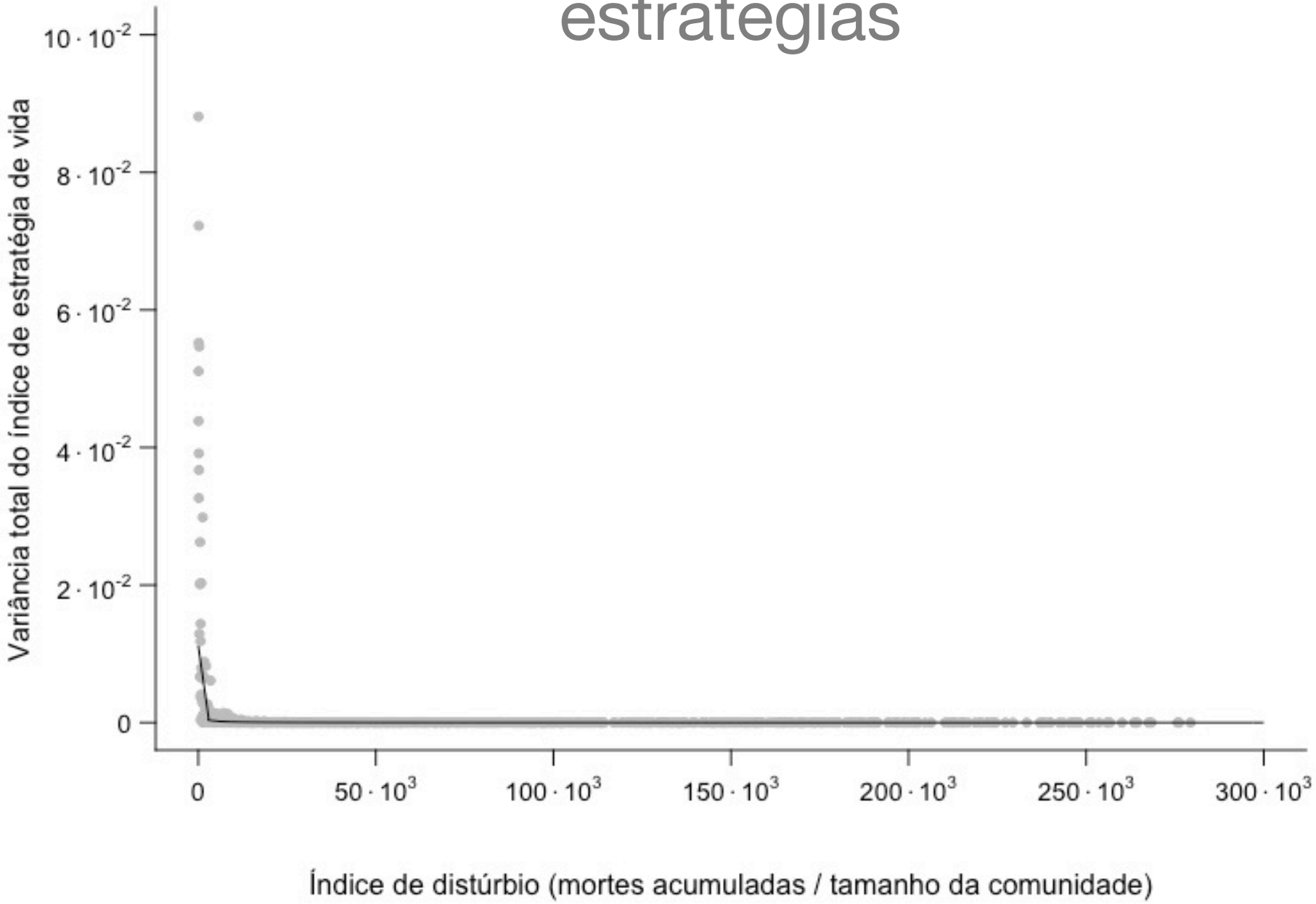

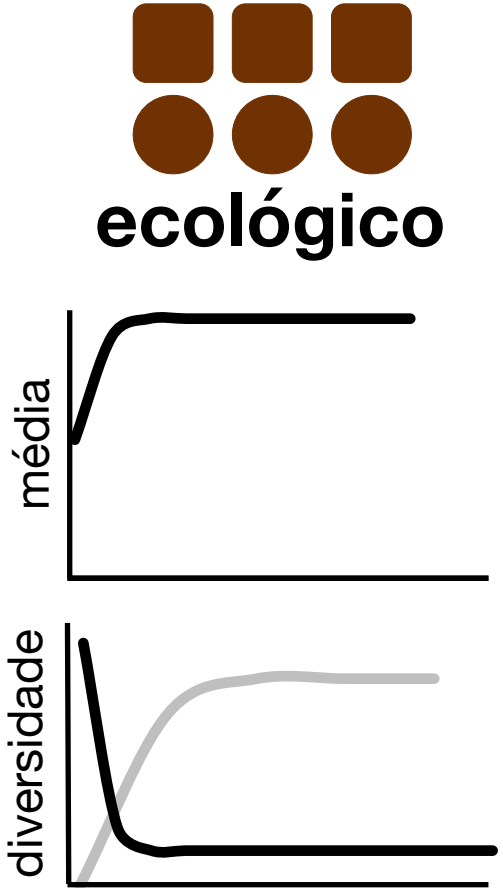

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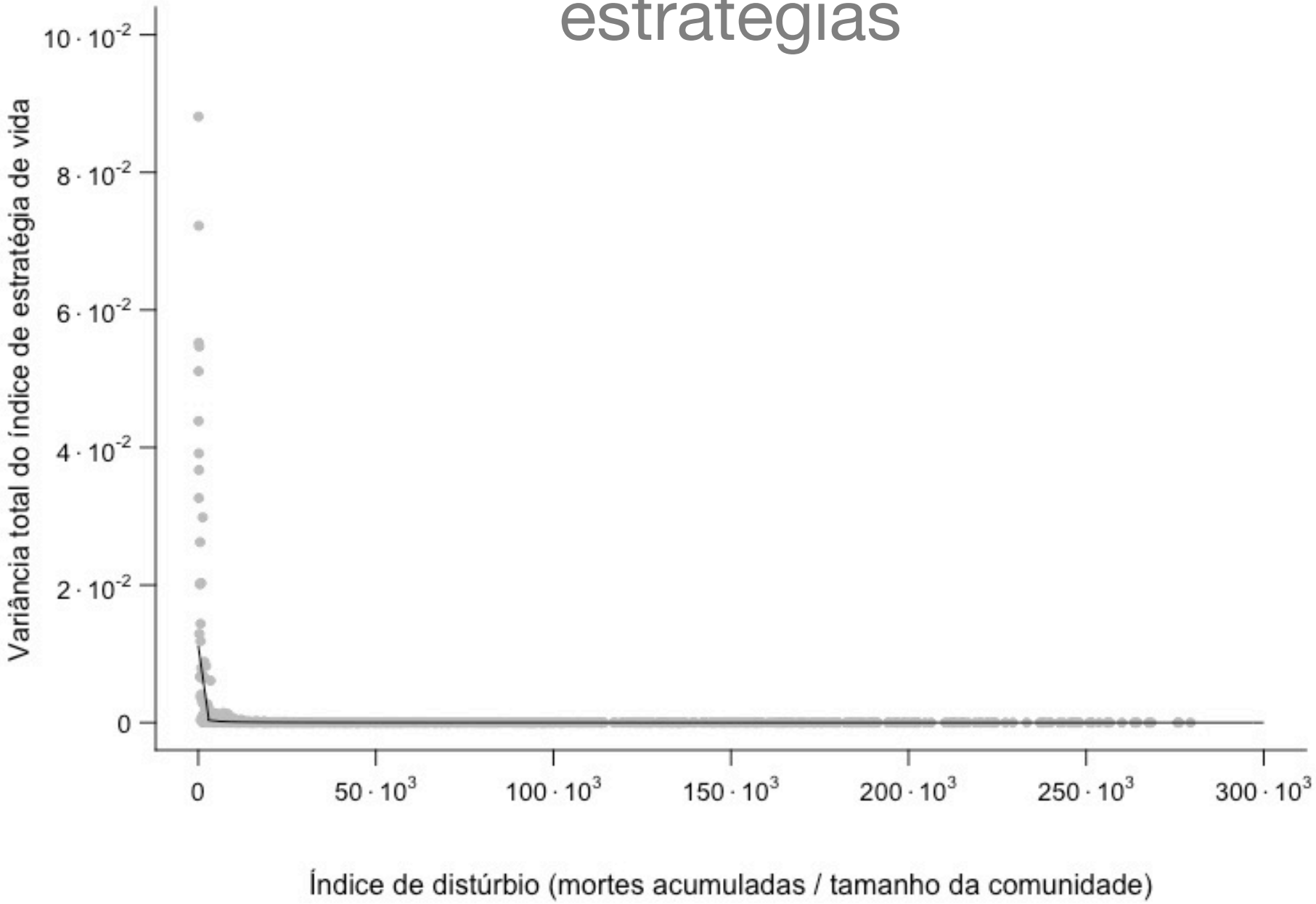
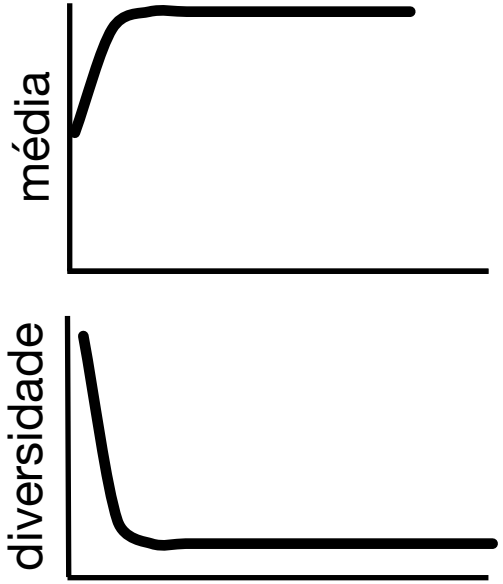
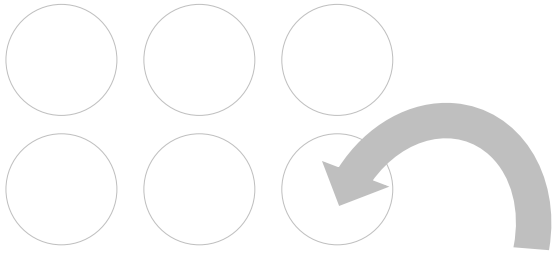
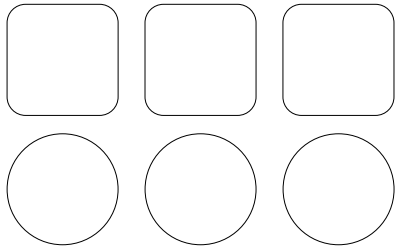
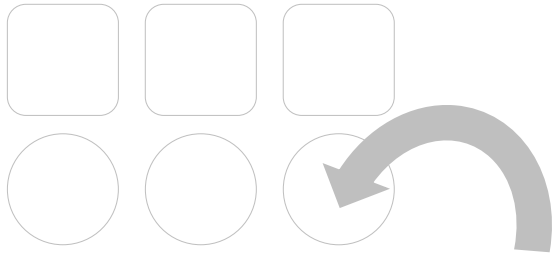
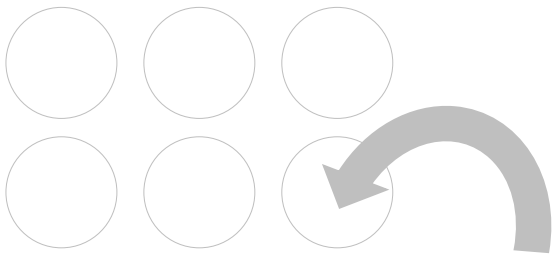
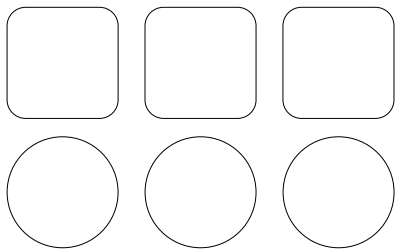
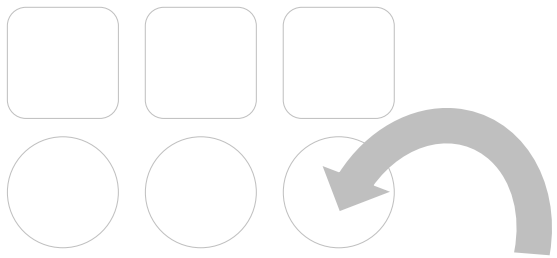
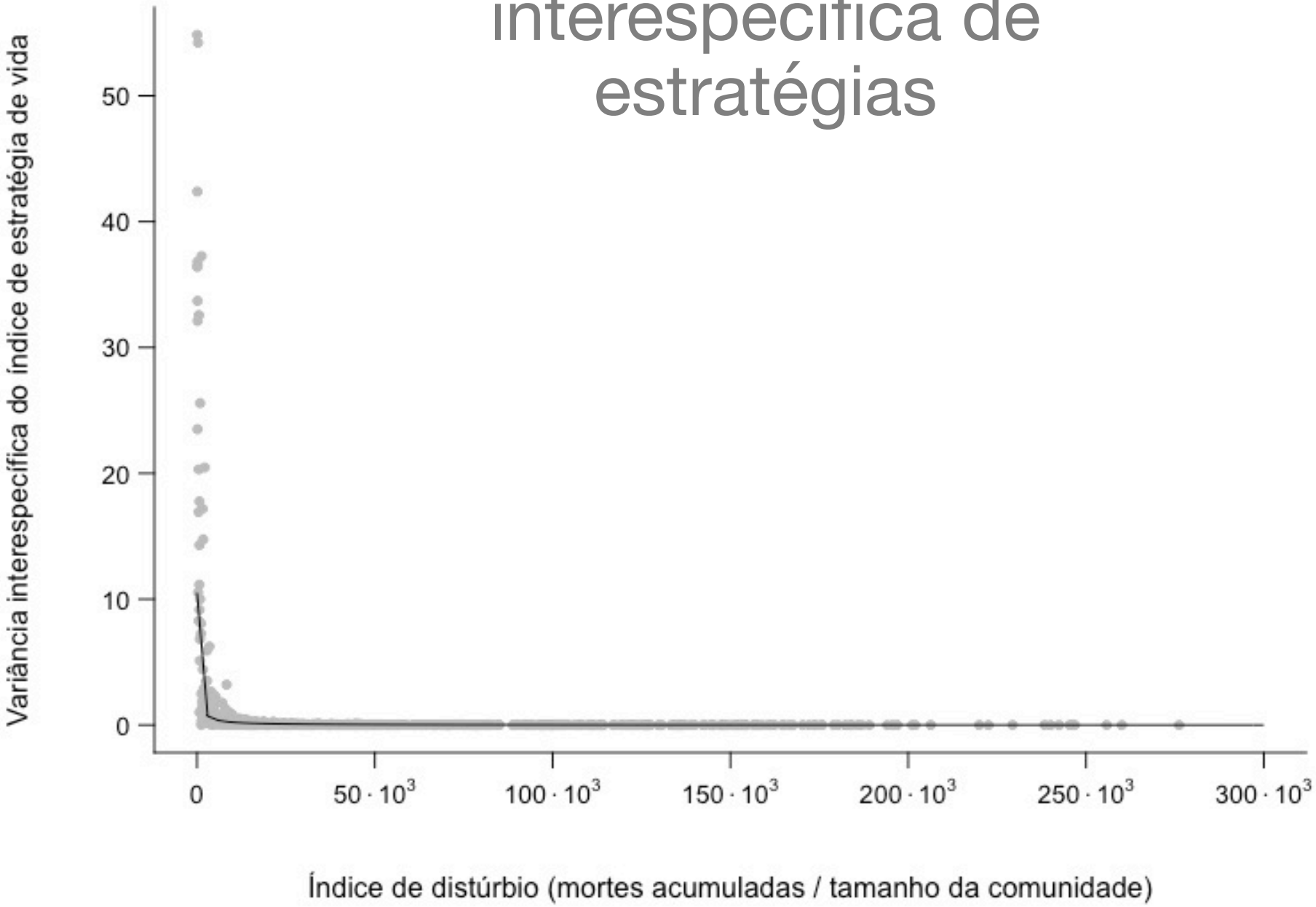


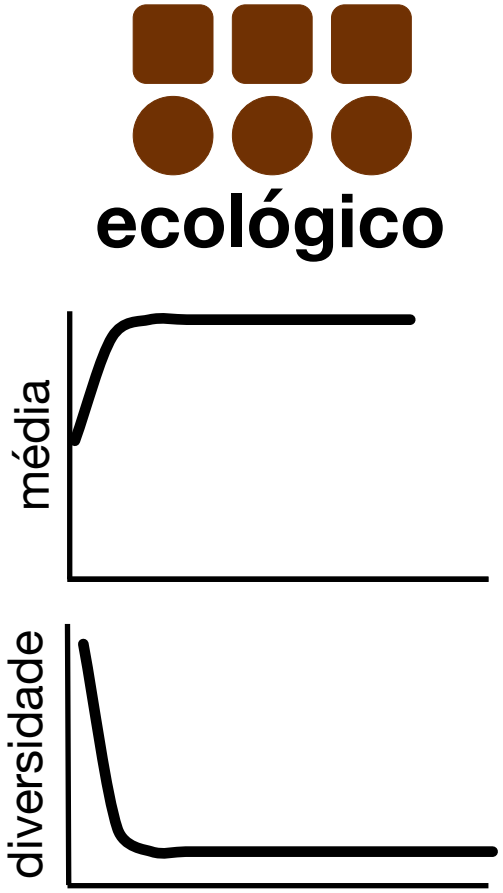


evolutivo	ecológico	eco-evolutivo
		
estratégia média	estratégia média	estratégia média
diversidade de estratégias	diversidade de estratégias	diversidade de estratégias
-	heterogeneidade interespecífica de estratégias	heterogeneidade interespecífica de estratégias

evolutivo	ecológico	eco-evolutivo
		
estratégia média	estratégia média	estratégia média
diversidade de estratégias	diversidade de estratégias	diversidade de estratégias
-	heterogeneidade interespecífica de estratégias	heterogeneidade interespecífica de estratégias

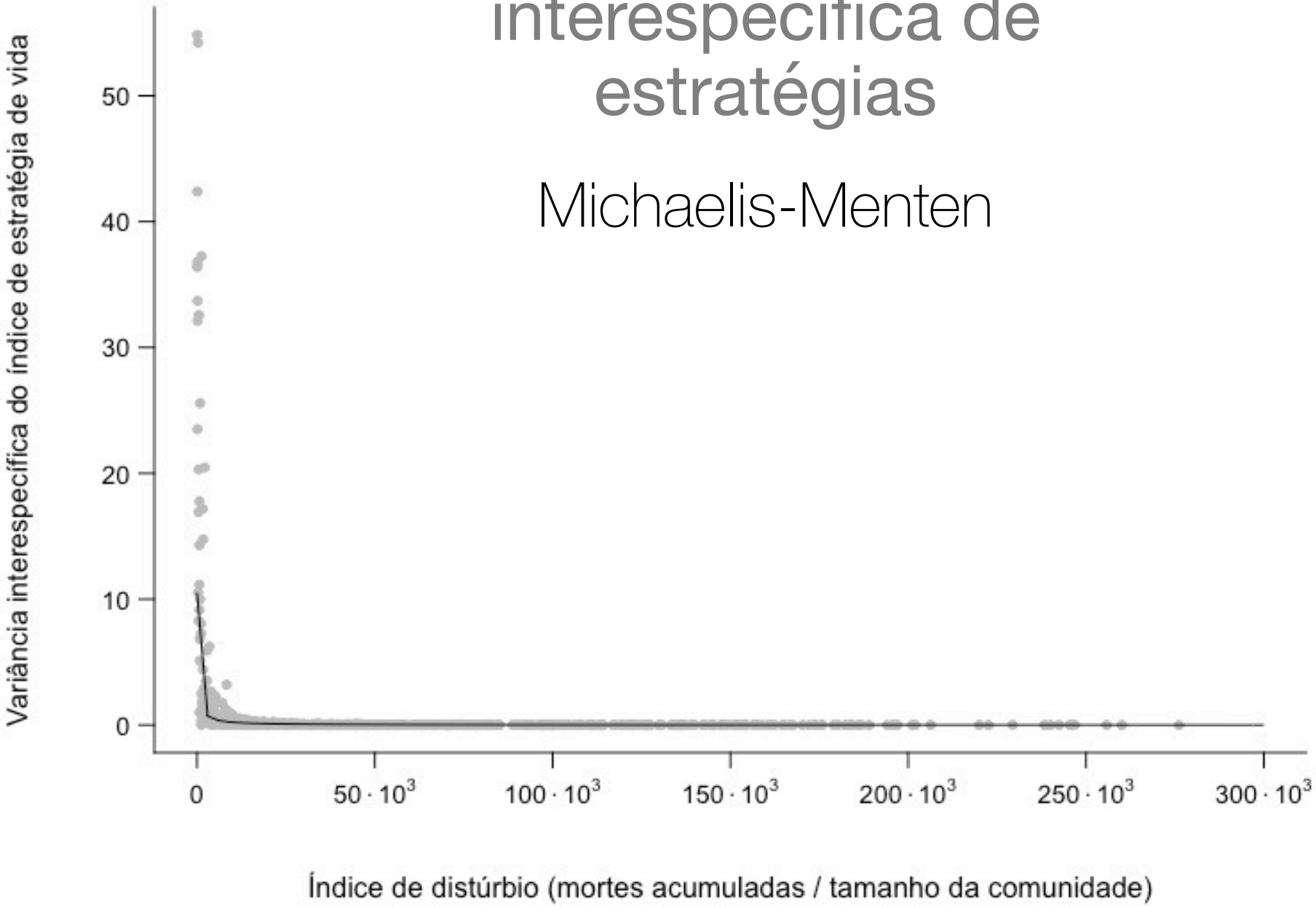
heterogeneidade interespecífica de estratégias

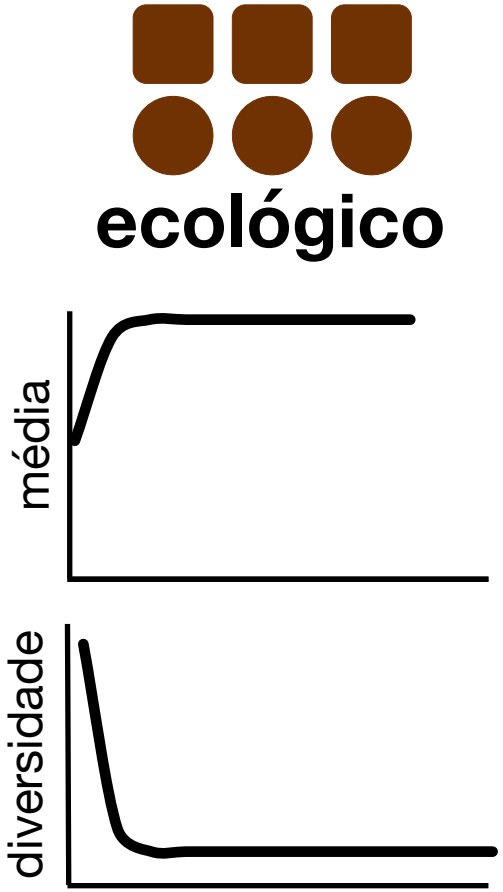




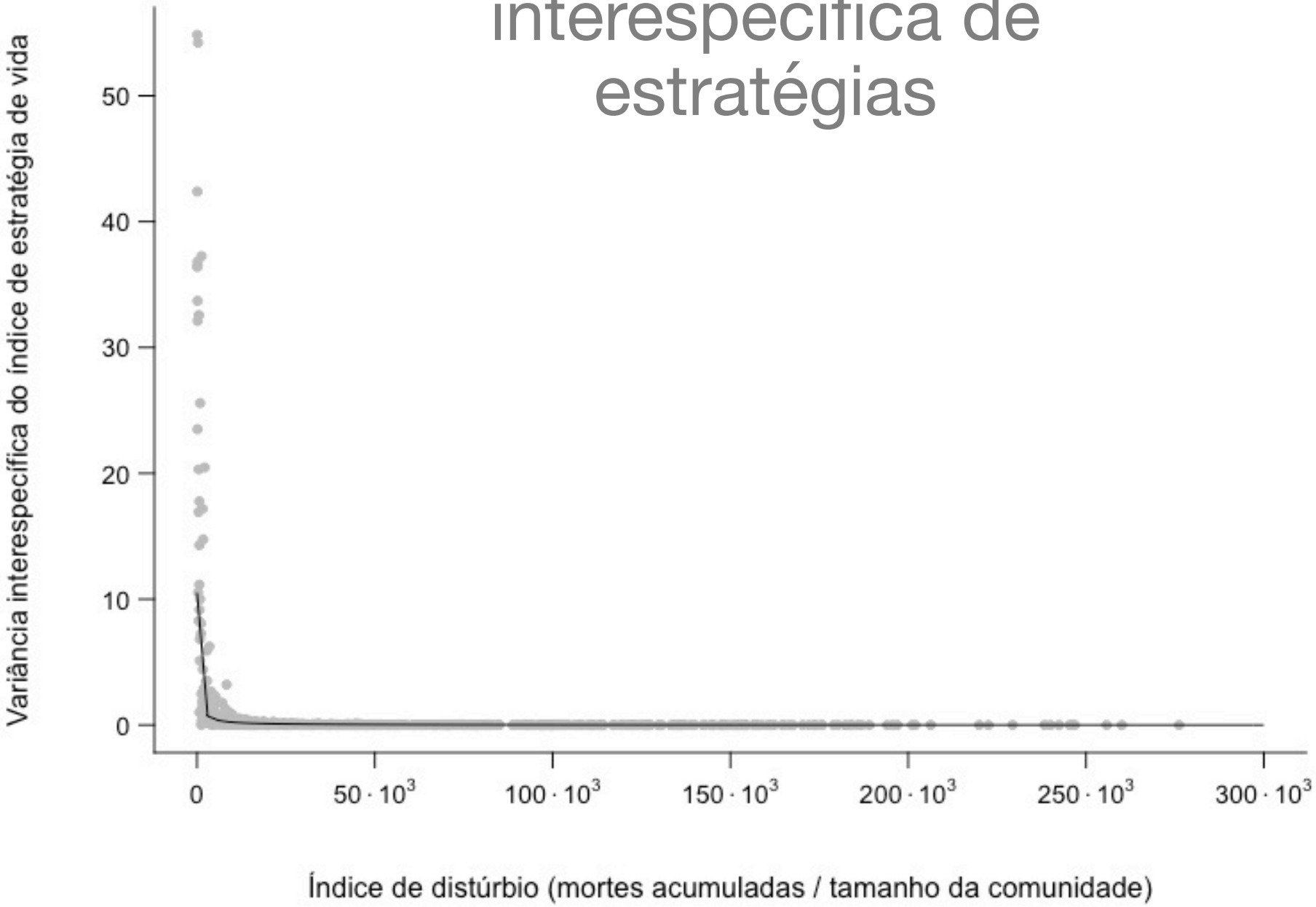
heterogeneidade interespecífica de estratégias

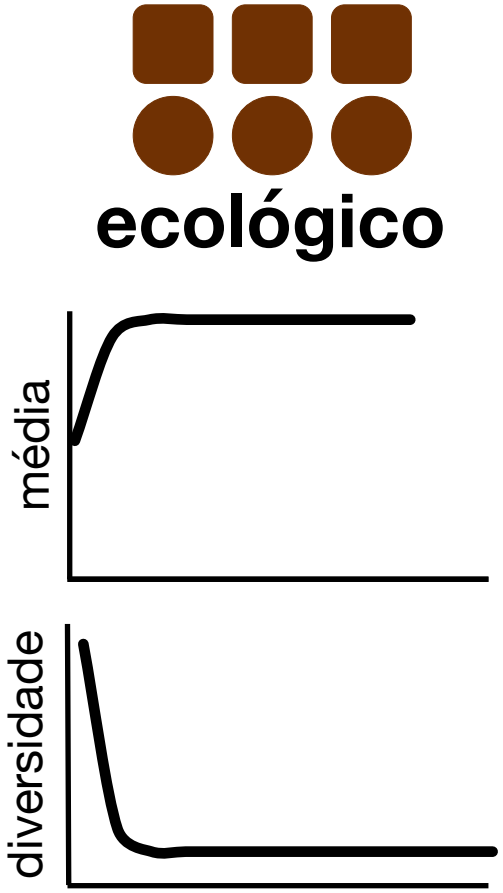
Michaelis-Menten



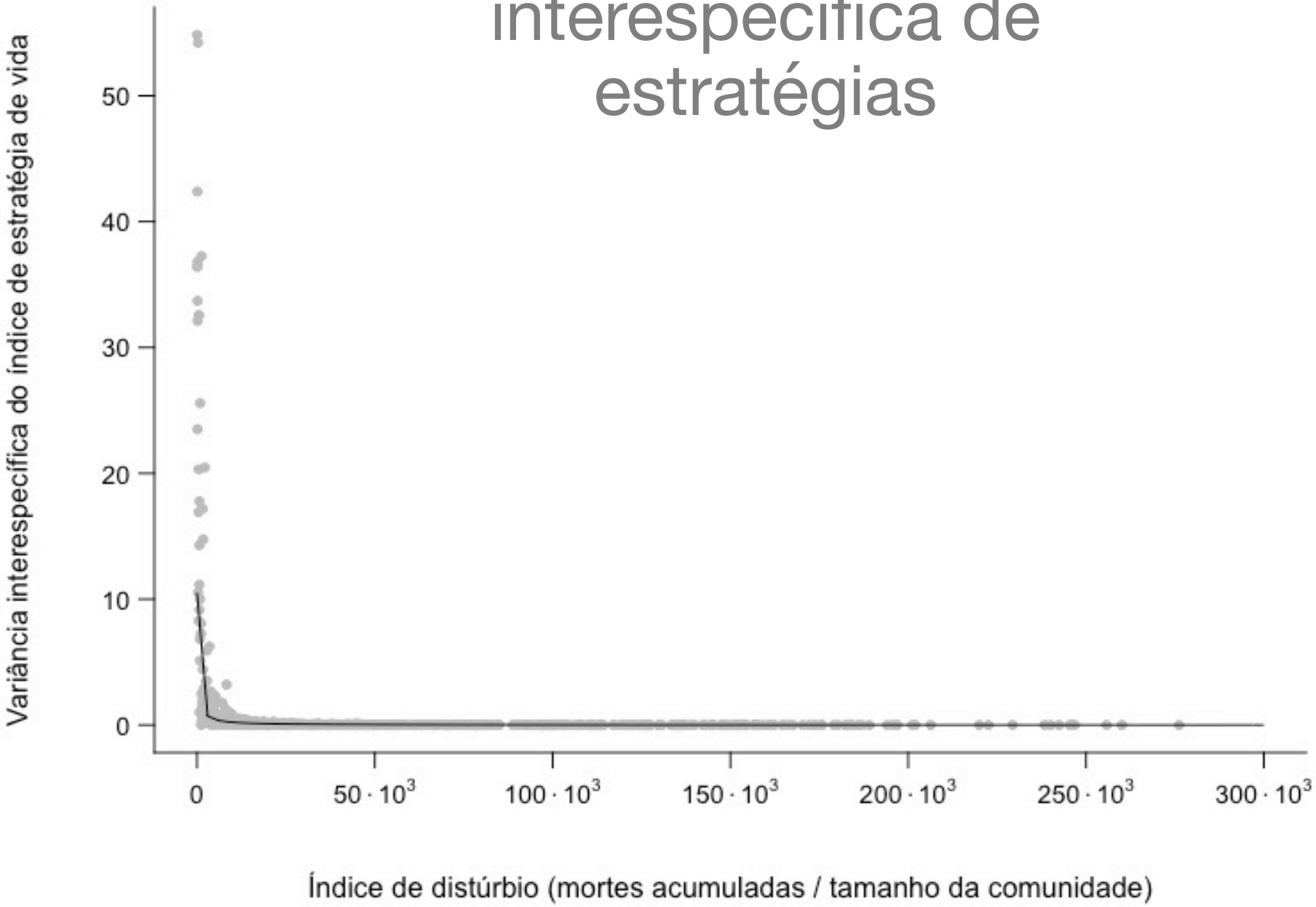


heterogeneidade interespecífica de estratégias





heterogeneidade interespecífica de estratégias



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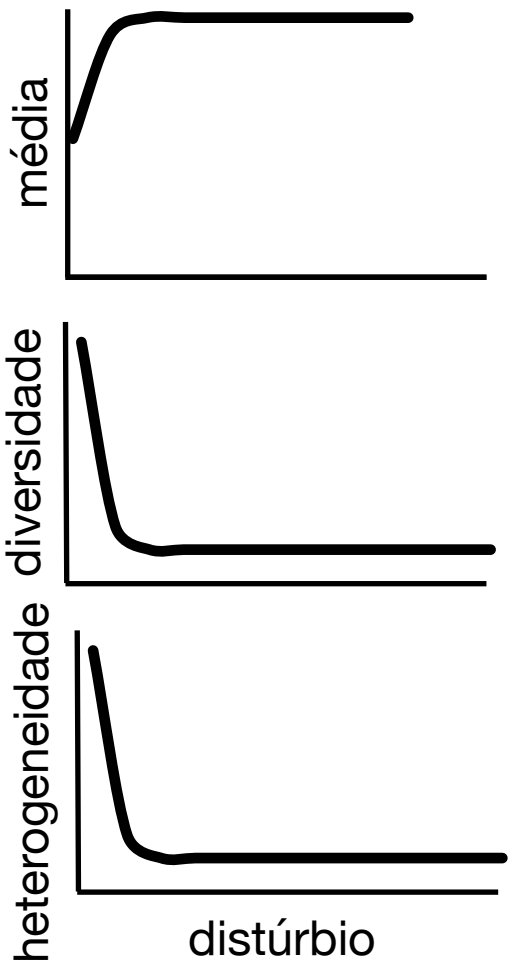

ecológico

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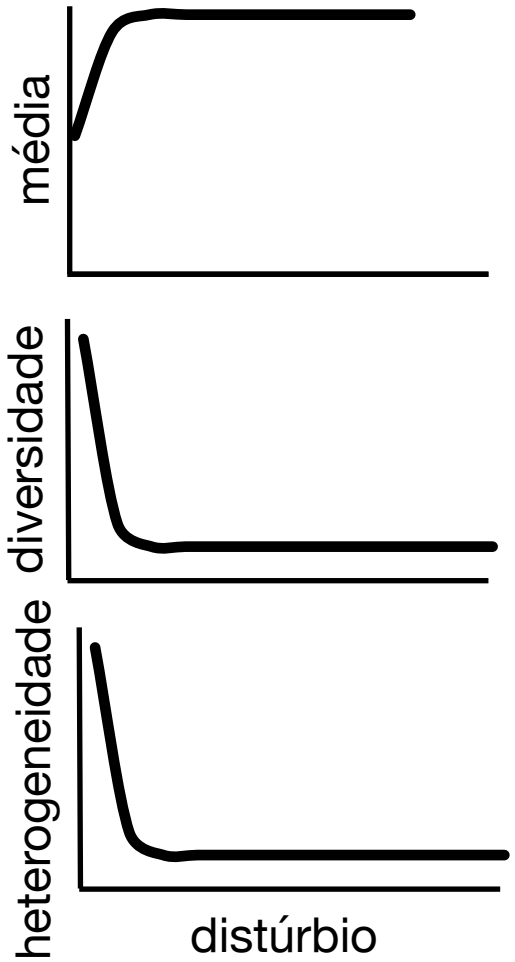

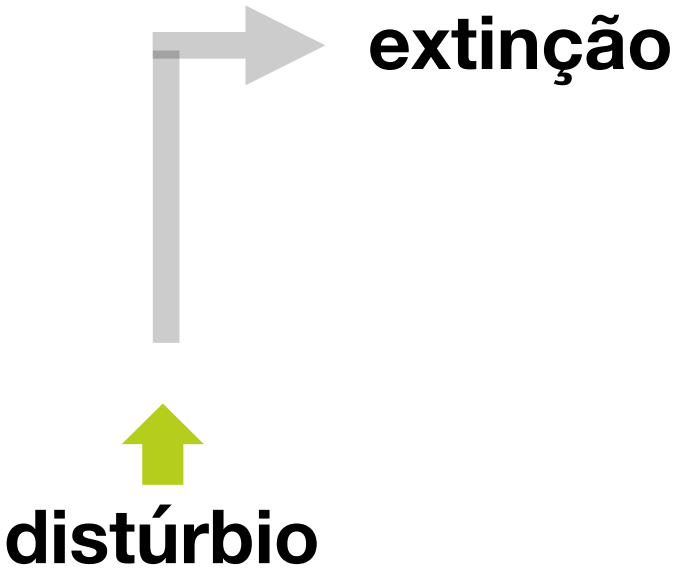
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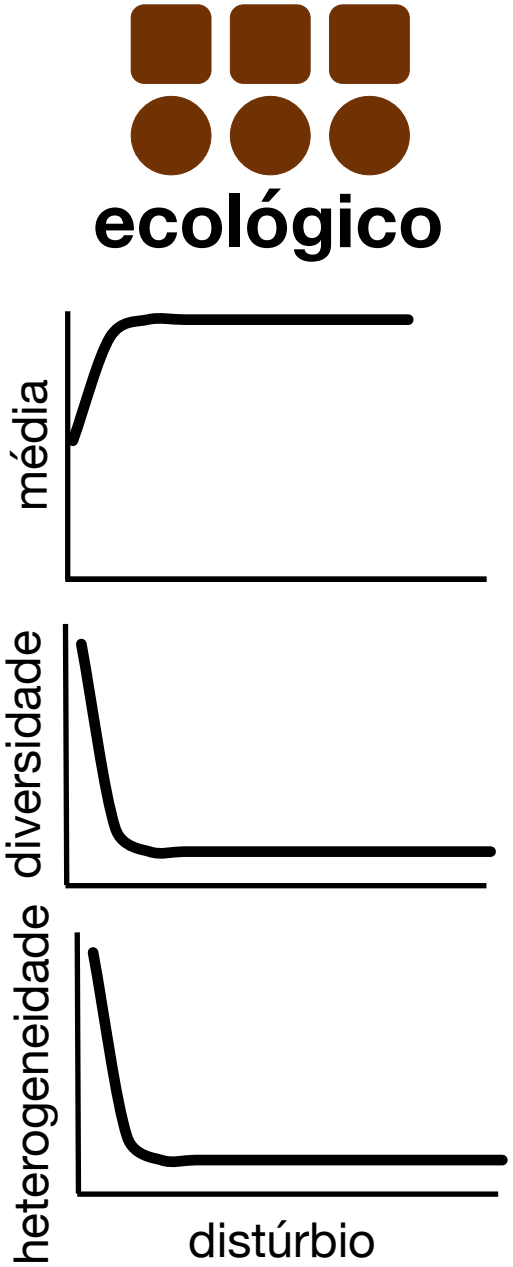
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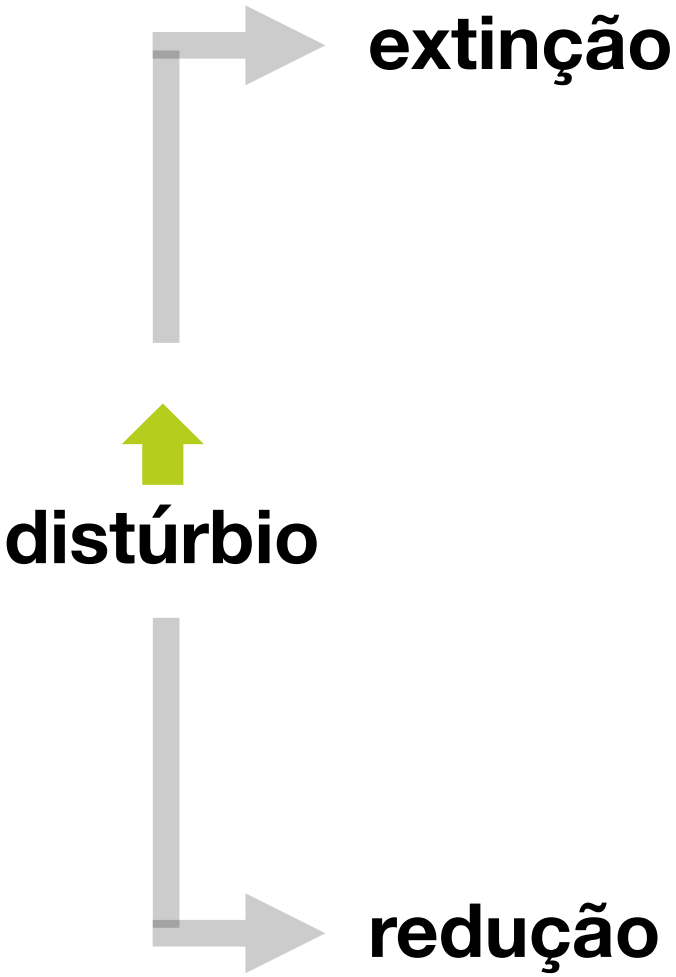
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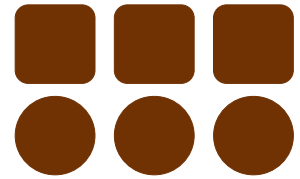

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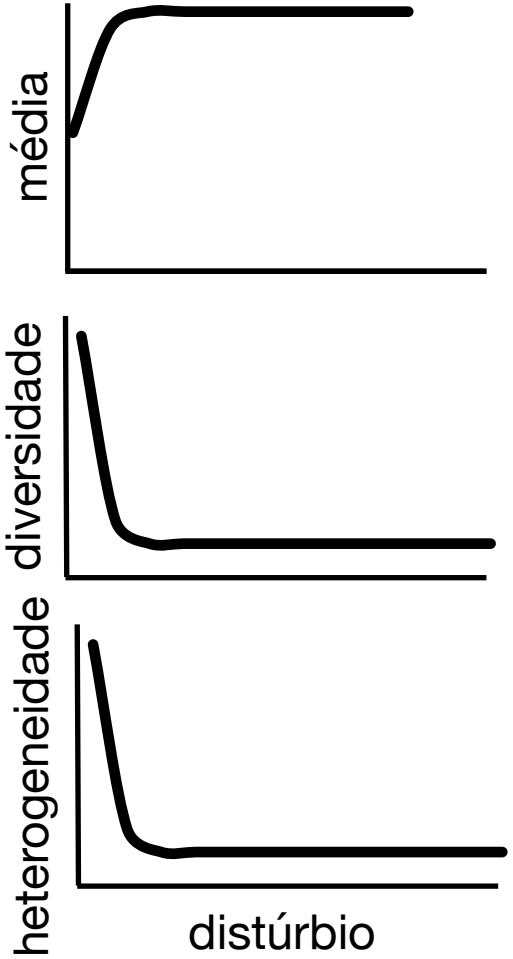
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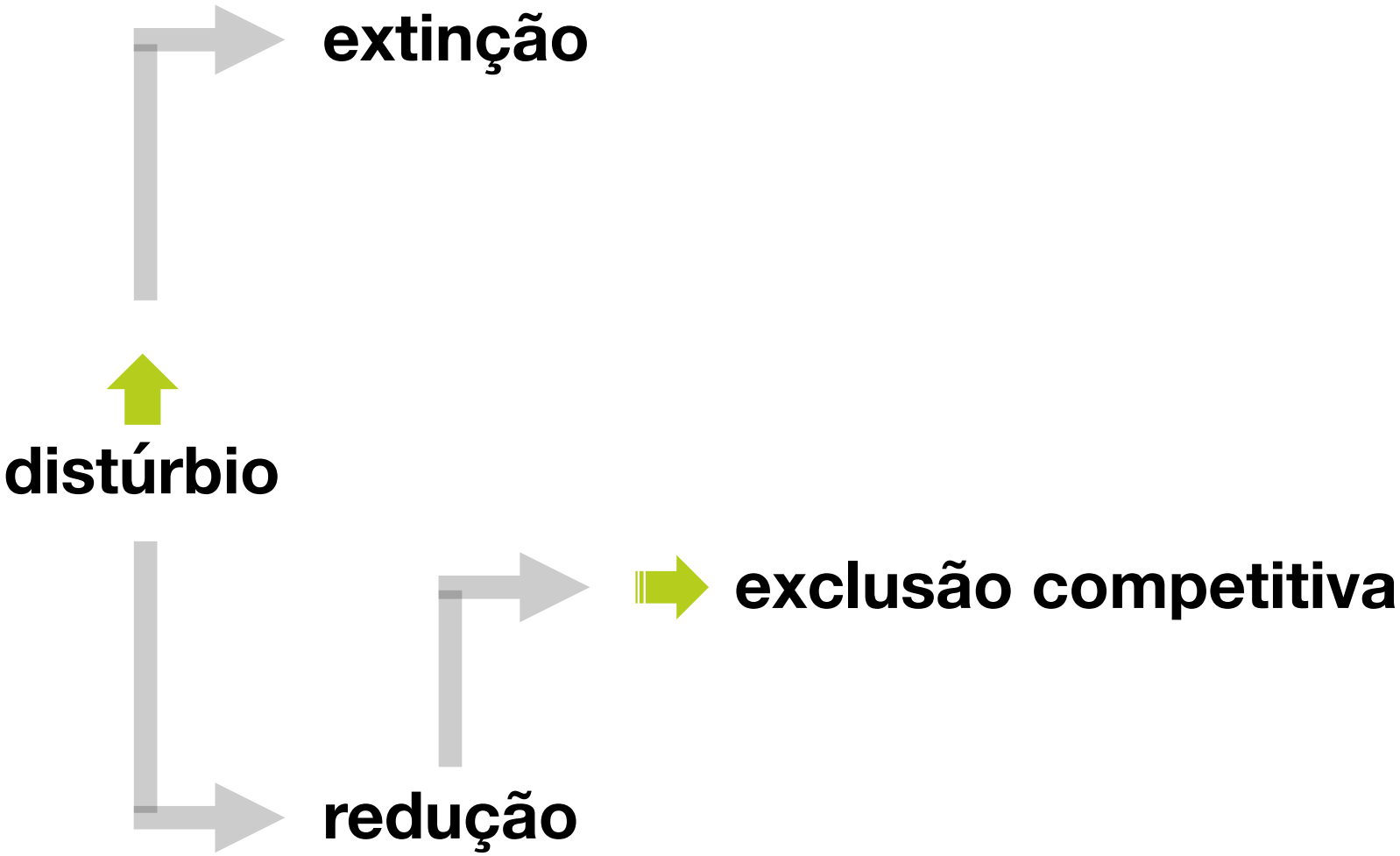
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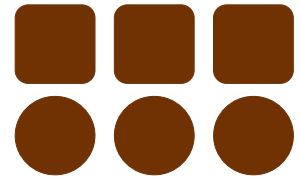

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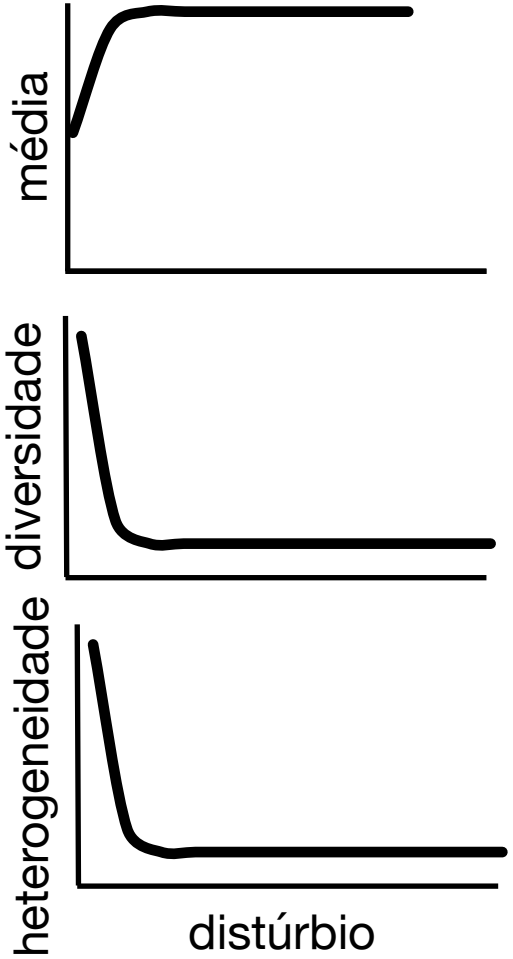
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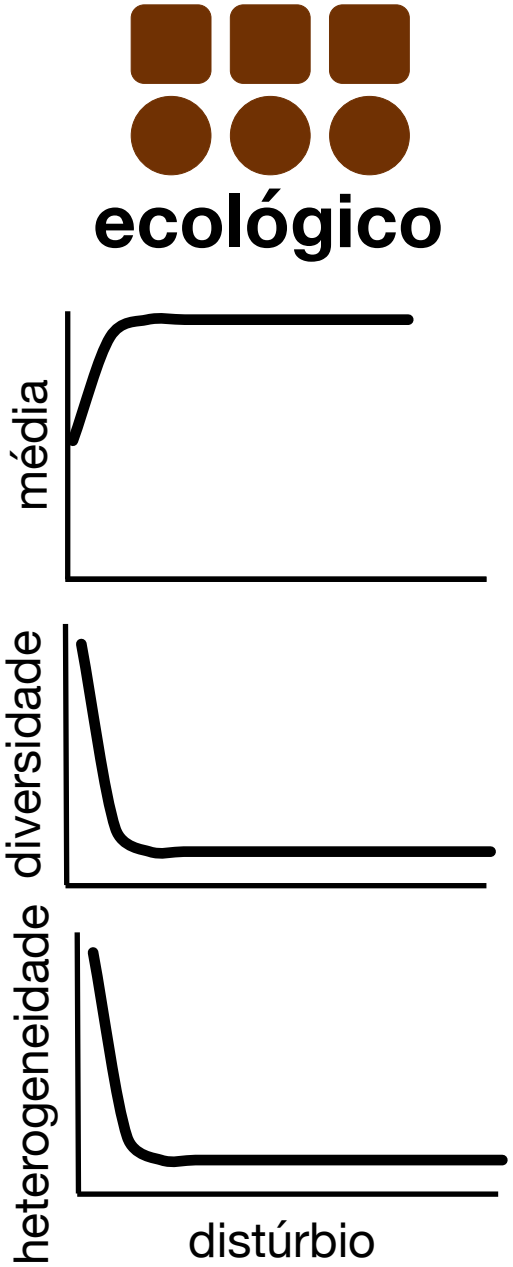
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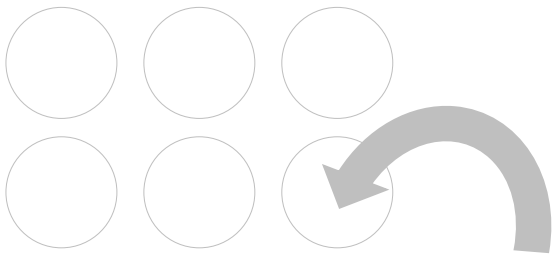
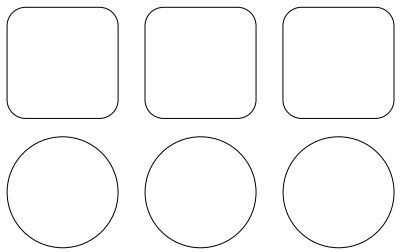
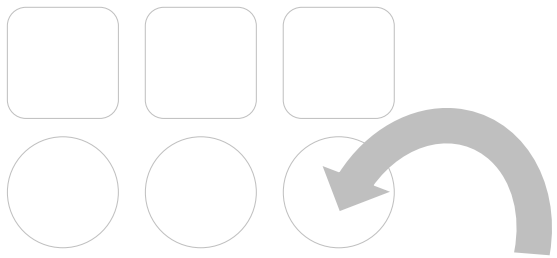
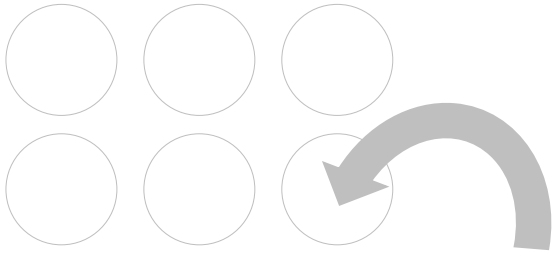
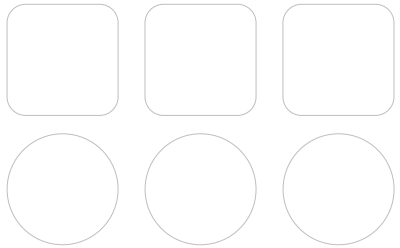
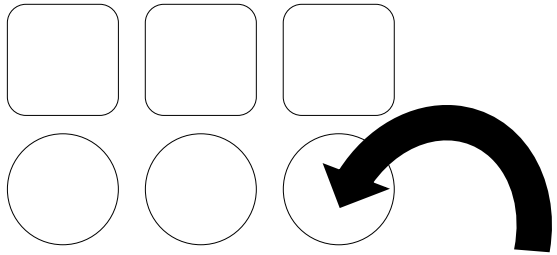
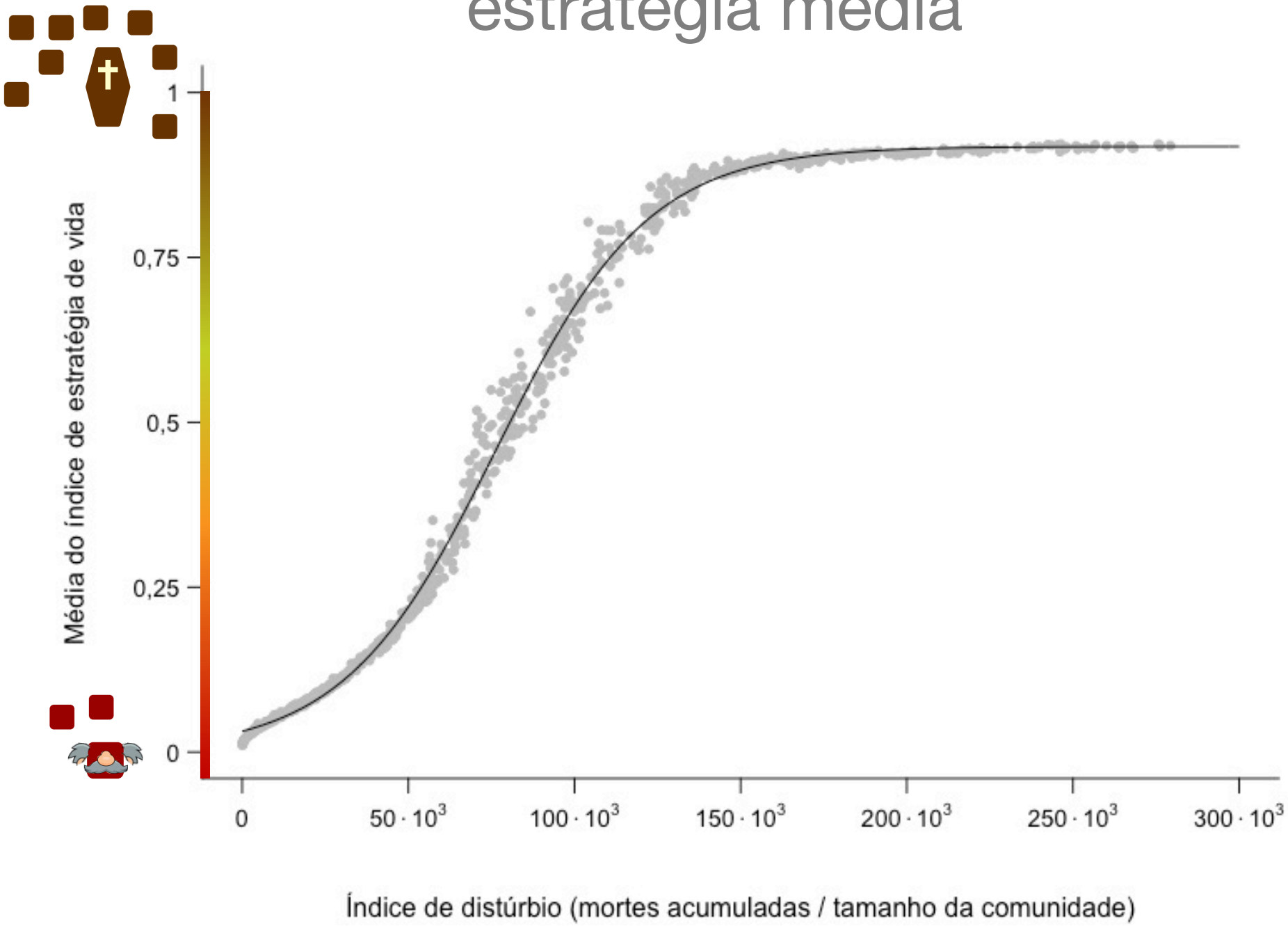
média
diversidade
heterogeneidade
distúrbio

evolutivo	ecológico	eco-evolutivo
		
estratégia média	estratégia média	estratégia média
diversidade de estratégias	diversidade de estratégias	diversidade de estratégias
-	heterogeneidade interespecífica de estratégias	heterogeneidade interespecífica de estratégias

evolutivo	ecológico	eco-evolutivo
		
estratégia média	estratégia média	estratégia média
diversidade de estratégias	diversidade de estratégias	diversidade de estratégias
-	heterogeneidade interespecífica de estratégias	heterogeneidade interespecífica de estratégias

eco-evolutivo

estratégia média



eco-evolutivo

estratégia média

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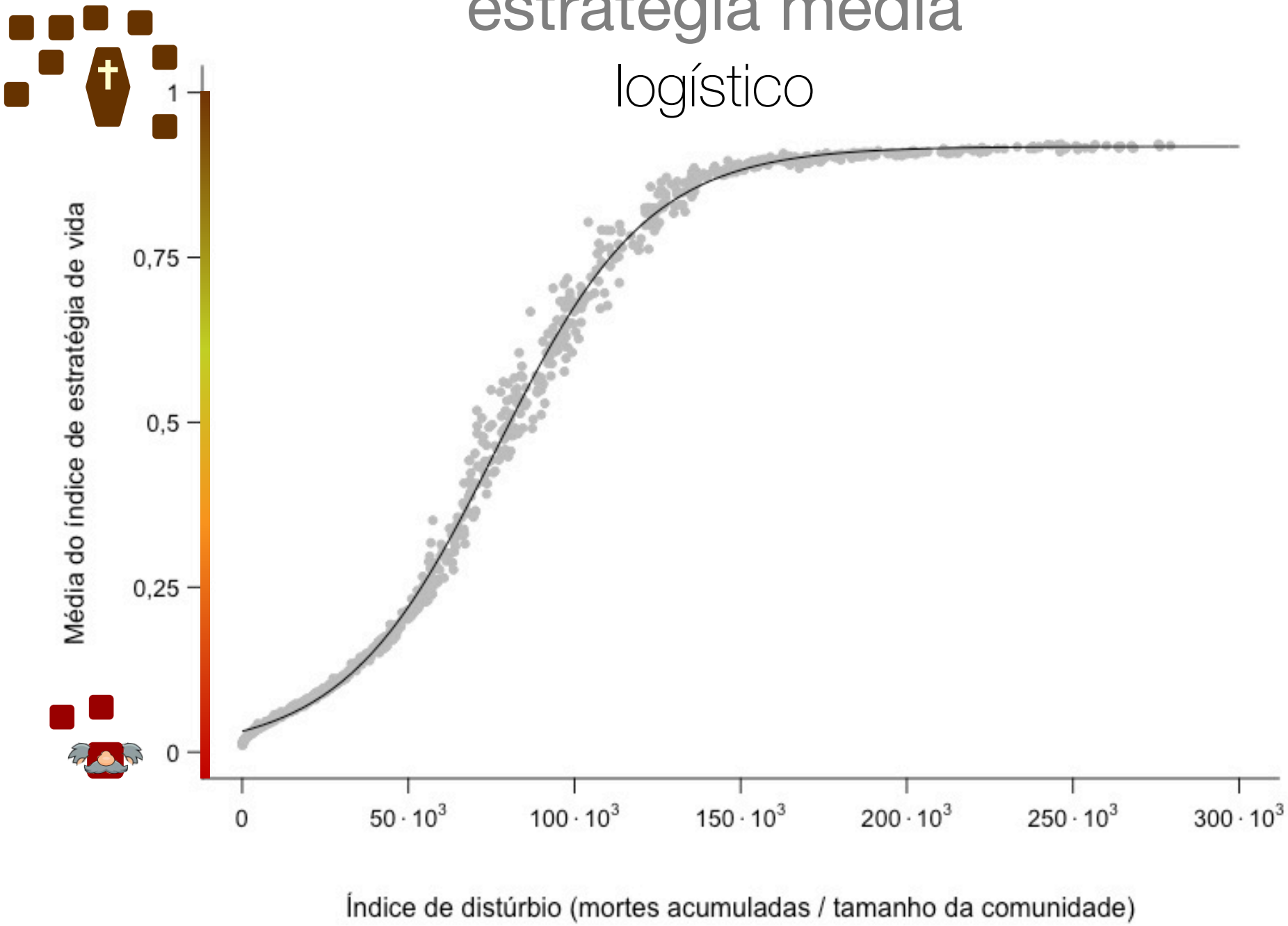
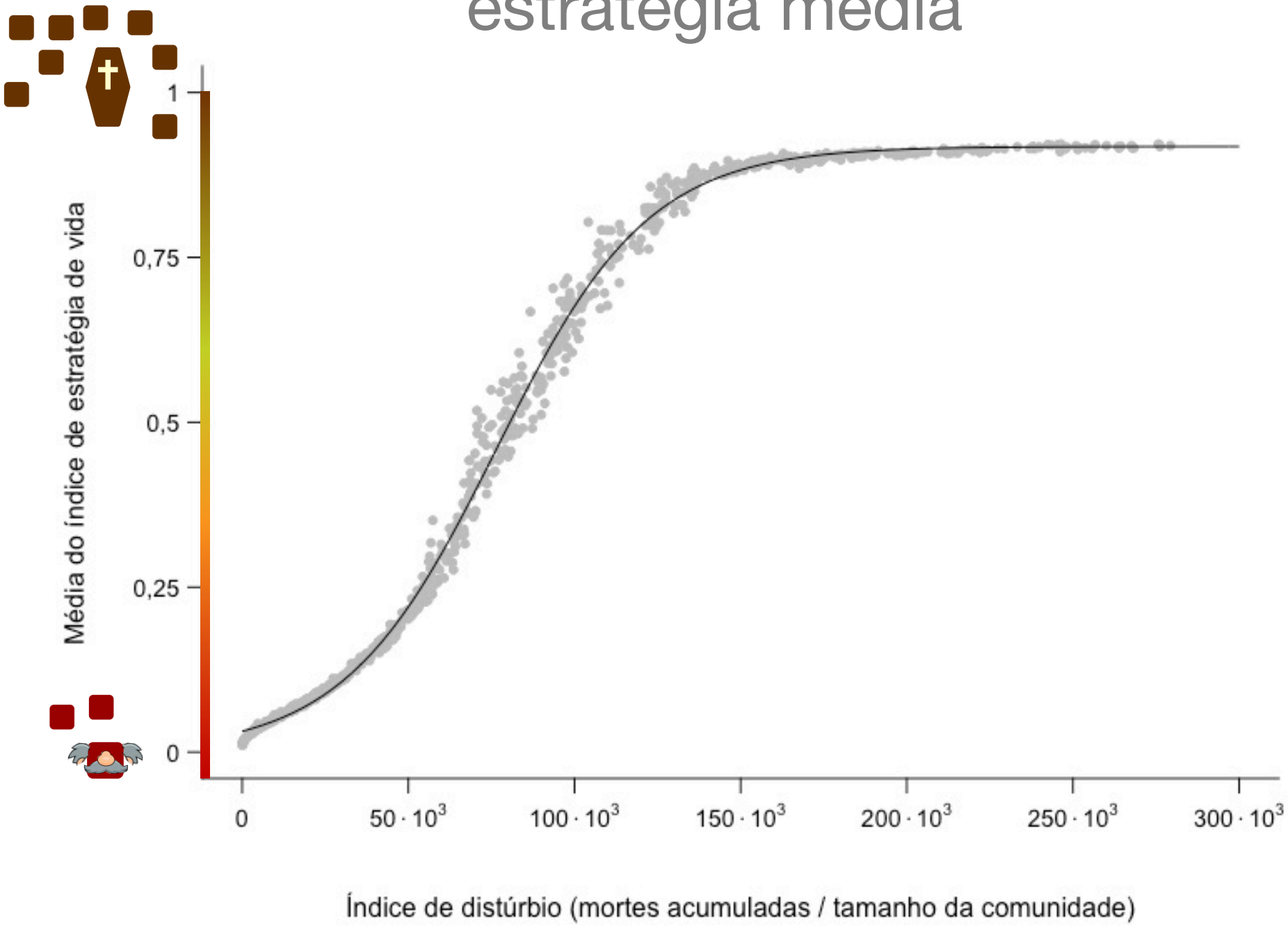


eco-evolutivo

estratégia média



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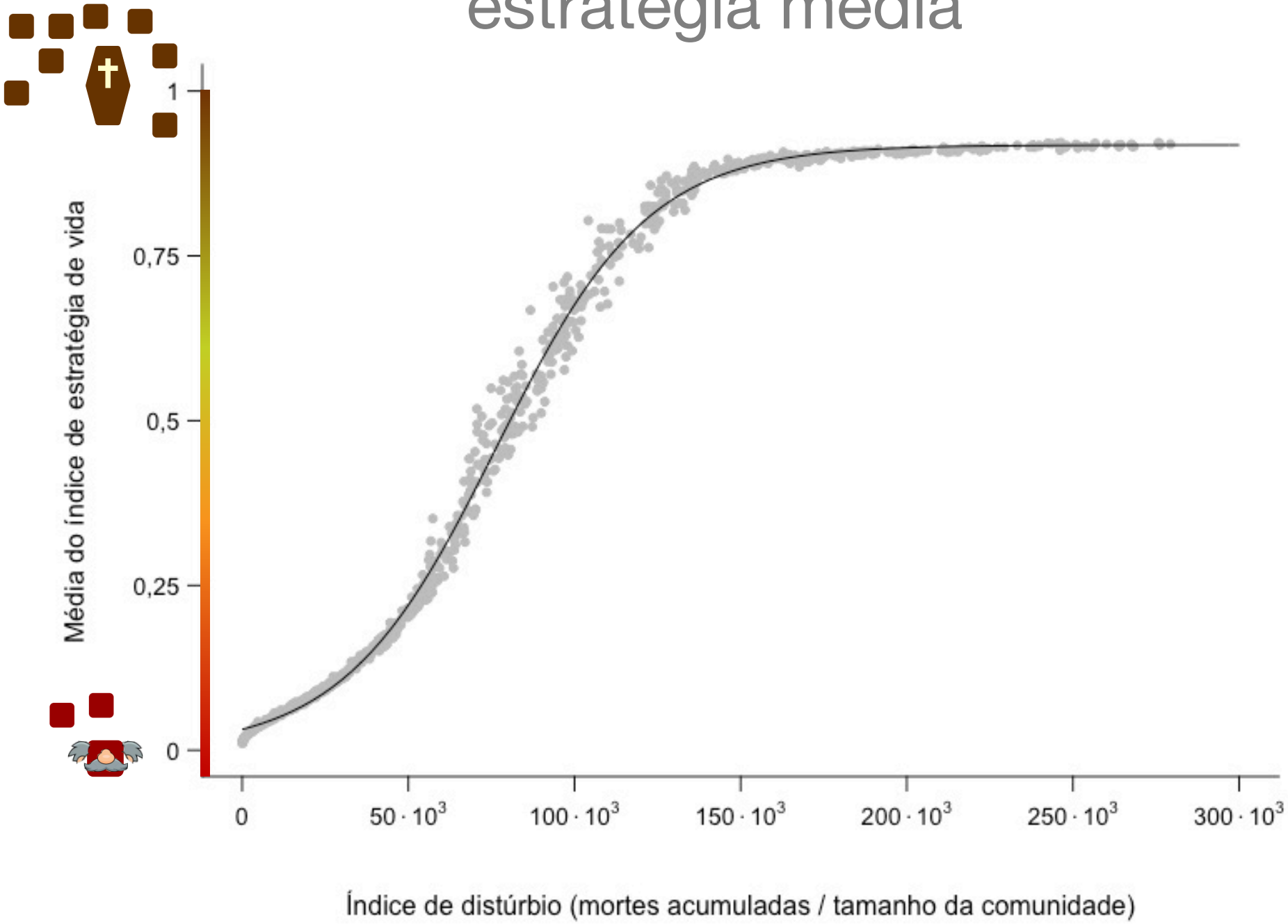
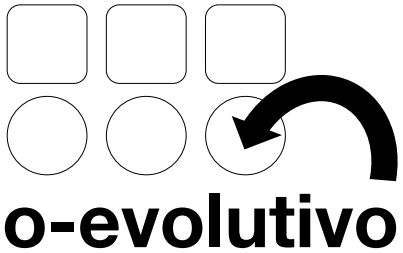
estratégia média





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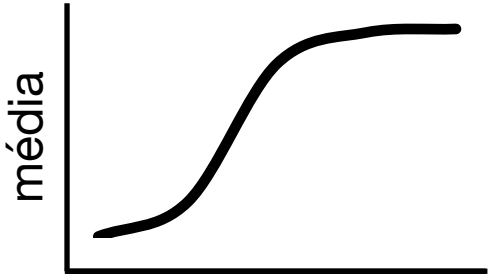

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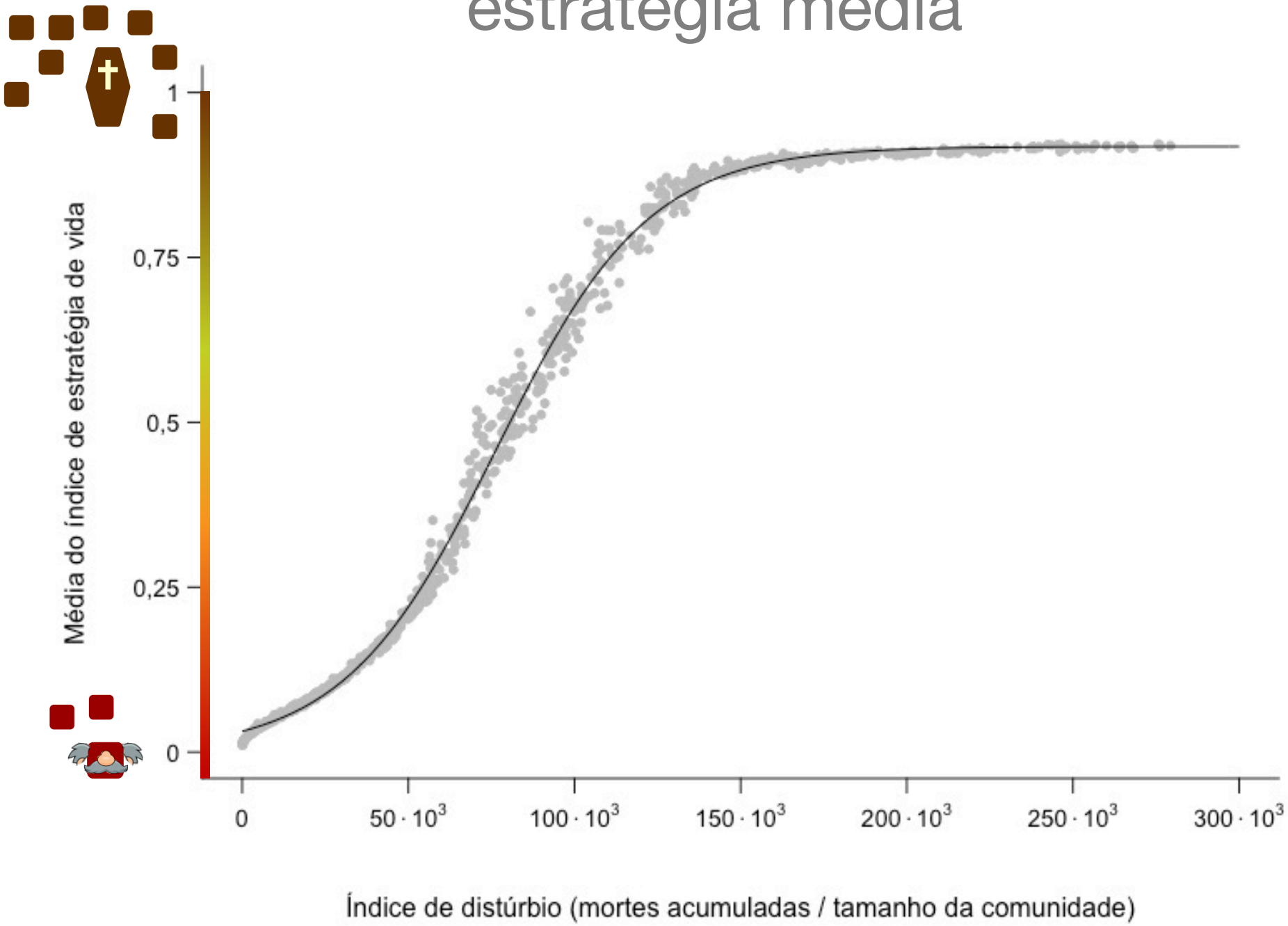
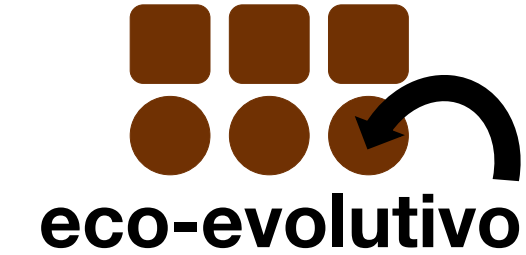
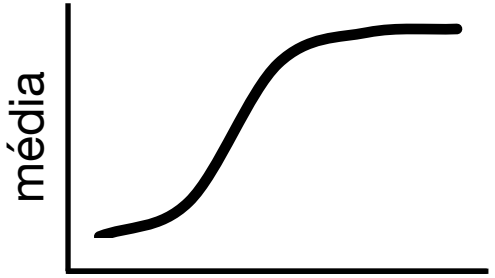
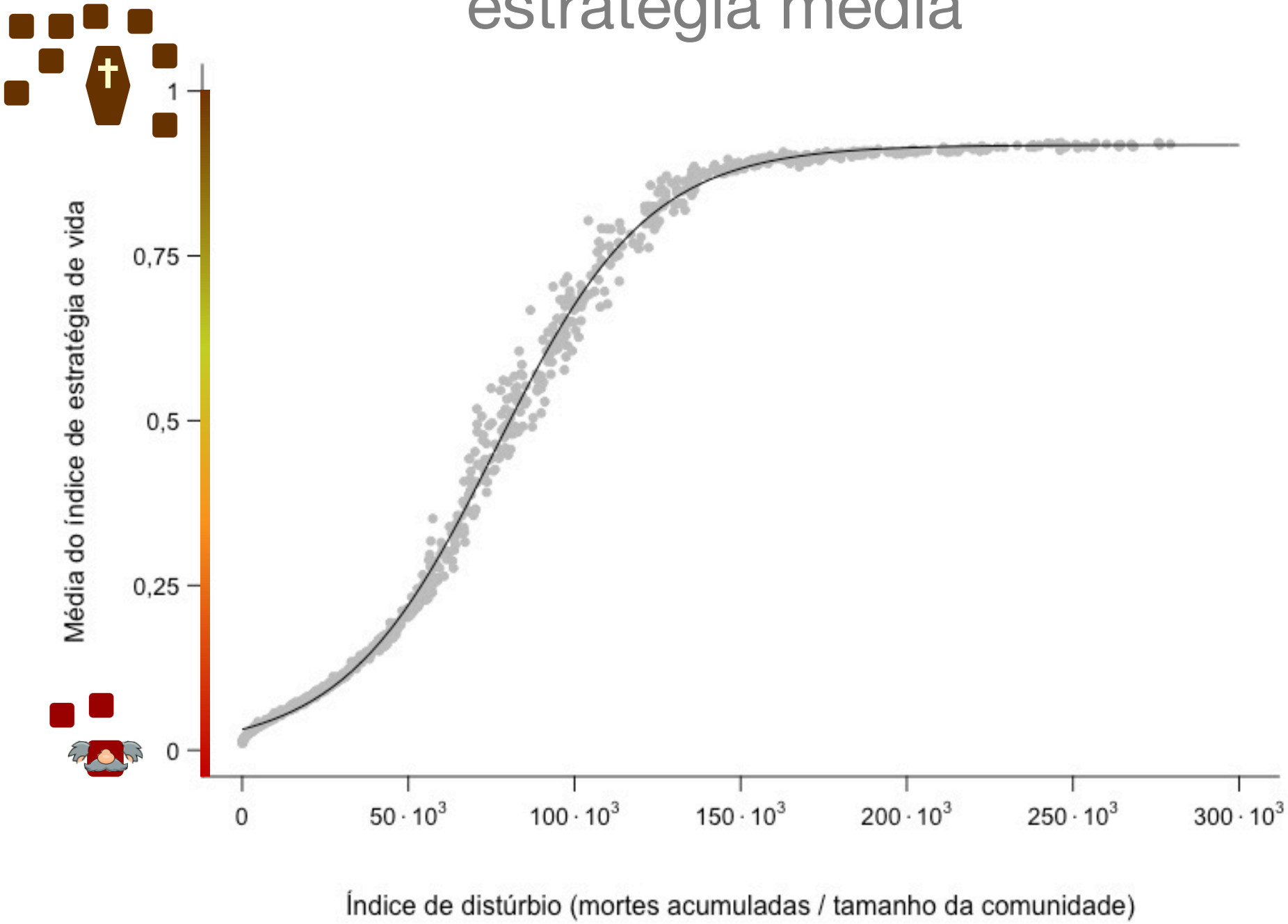
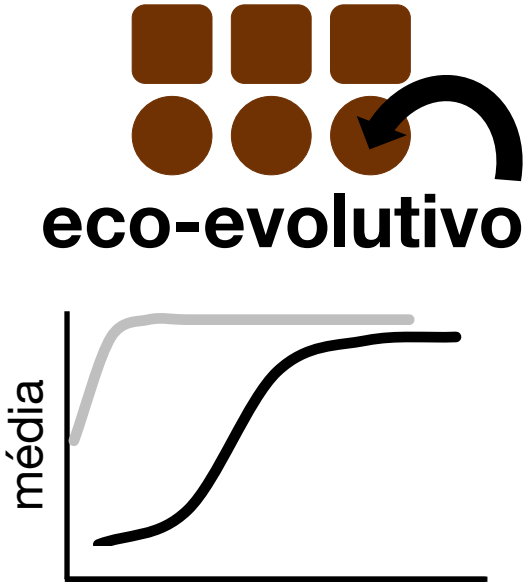






estratégia média





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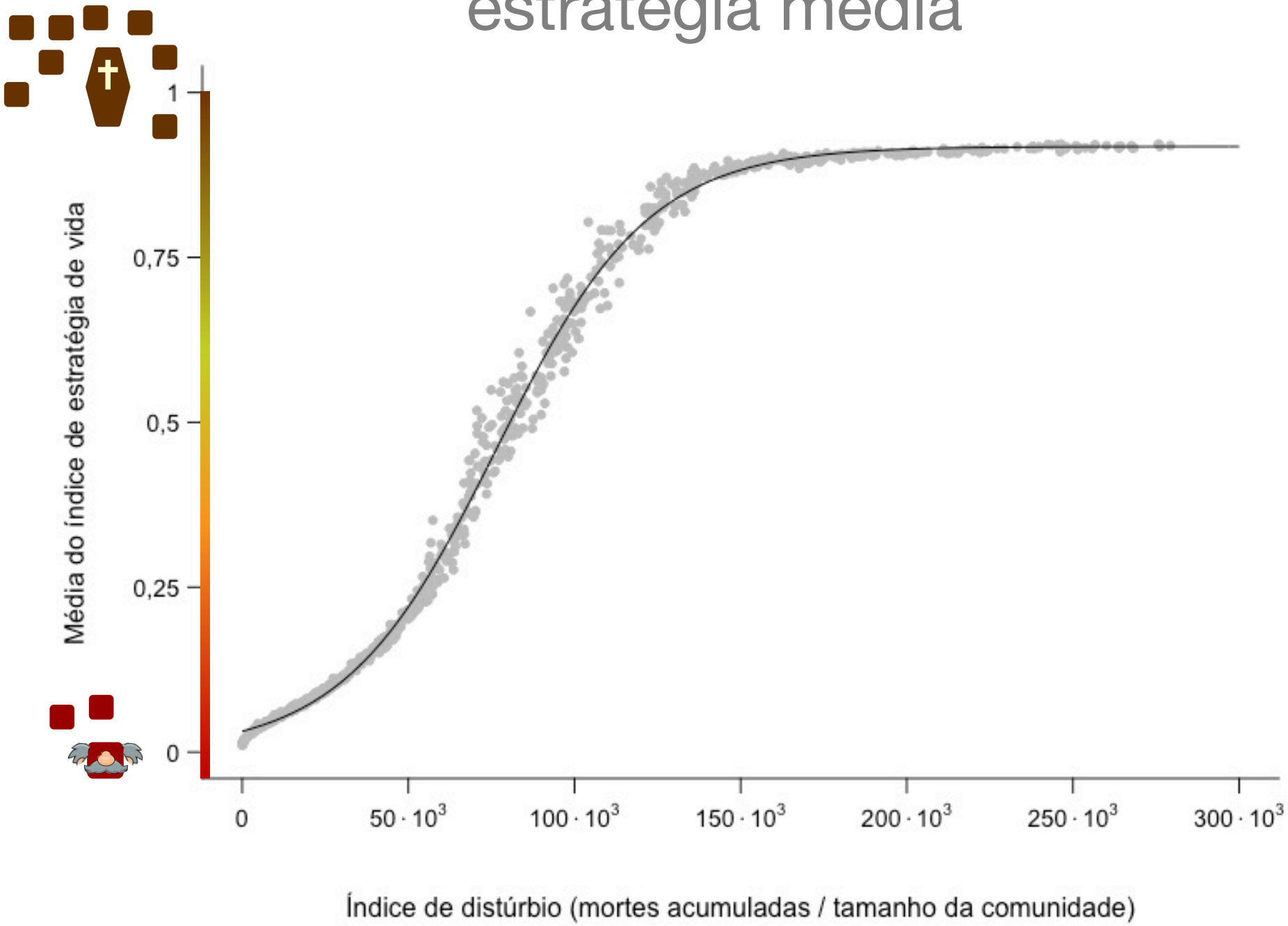
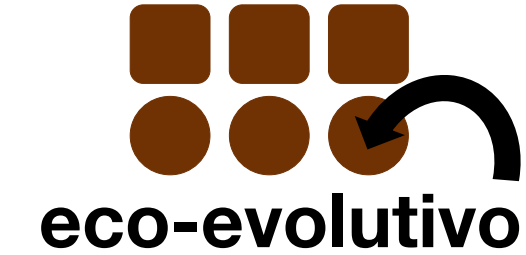
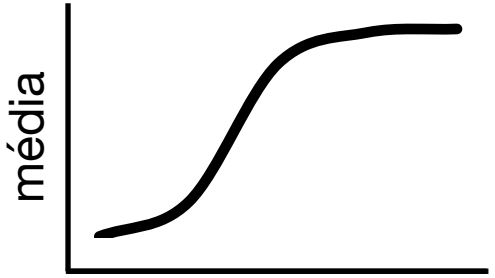
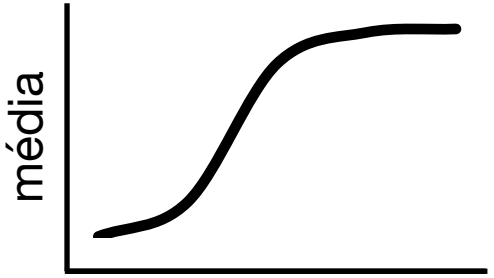






eco-evolutivo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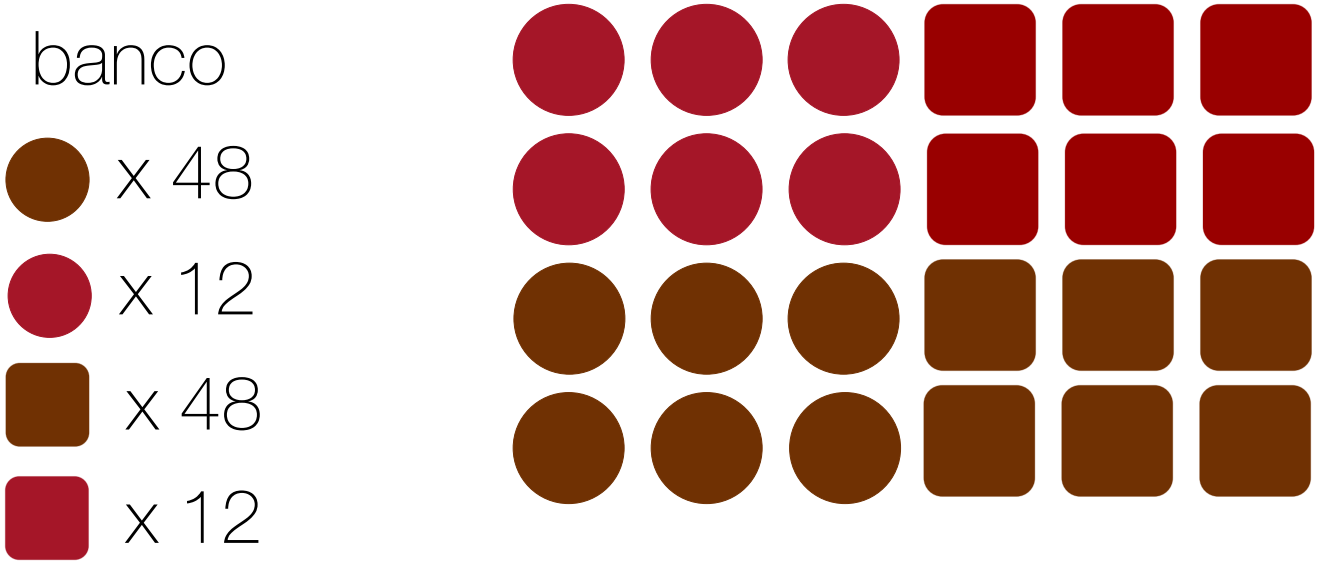
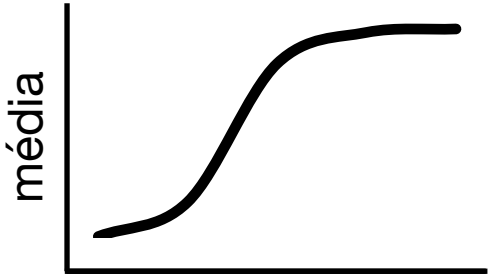

banco
x 48
x 12
x 48
x 12

eco-evolutivo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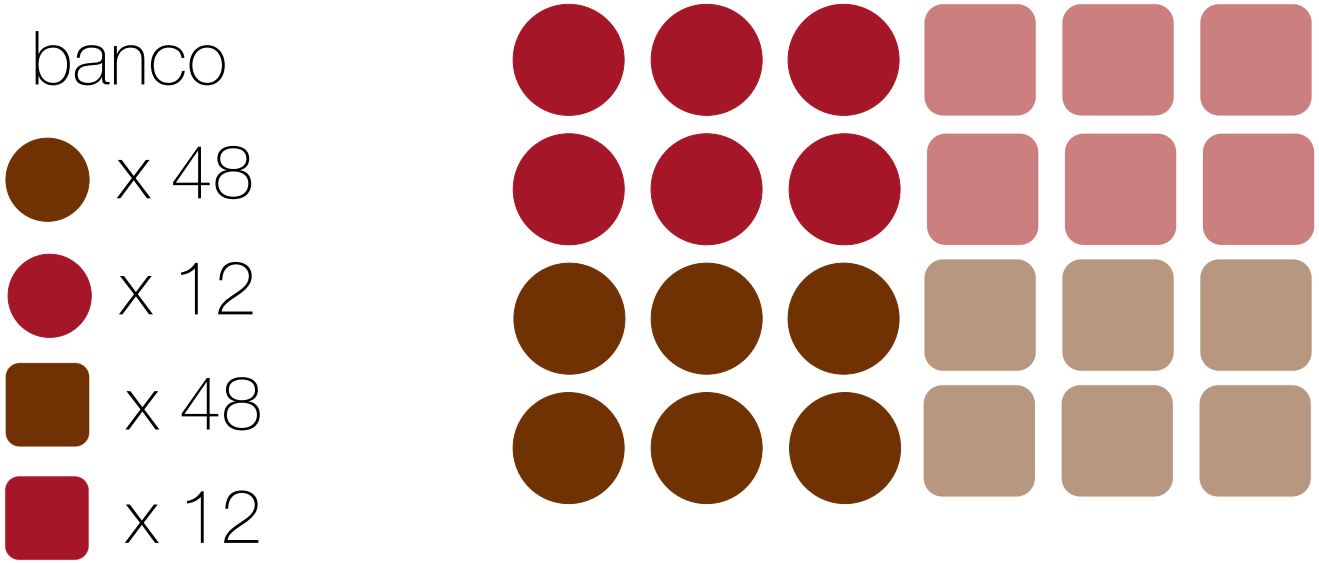
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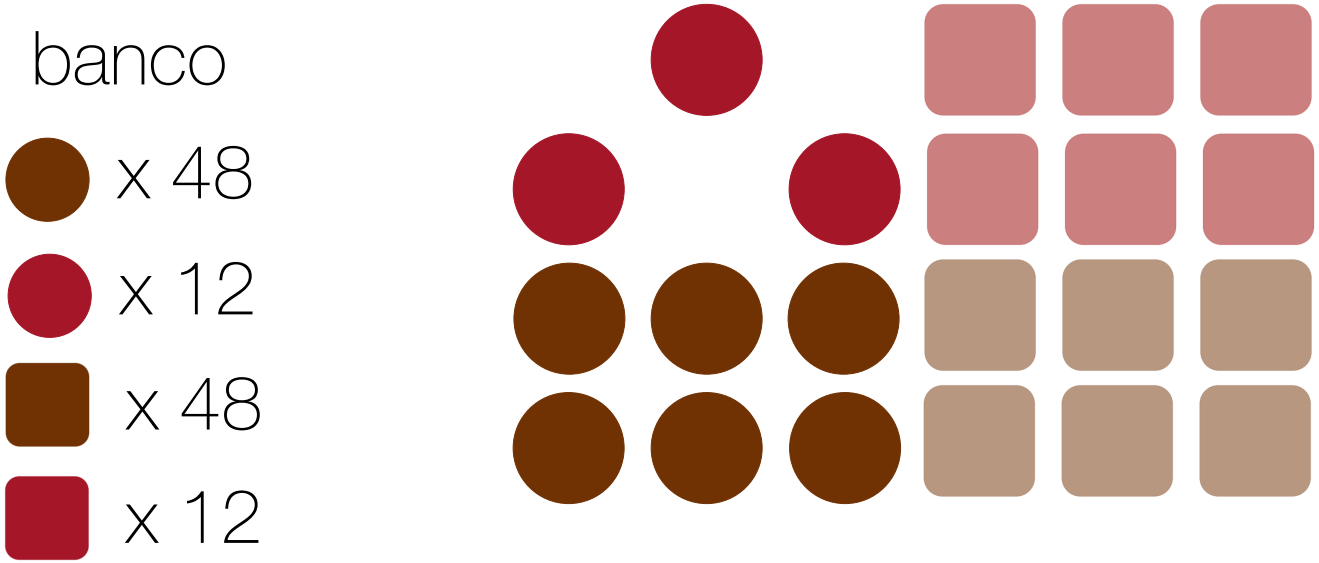
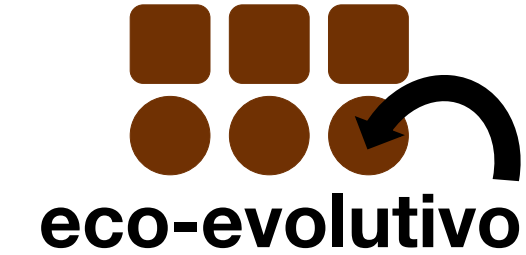
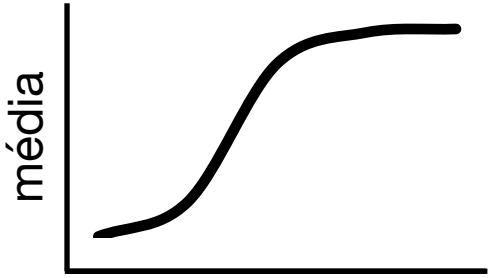
x 48
x 12
x 48
x 12

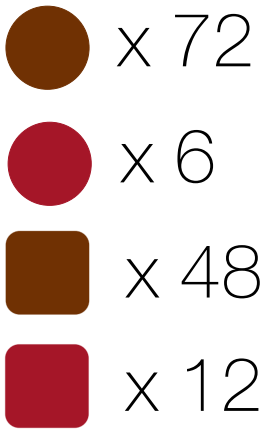
seleção natural

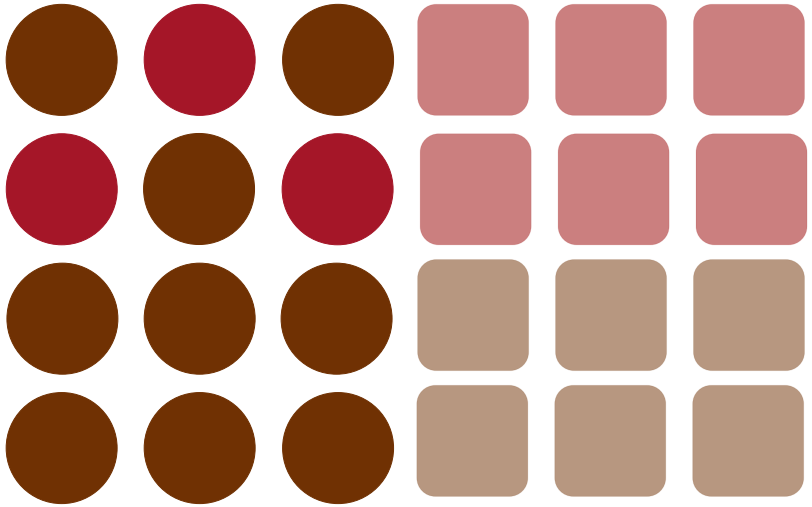


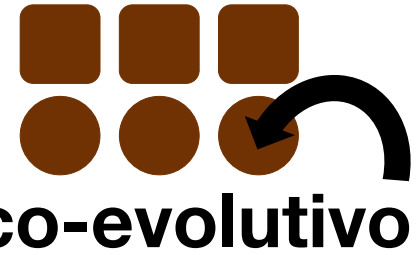


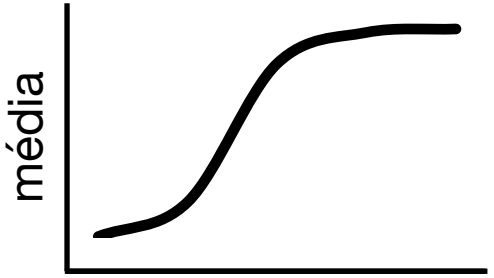


seleção natural

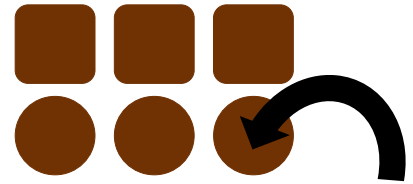




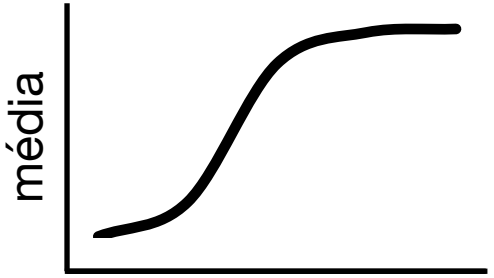




seleção natural
+
exclusão competitiva de espécies



eco-evolutivo



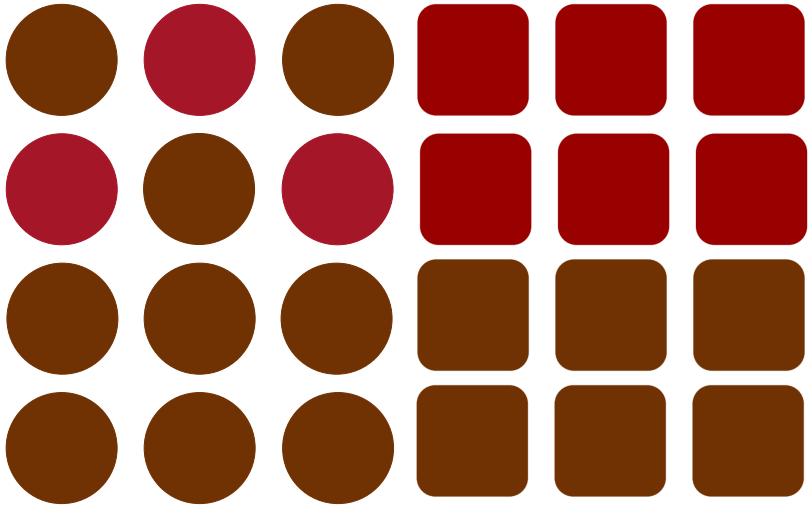
banco

x 72

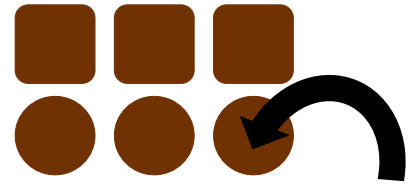
x 6

x 48

x 12



seleção natural
+
exclusão competitiva de espécies



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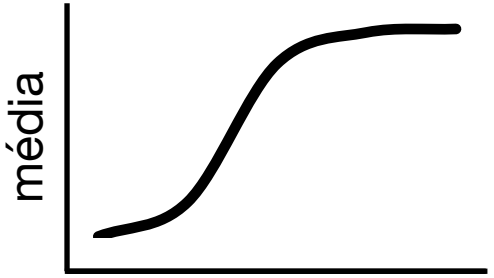

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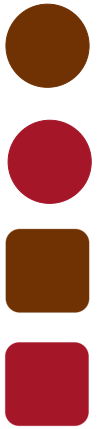
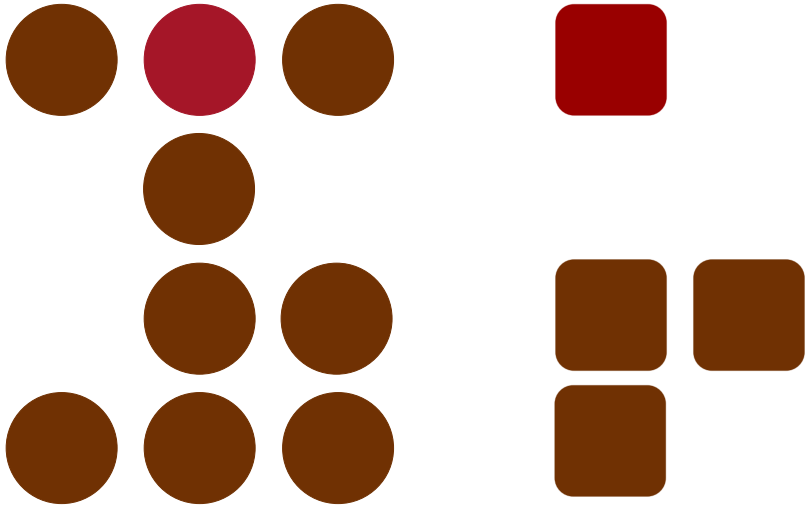


x 72

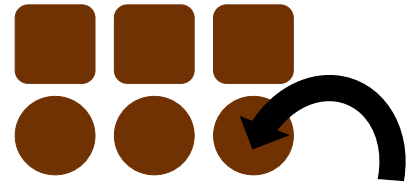
x 6

x 48

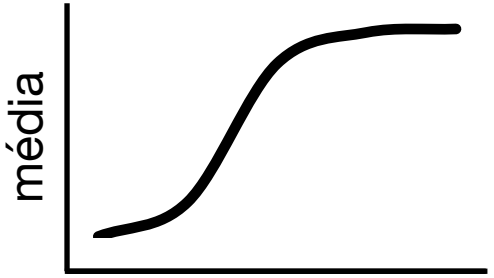
x 12



seleção natural
+
exclusão competitiva de espécies



eco-evolutivo



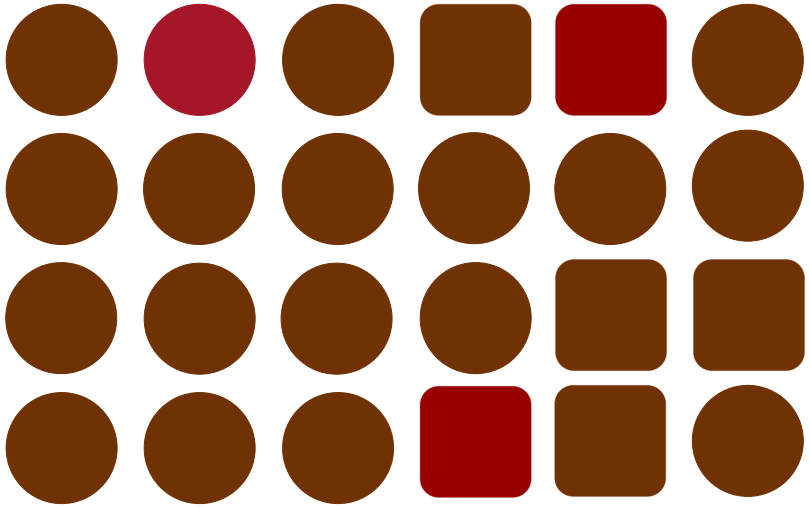
banco

x 136

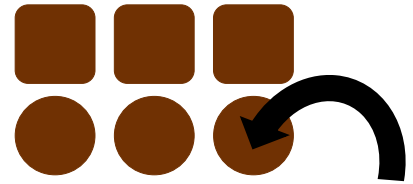
x 2

x 32

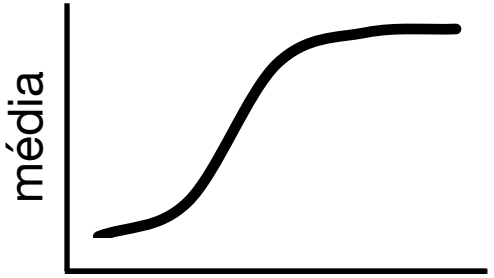
x 4



seleção natural
+
exclusão competitiva de espécies



eco-evolutivo



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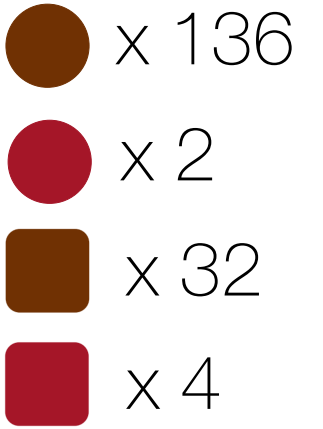

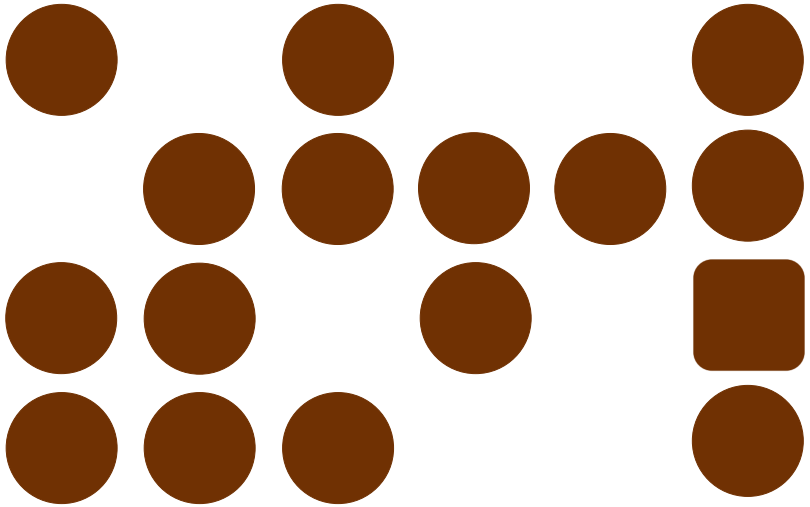

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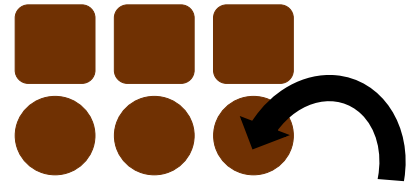

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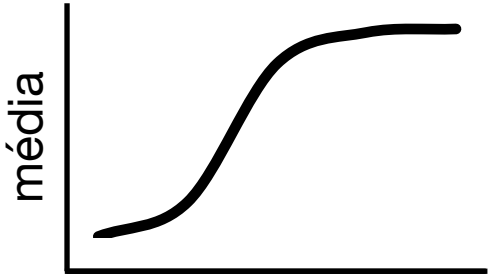
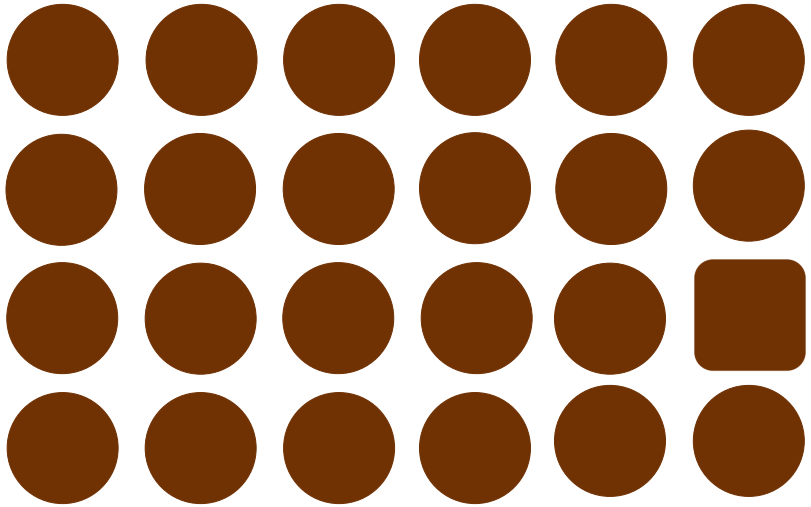


banco

x 184

x 8



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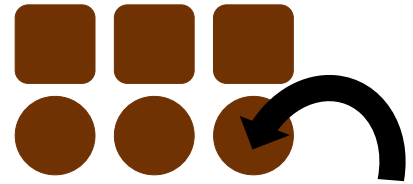

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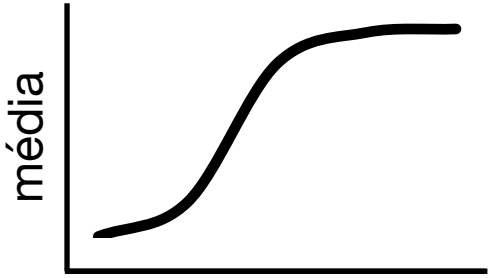

banco

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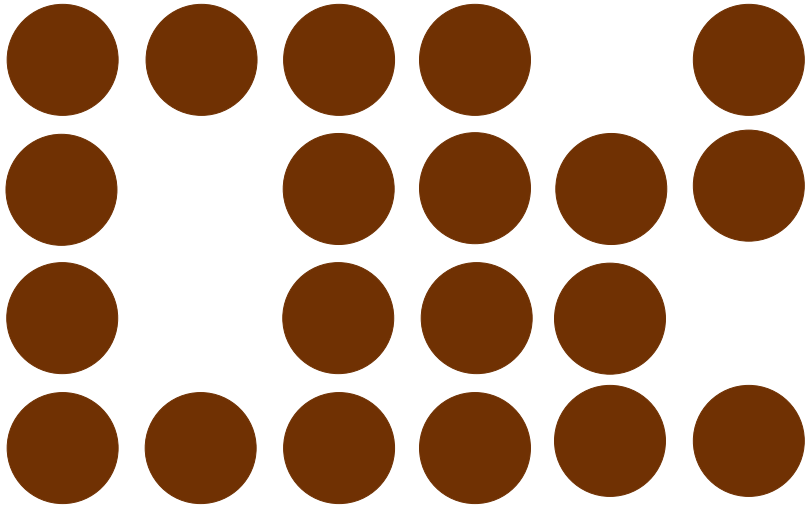
x 8



seleção natural
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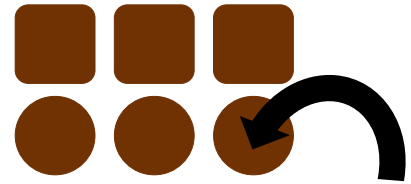

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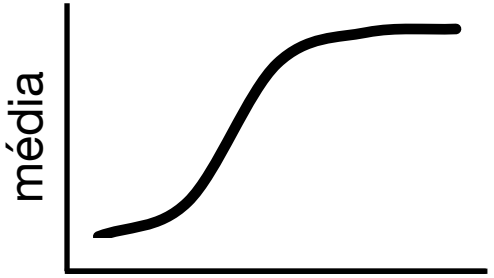
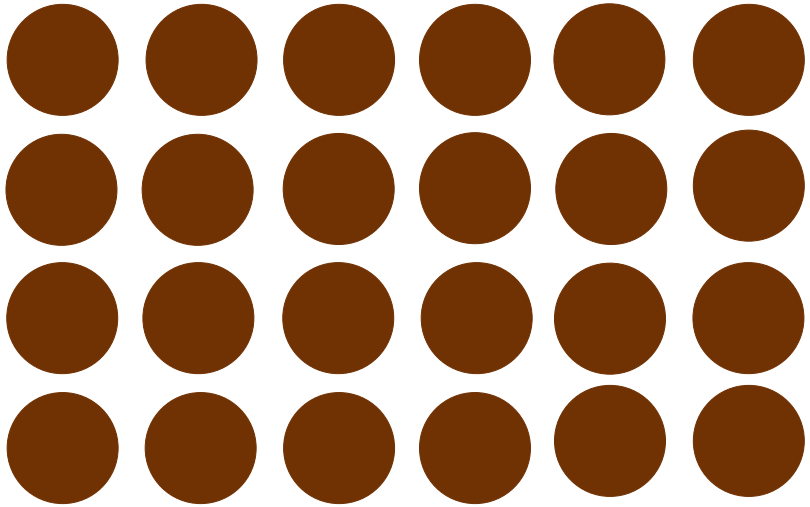
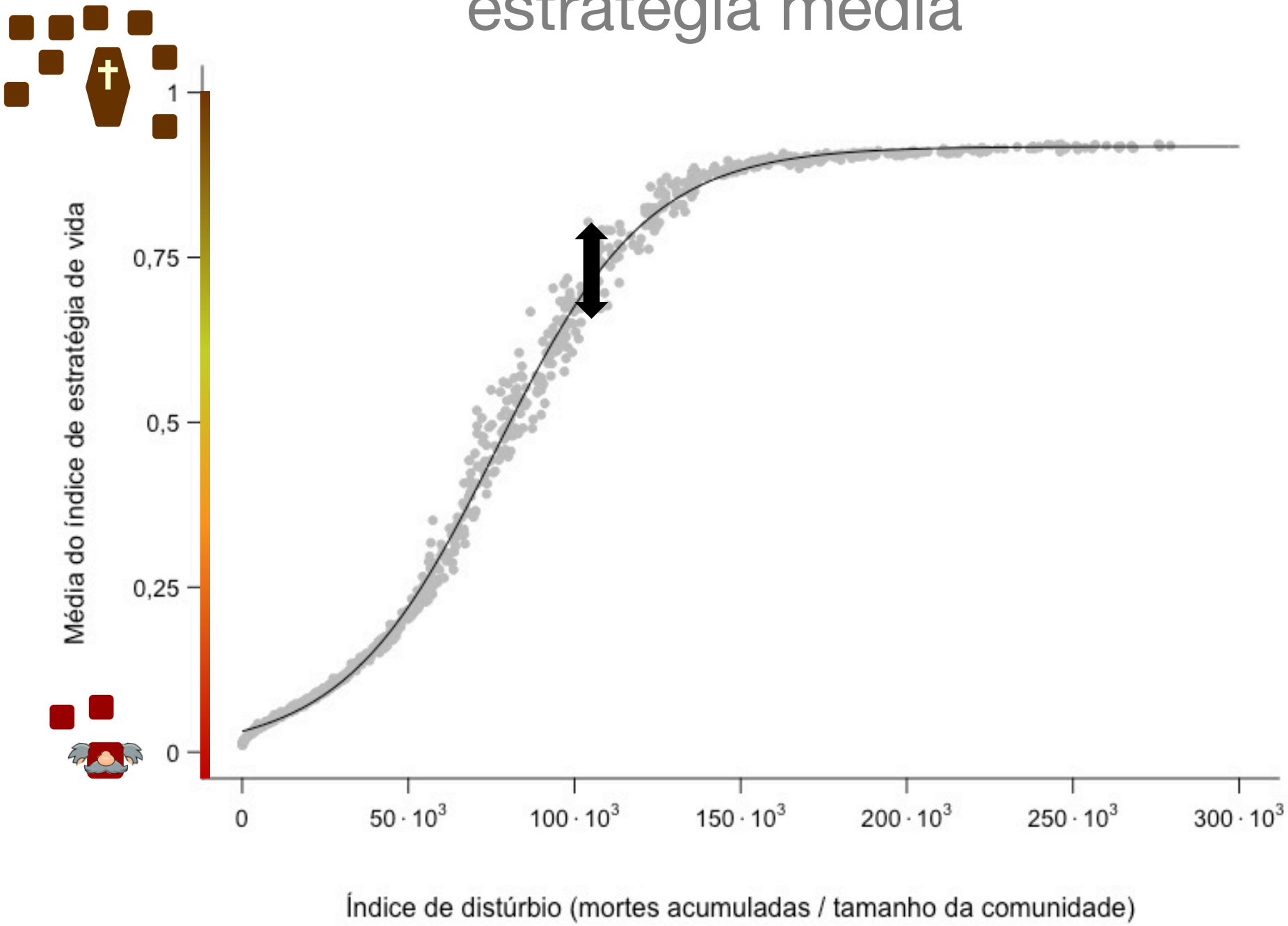


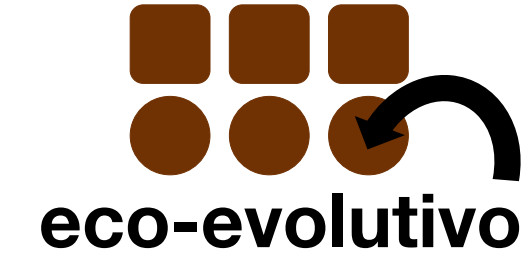
banco

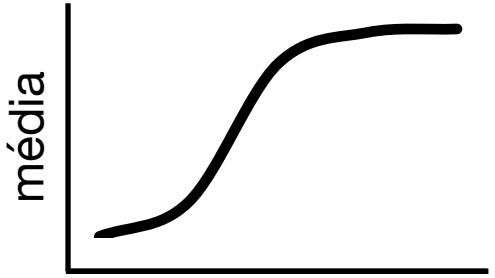
x 192



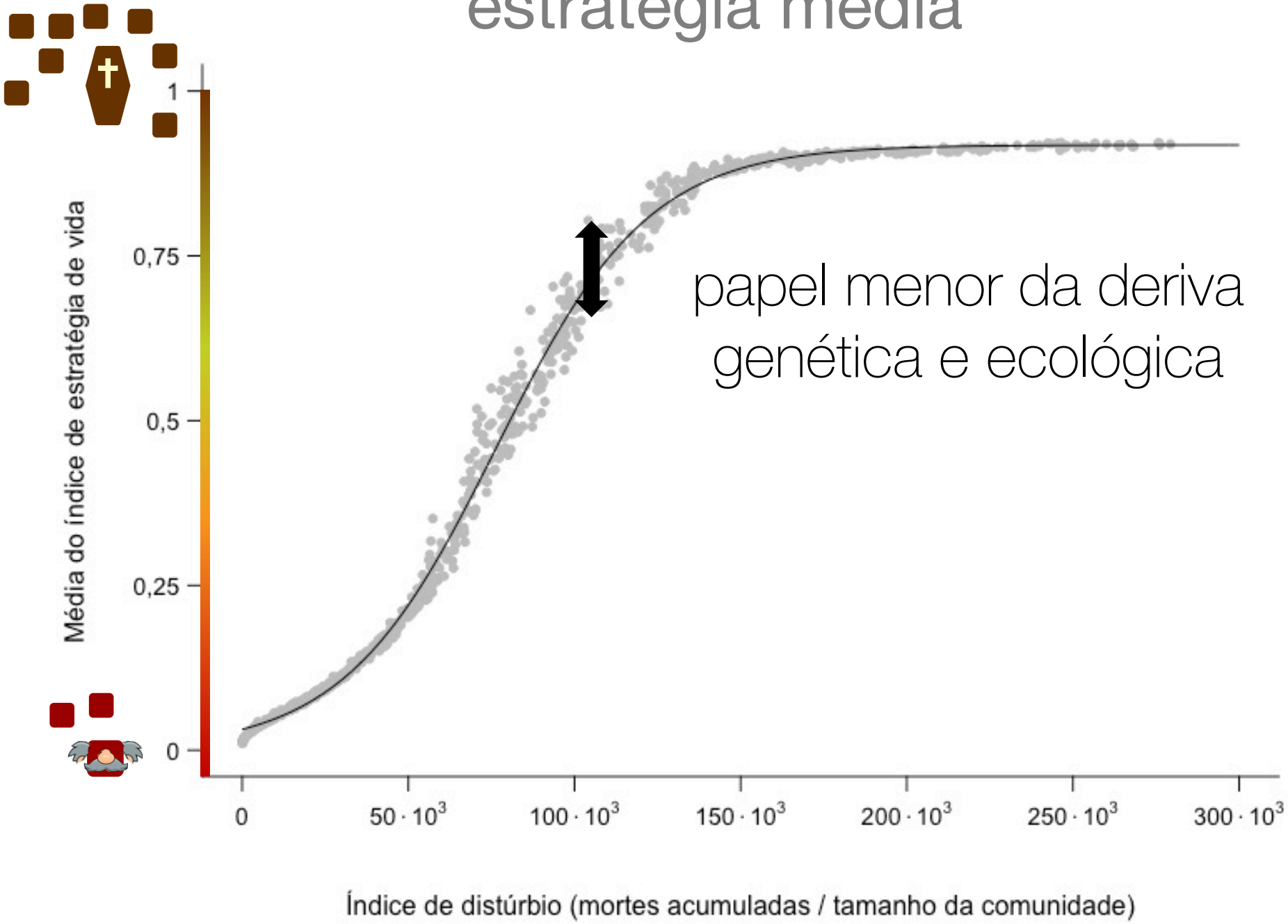
estratégia média

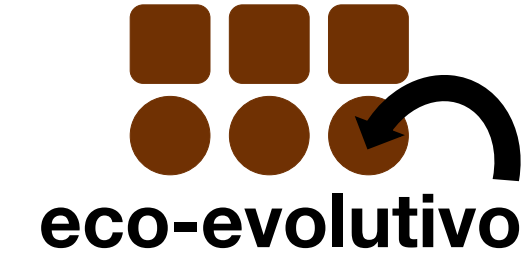


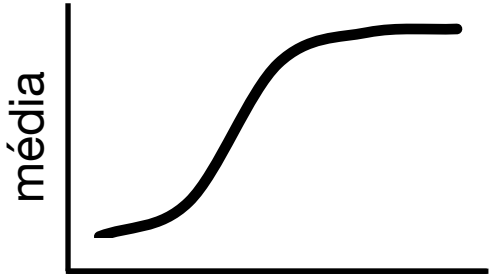


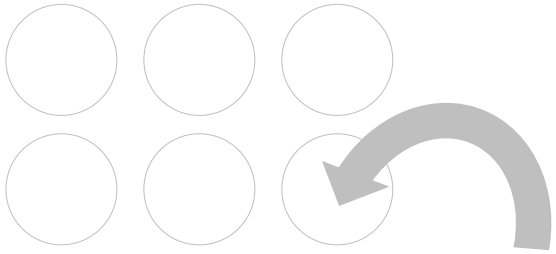
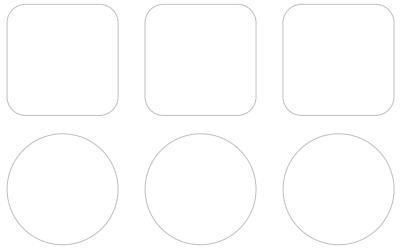
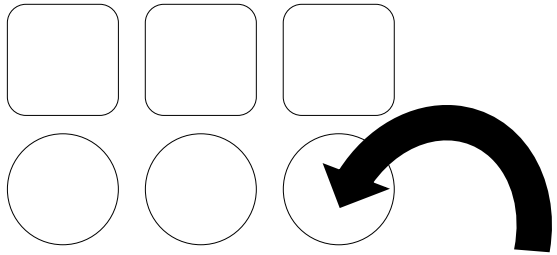


estratégia média







evolutivo	ecológico	eco-evolutivo
		
estratégia média	estratégia média	estratégia média
diversidade de estratégias	diversidade de estratégias	diversidade de estratégias
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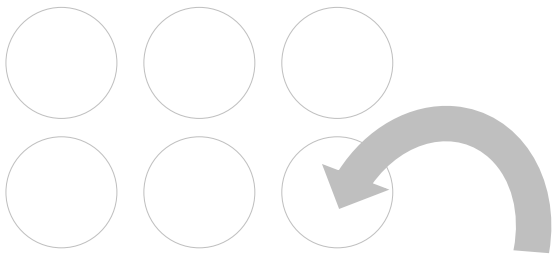
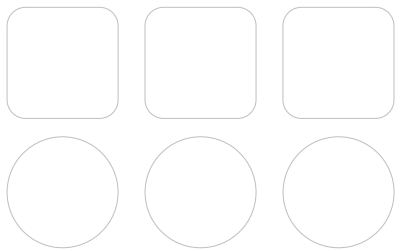
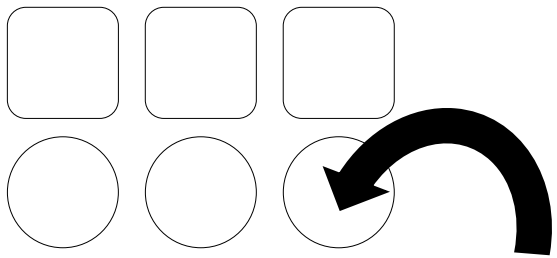
evolutivo	ecológico	eco-evolutivo
		
estratégia média	estratégia média	estratégia média
diversidade de estratégias	diversidade de estratégias	diversidade de estratégias
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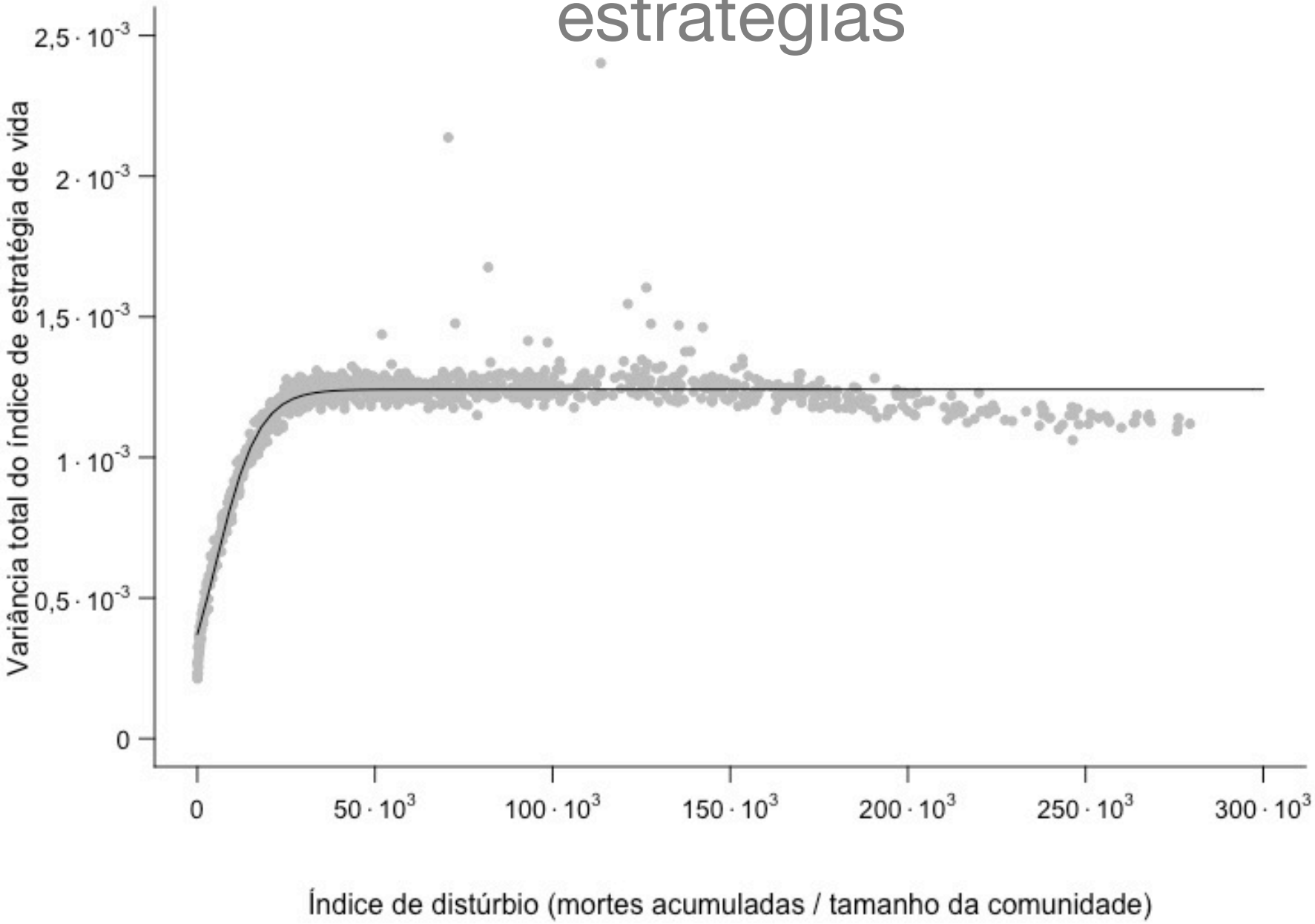
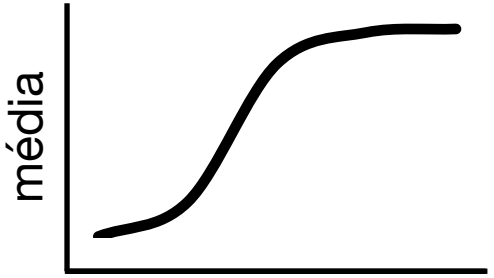
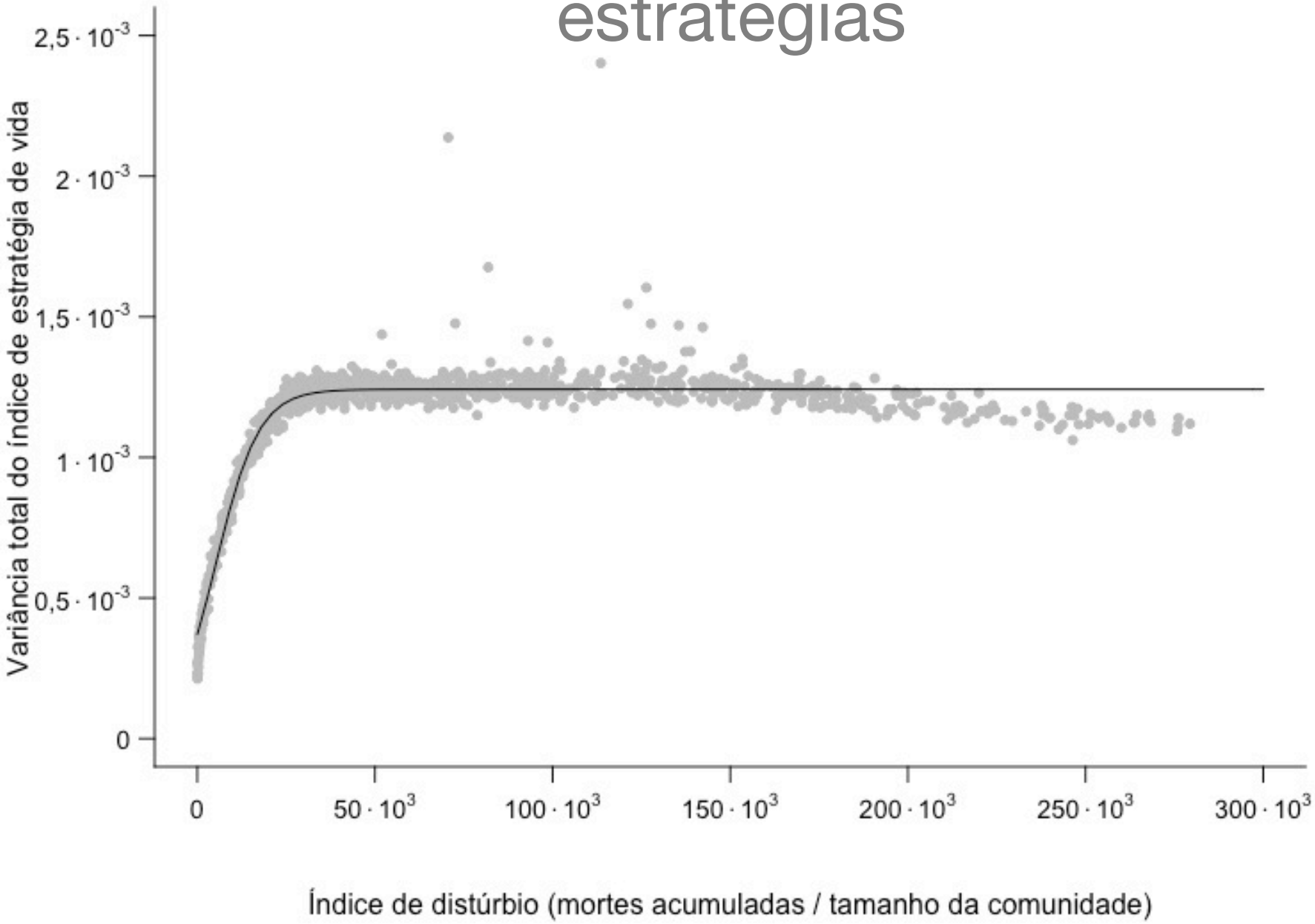
diversidade de estratégias



eco-evolutivo



diversidade de estratégias



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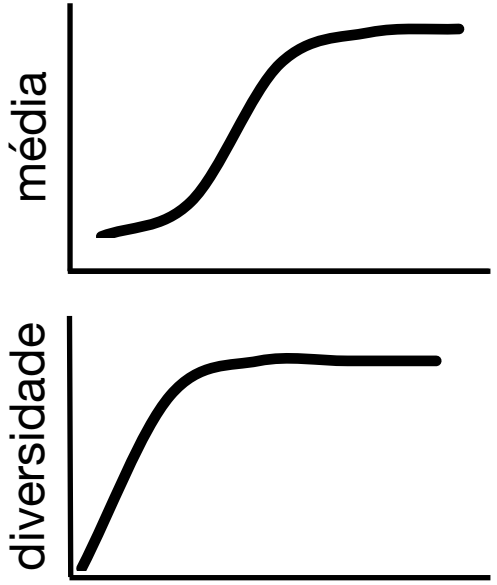

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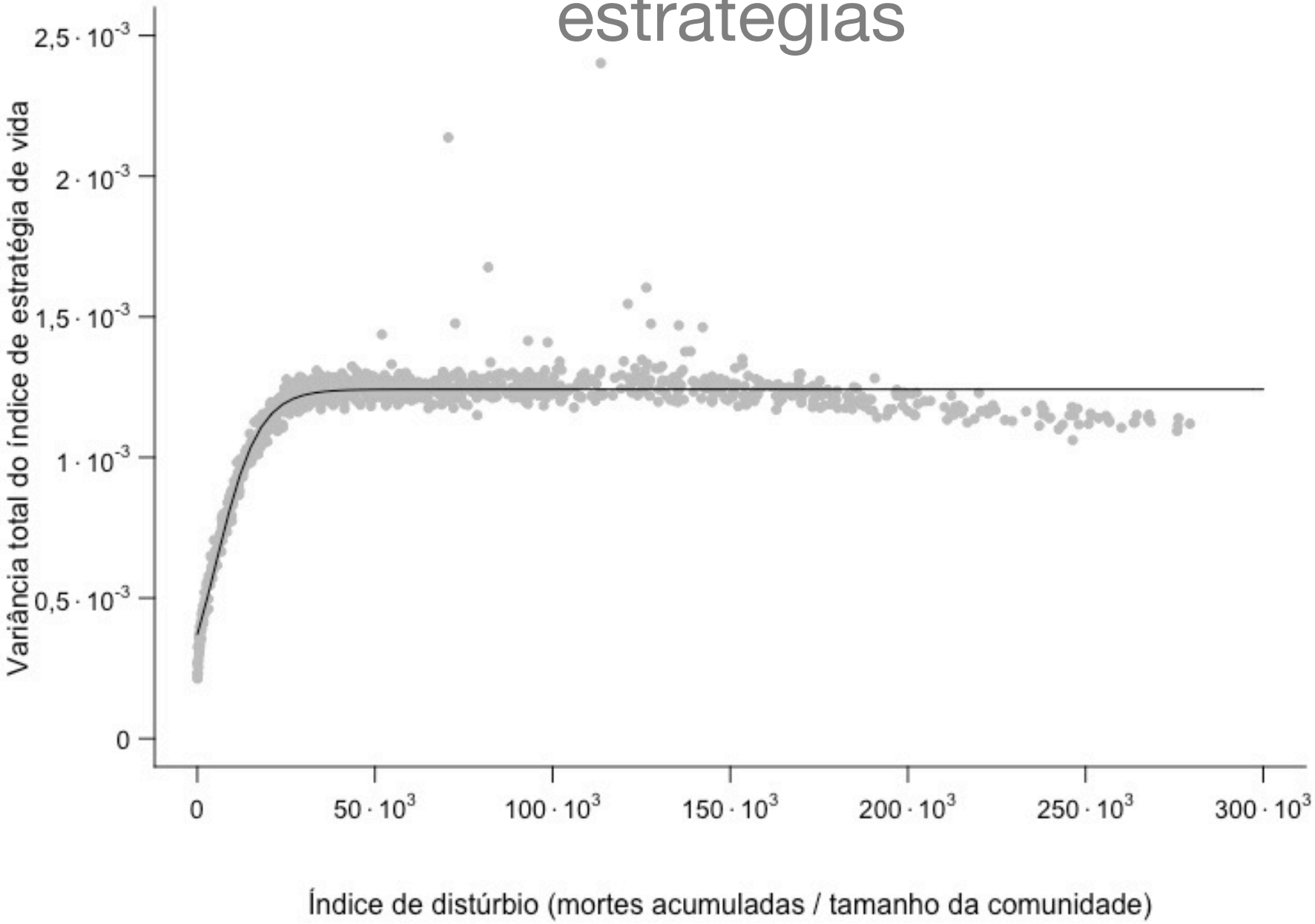

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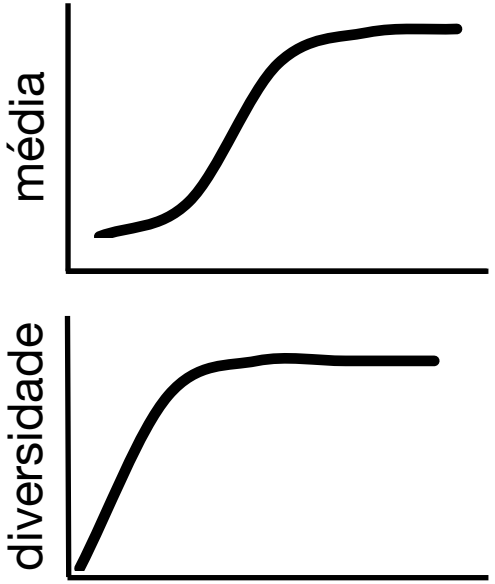

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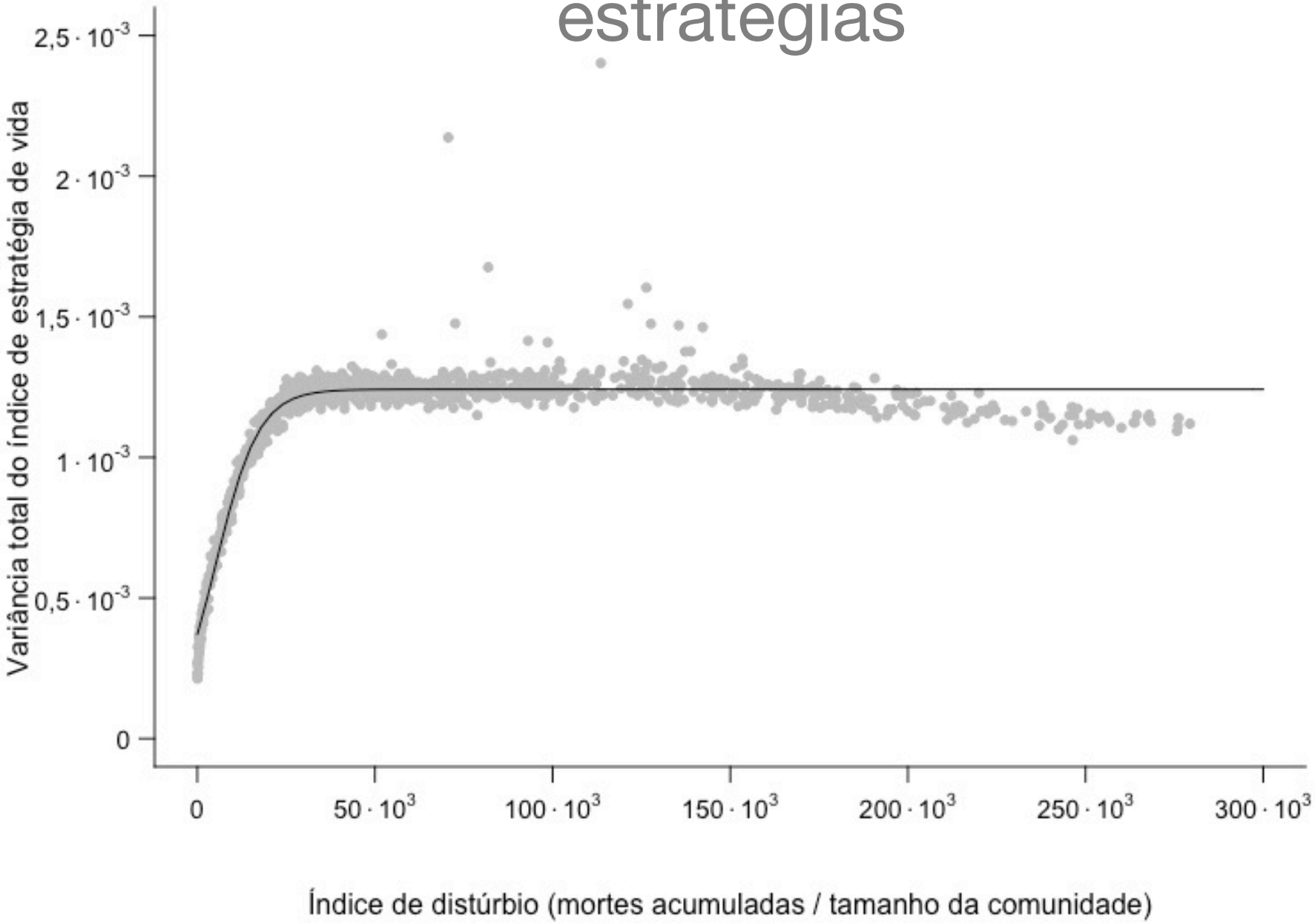

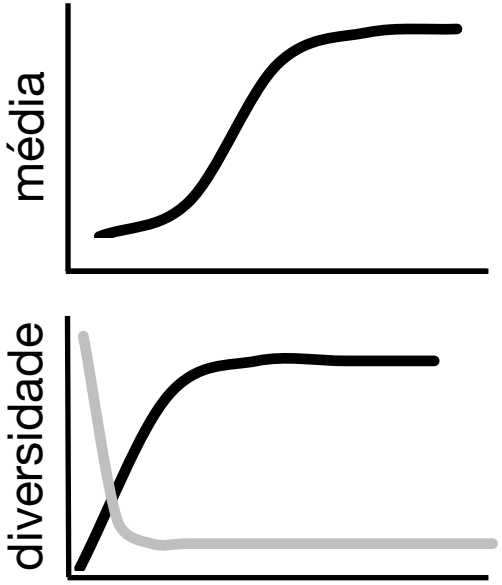

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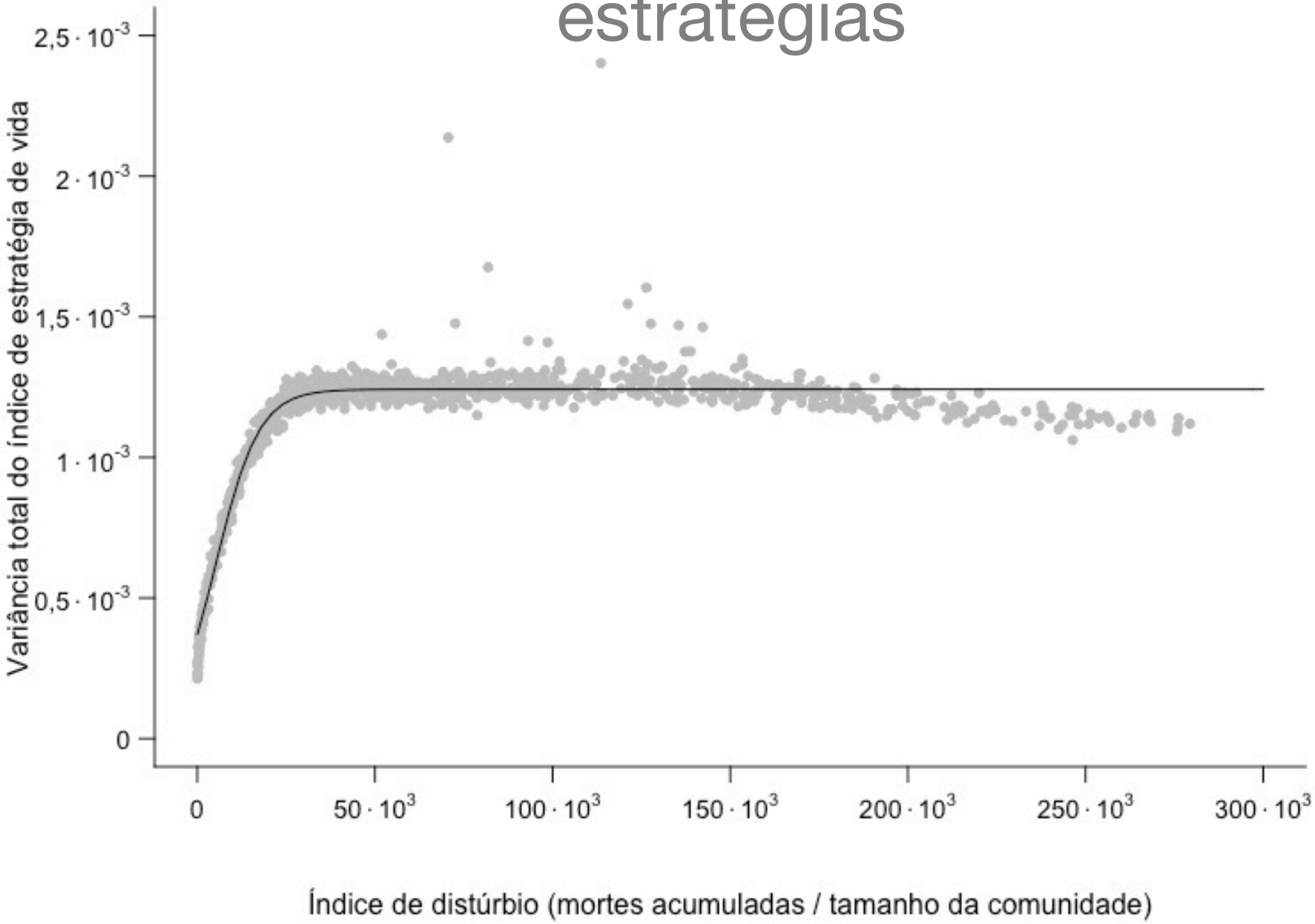
diversidade de estratégias



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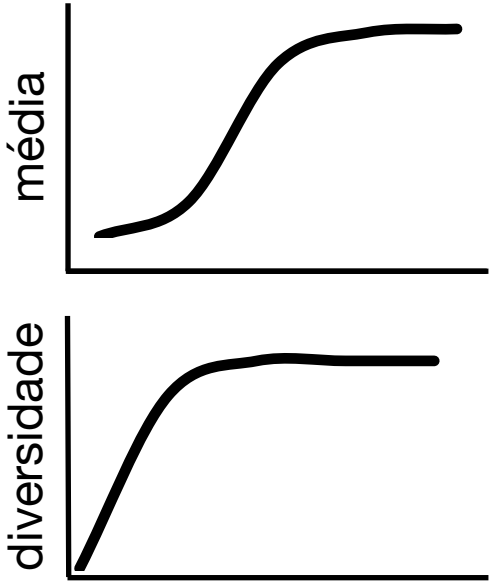

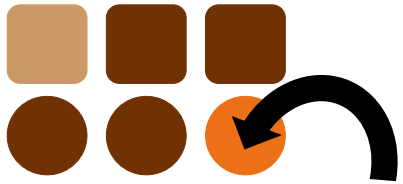

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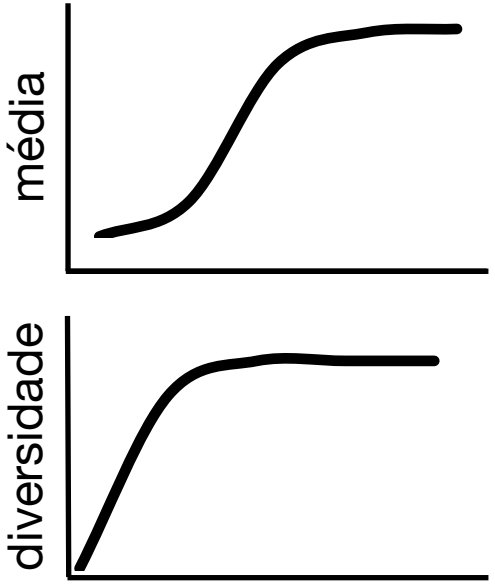

banco

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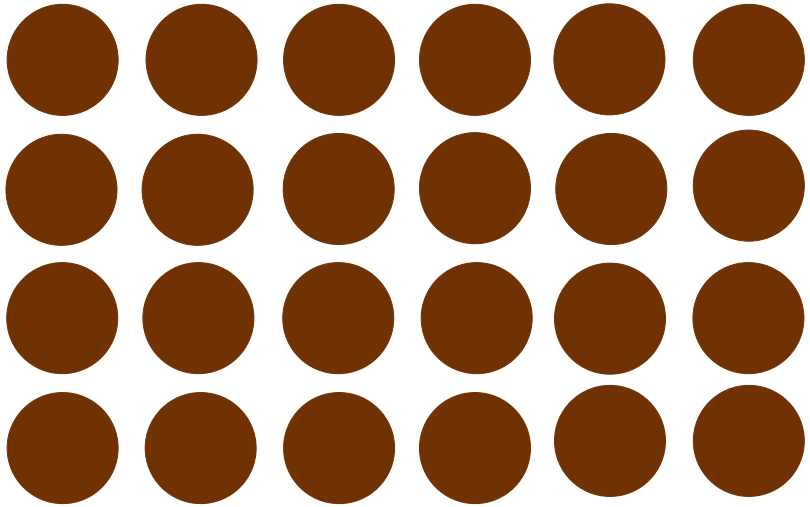

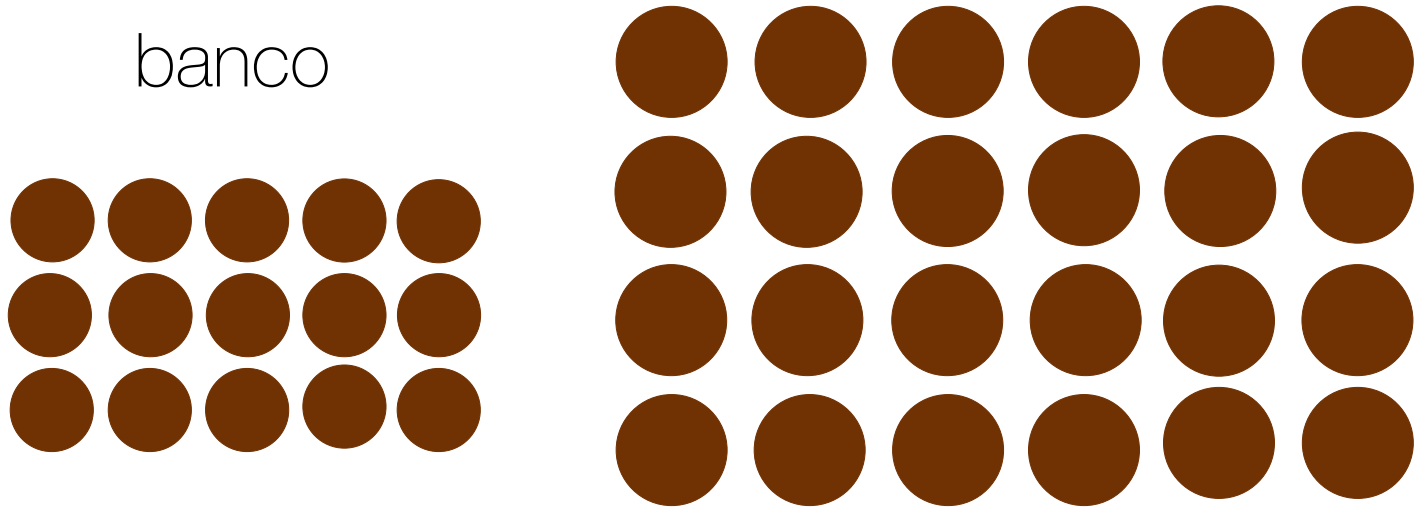
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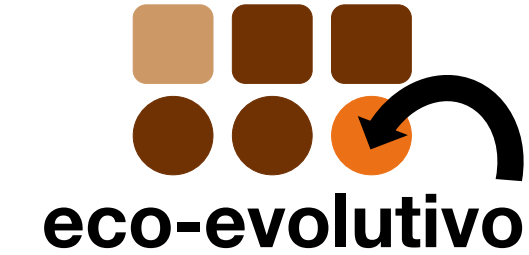
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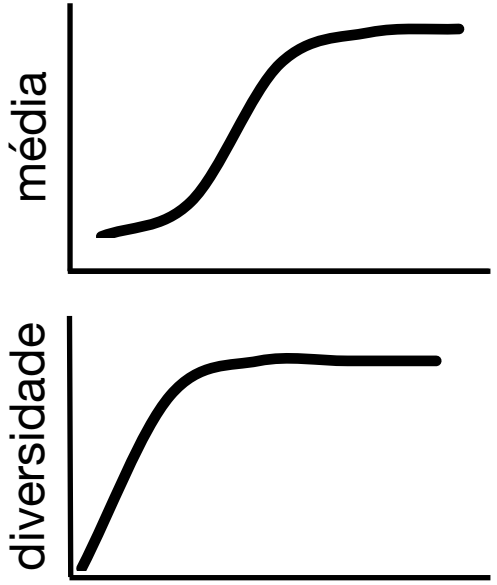
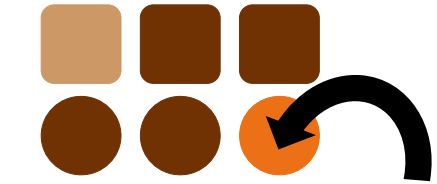

média
diversidade

mutação



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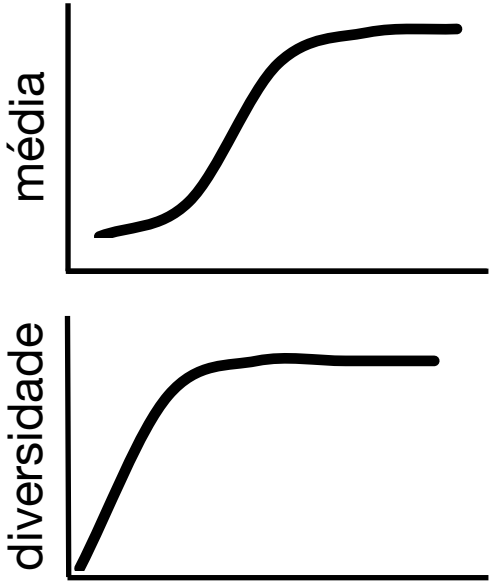

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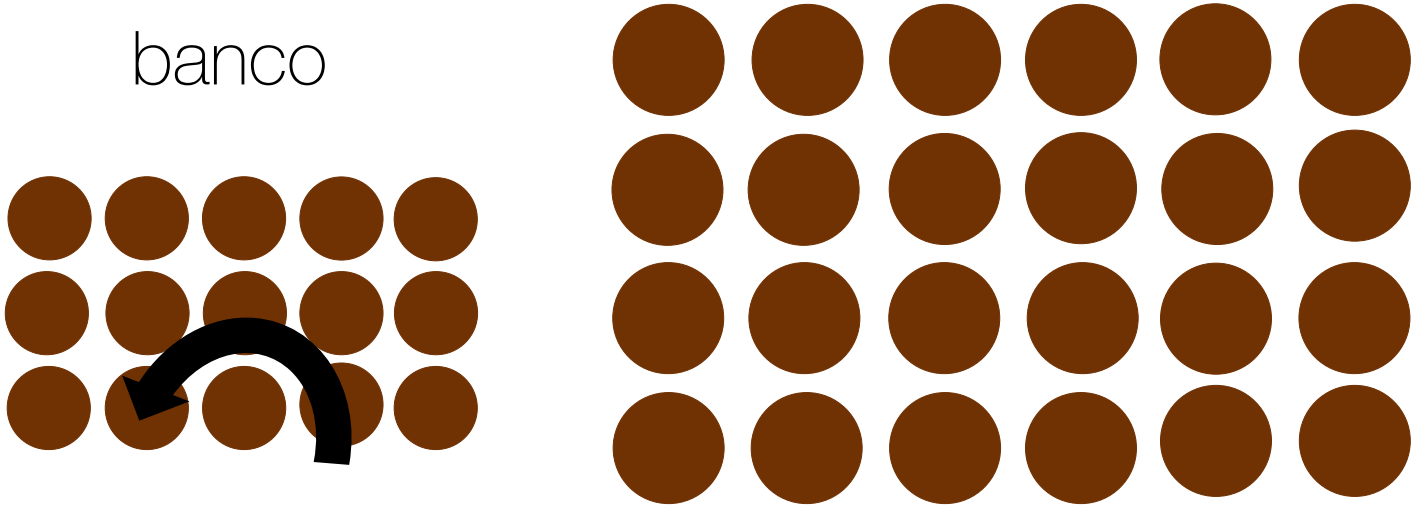

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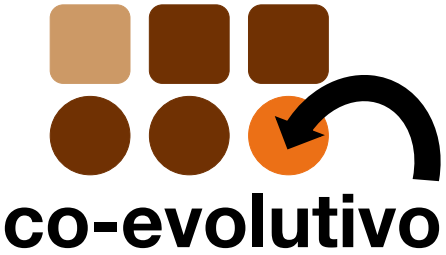

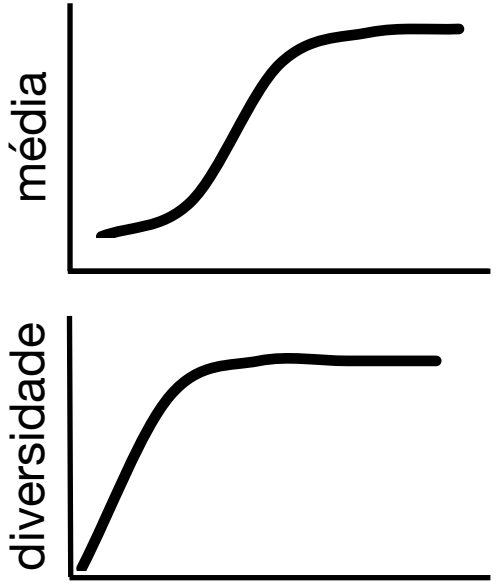

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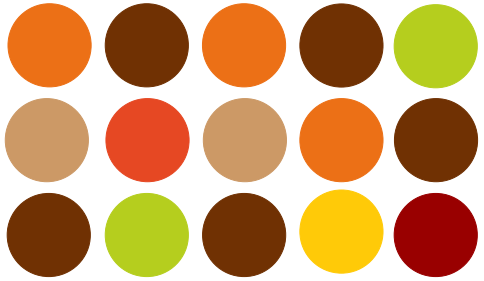

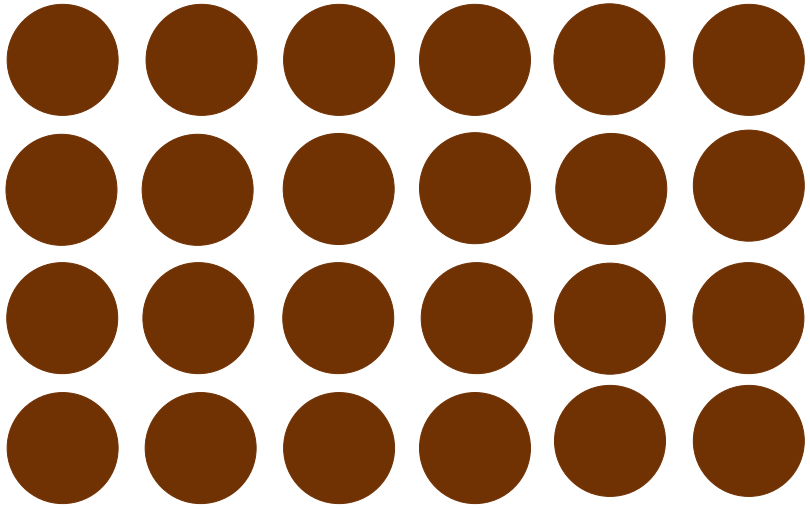

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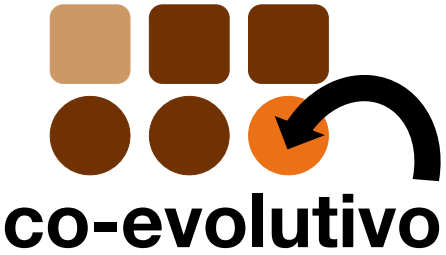

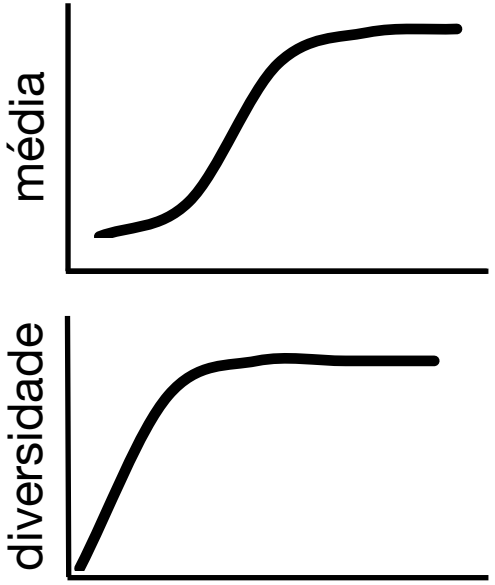

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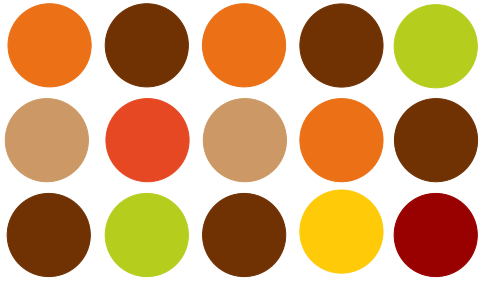
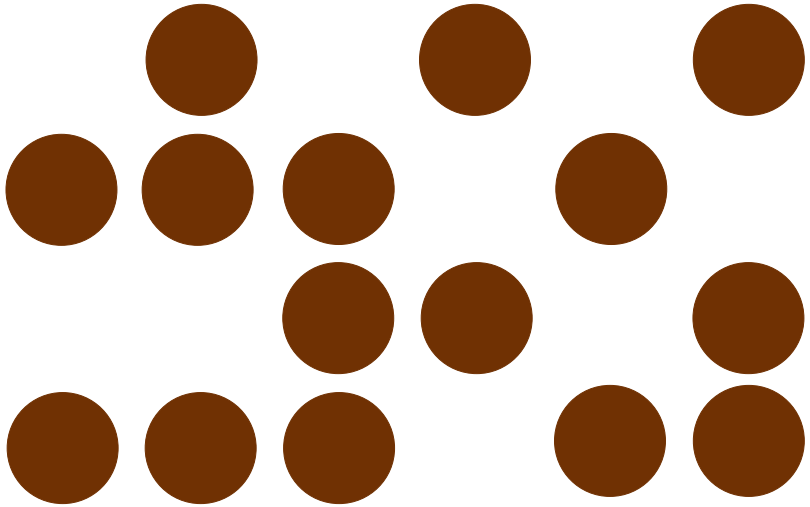
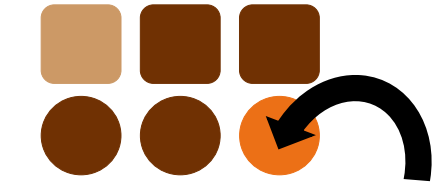
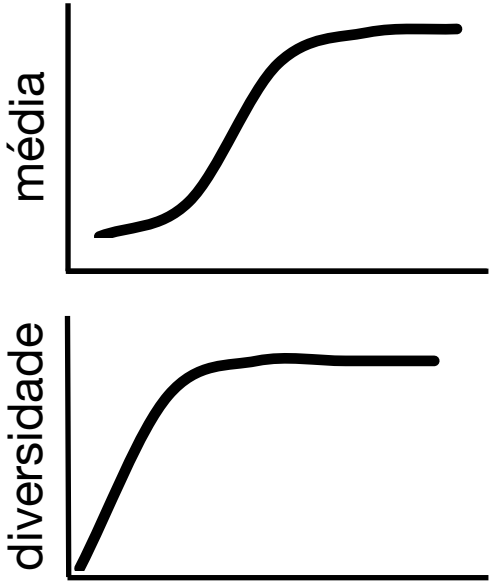




mutação + amostragem



eco-evolutivo



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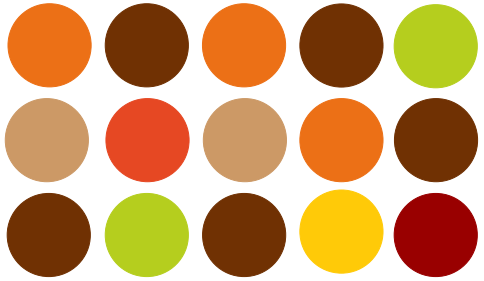

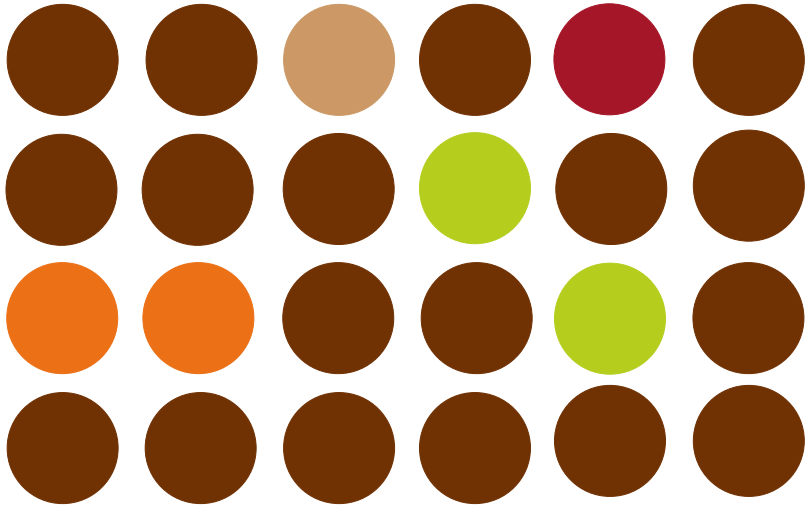

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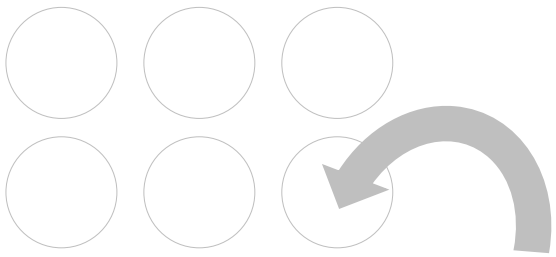	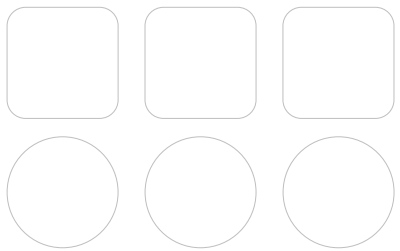	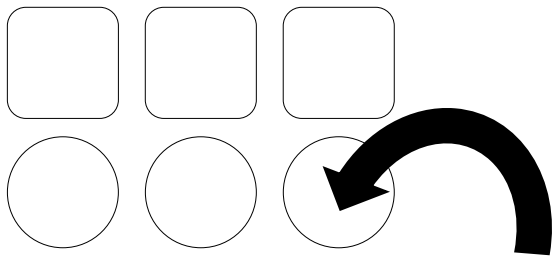
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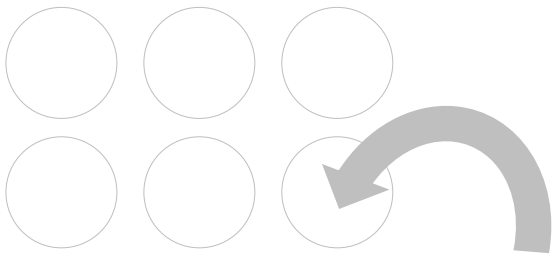	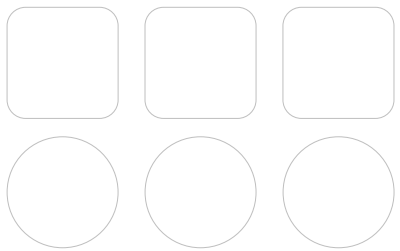	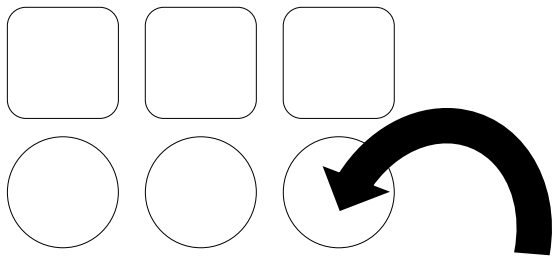
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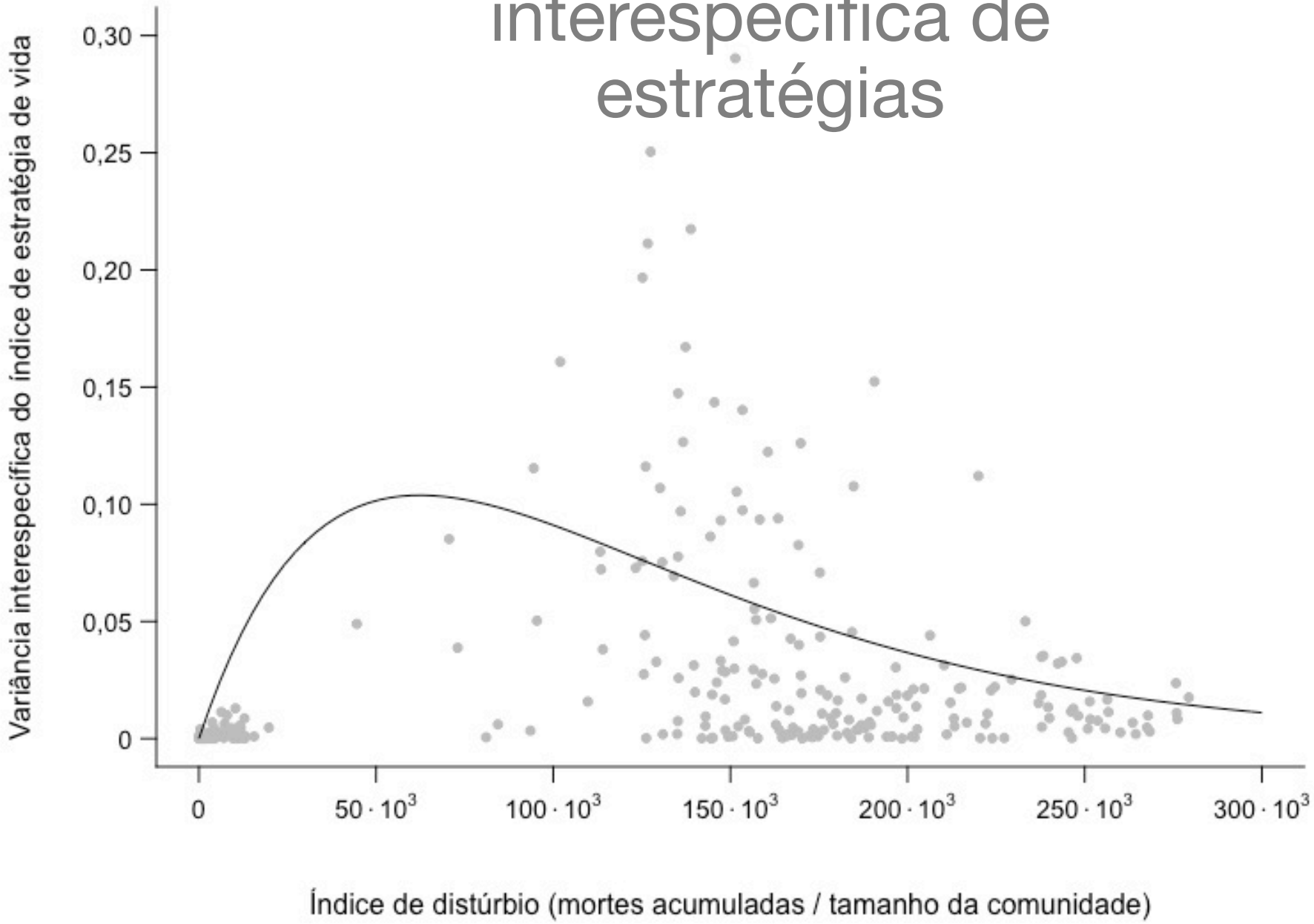
diversidade de estratégias	diversidade de estratégias	diversidade de estratégias
-	heterogeneidade interespecífica de estratégias	**heterogeneidade interespecífica de estratégias**

heterogeneidade interespecífica de estratégias



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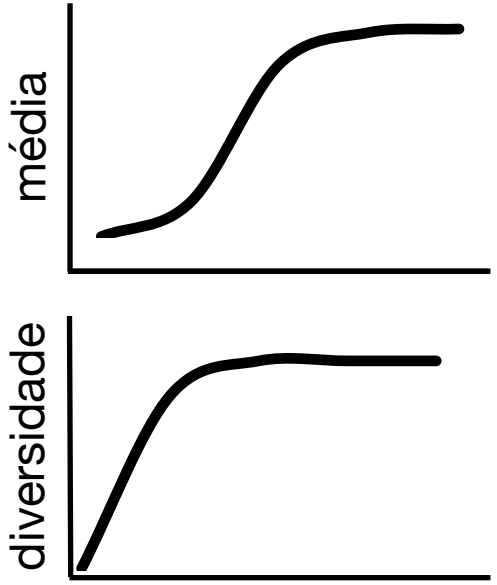

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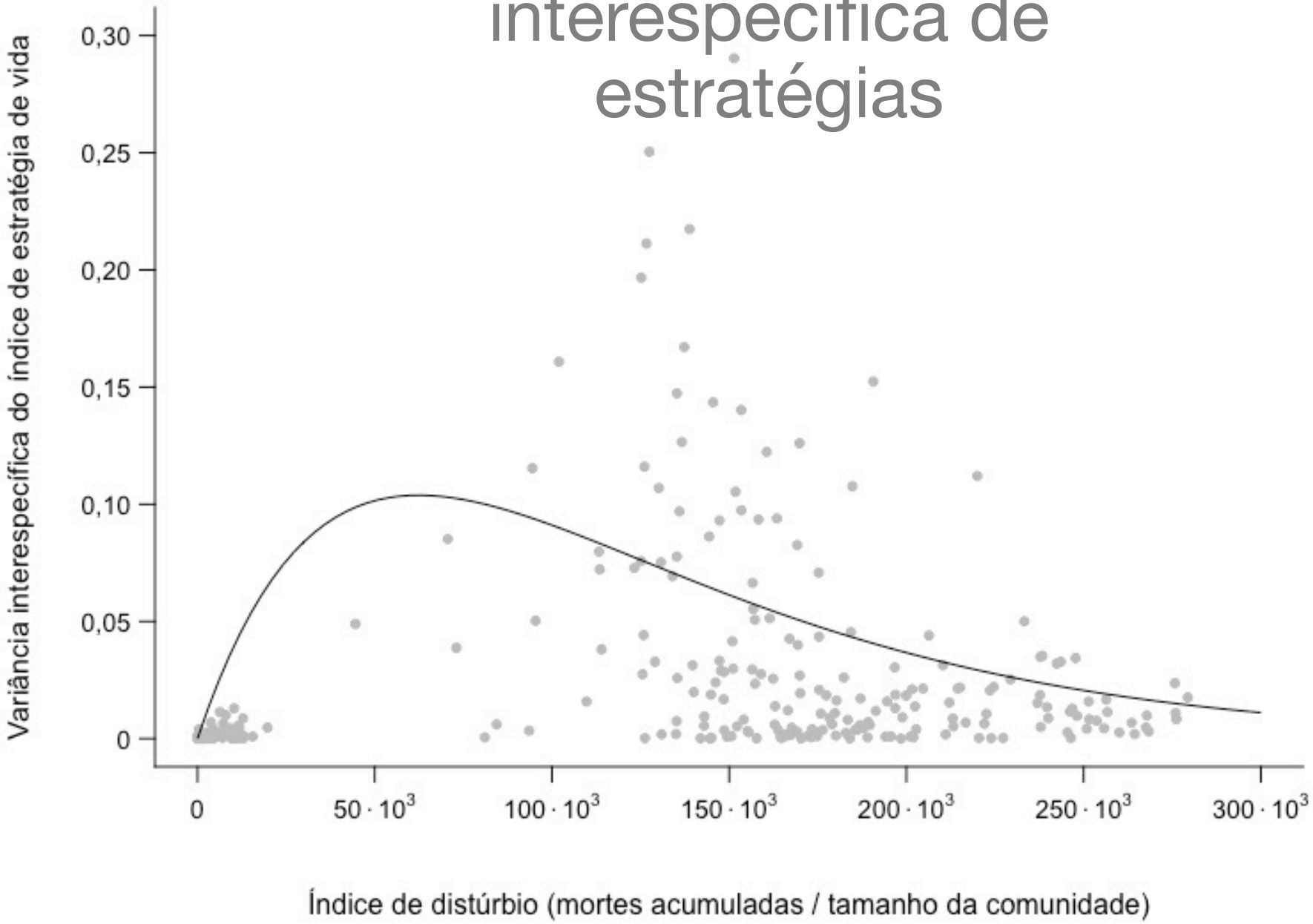

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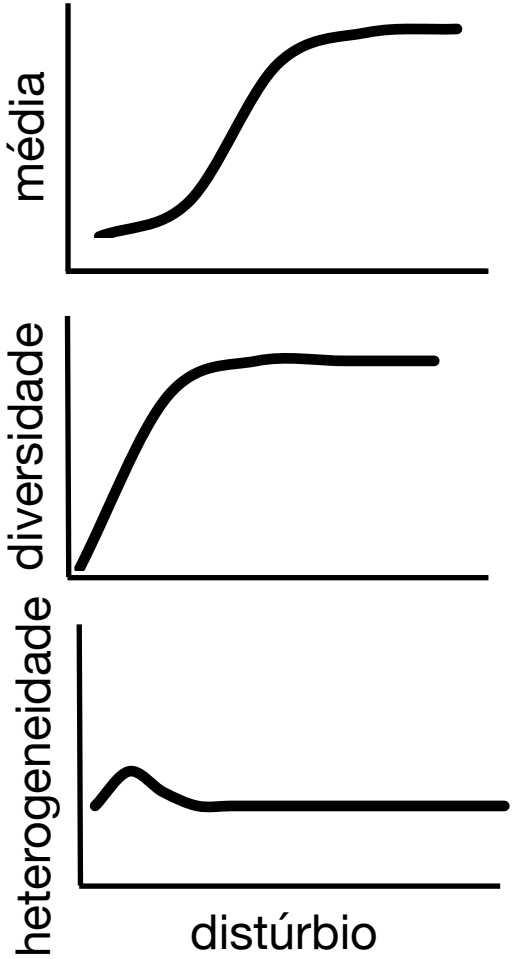

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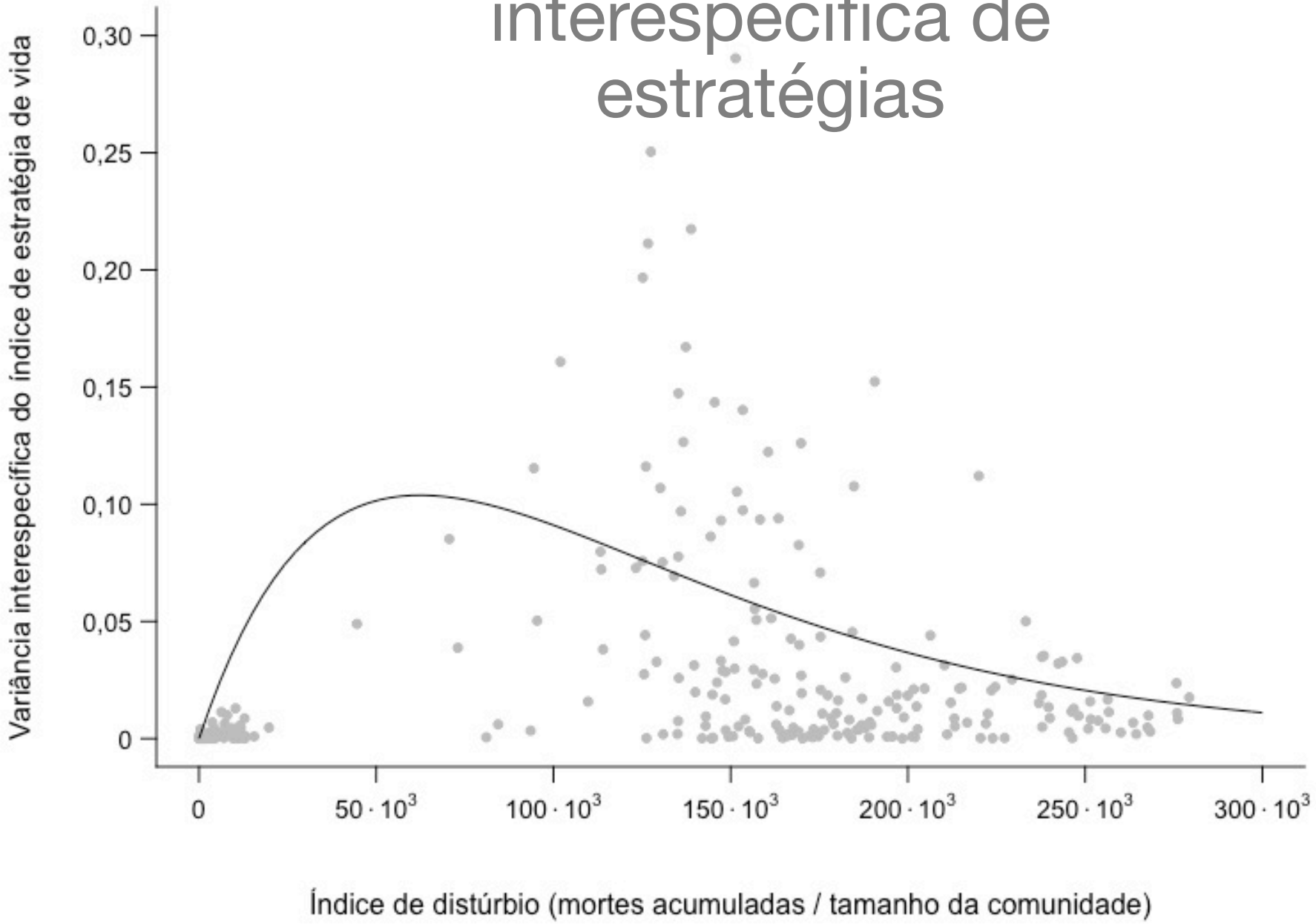

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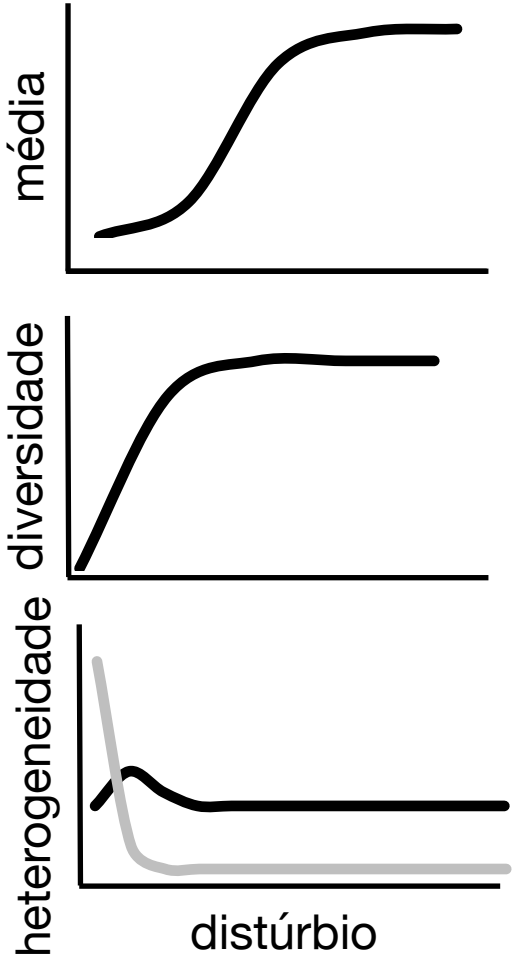

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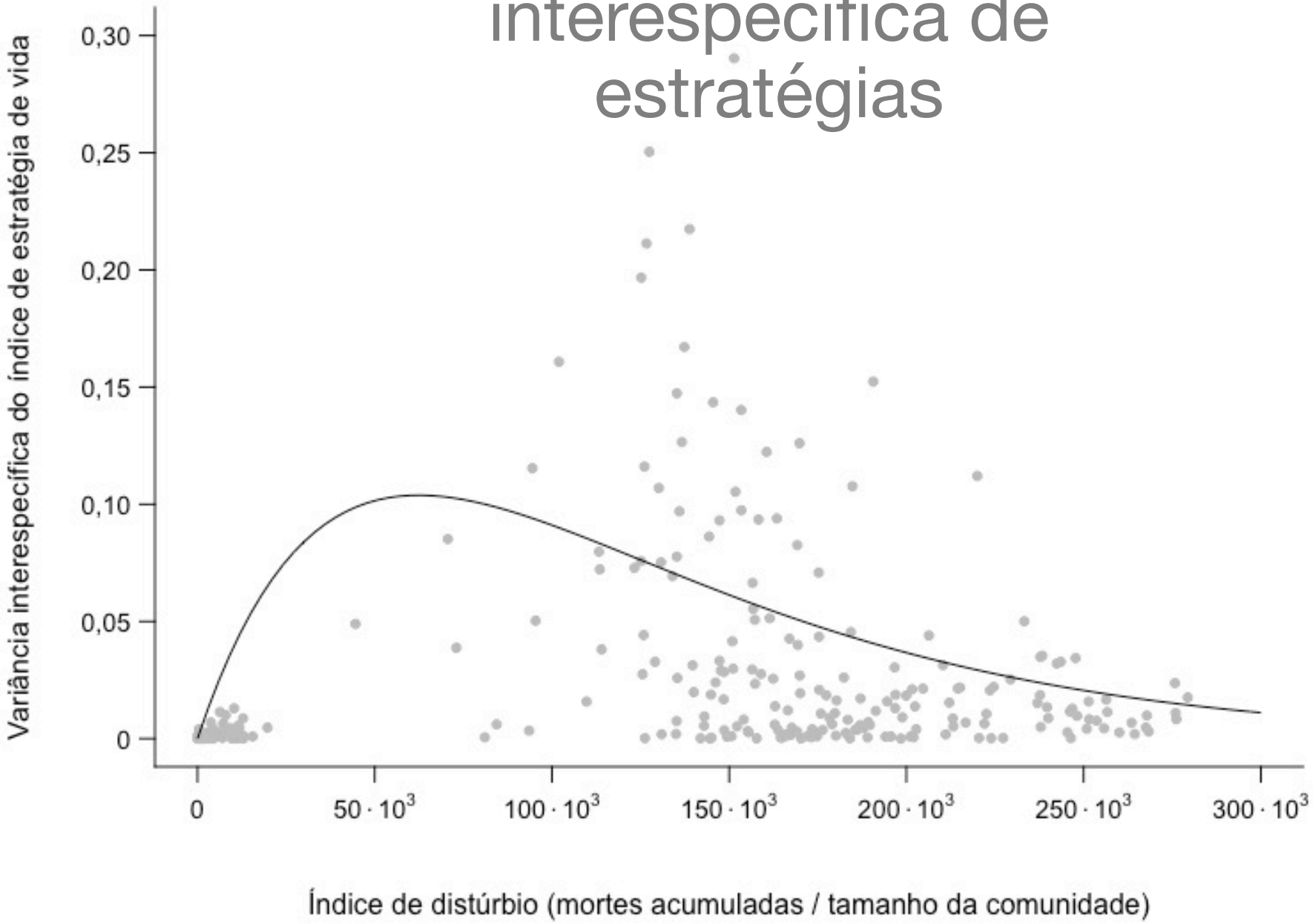

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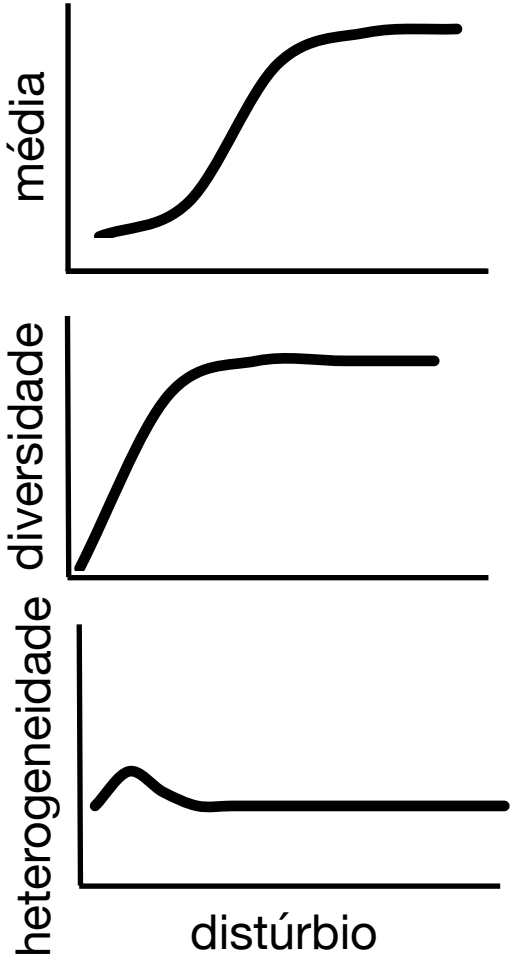

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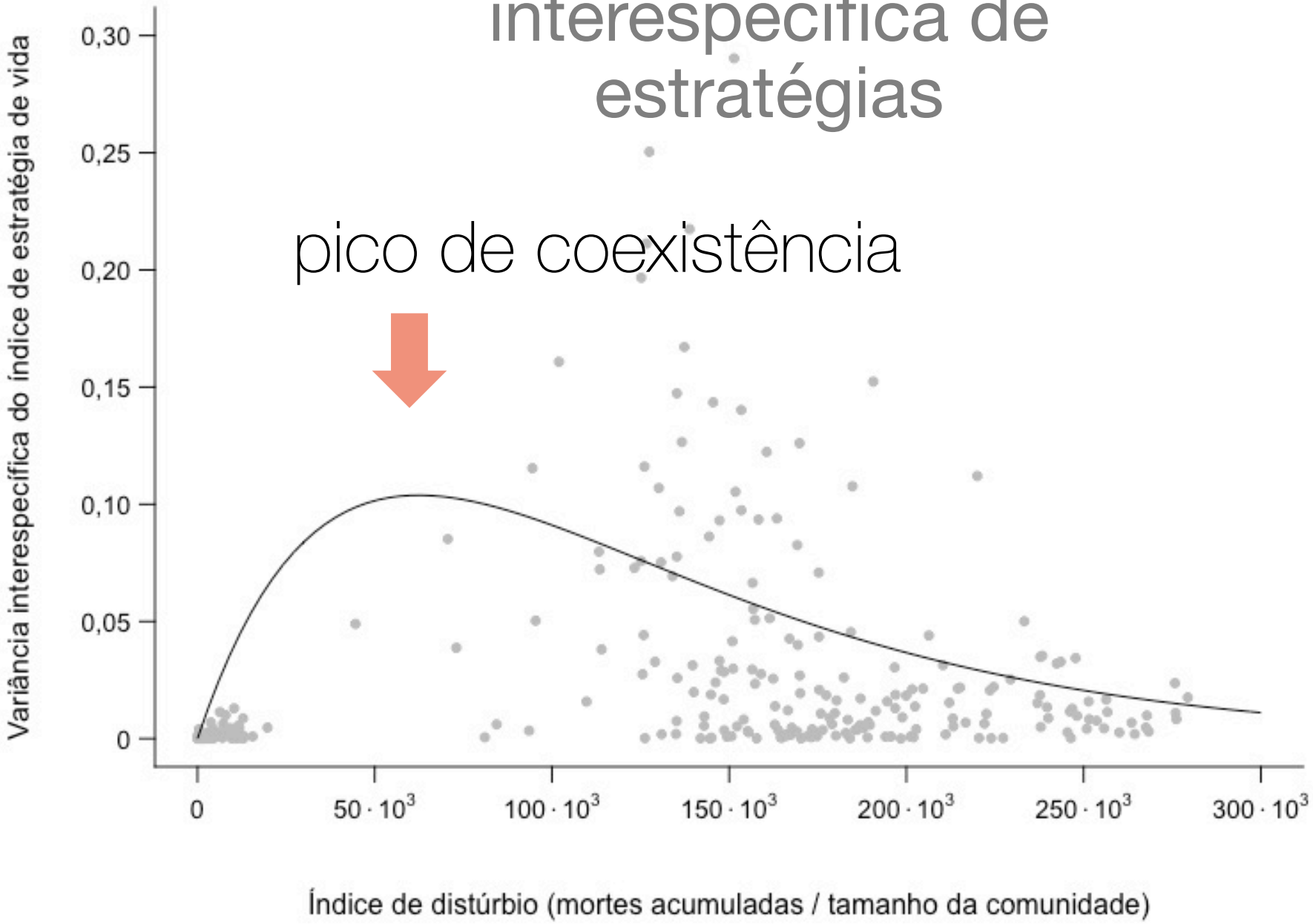

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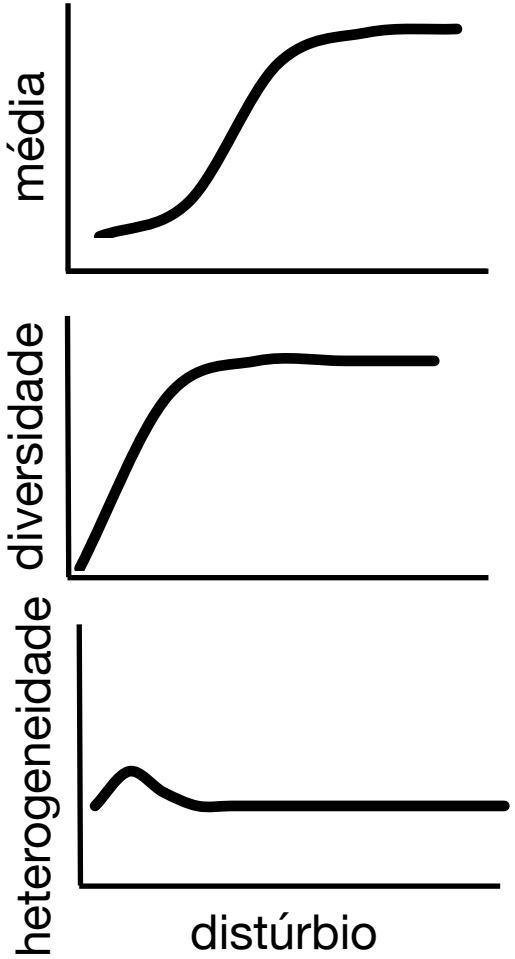

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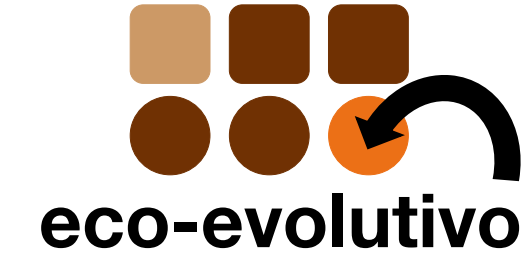

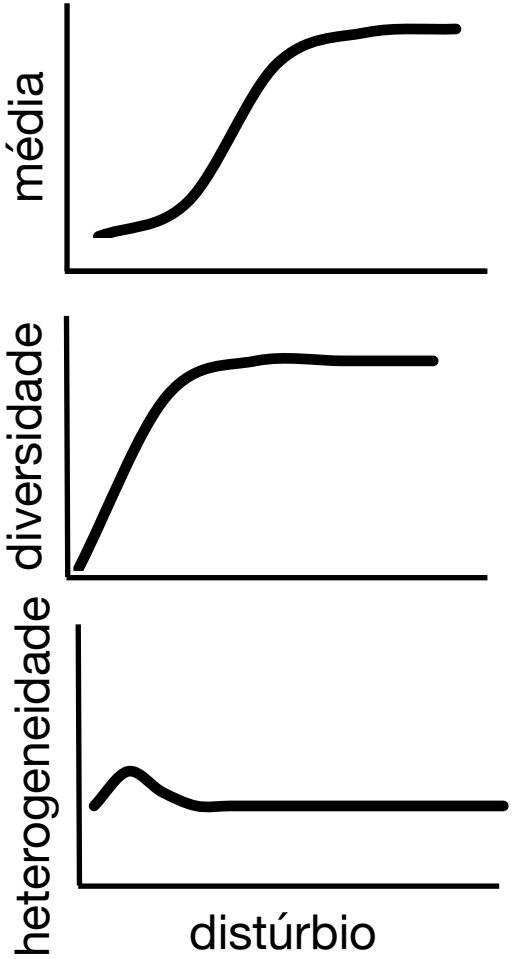

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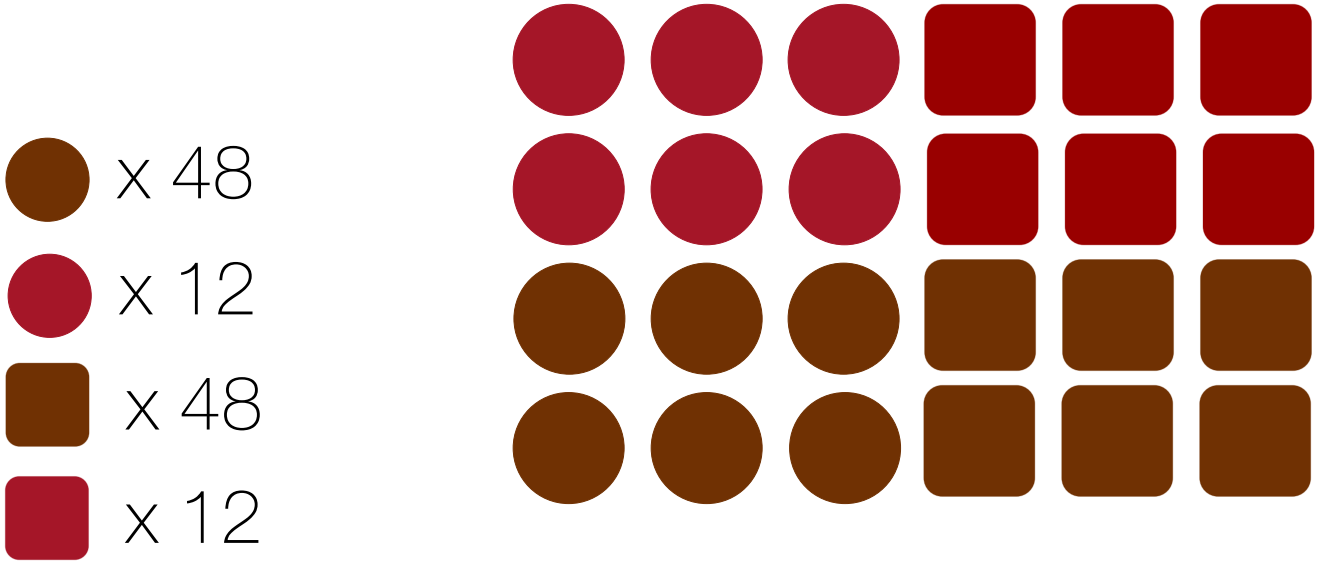

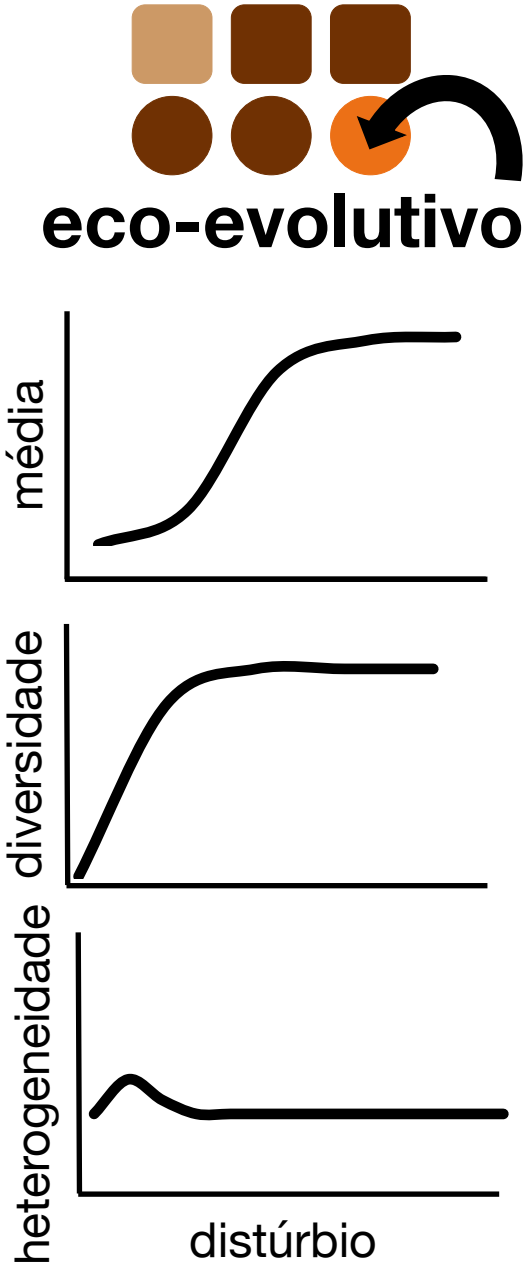

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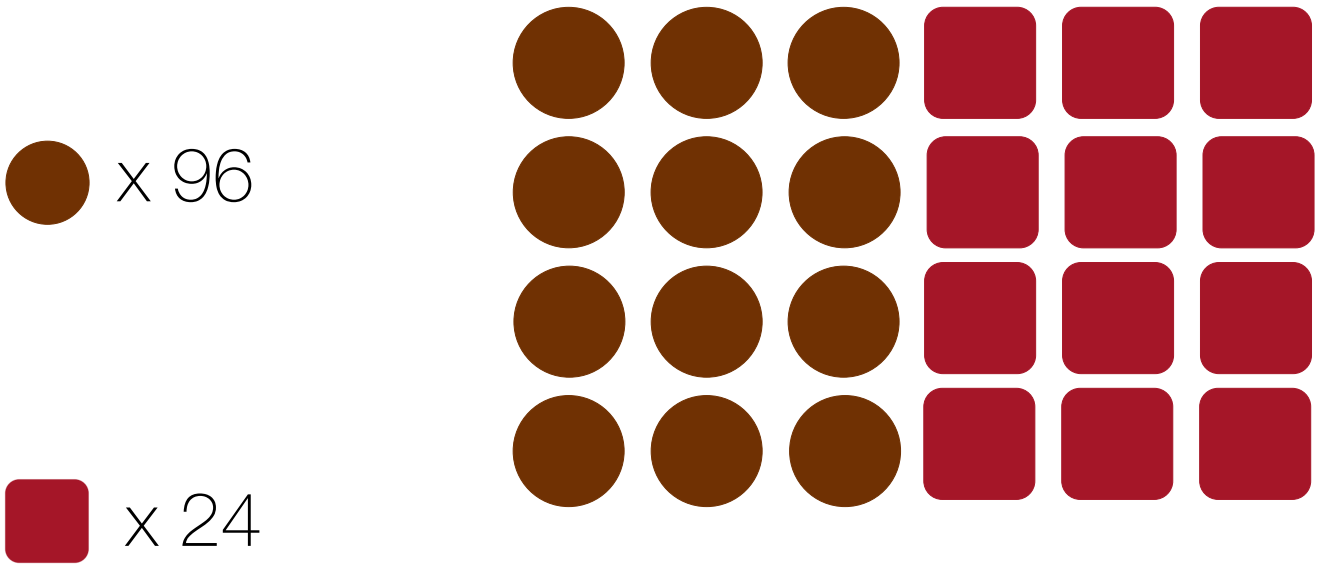

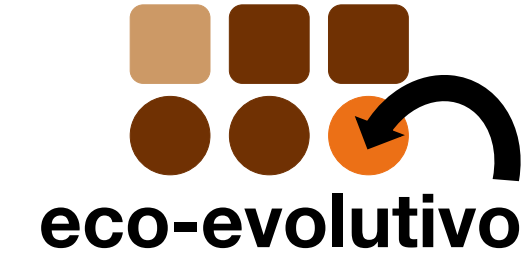

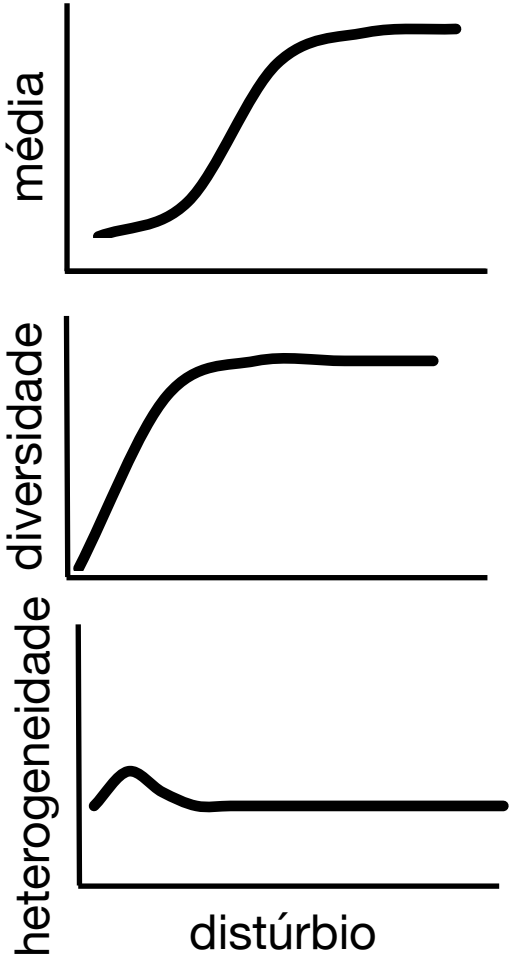

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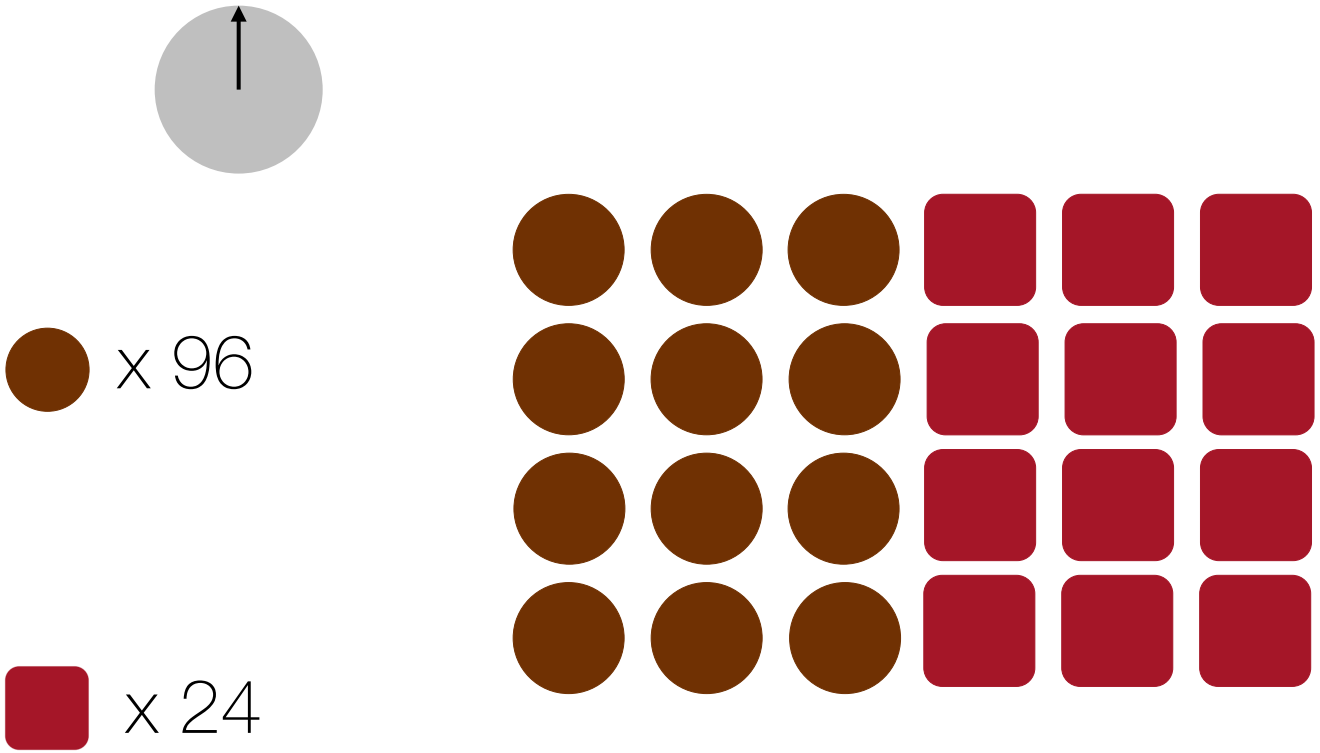

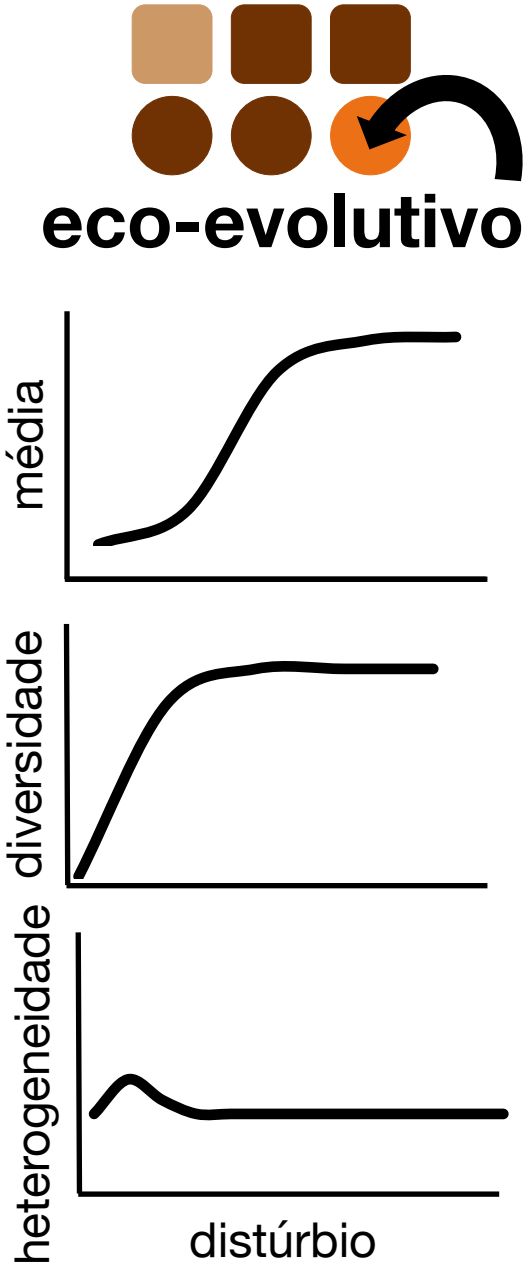

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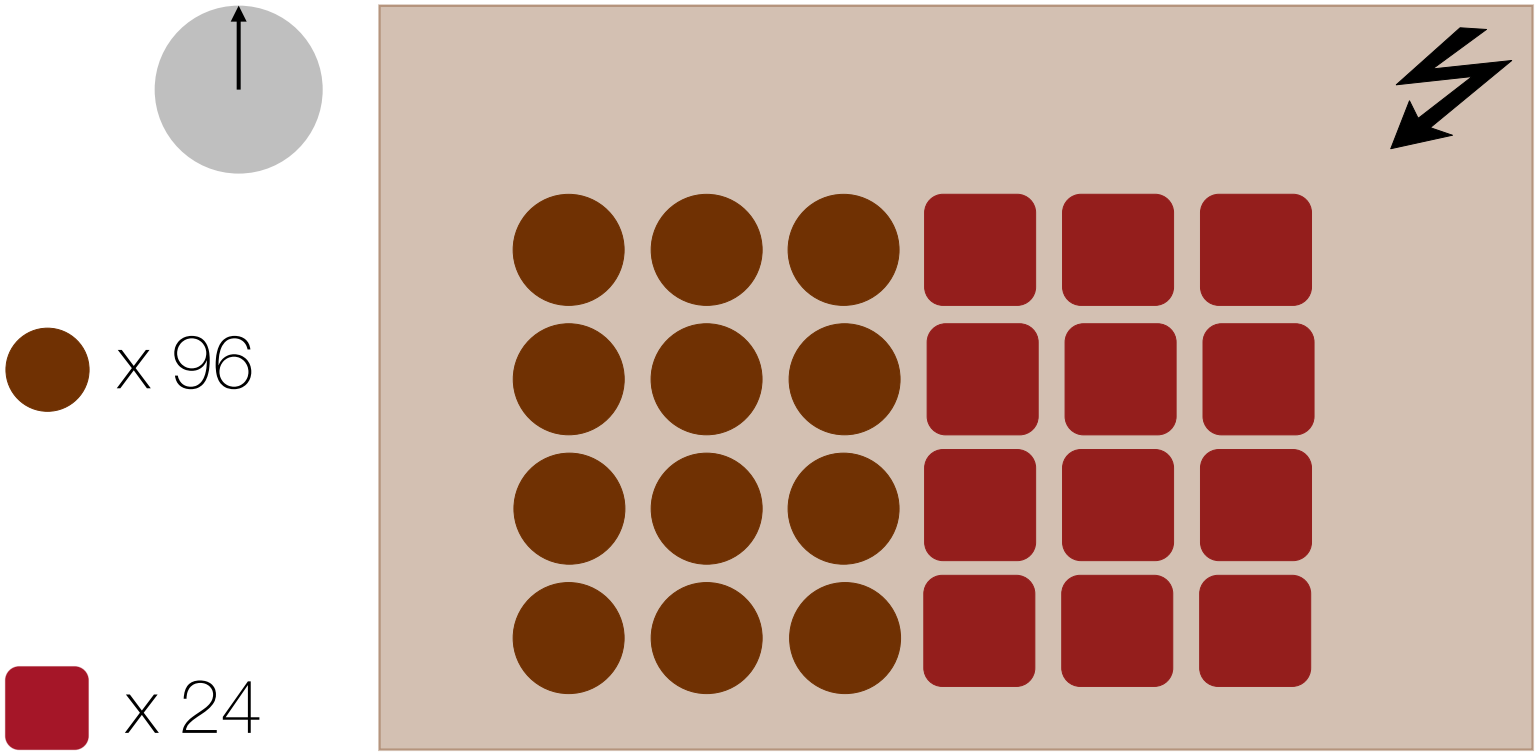

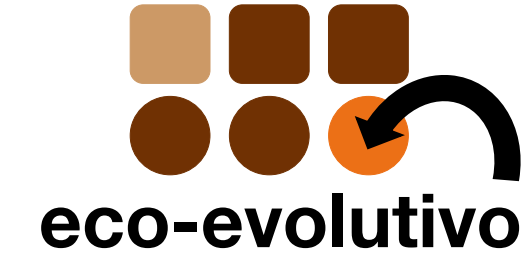

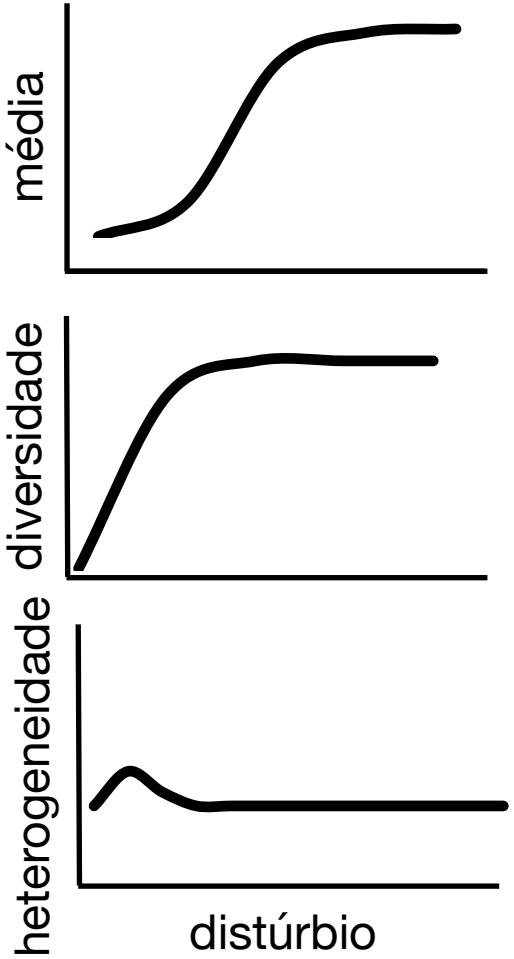

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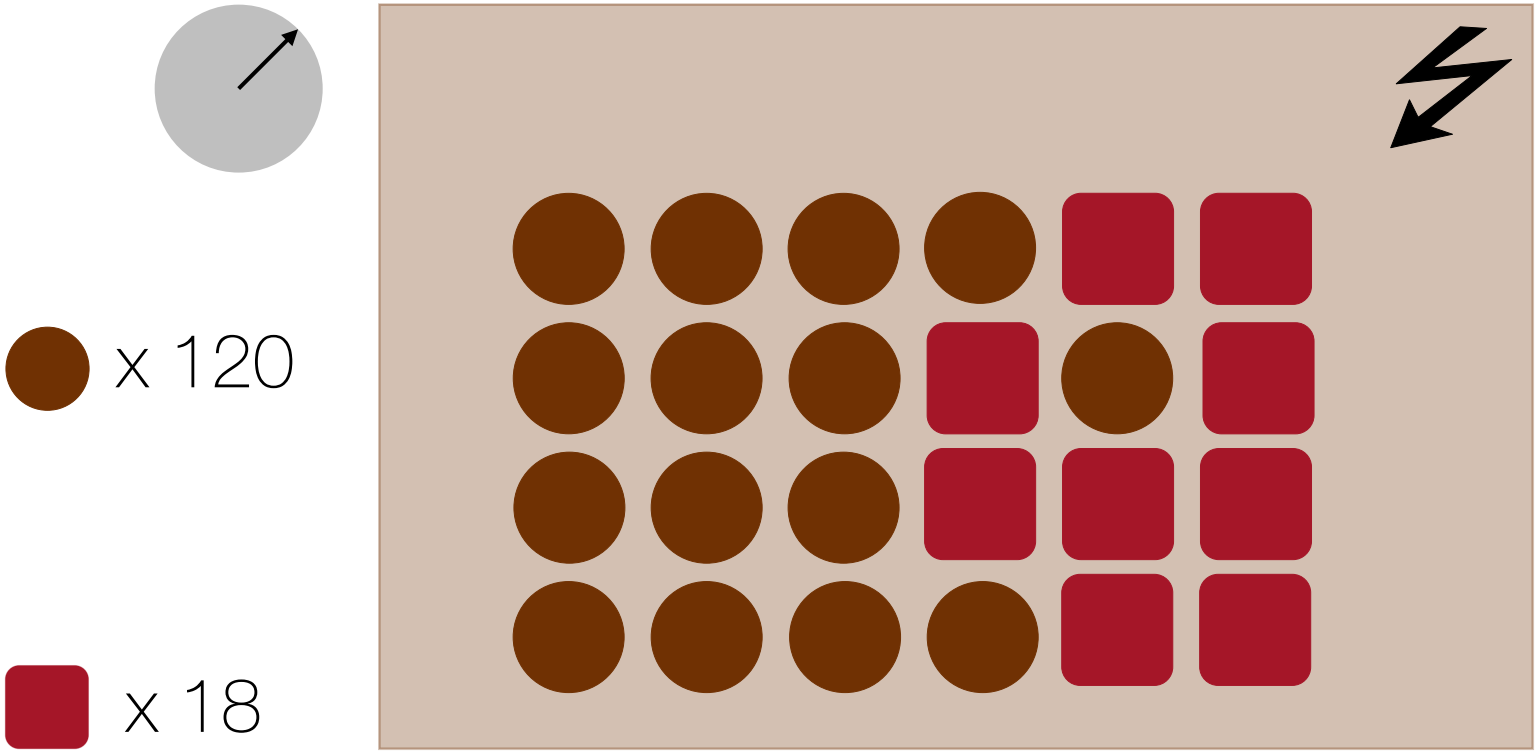

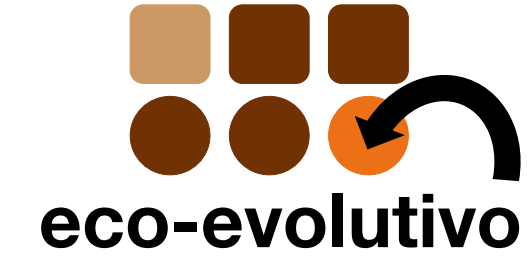

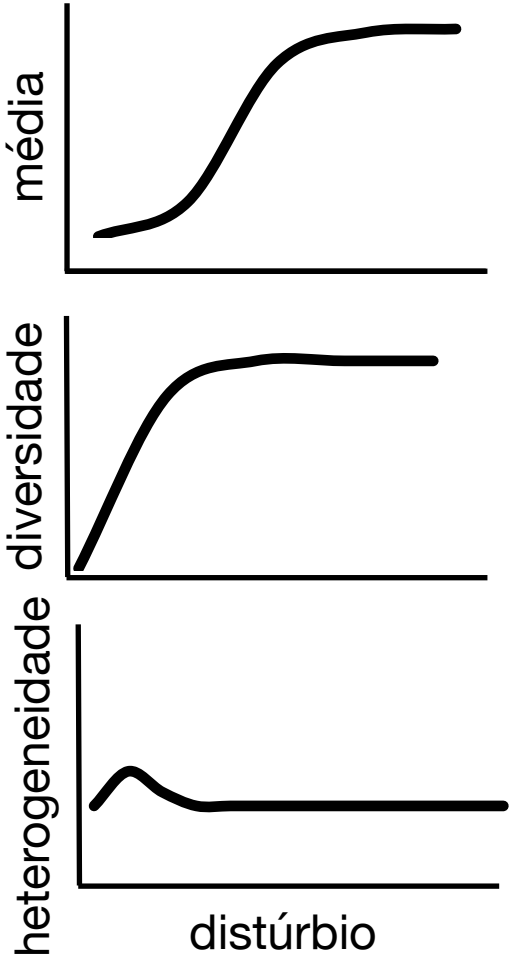

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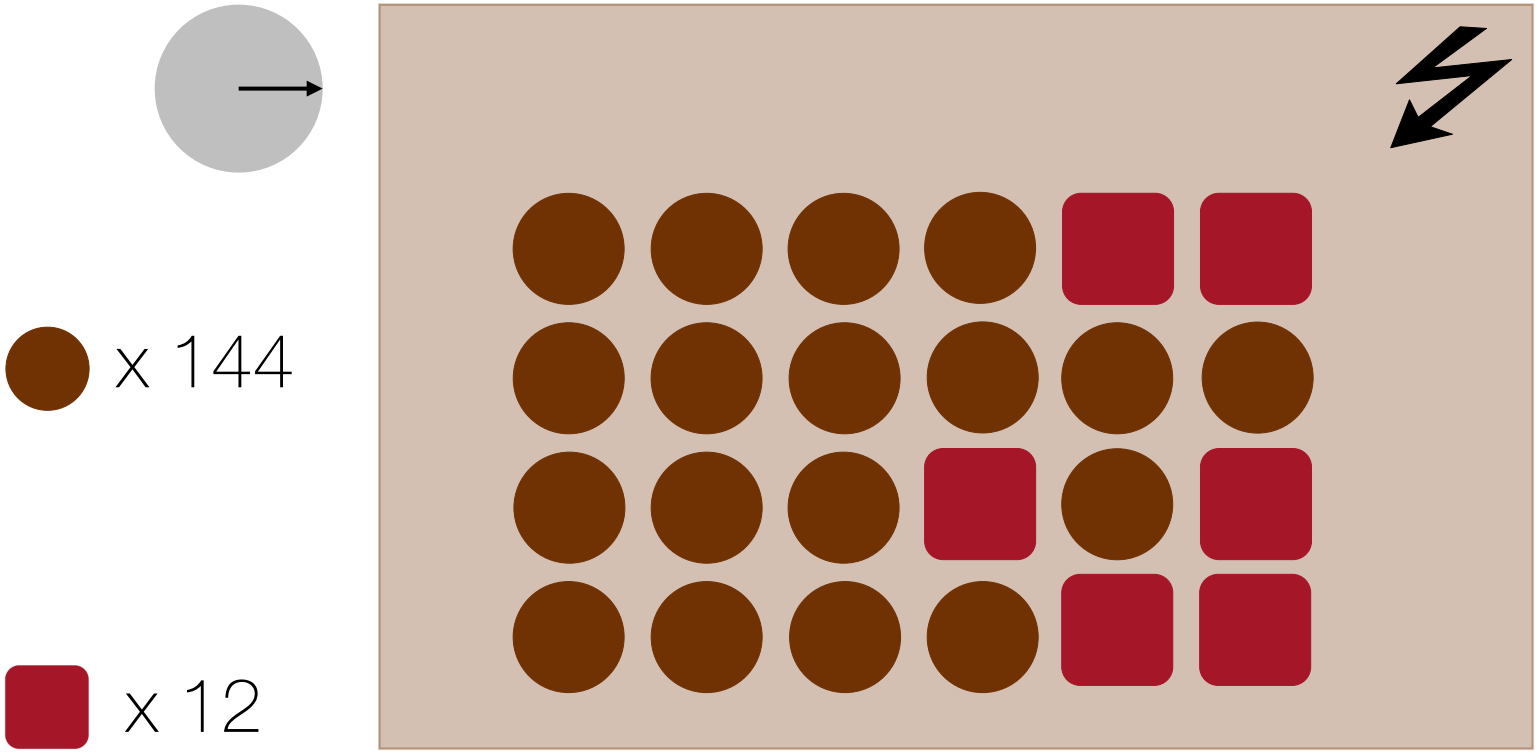

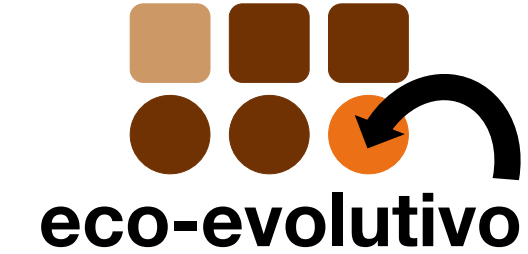

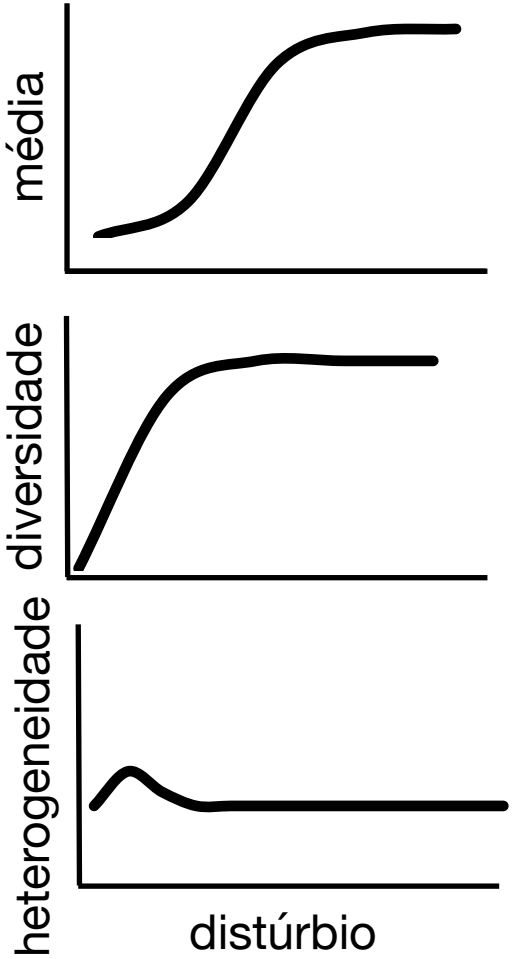

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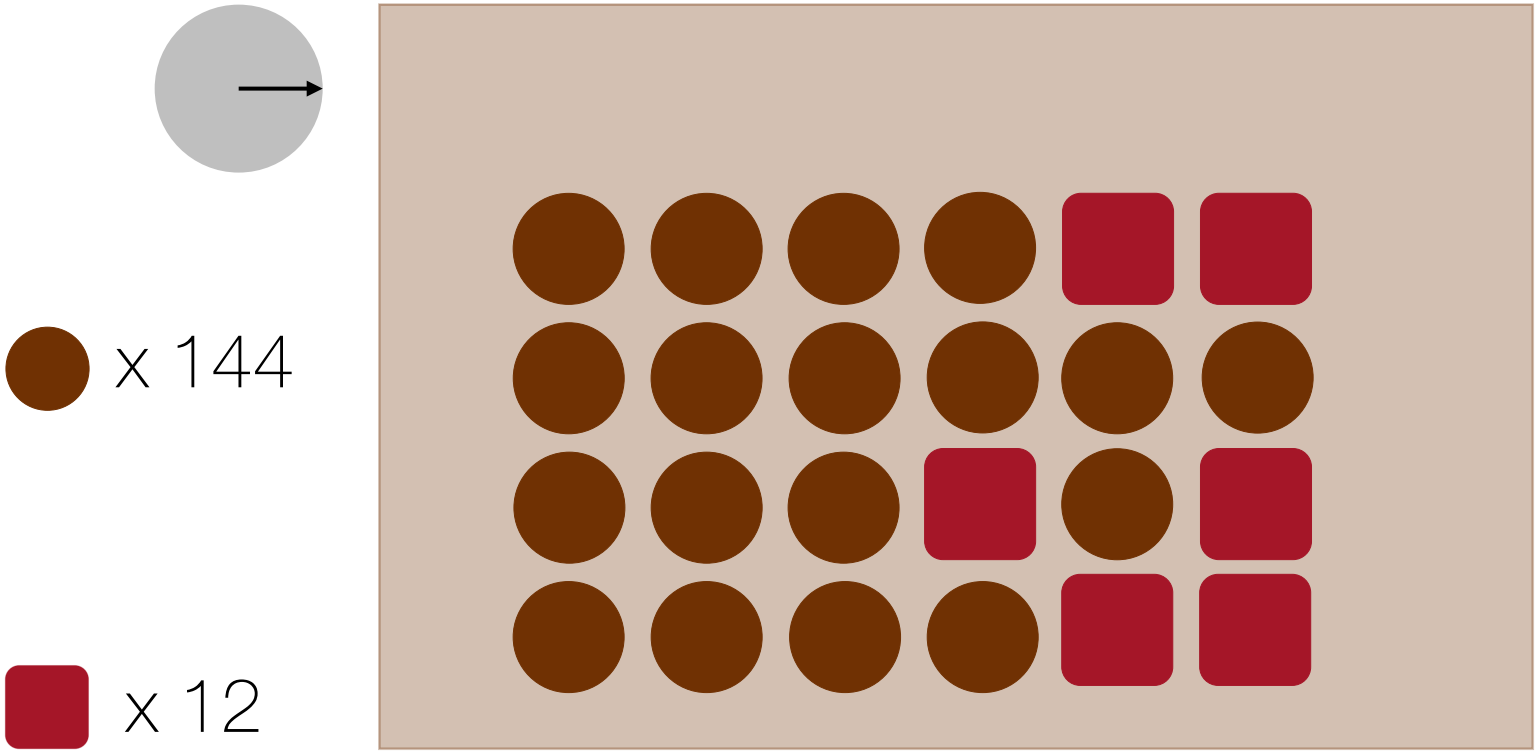

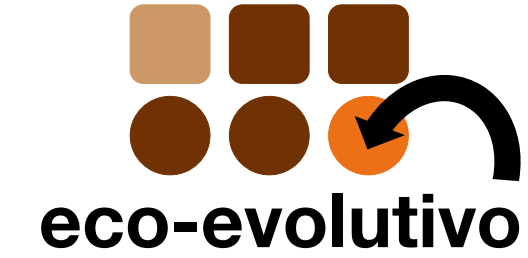

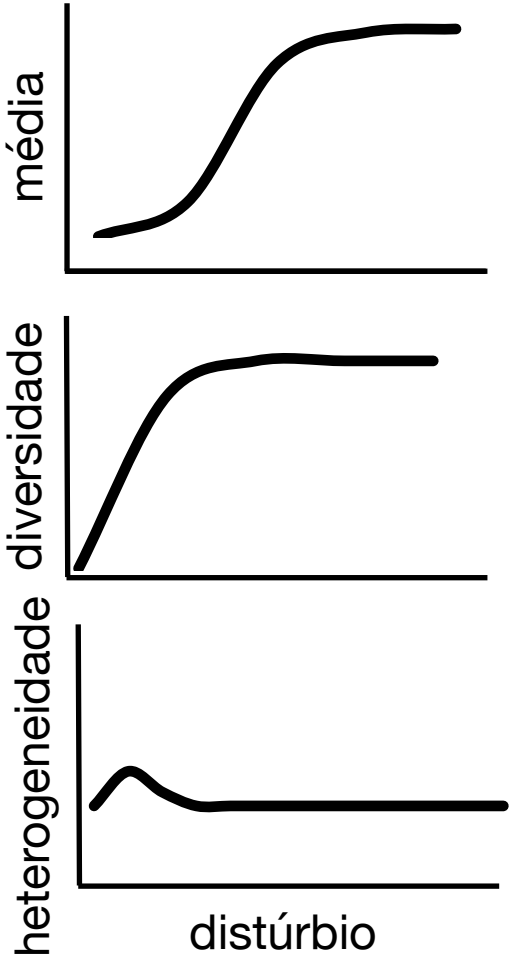

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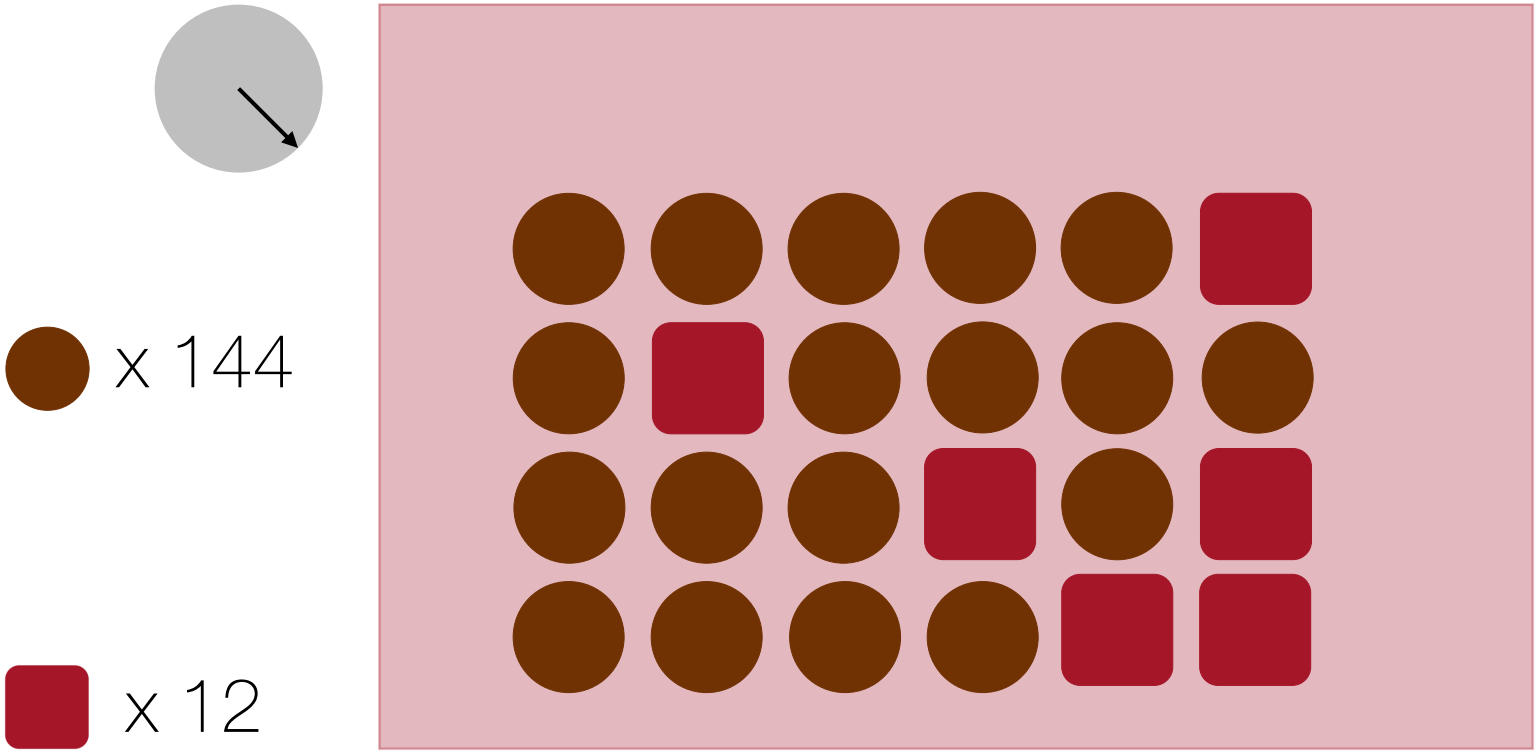

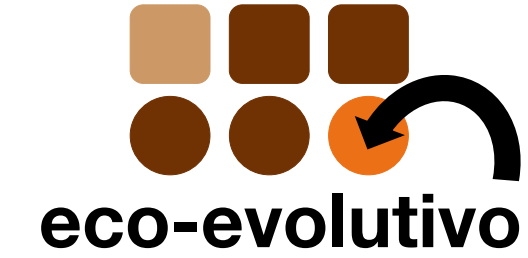

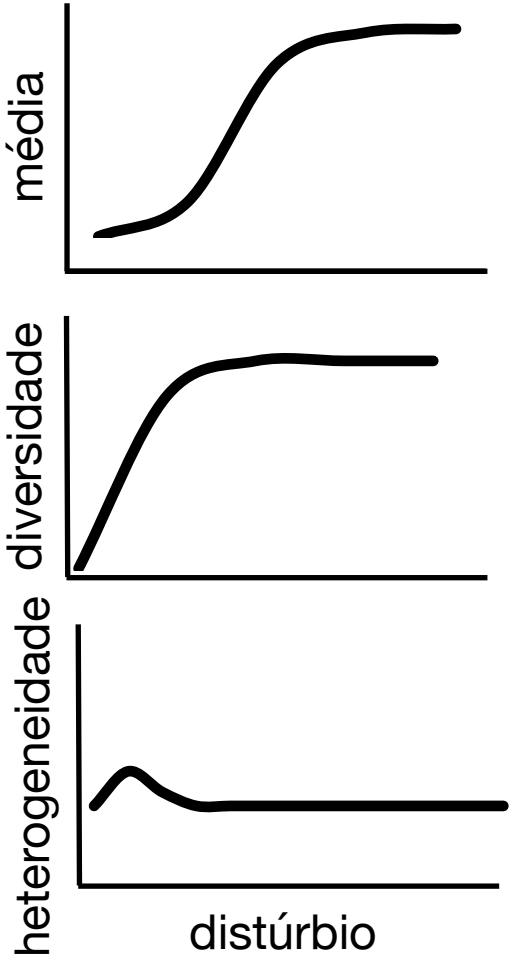

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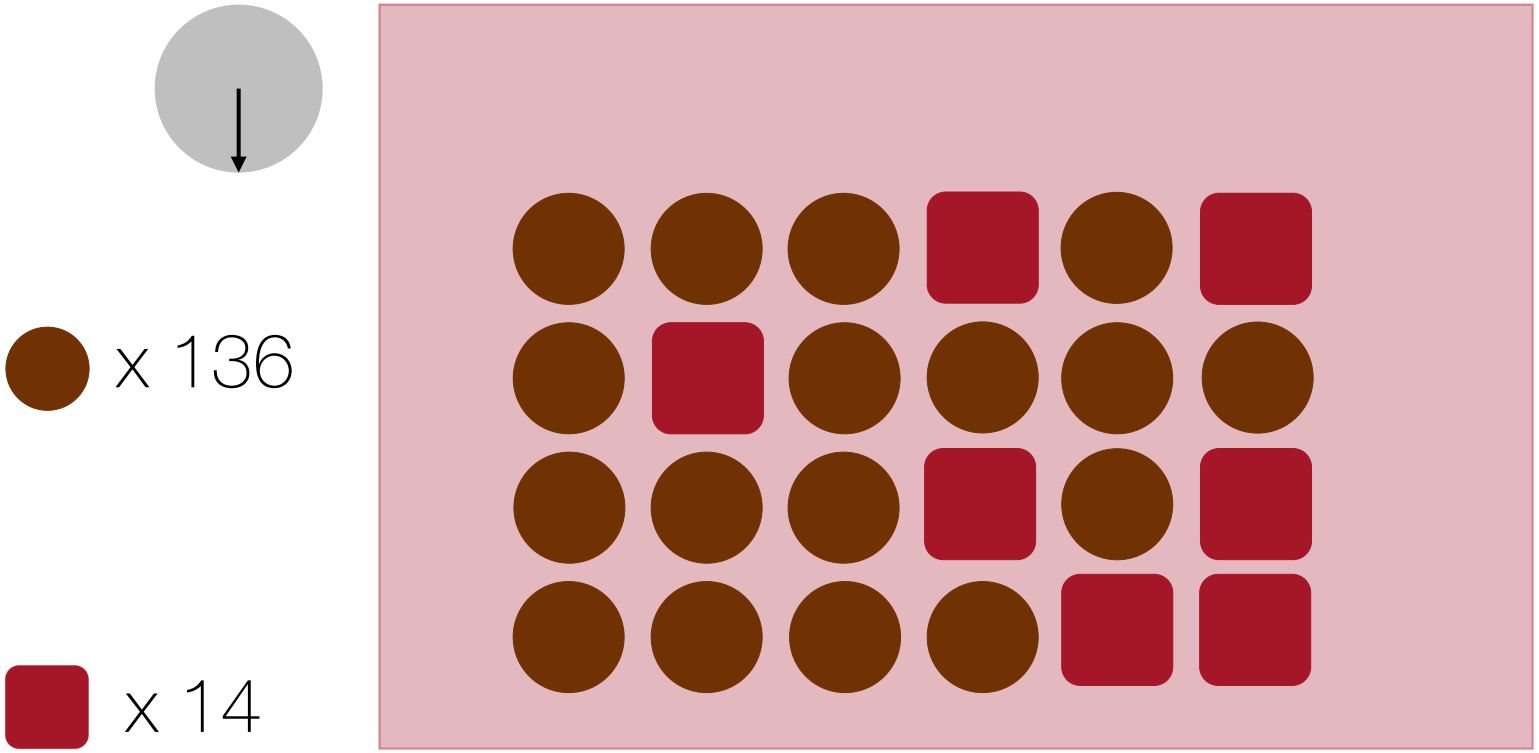

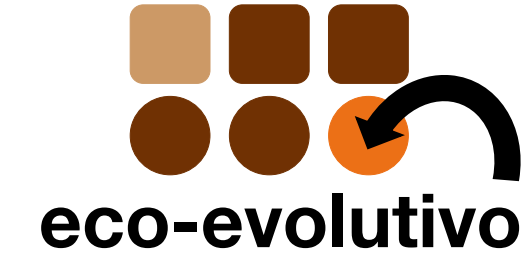

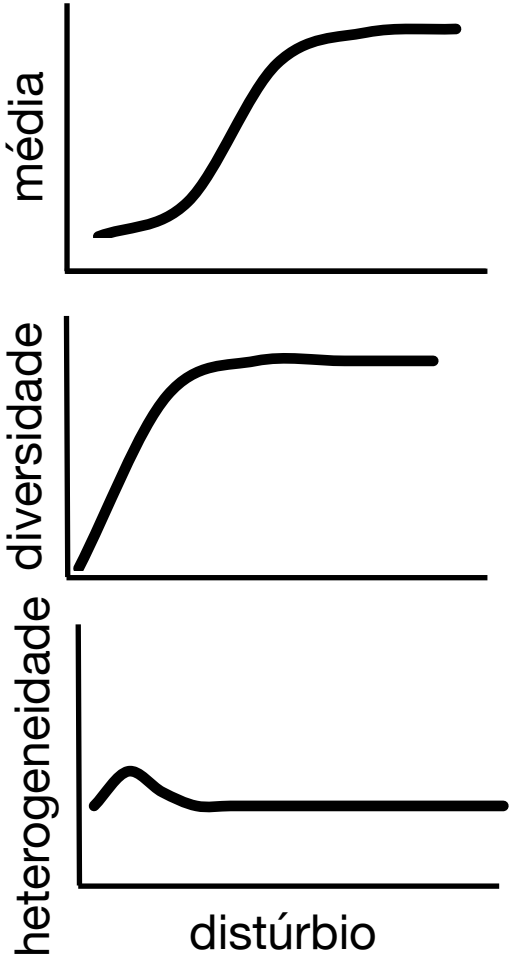

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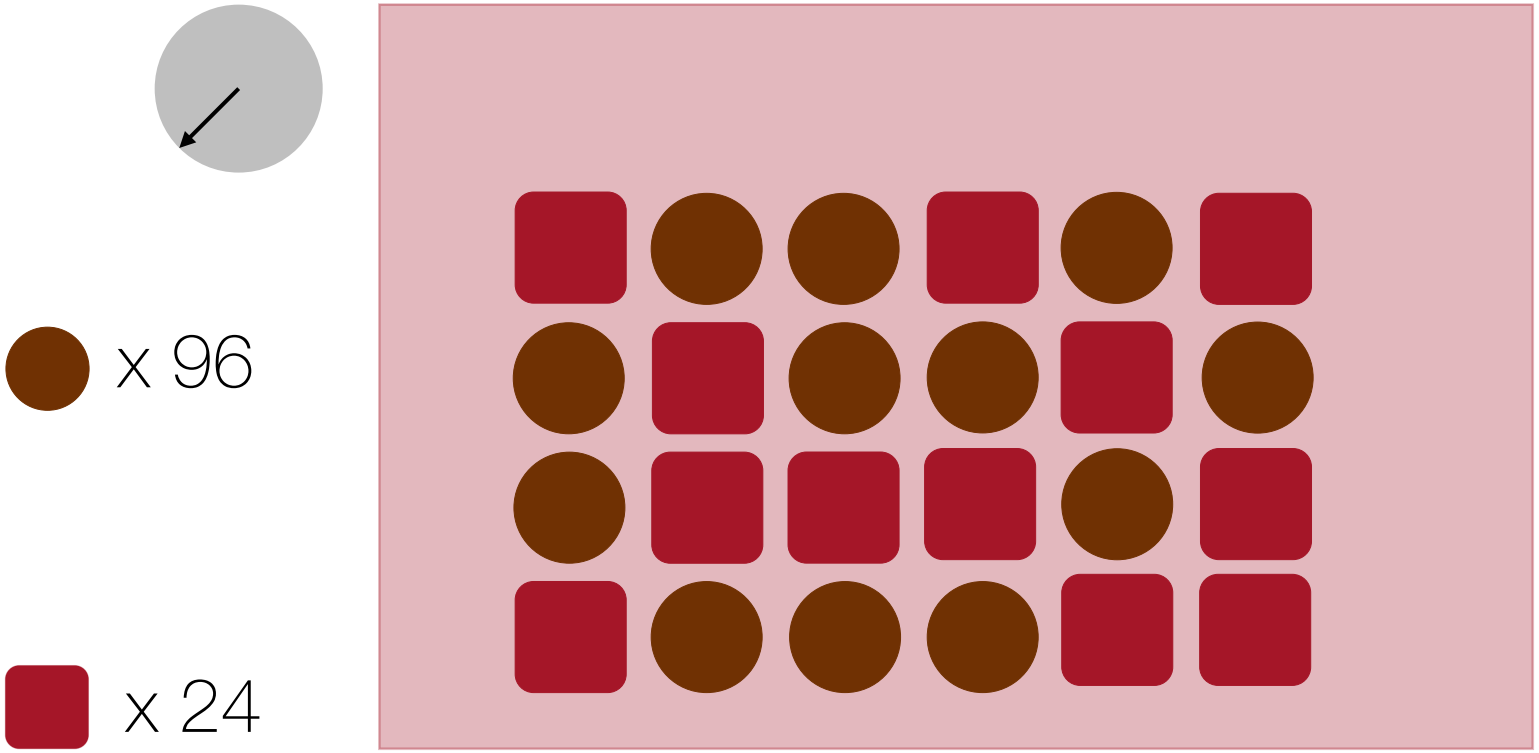

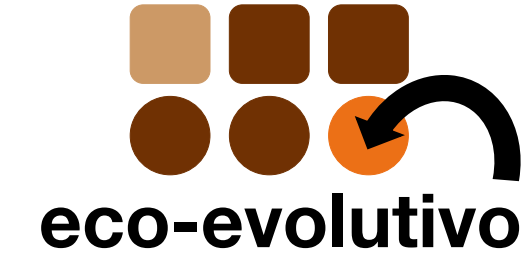

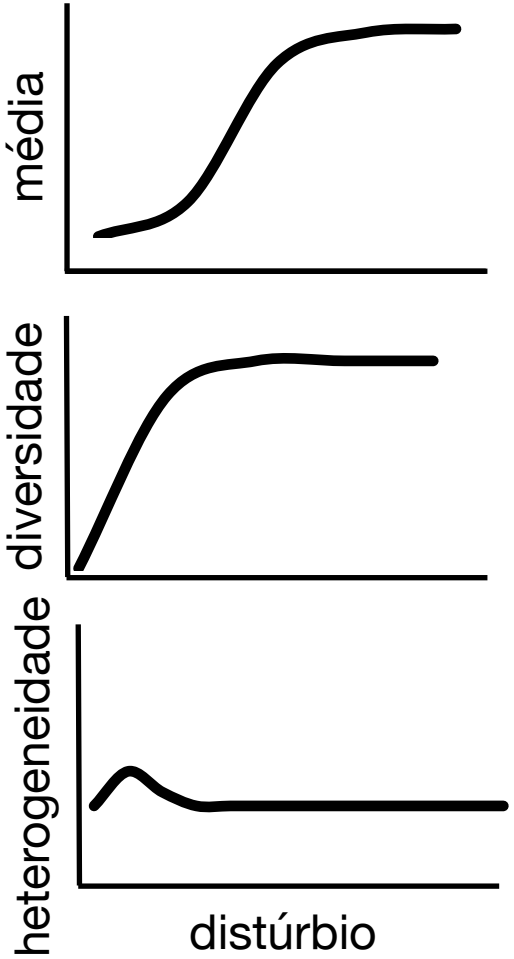

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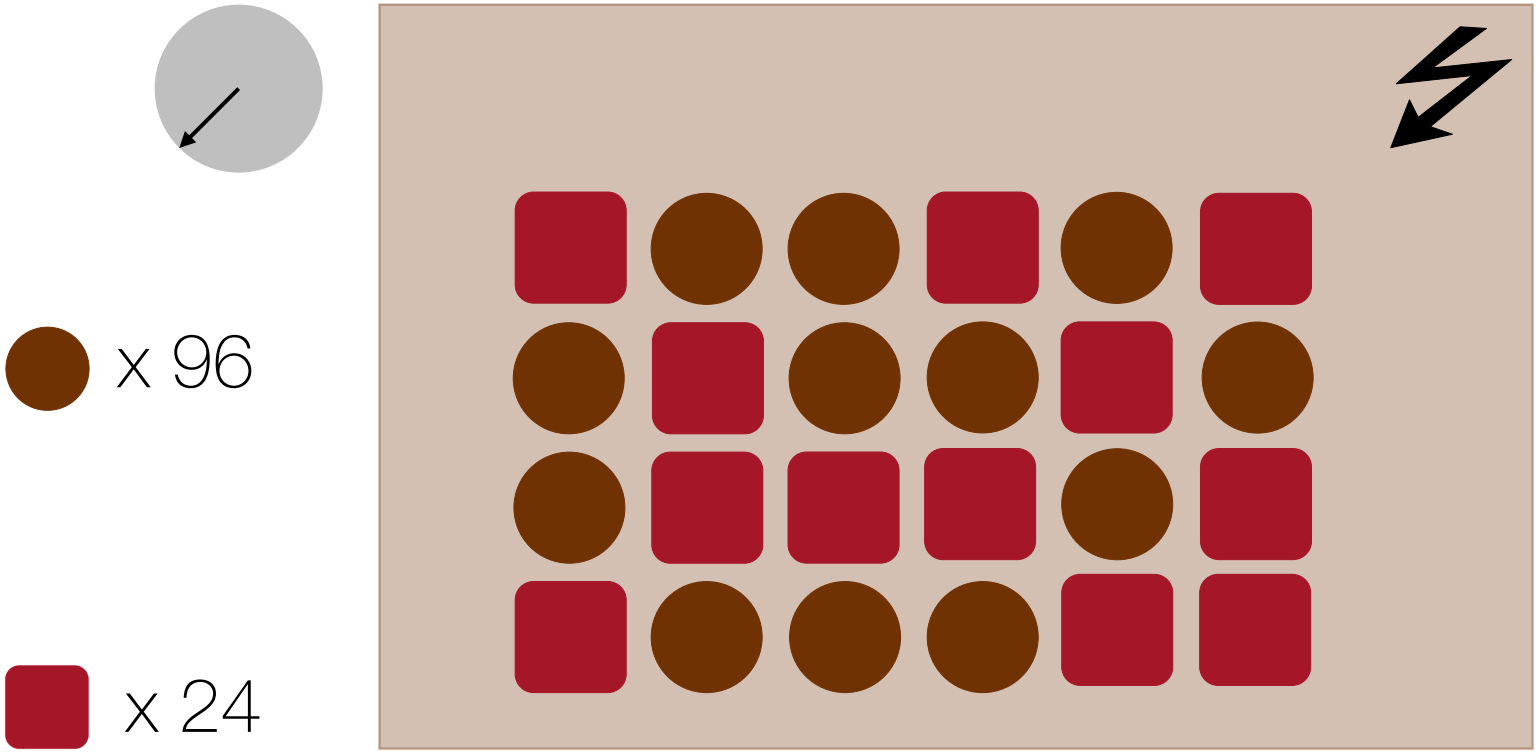

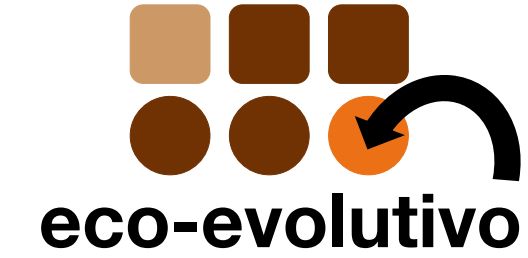

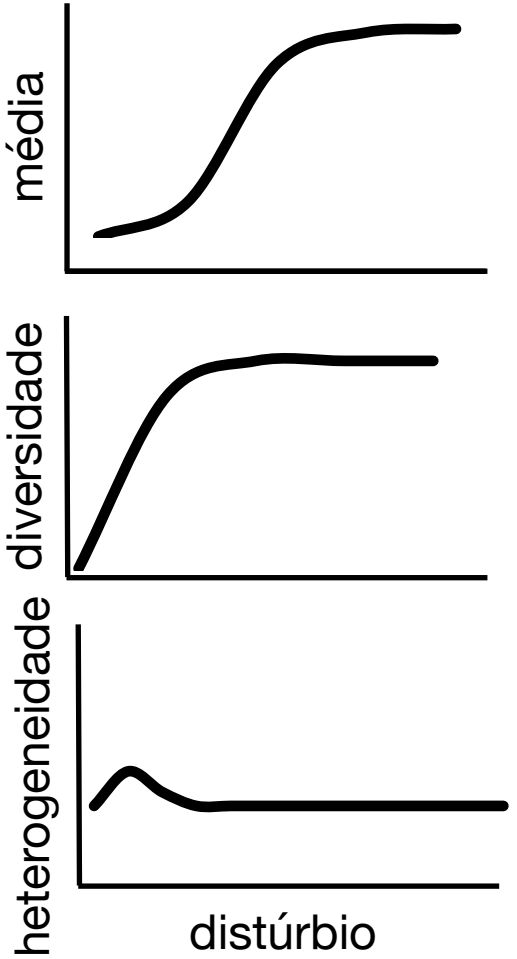

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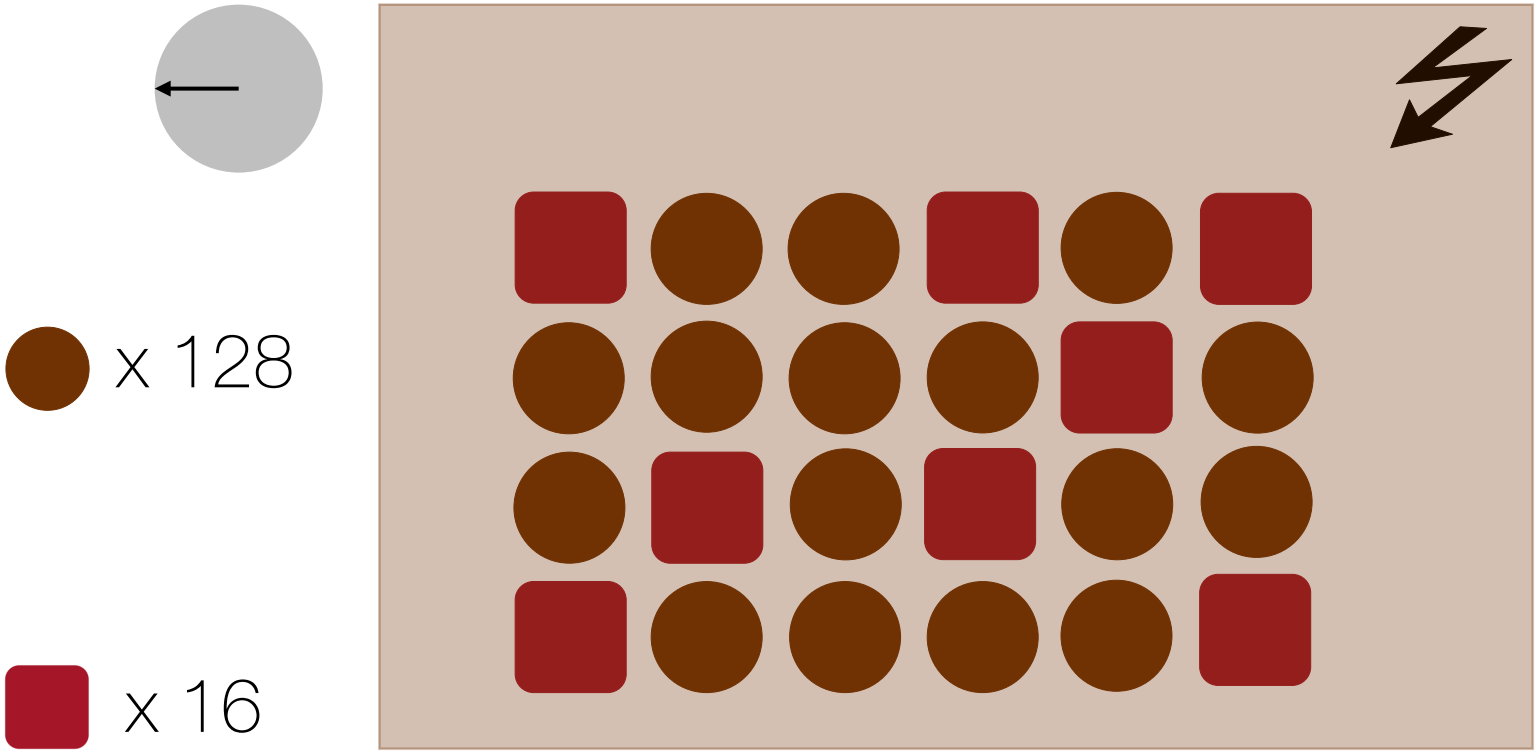

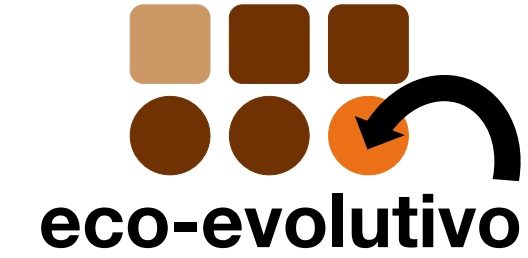

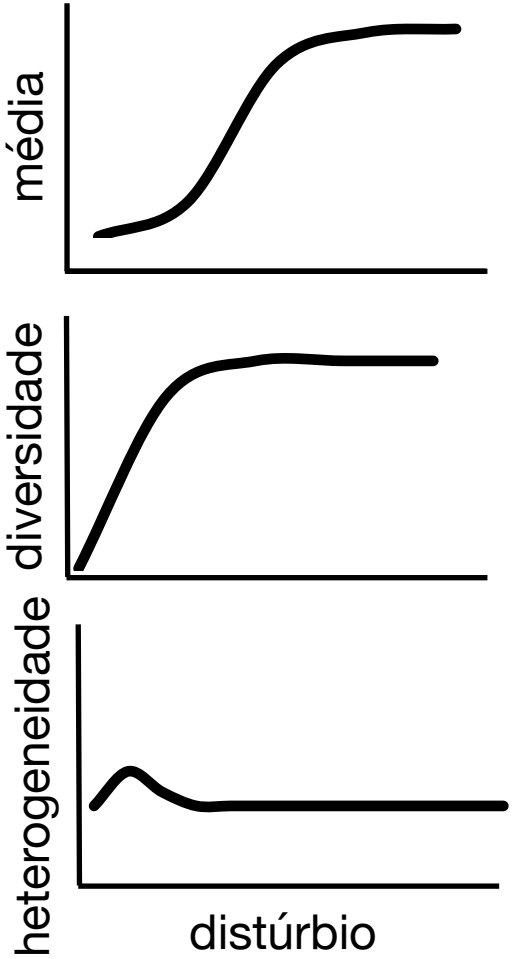

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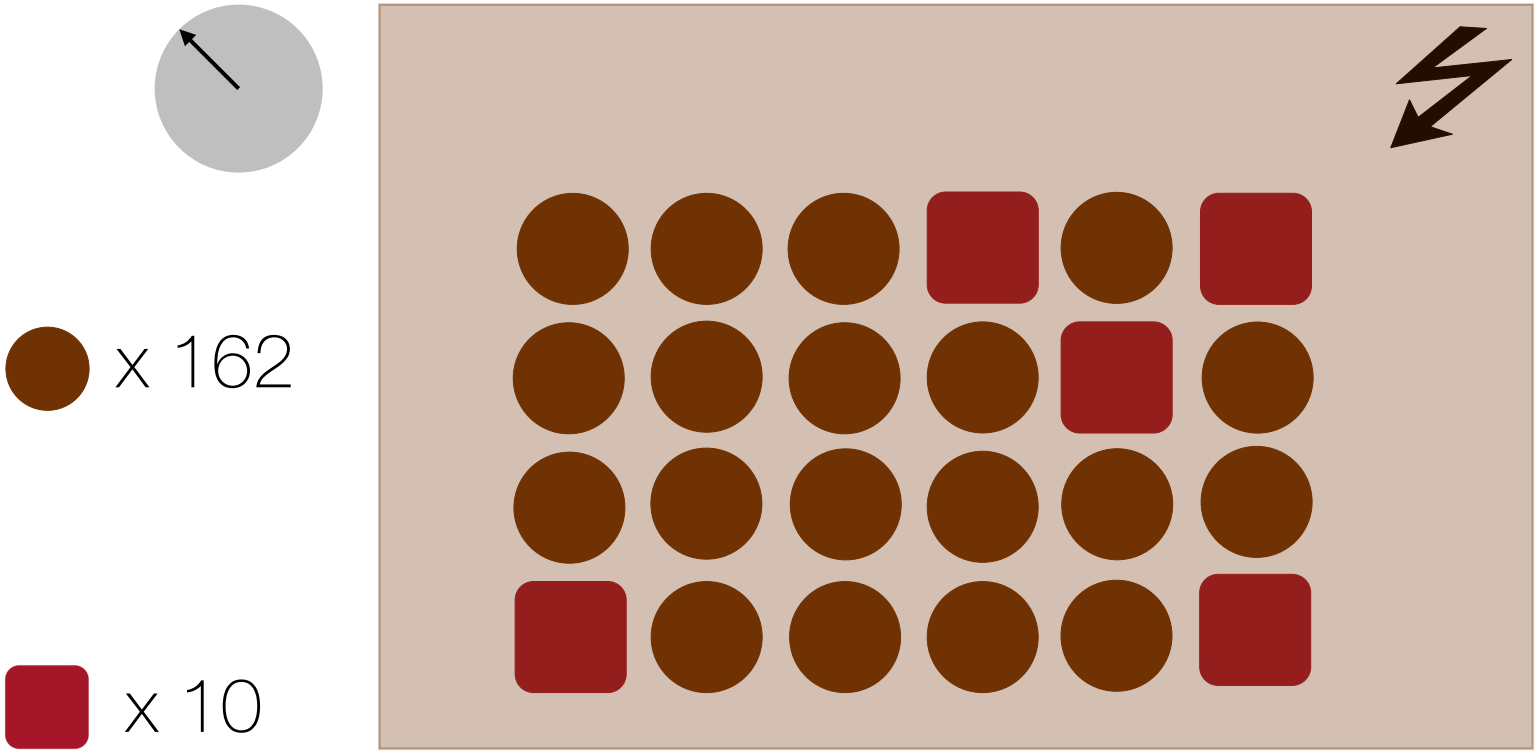

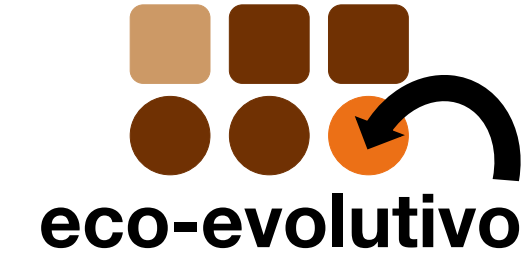

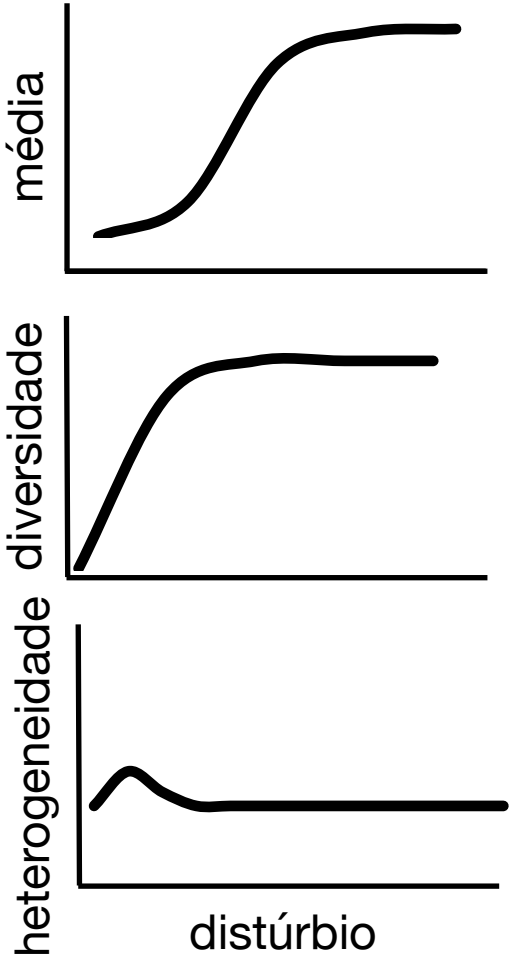

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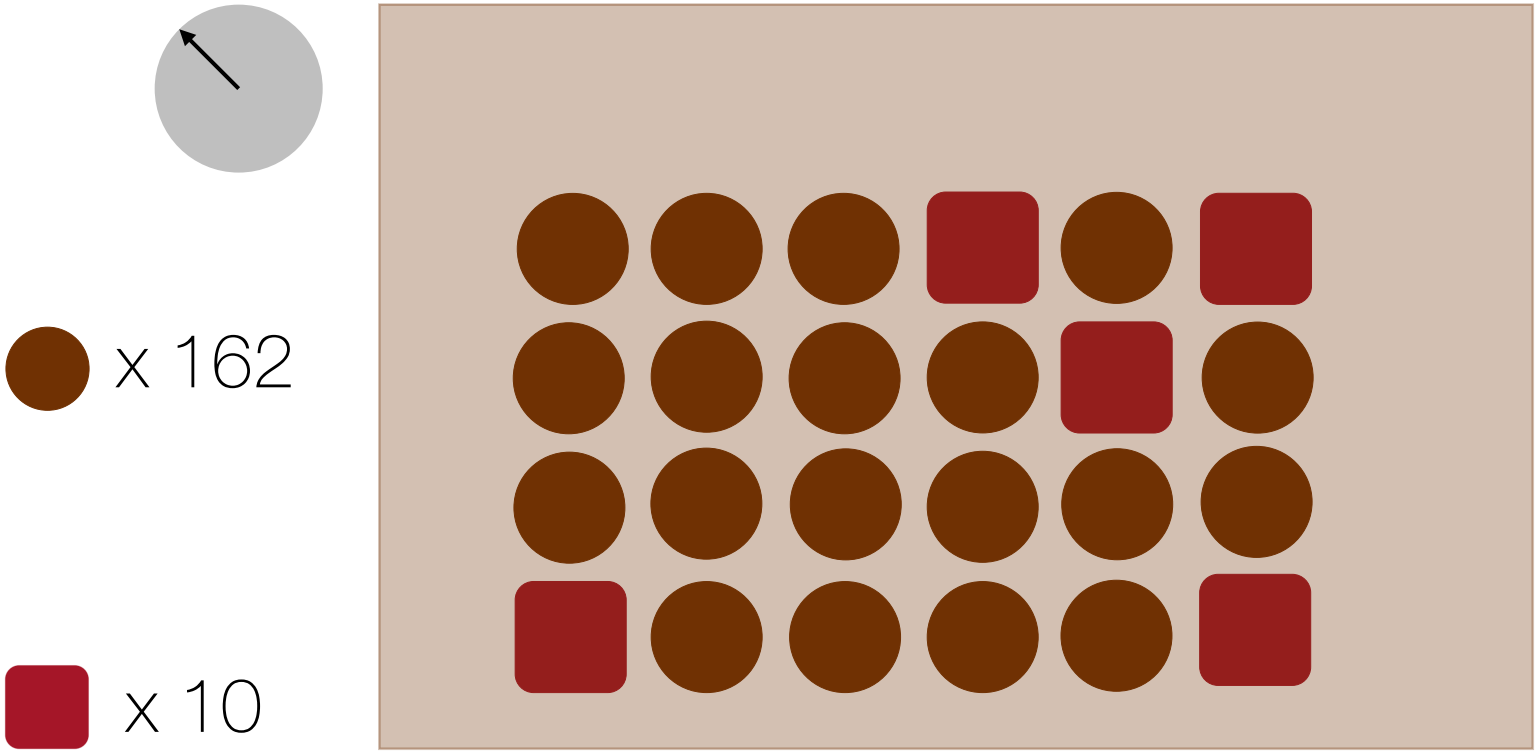

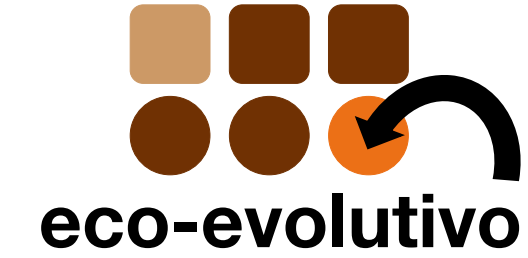

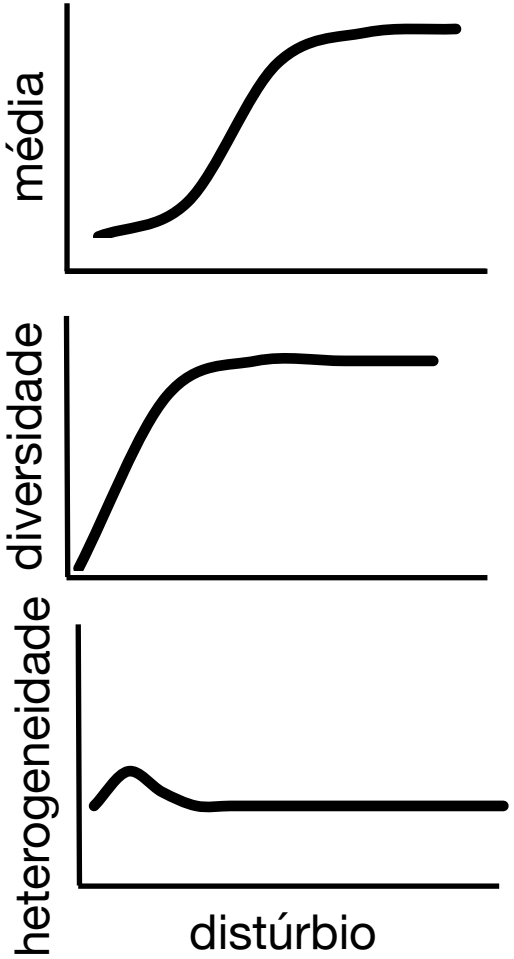

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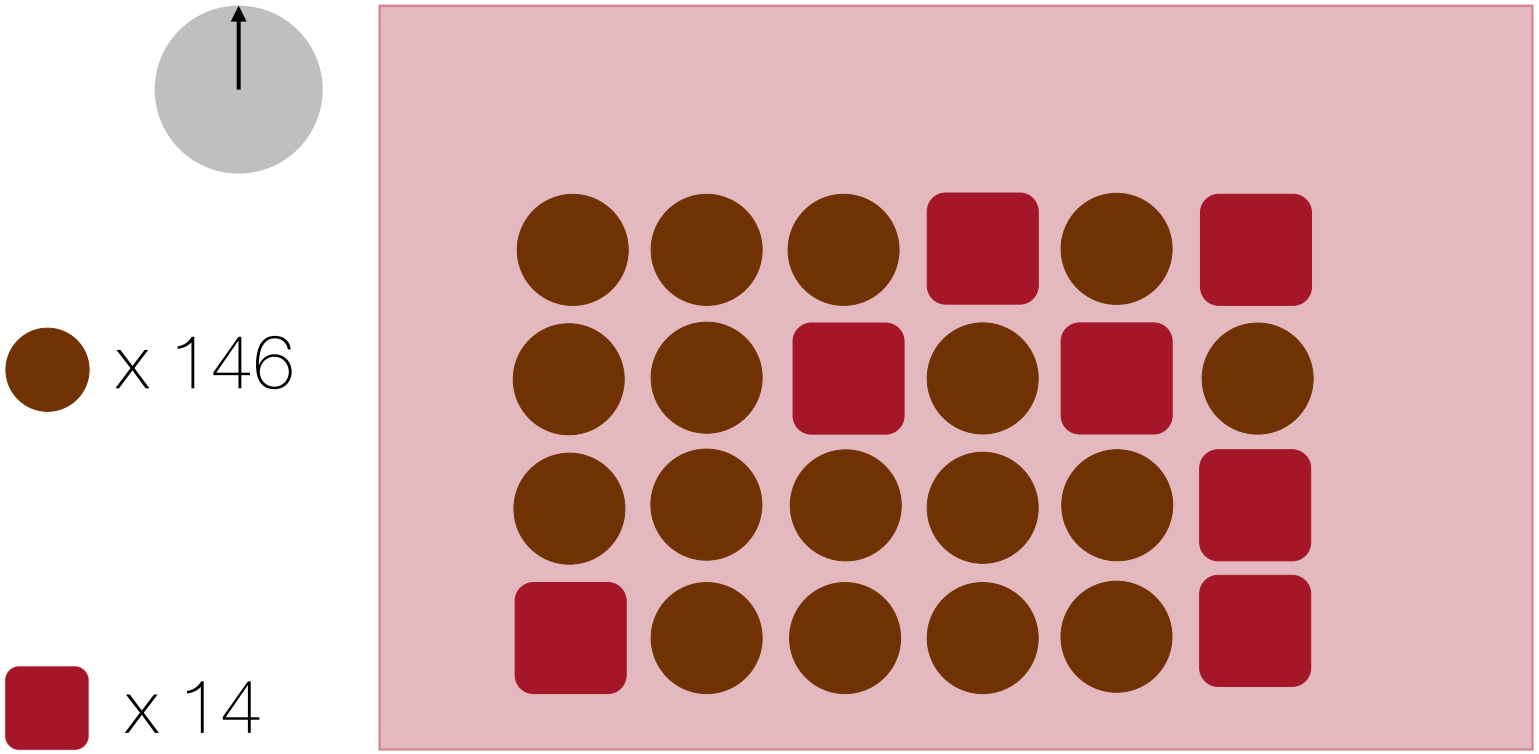

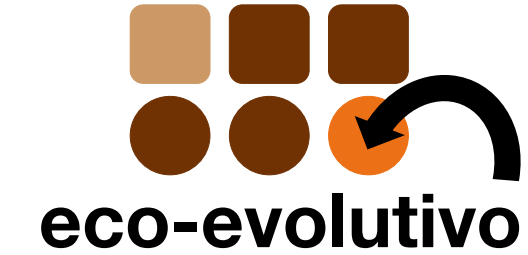

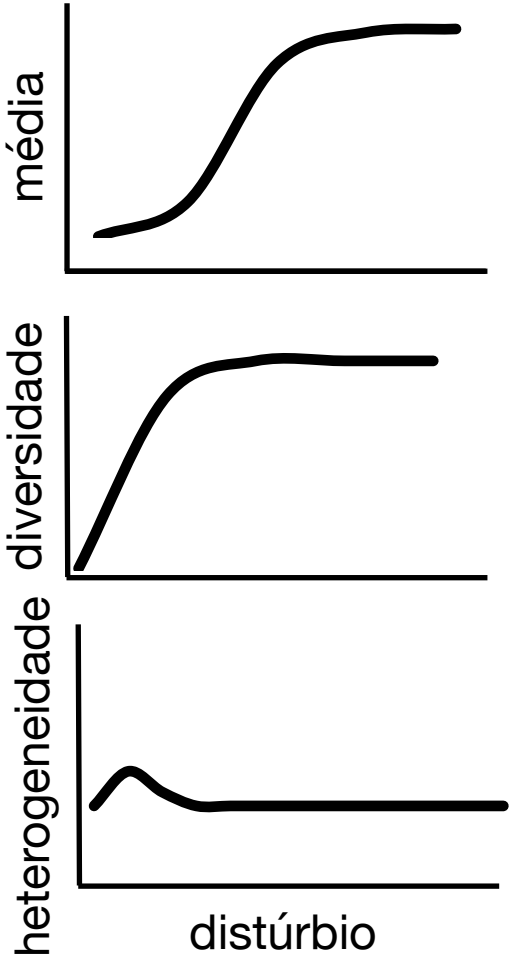

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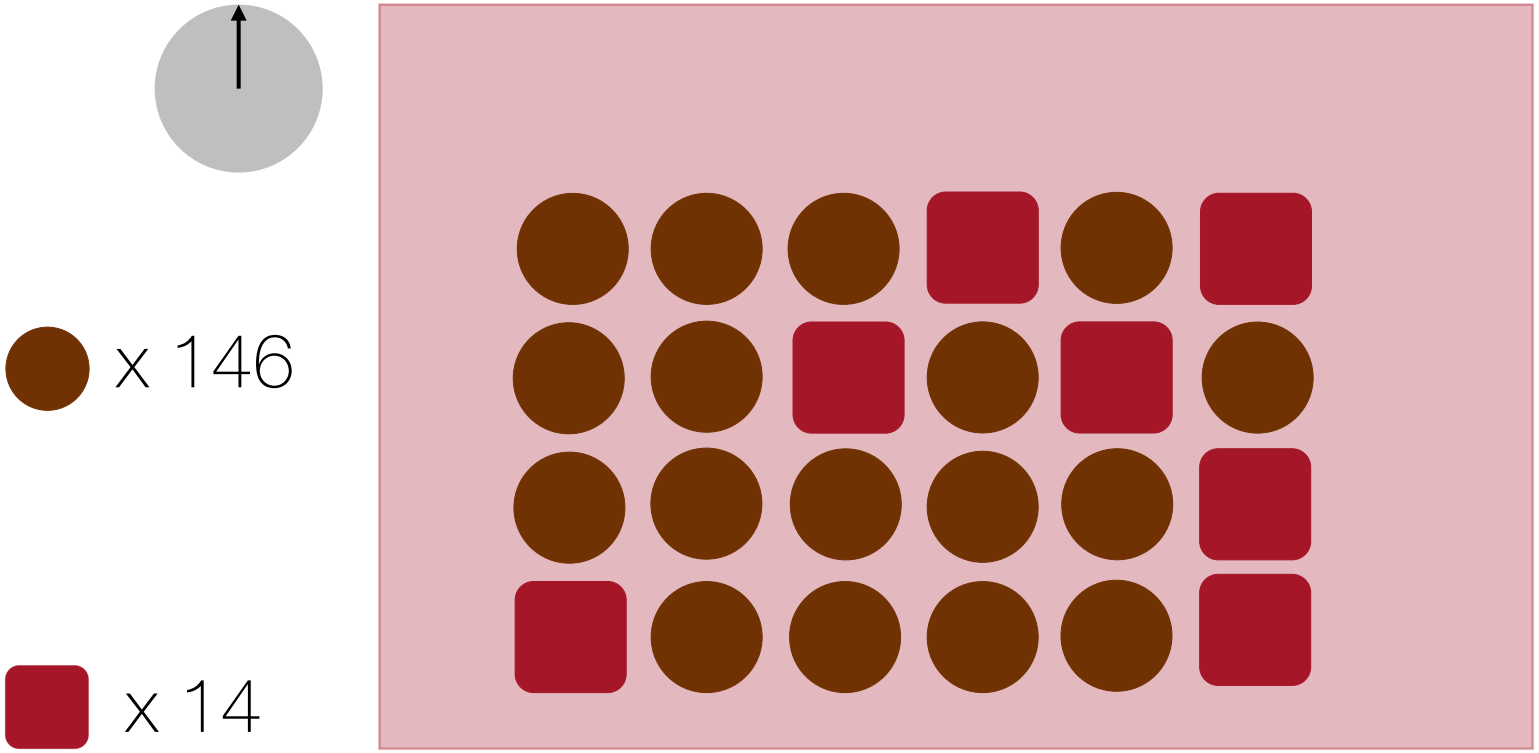

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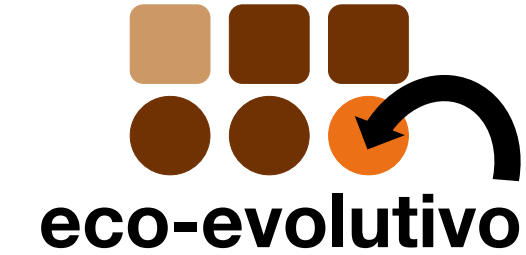

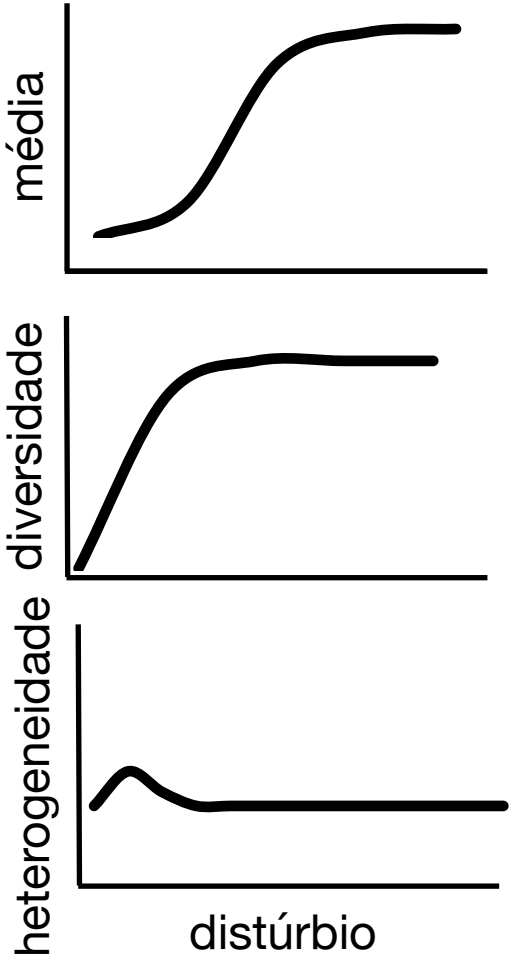

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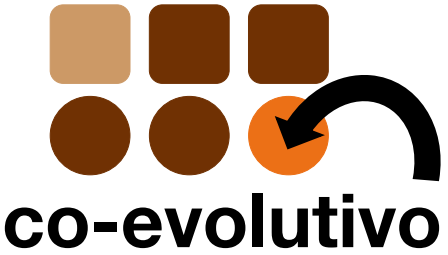
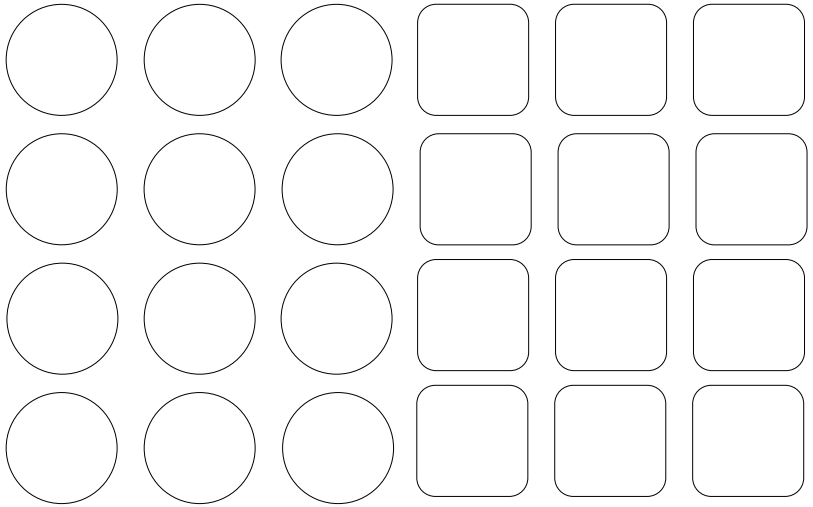
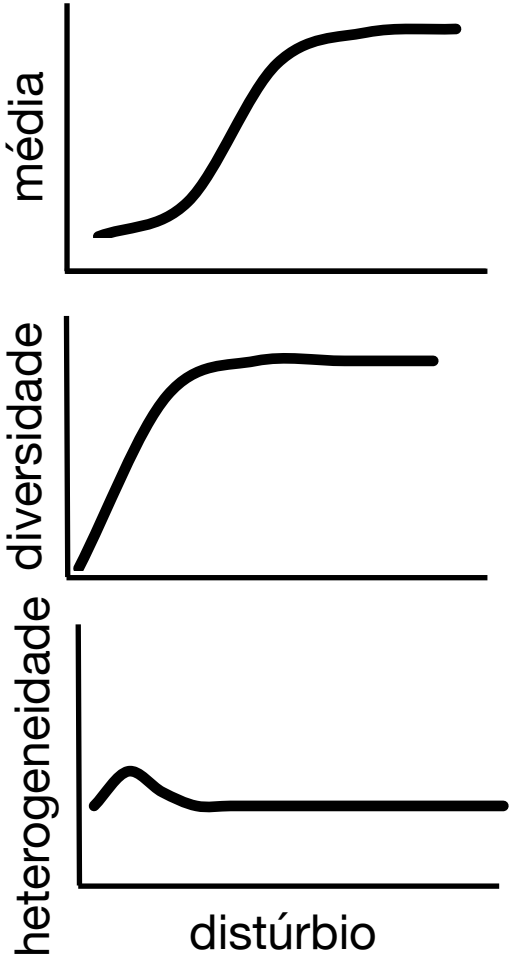


cenário eco-evolutivo = isolamento reprodutivo





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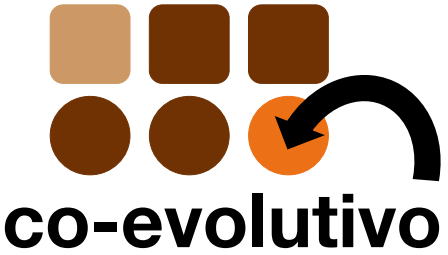
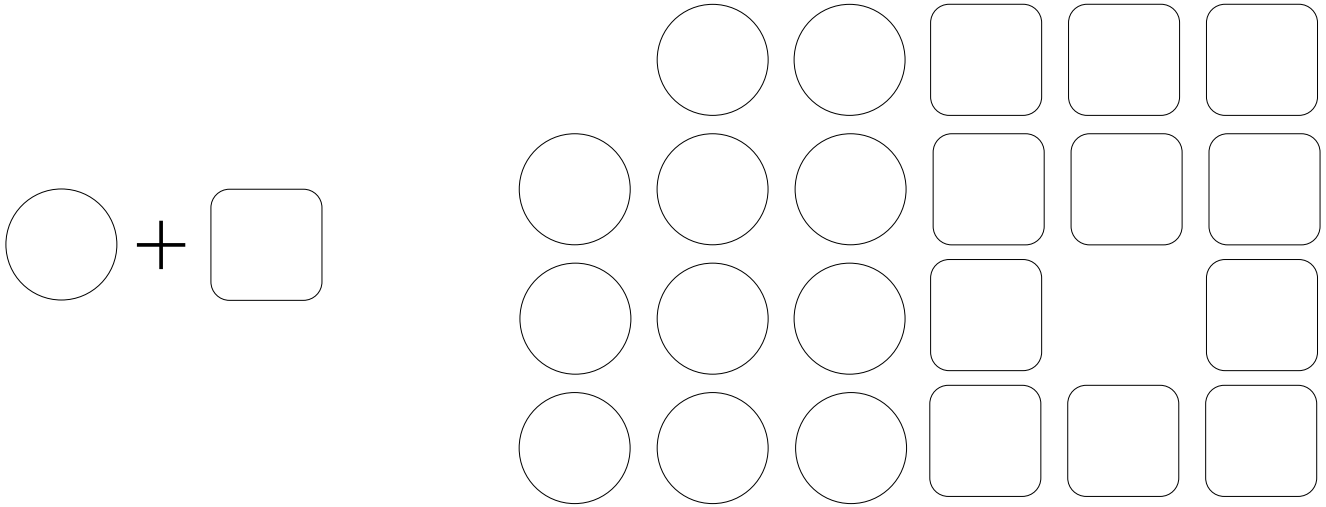
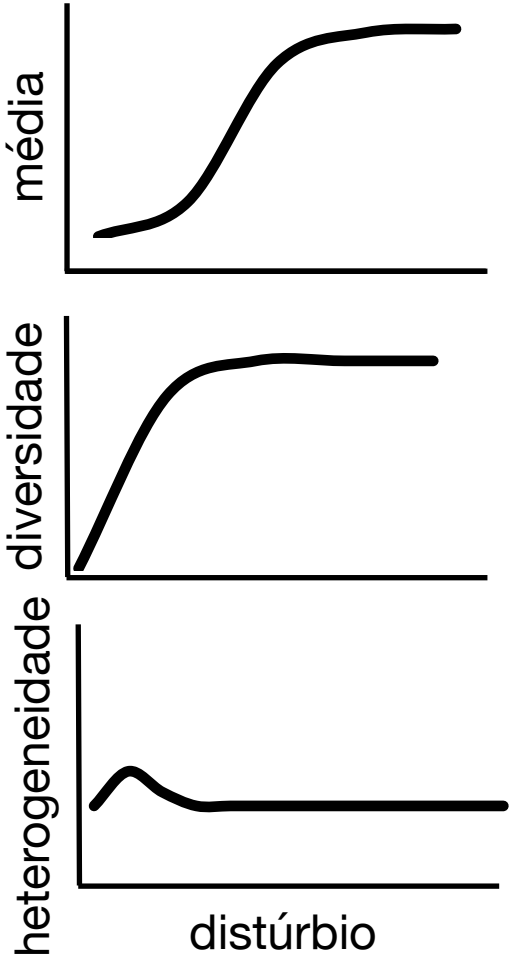


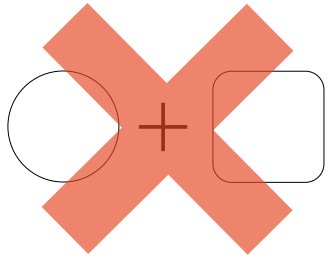
cenário eco-evolutivo = isolamento reprodutivo

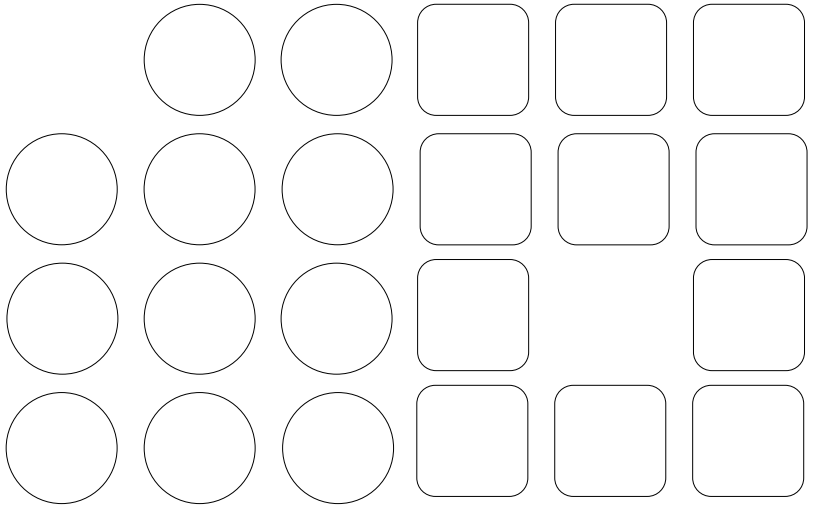


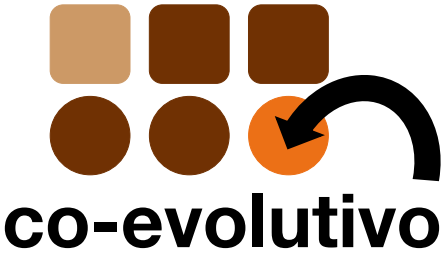


coexistência de estratégias mediada pelo distúrbio

cenário eco-evolutivo = isolamento reprodutivo







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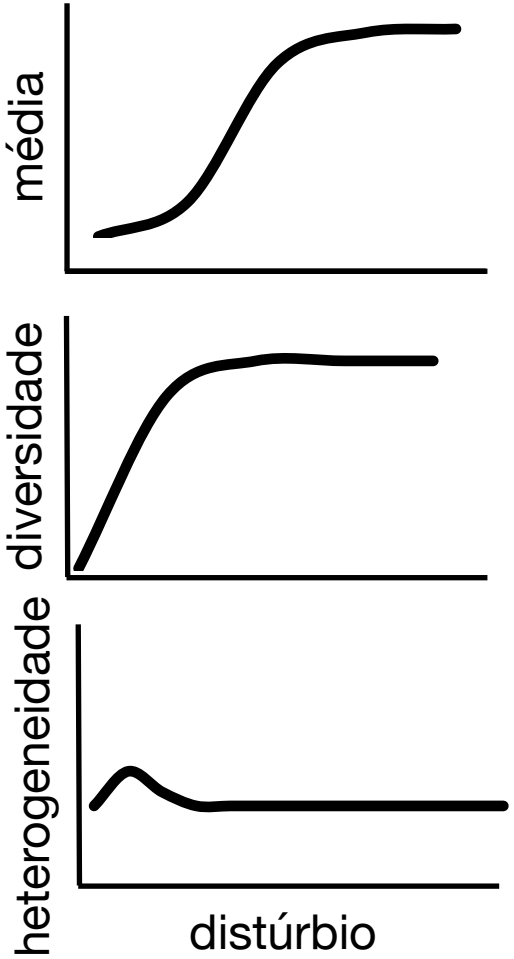

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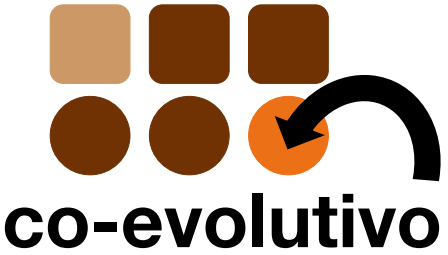

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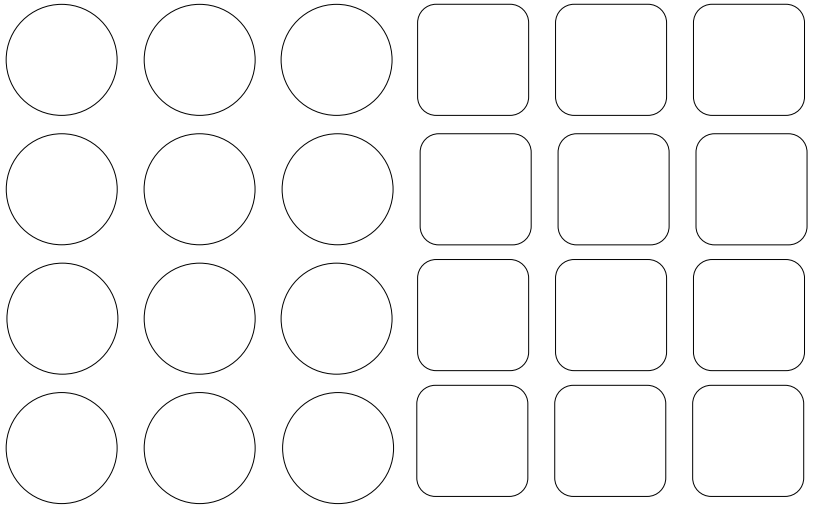
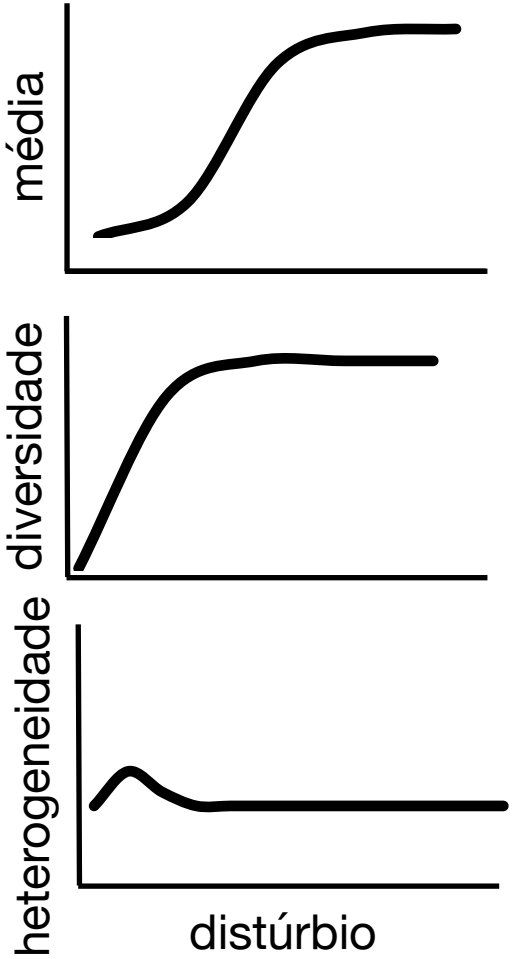
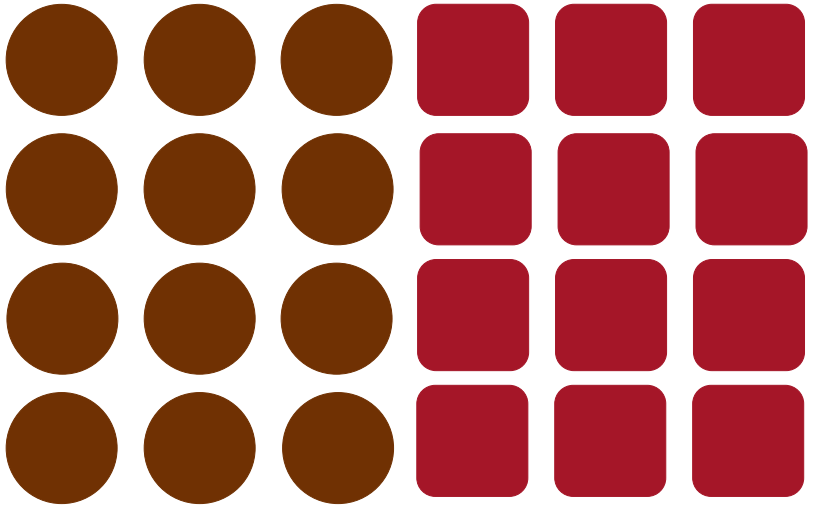
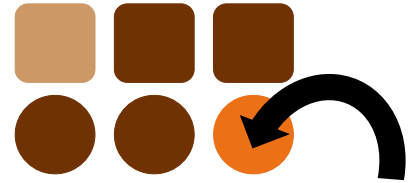




coexistência de estratégias mediada pelo distúrbio

cenário eco-evolutivo = isolamento reprodutivo





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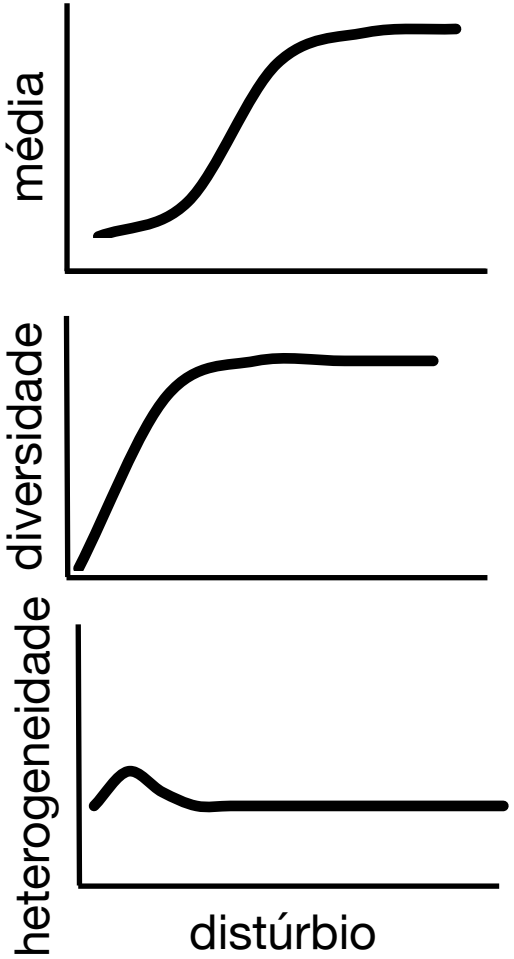
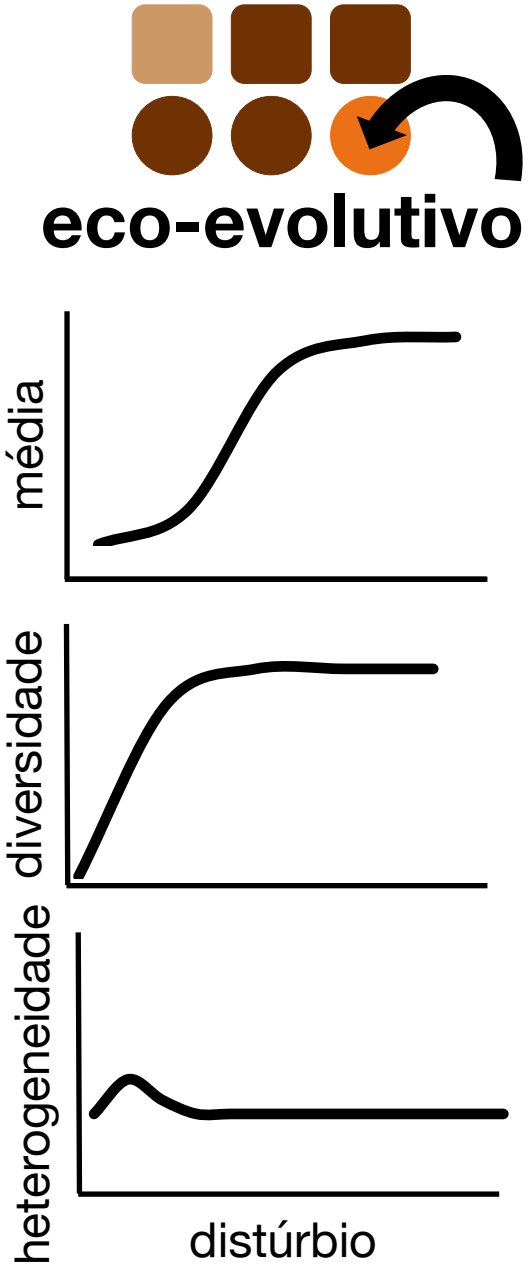


coexistência de estratégias mediada pelo distúrbio

cenário eco-evolutivo = mutação



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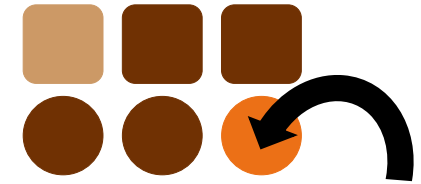
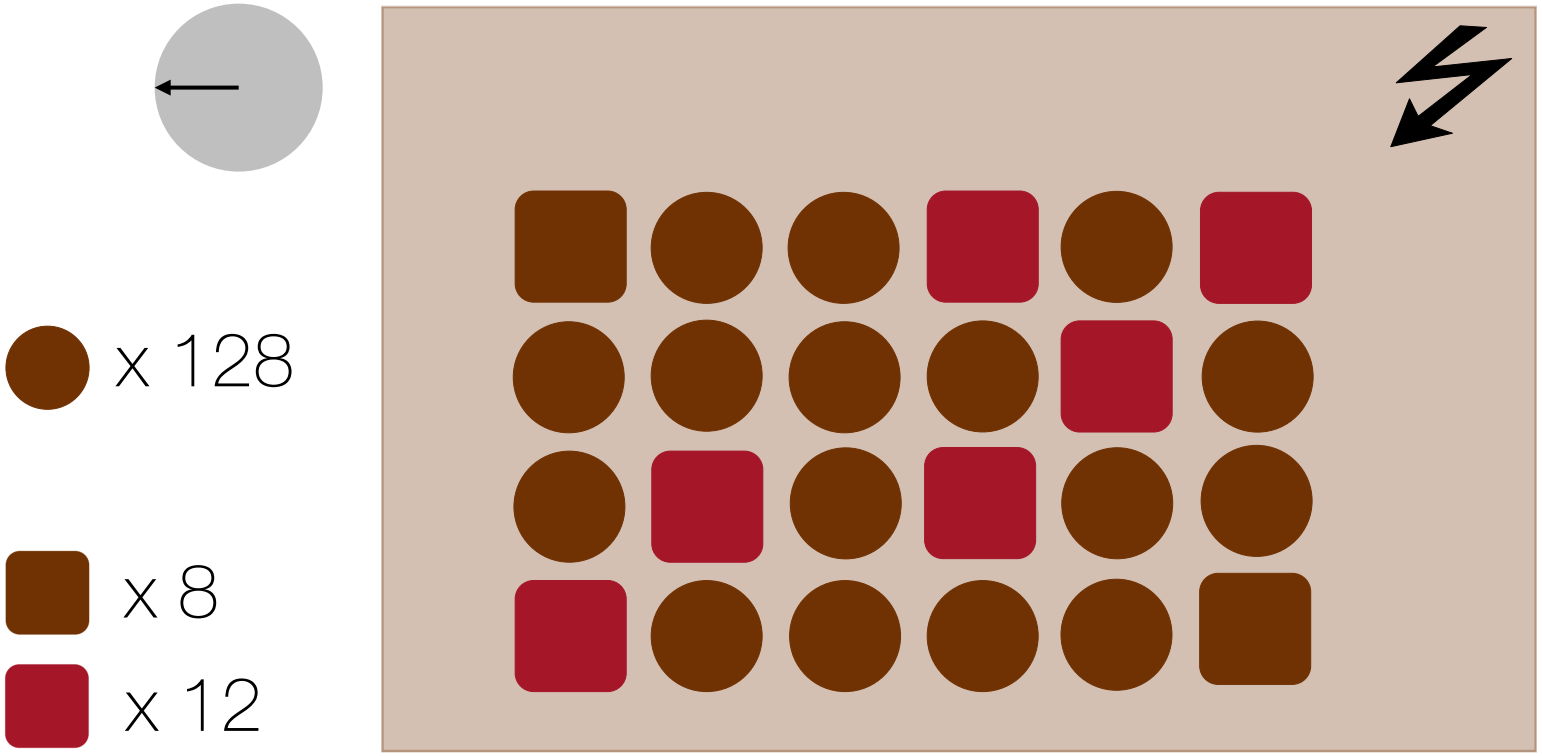
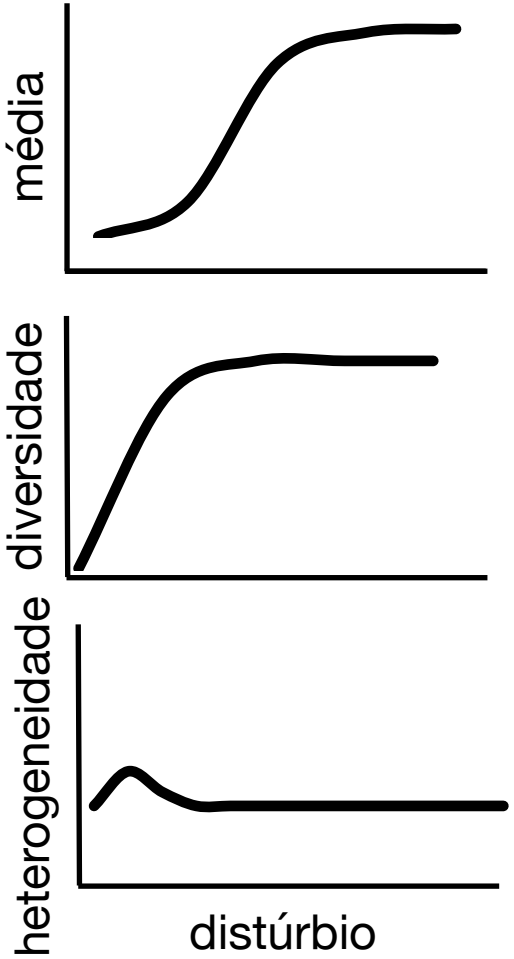


eco-evolutivo

cenário eco-evolutivo = mutação





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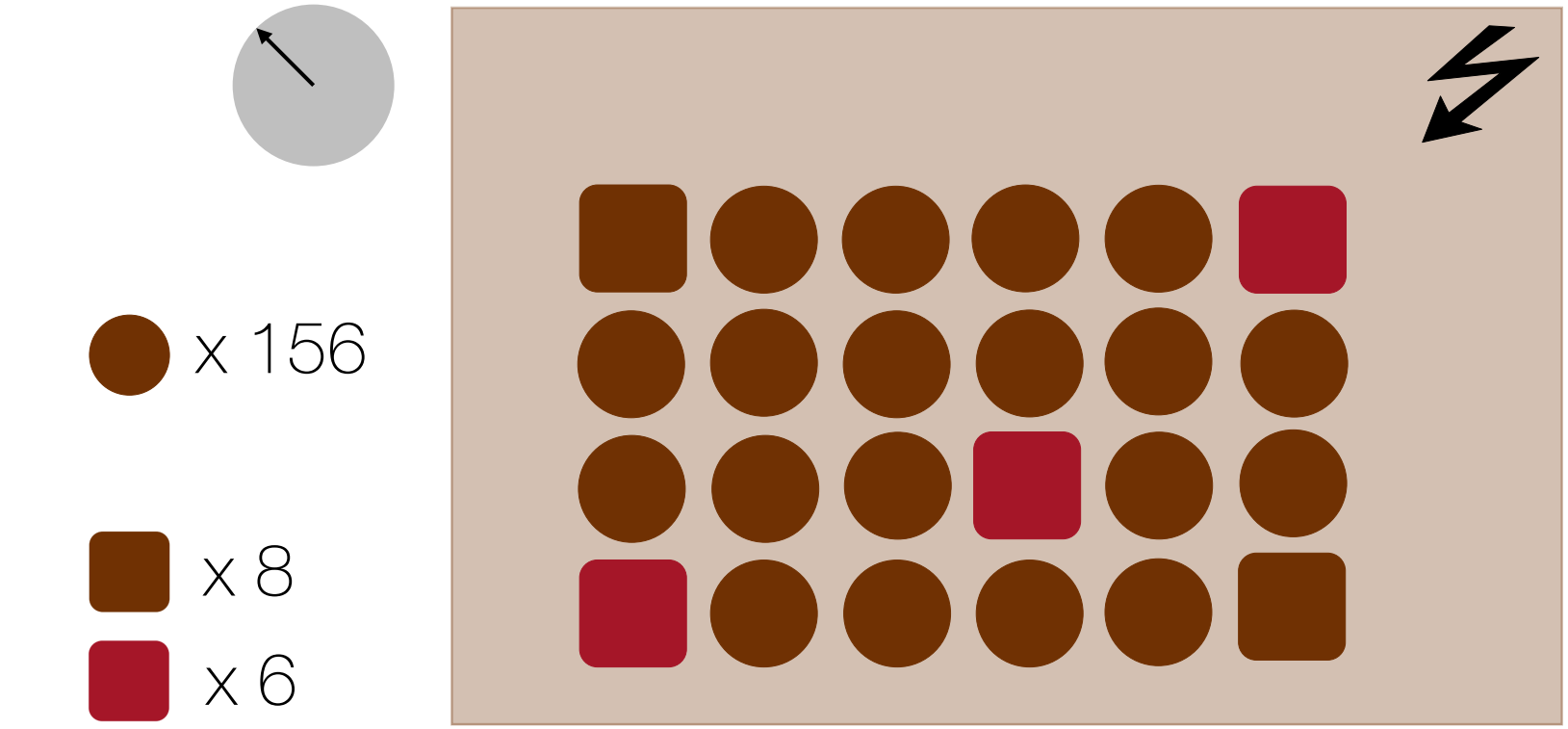

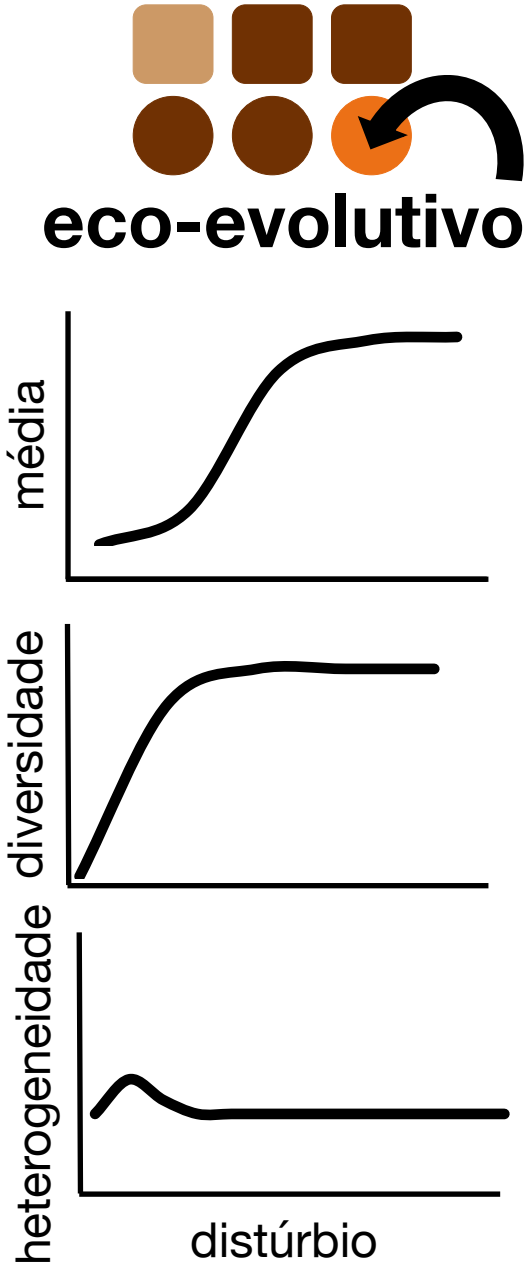

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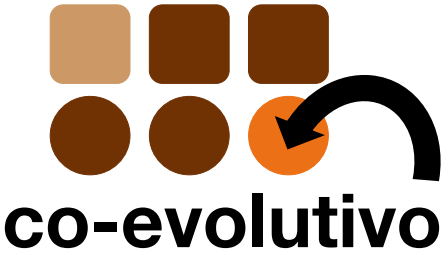

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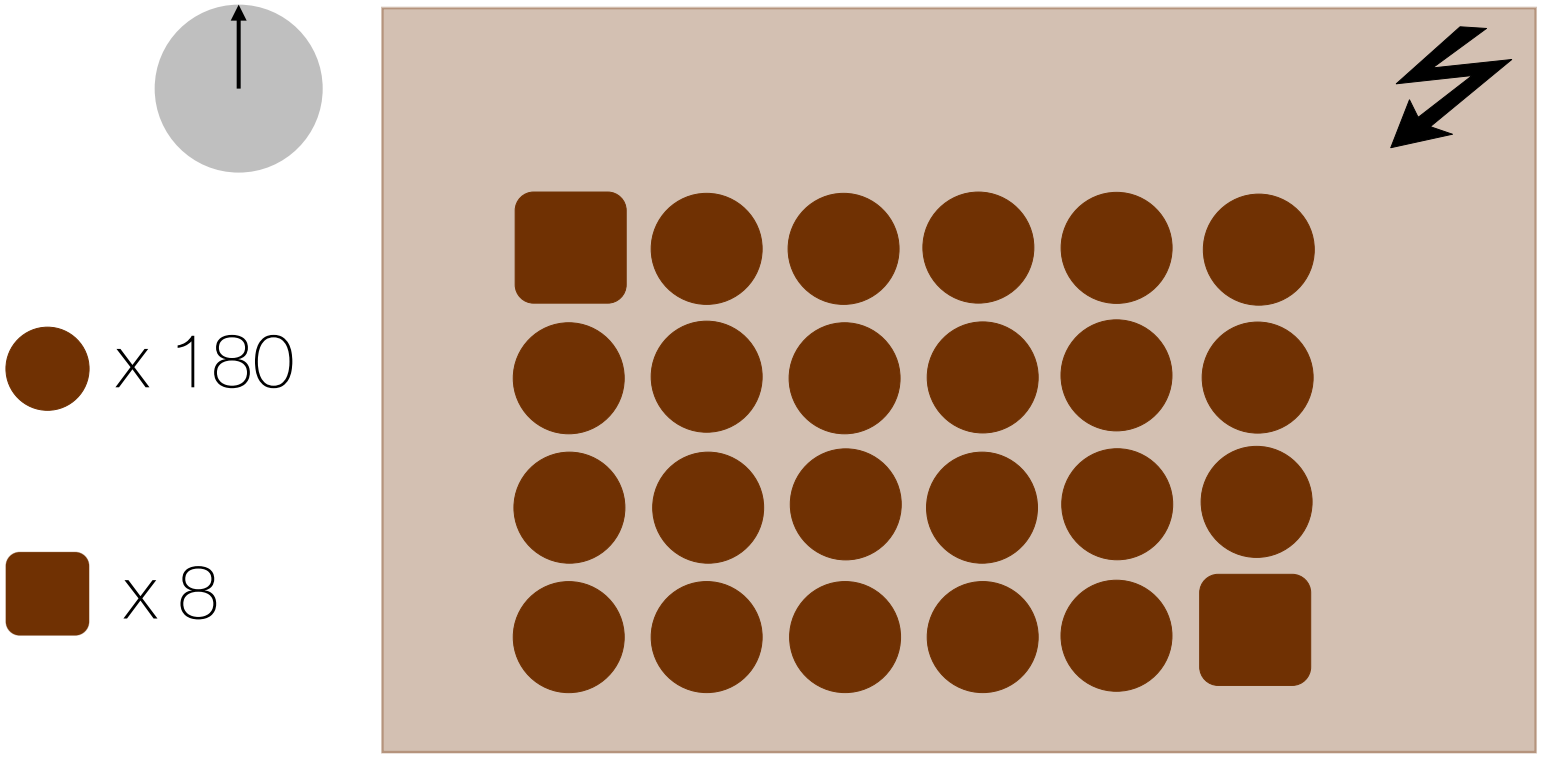

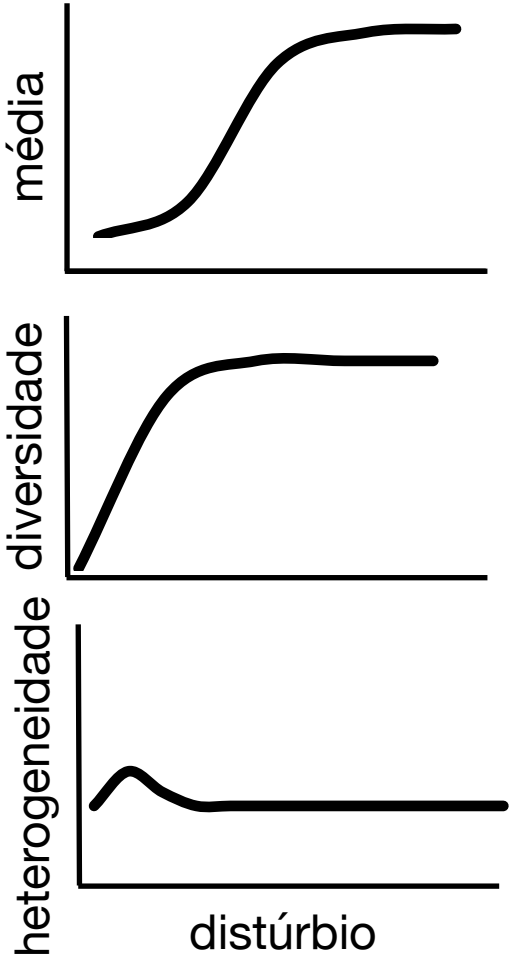

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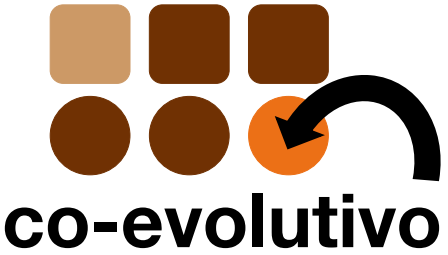

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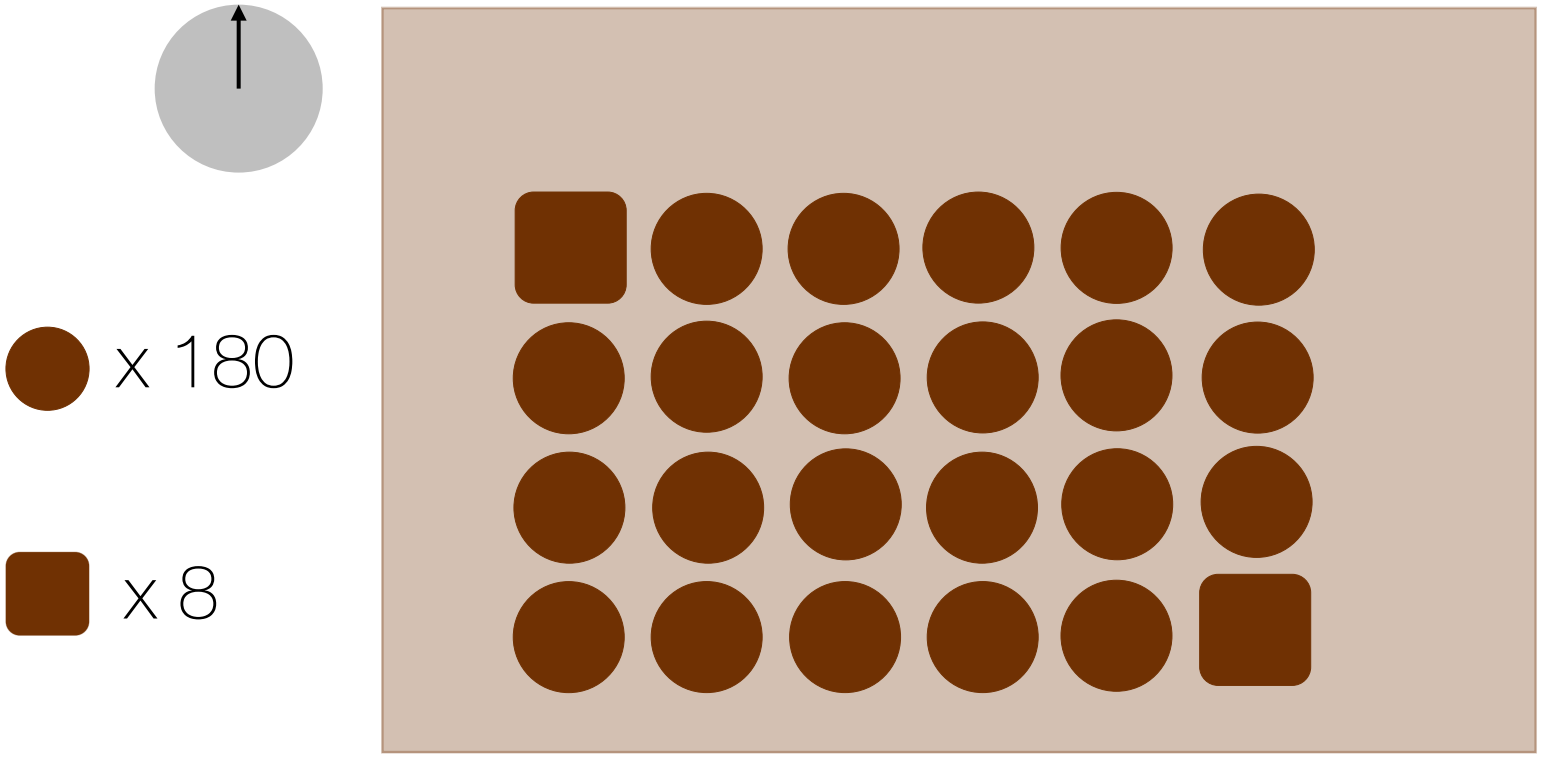

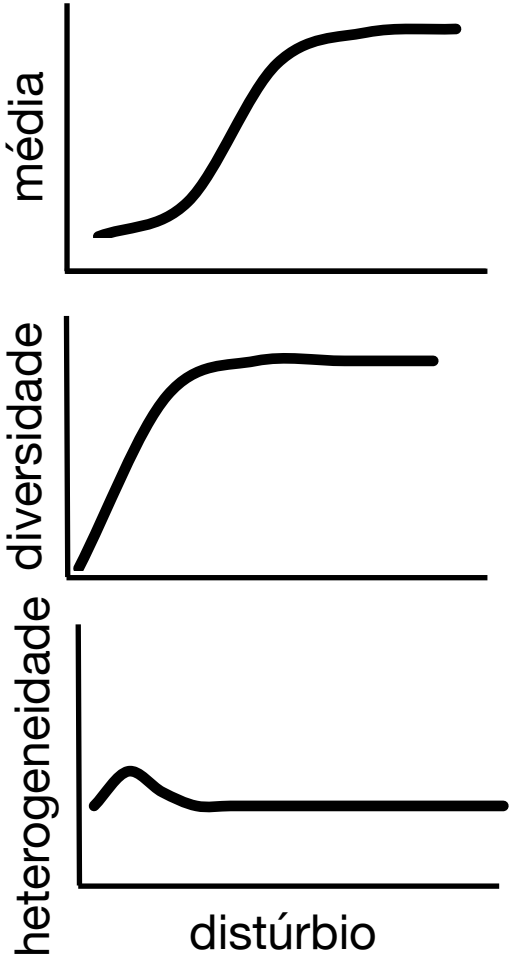

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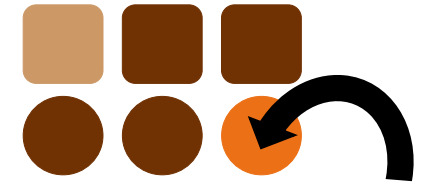
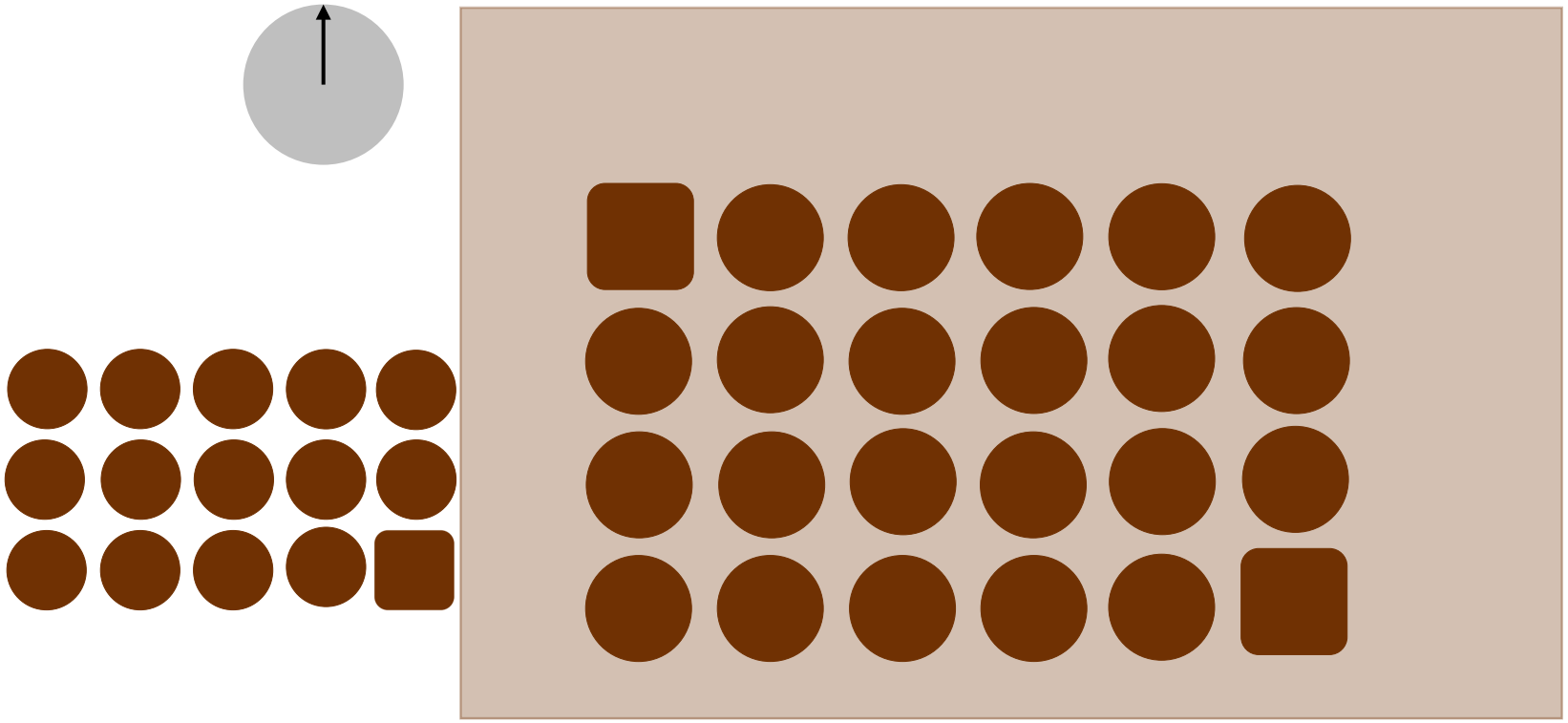
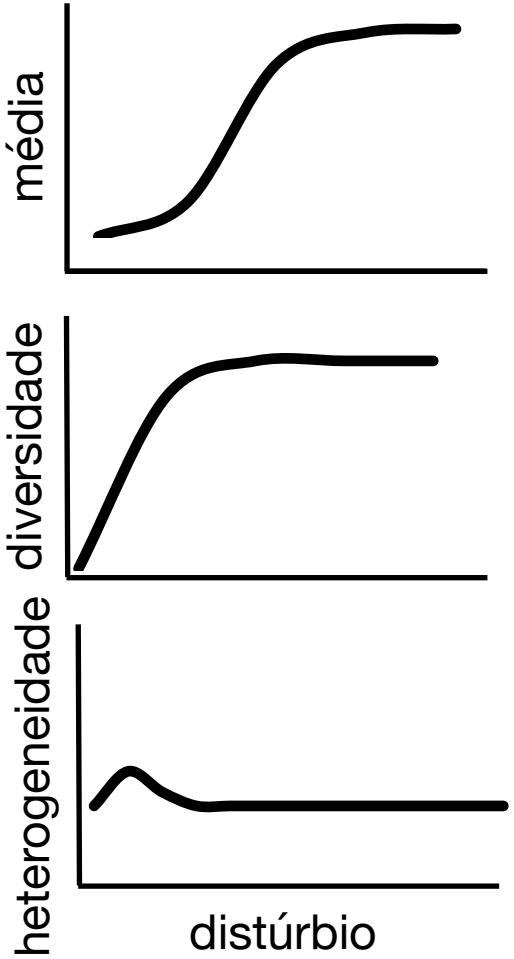


eco-evolutivo

cenário eco-evolutivo = mutação





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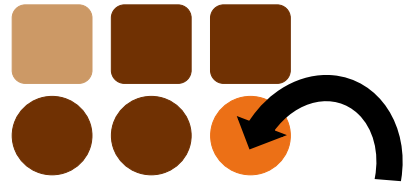

eco-evolutivo

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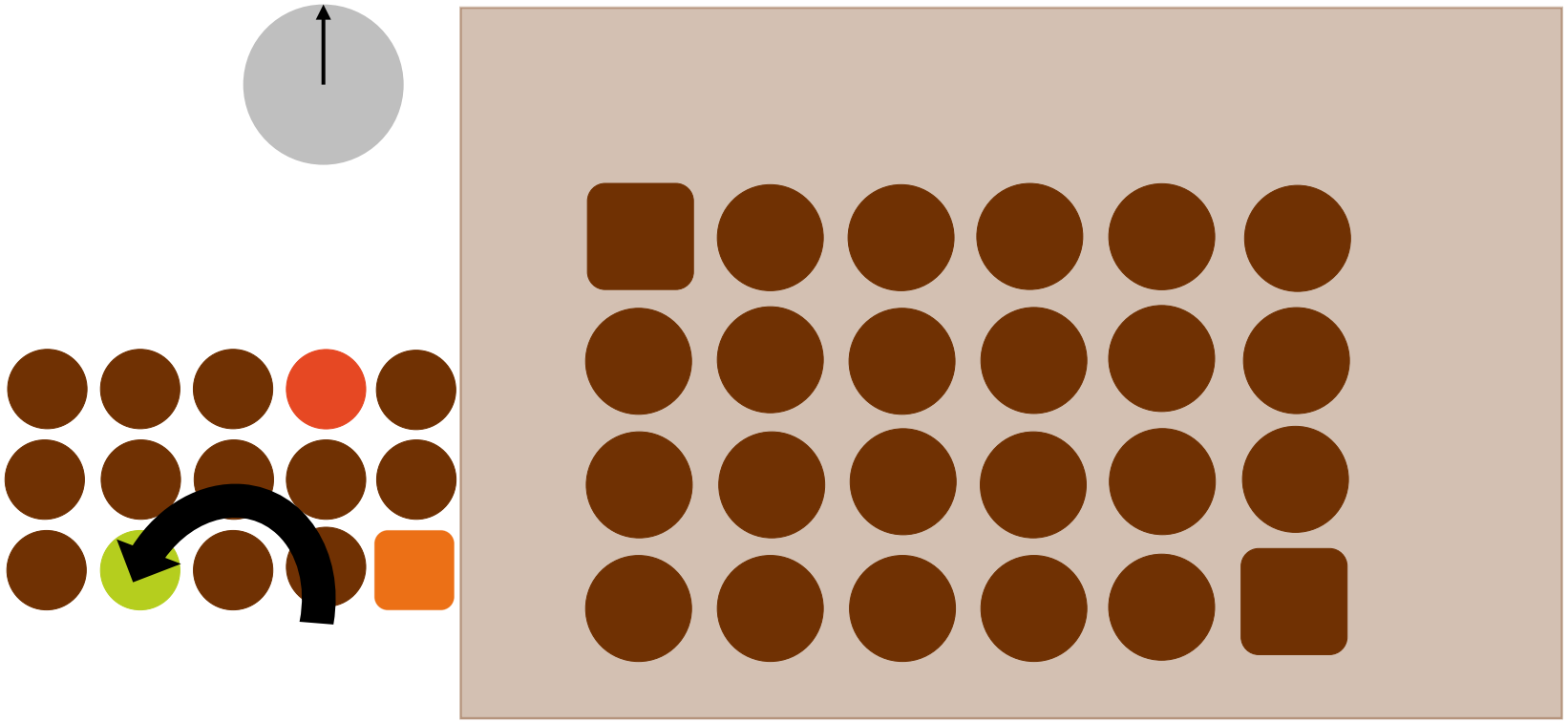

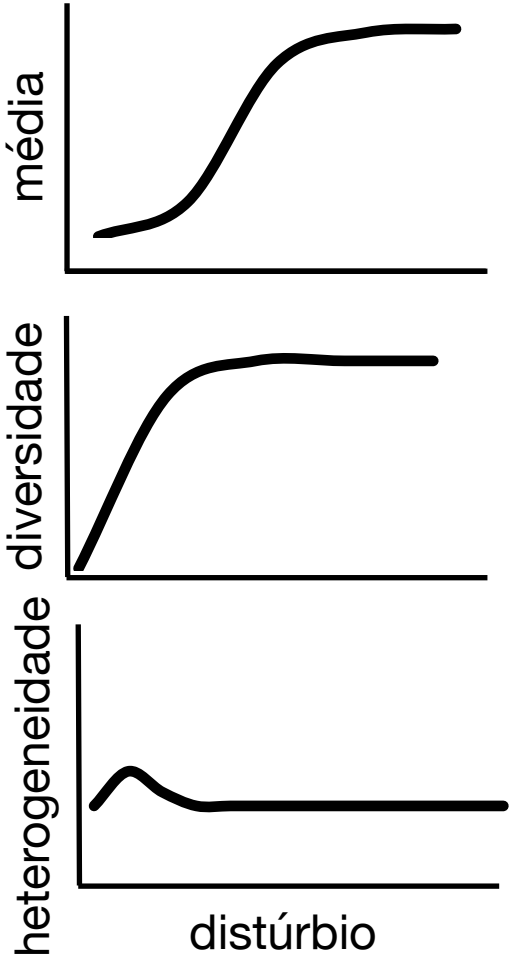

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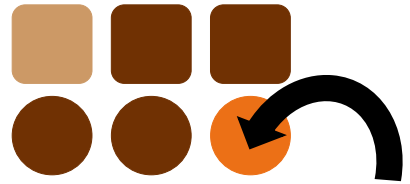

eco-evolutivo

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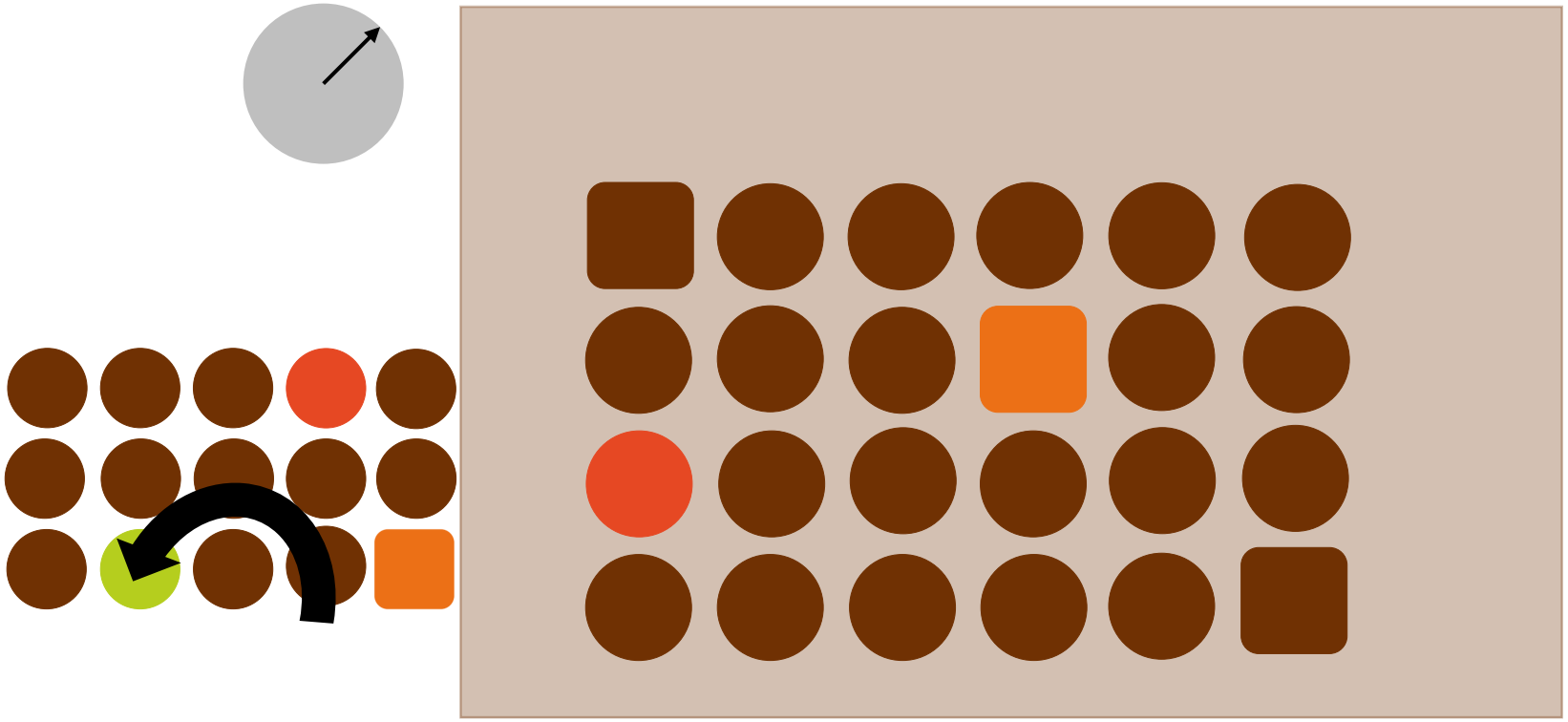
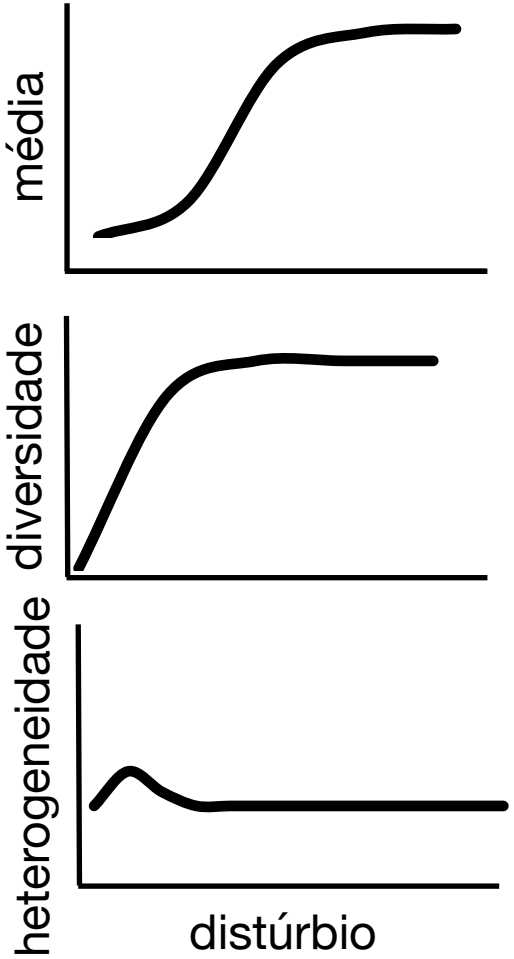
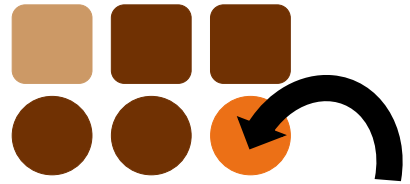


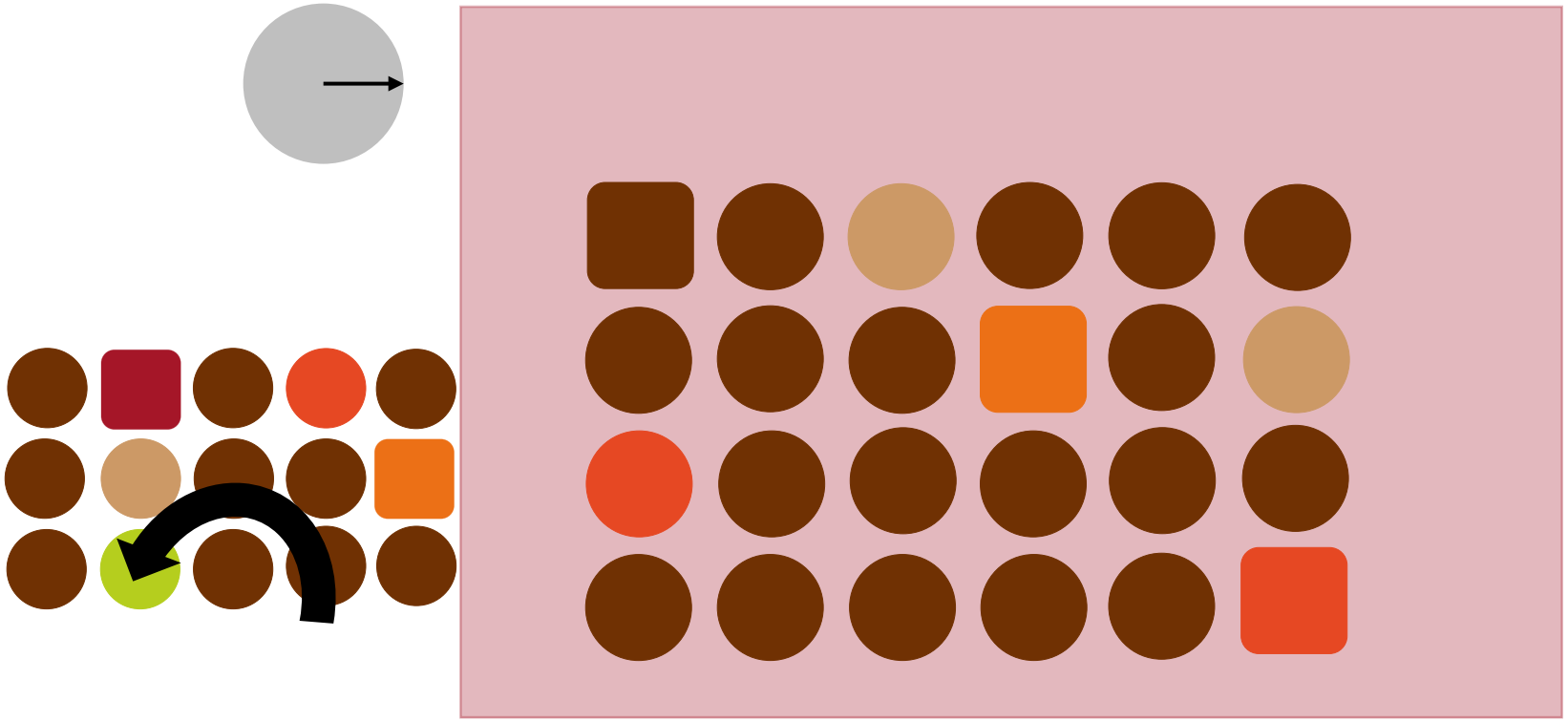


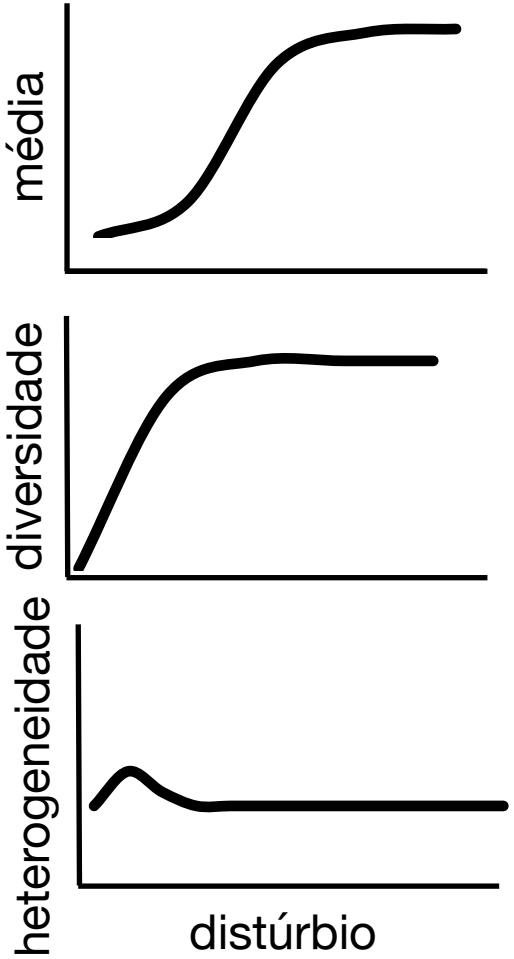
coexistência de estratégias mediada pelo distúrbio



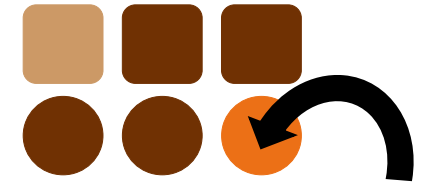
eco-evolutivo

cenário eco-evolutivo = mutação



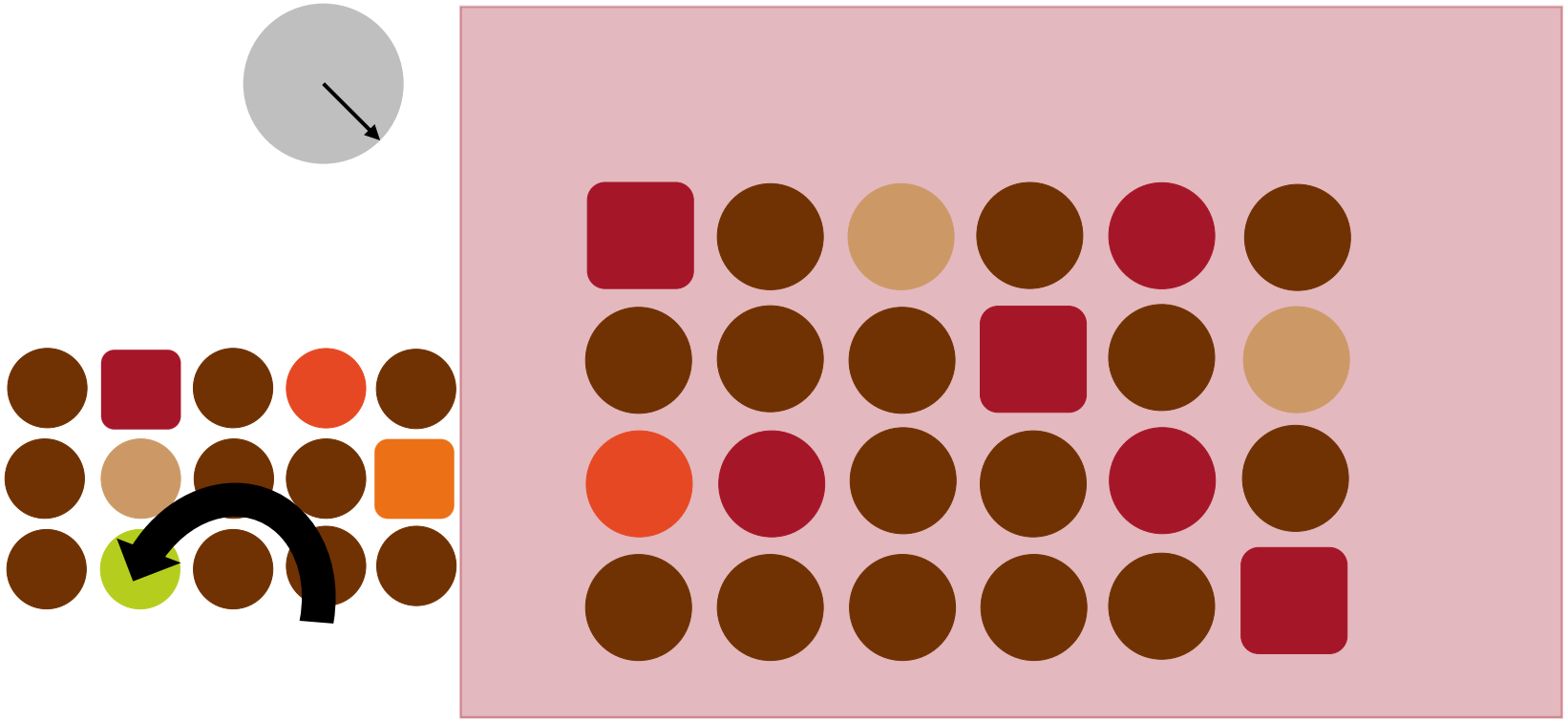


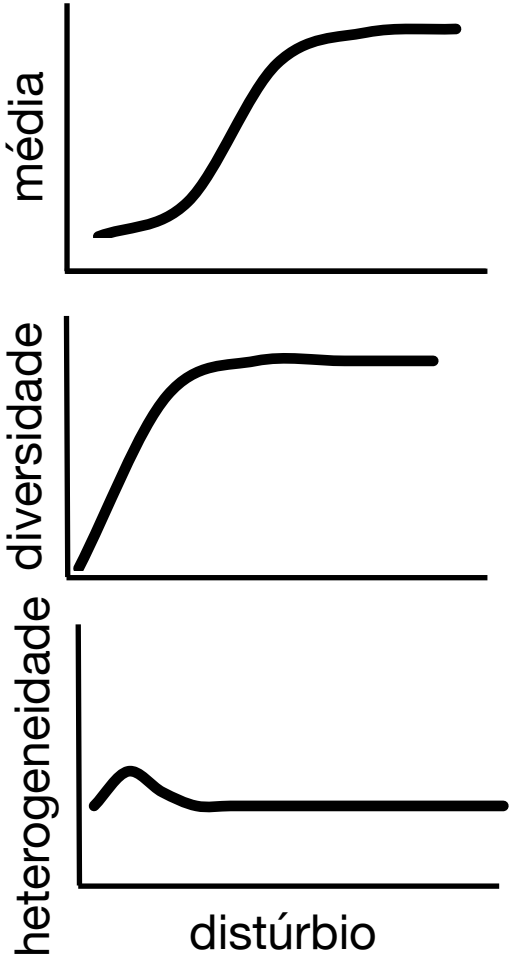
coexistência de estratégias mediada pelo distúrbio



eco-evolutivo

cenário eco-evolutivo = mutação

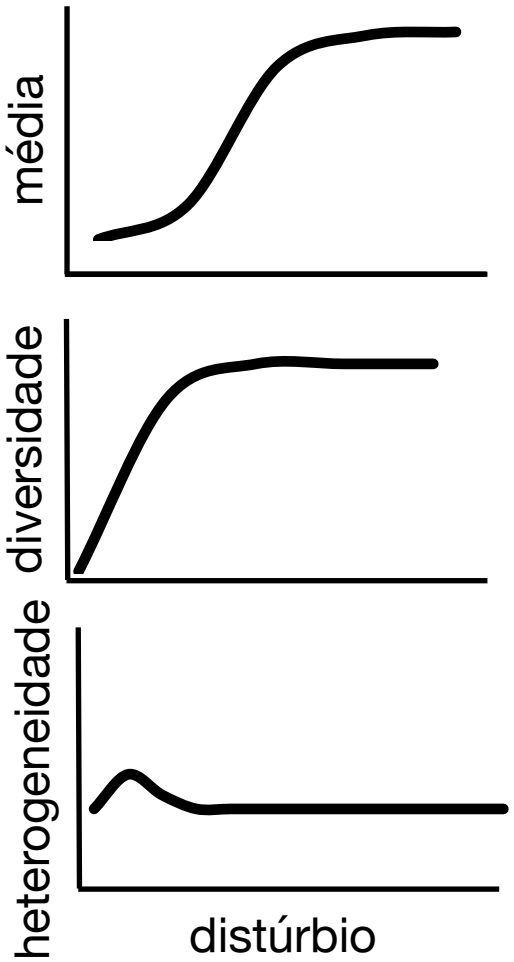




coexistência de estratégias mediada pelo distúrbio

eco-evolutivo

storage effect:

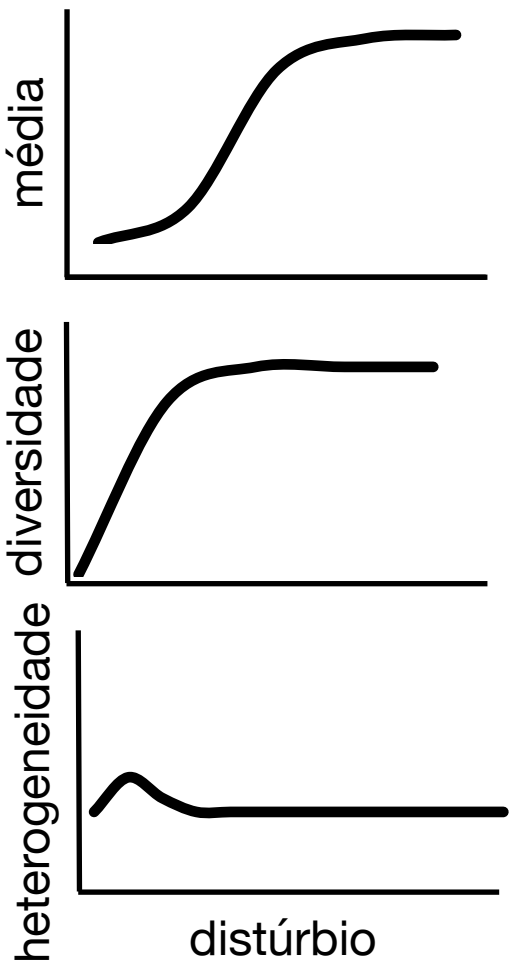


coexistência de estratégias mediada pelo distúrbio

eco-evolutivo

storage effect:

- diferença na reposta ao ambiente

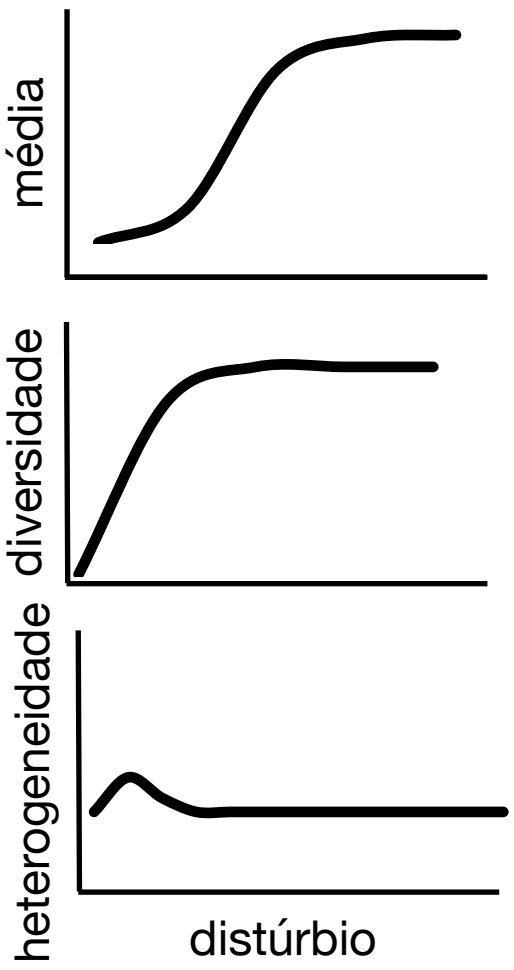


coexistência de estratégias mediada pelo distúrbio

eco-evolutivo

storage effect:

- diferença na reposta ao ambiente
- crescimento populacional tamponado

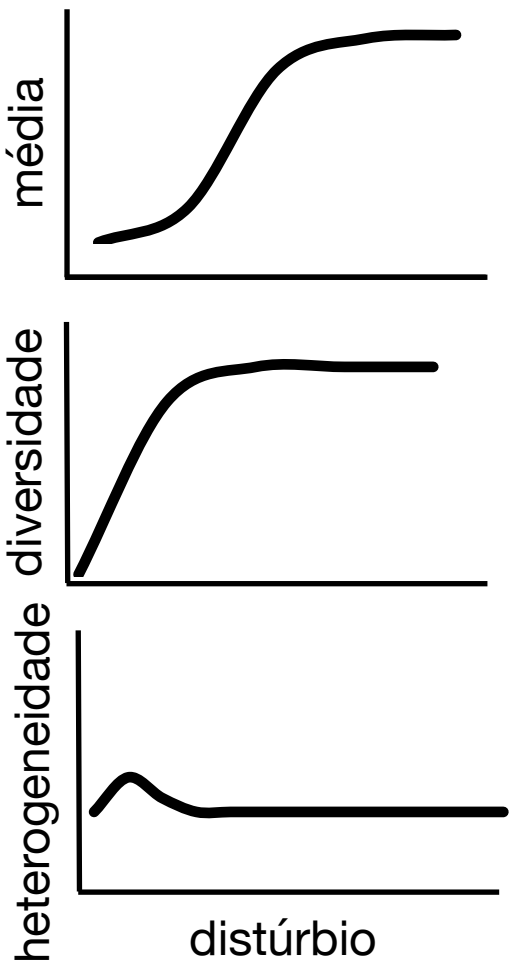


coexistência de estratégias mediada pelo distúrbio

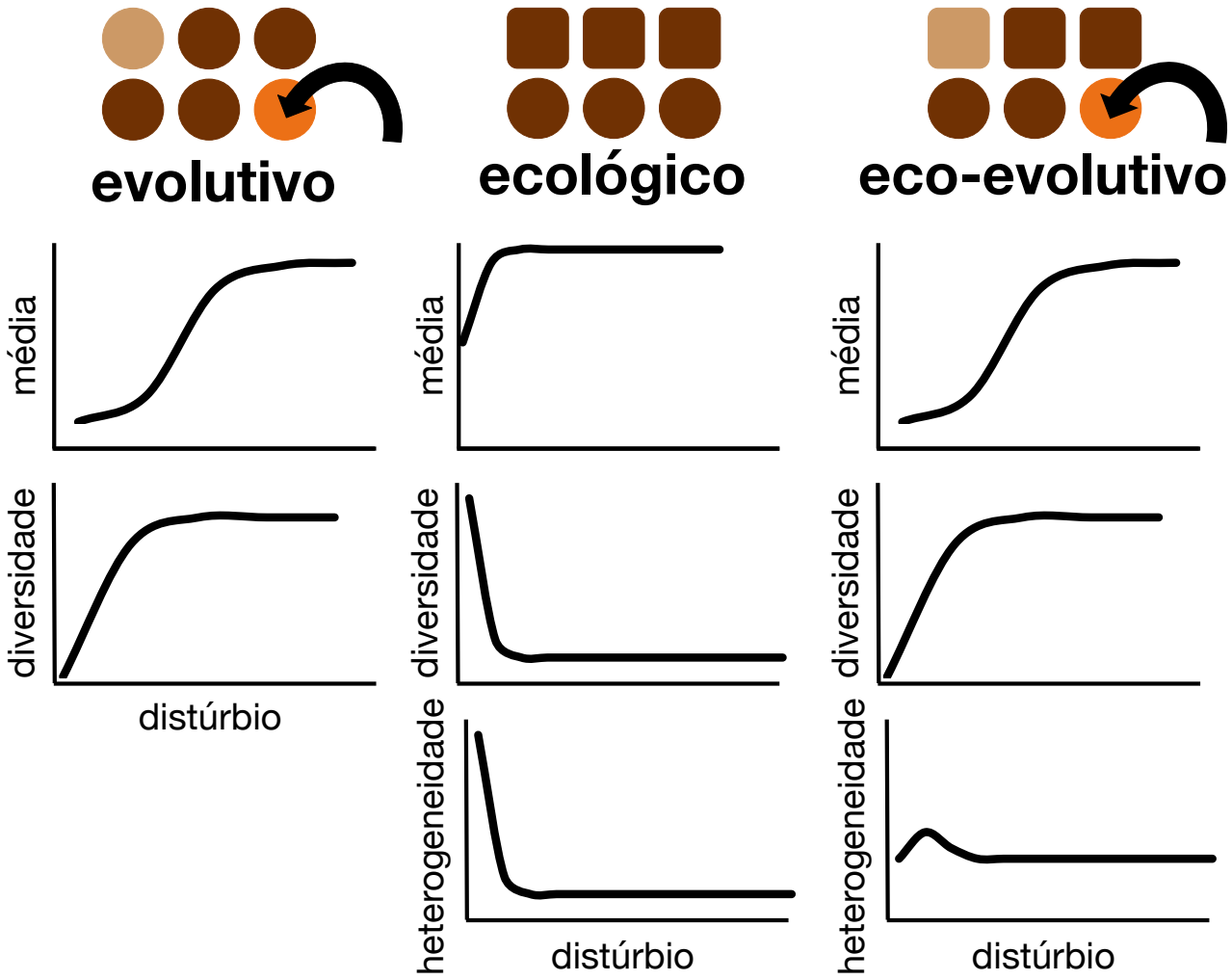
eco-evolutivo

storage effect:

- diferença na reposta ao ambiente (isolamento reprodutivo das espécies)
- crescimento populacional tamponado (mutação)



cenários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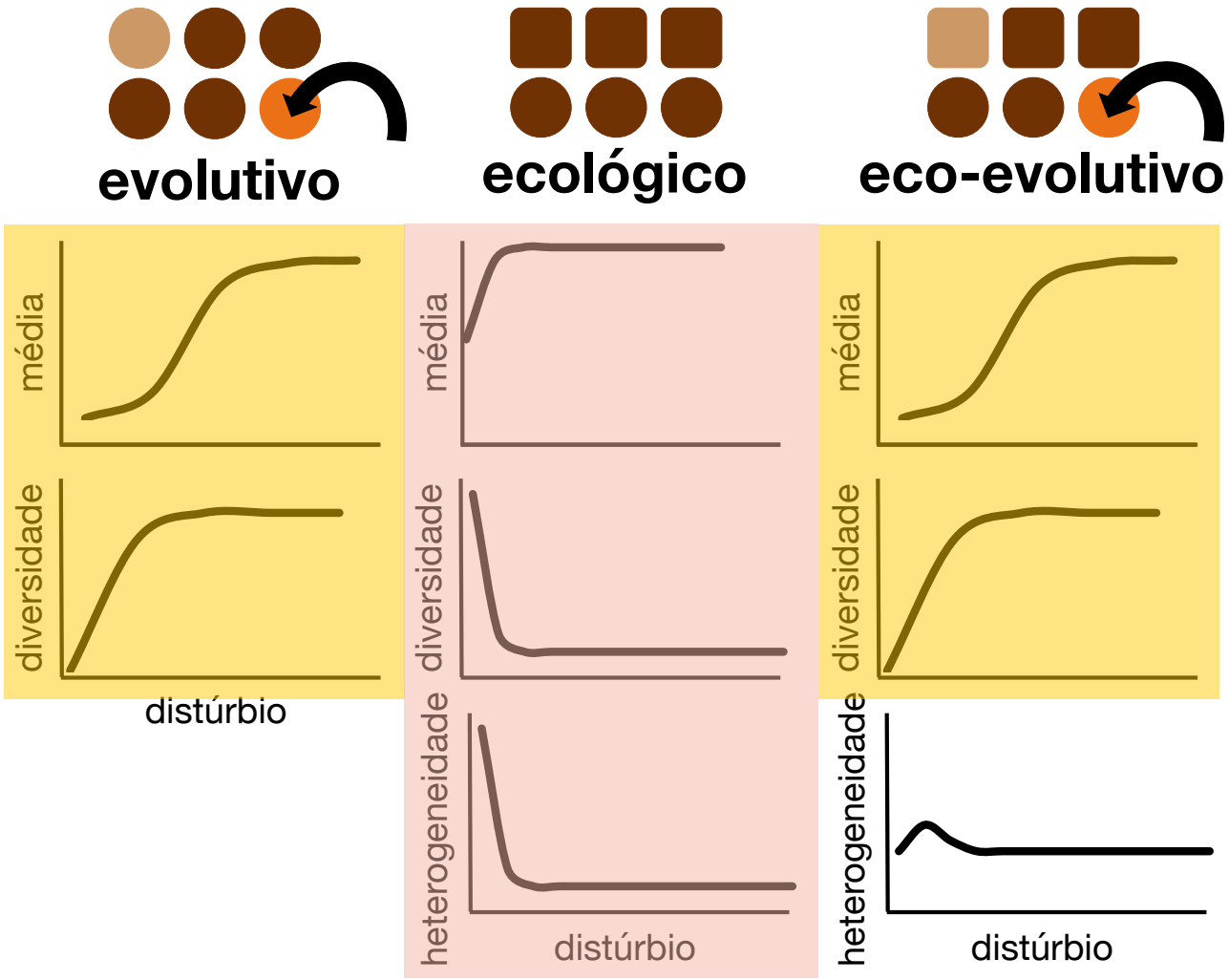
cenários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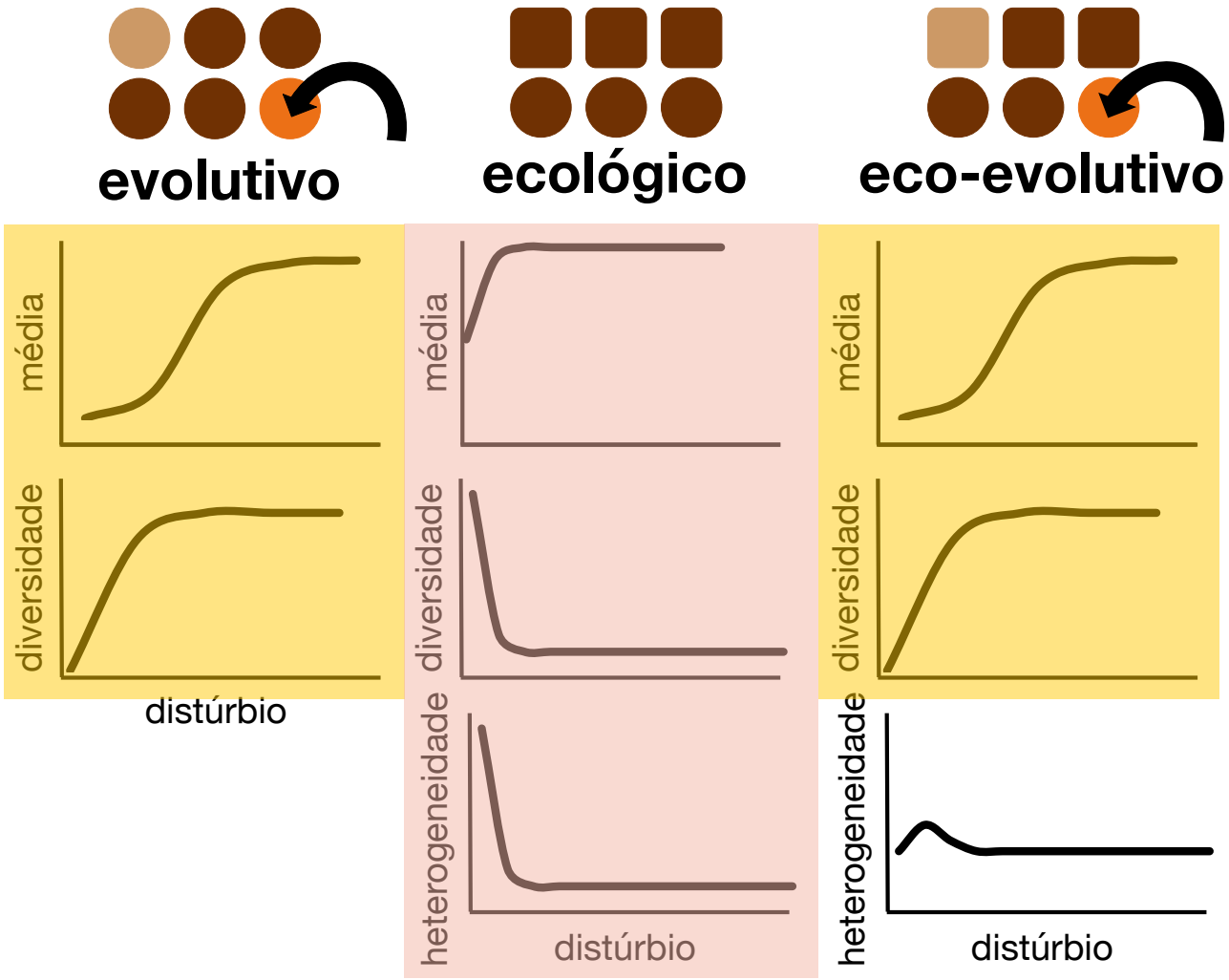
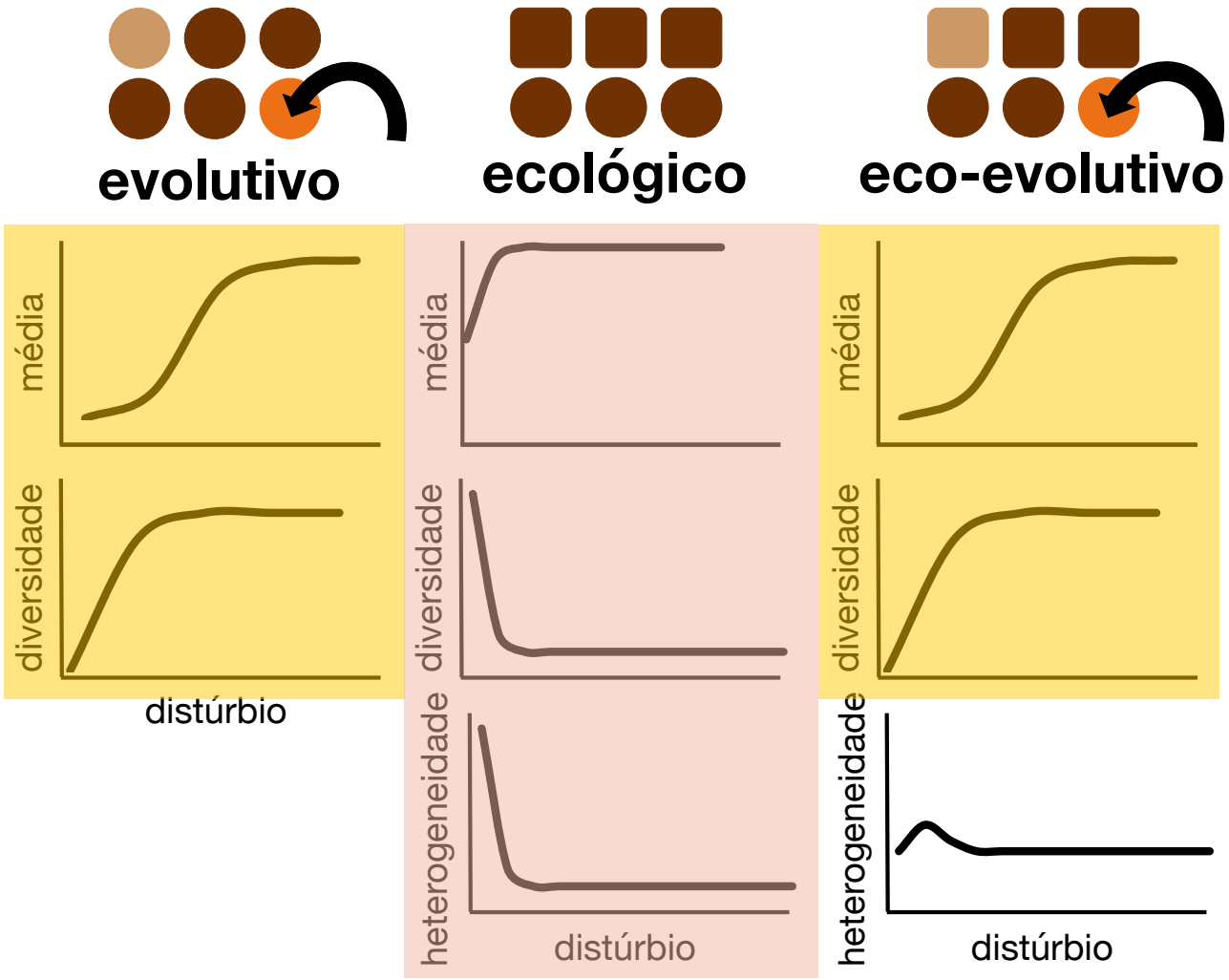
cenários



mutação

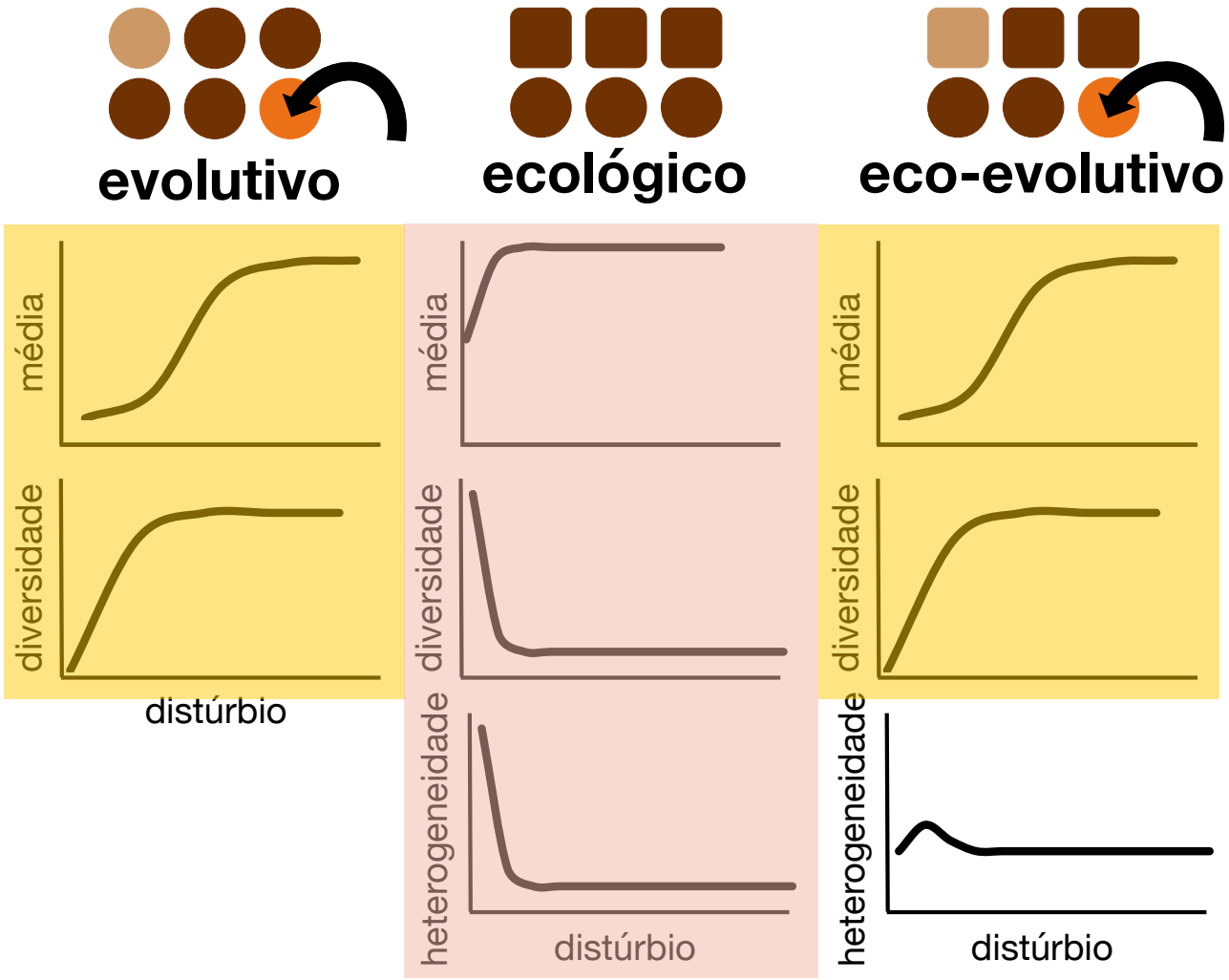
cenários



mutação

- é o único processo de entrada de variação (vs. exclusão competitiva e seleção e vs. deriva)

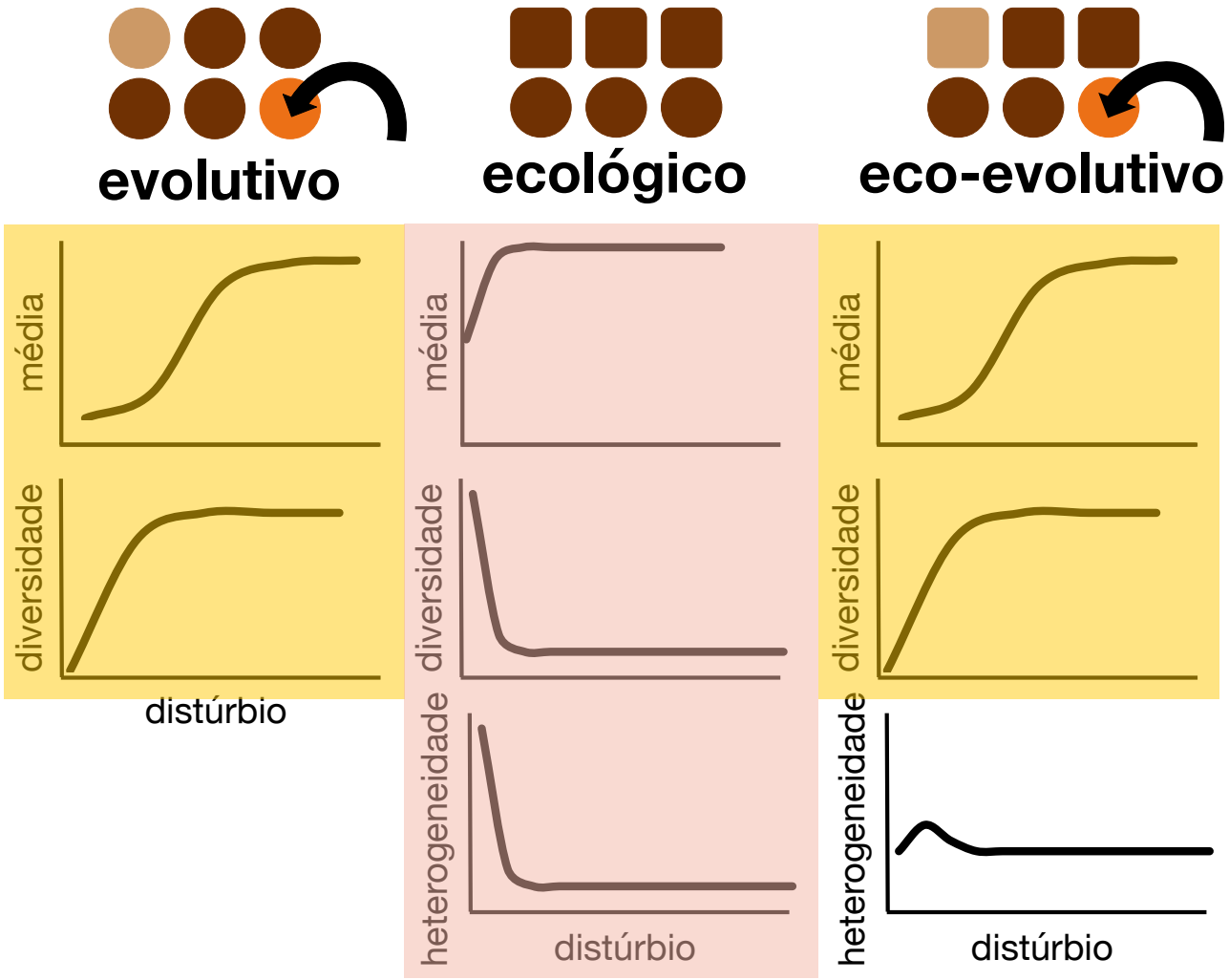
cenários



mutação

- é o único processo de entrada de variação (vs. exclusão competitiva e seleção e vs. deriva)
- cria novas estratégias e pode resgatar estratégias extintas ou quase extintas

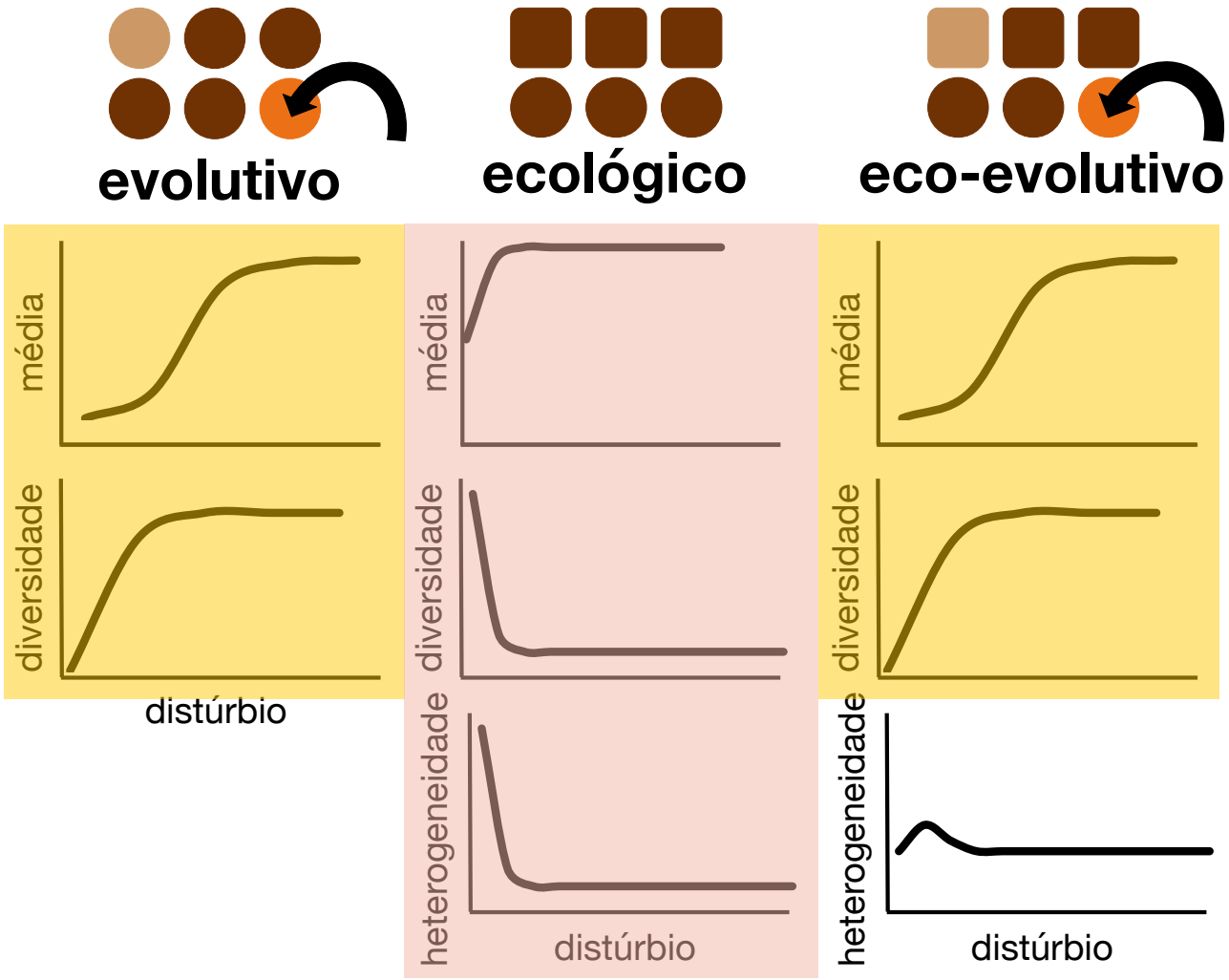
cenários



mutação

- é o único processo de entrada de variação (vs. exclusão competitiva e seleção e vs. deriva)
- cria novas estratégias e pode resgatar estratégias extintas ou quase extintas
- permite resposta contínua às pressões variadas ao longo do tempo

cenários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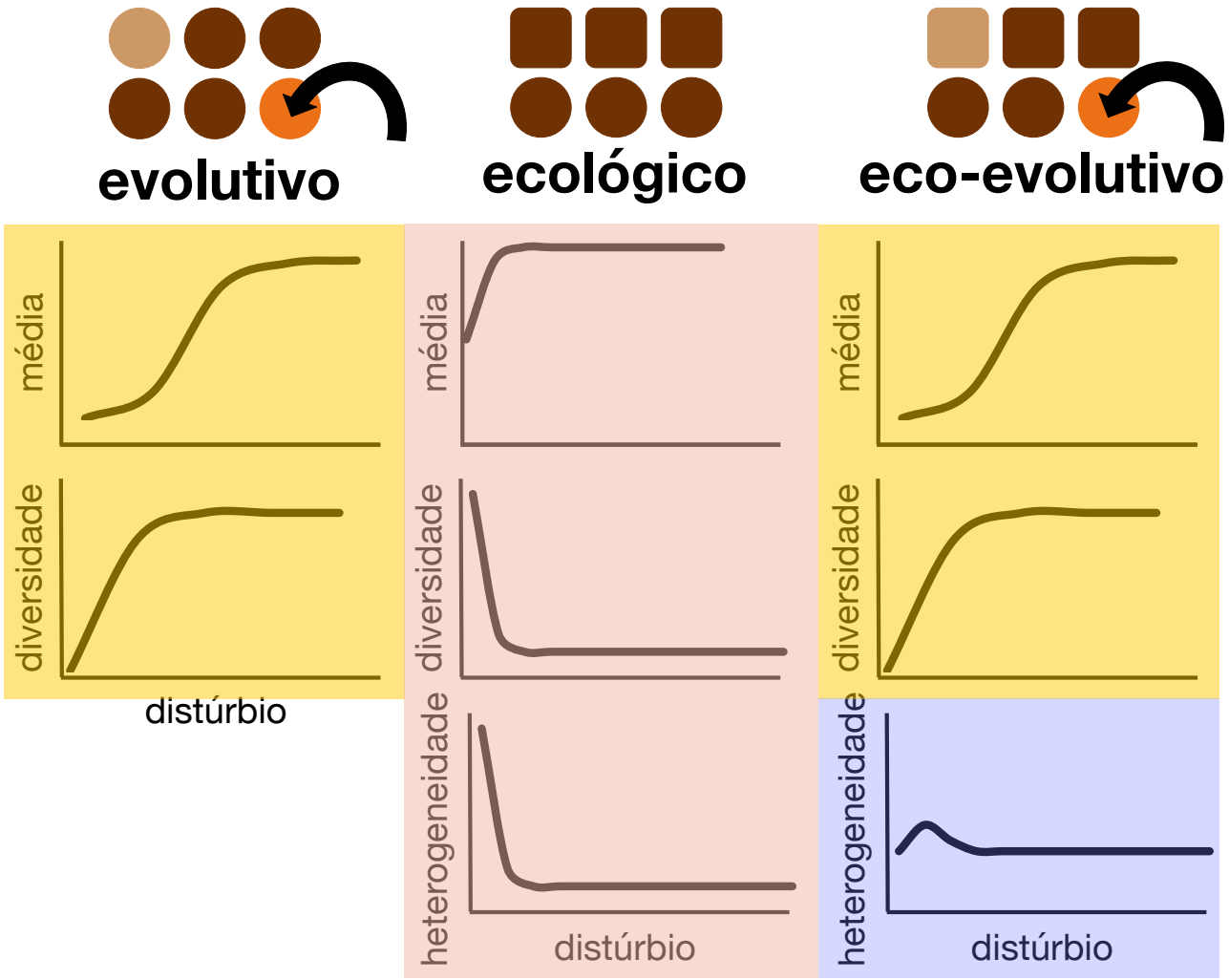
cenários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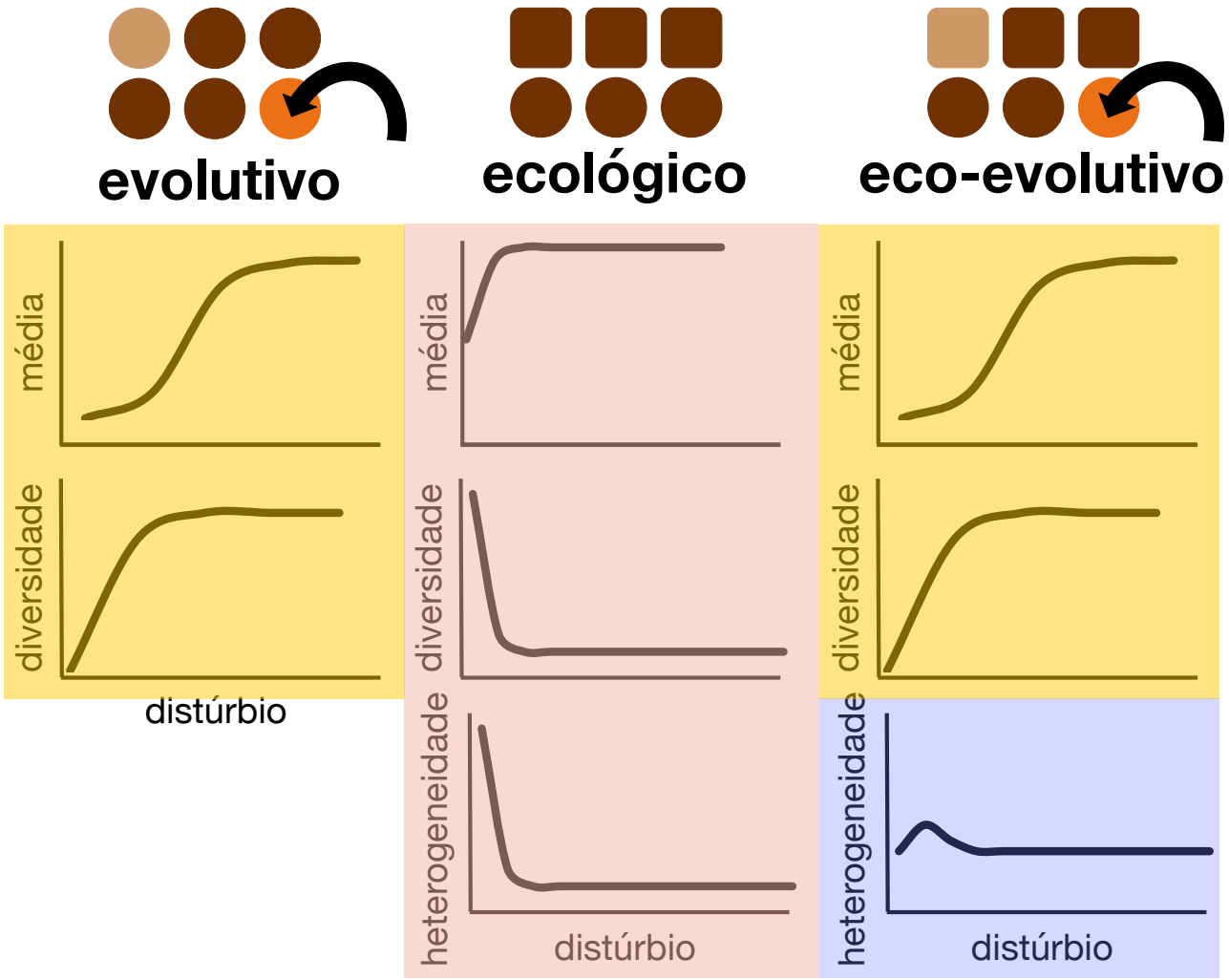
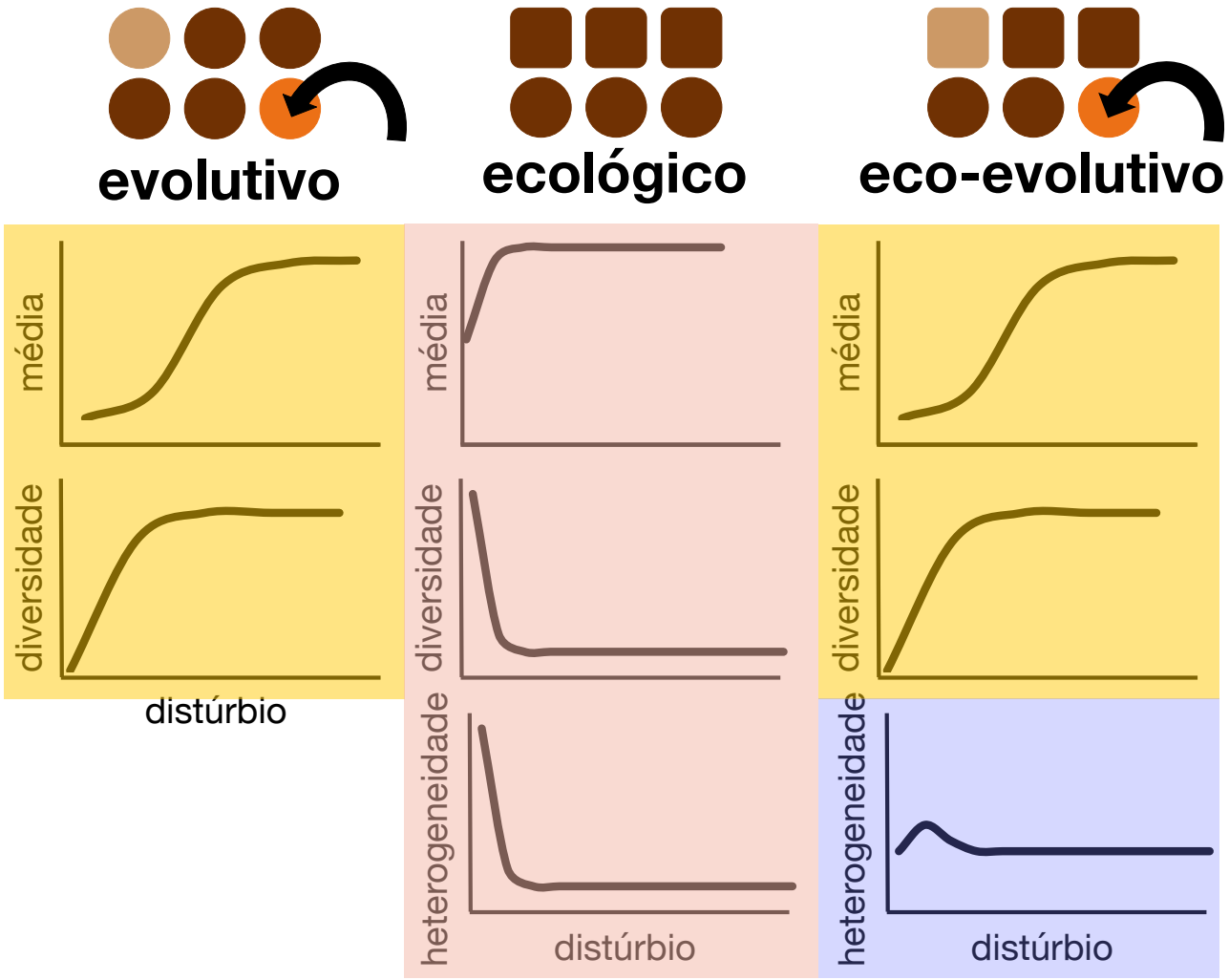
interação eco-evo

cenários



interação eco-evo

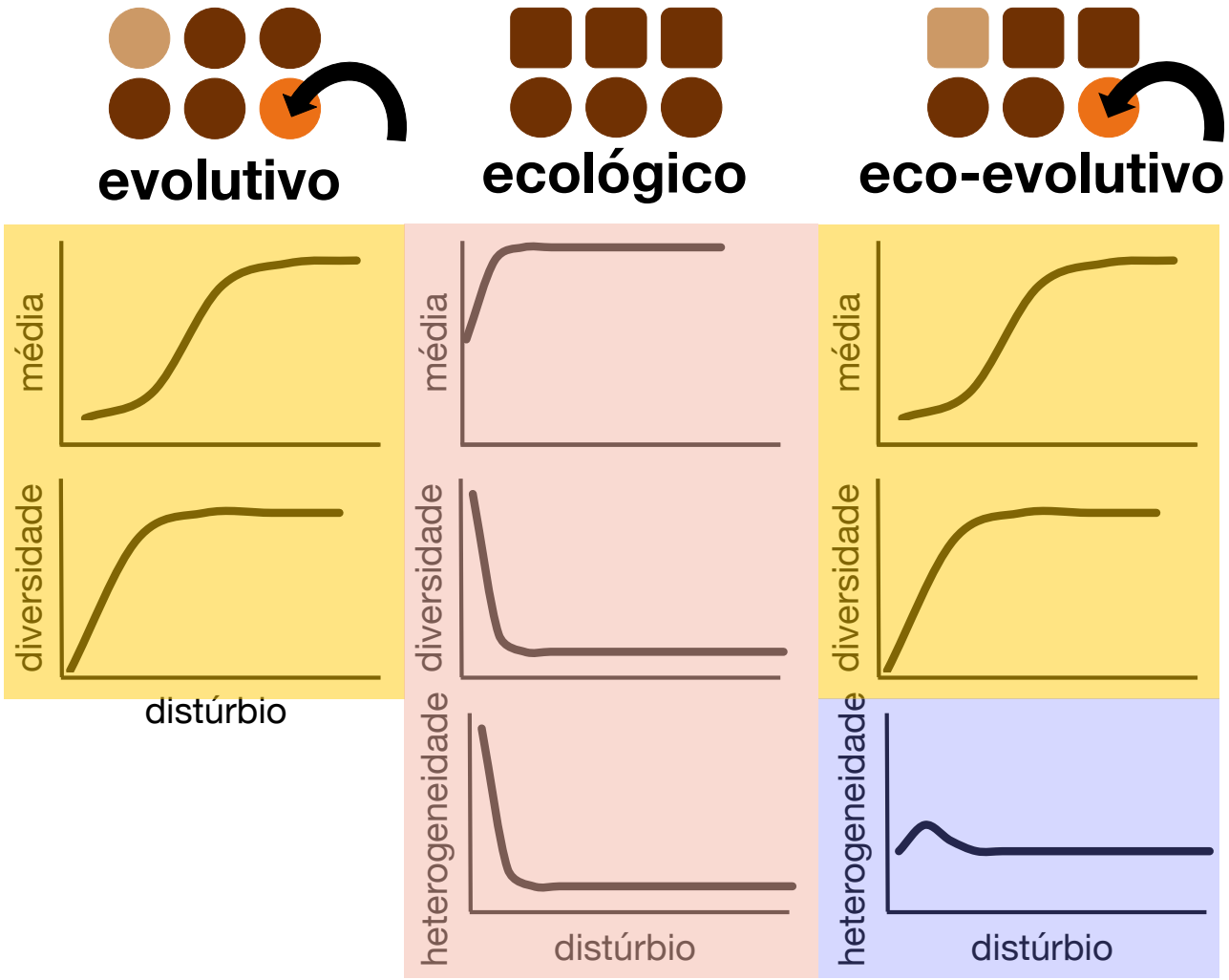
cenários



- entrada de variação por mutação
- competição entre linhagens isoladas (espécies diferentes)

interação eco-evo

cenários



- entrada de variação por mutação
- competição entre linhagens isoladas (espécies diferentes)
- coexistência de estratégias distintas mediadas por distúrbio

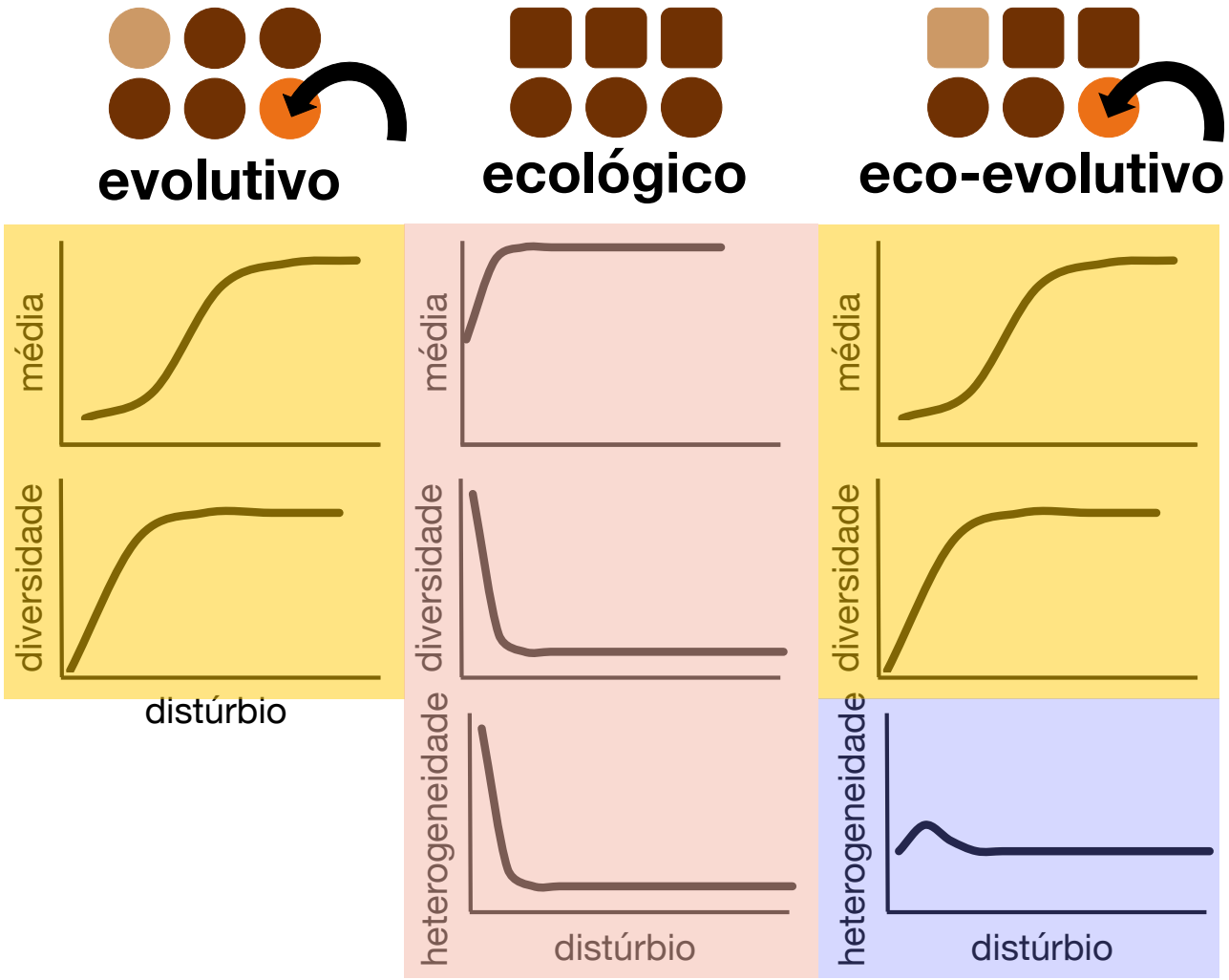
ainda assim…

Ecologia

- desconsidera adaptação

- possíveis consequências:
  - gerar predições erradas
  - relacionar padrões a processos equivocados

cenários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ainda assim…

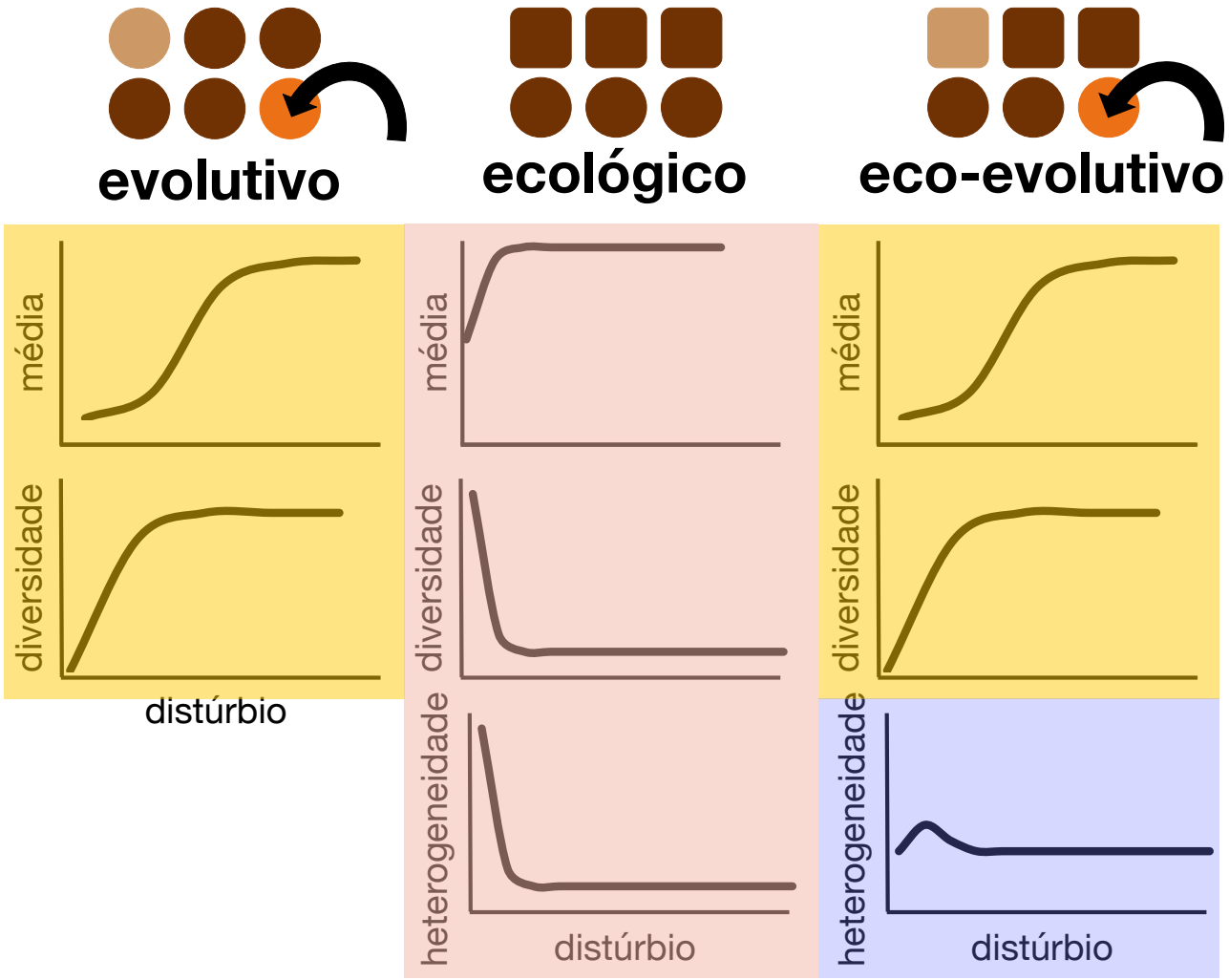
Ecologia

- desconsidera adaptação
- possíveis consequências:
  - gerar predições erradas quanto à diversidade
  - relacionar padrões a processos equivocados

Biologia Evolutiva

- desconsidera contexto multiespecífico
- possíveis consequências:
  - gerar predições erradas quanto à estratégia média das populações
  - não acessar padrões que emergem em escalas maiores

cenários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conclusões

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-
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conclusões

- efeito do **distúrbio** é *diferente* comparando dinâmicas **ecológicas** e **evolutivas**

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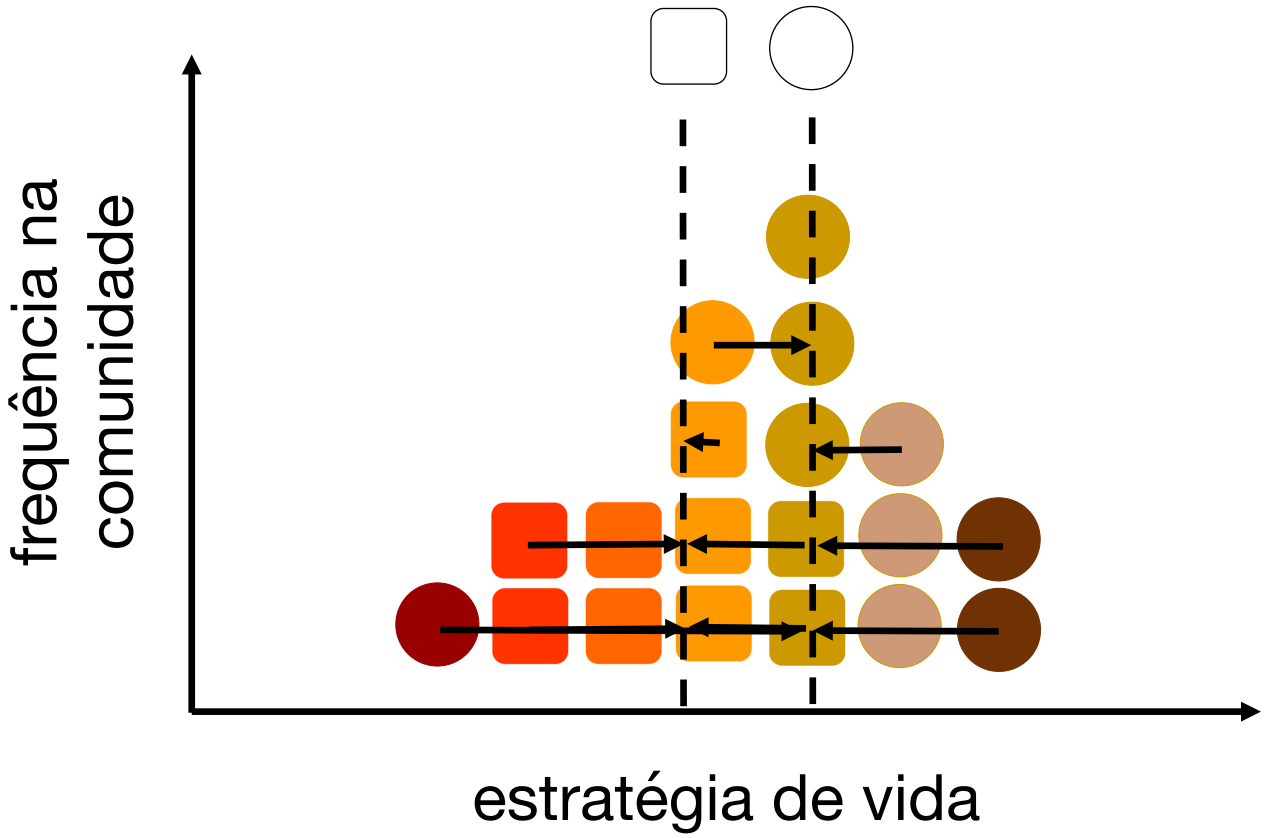
conclusões

- efeito do **distúrbio** é *diferente* comparando dinâmicas **ecológicas** e **evolutivas**
- há padrões que emergem *apenas* em dinâmicas **eco-evolutivas**
-

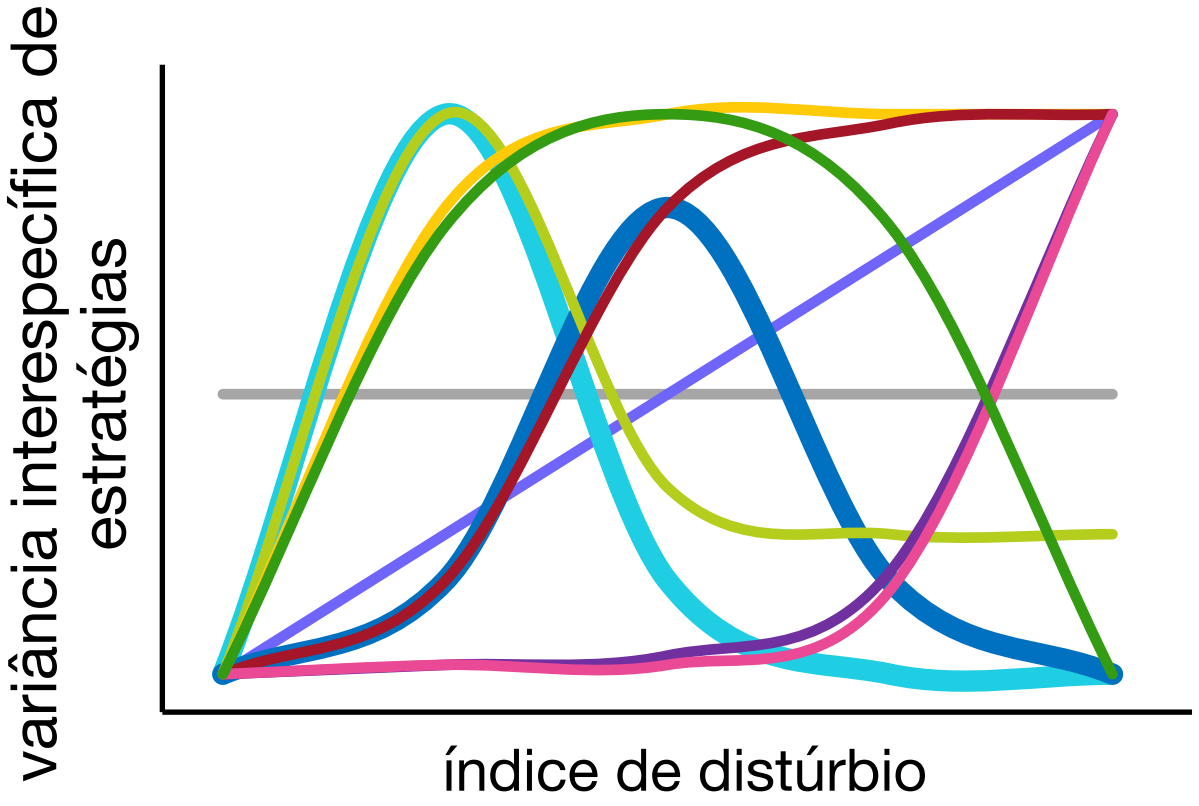
conclusões

- efeito do **distúrbio** é *diferente* comparando dinâmicas **ecológicas** e **evolutivas**
- há padrões que emergem *apenas* em dinâmicas **eco-evolutivas**
- o **distúrbio** deve ser estudado em dinâmicas **eco-evolutivas**

variáveis de interesse



média da estratégia	**estratégia média**
variância total da estratégia	**diversidade de estratégias**
variância interespecífica da estratégia	**heterogeneidade interespecífica de estratégias**

variância

(heterogeneidade interespecífica de estratégias) ~ distúrbio