# Modelling infection in clonal networks

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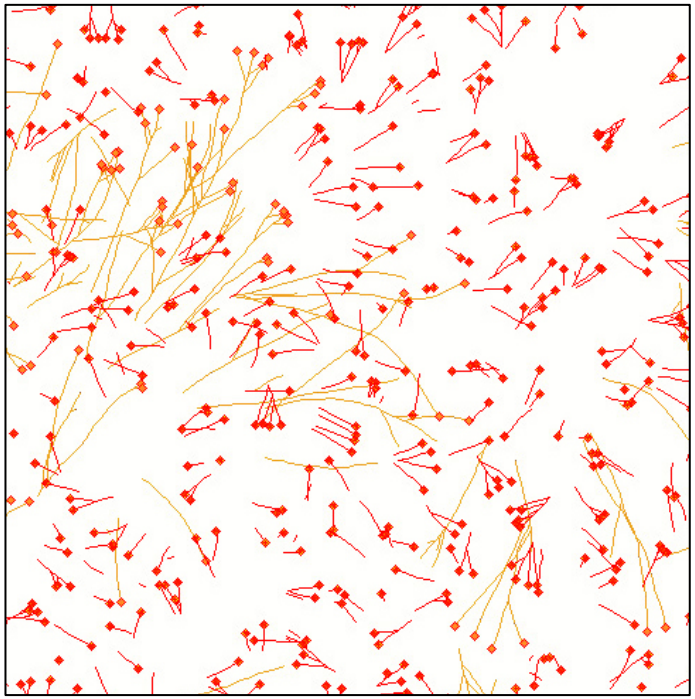
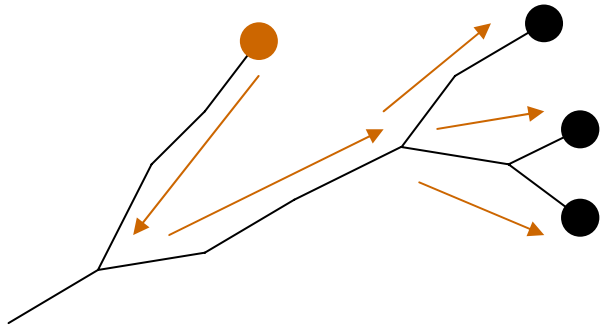




# Introduction

**The integration in clonal plants has**

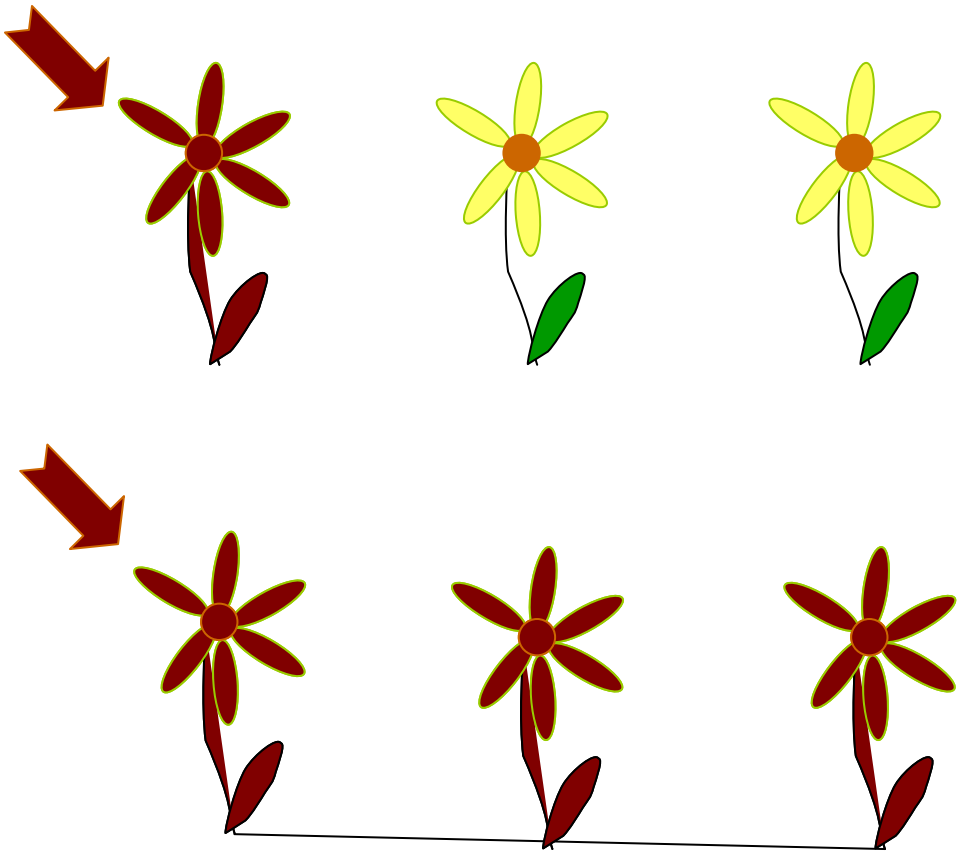
**advantages**

- support of young ramets
- resource sharing
- division of labour
- information sharing

**disadvantages**

- easy spread of diseases in the clonal network

# Introduction



# Hypothesis

1. The more integrated the clonal network is, the more the population of the species suffers from disease
2. With higher infection rates, the integrated networks are more influenced by the disease

⇨ this can be tested by spatially explicit model

# The model (previous results)

1. Different arrangements of translocation directions (sinks) produce different growth forms of the plant
2. Translocation is beneficial even in homogeneous environment, because the plants themselves create the heterogeneity

*Herben T. (2004) Evolutionary ecology*

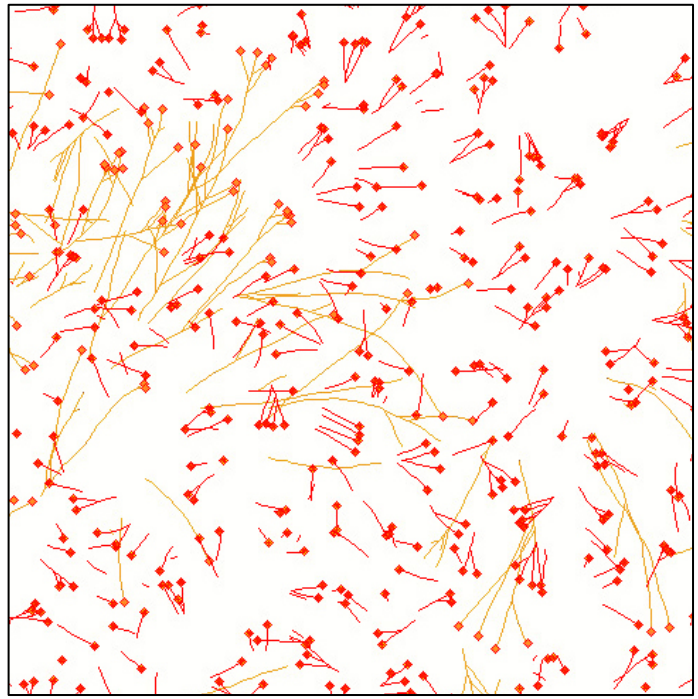
# The model

**RHIZOME**

- processes
  - growth of rhizomes
  - branching
  - rhizome fragmentation

  - ramet formation and growth
  - resources acquisition
  - competition
  - translocation

  - infection at specified rate
  - infection spread and effects



*http://www.natur.cuni.cz/~herben/rhizome/rhizome.html*

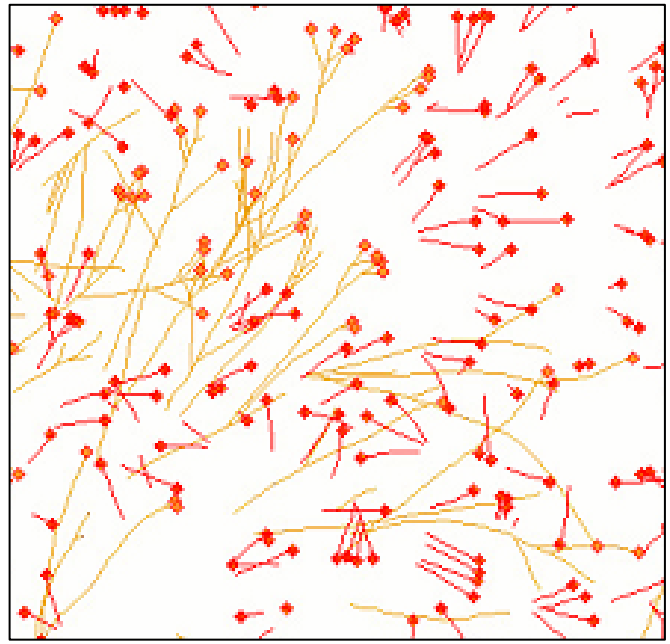
# Settings

length of the network

⇩

**SPECIES**

- **splitter** – connection dies off when 10 nodes are formed
- **integrator** – connection dies off after 20 or 30 nodes are formed, otherwise identical to splitter
- integrator 10 nodes long used as control



# Parameters

**INFECTION RATE** – proportion of ramets infected at each step, spatially independent, *zero means no infection*

(log scale from 0 to 0.1)

**SEVERITY** – proportion of resources retained by the ramet under pressure of the infection, *zero means the ramet is killed instantly*

(0 and 0.25)

**PROPORTION SHARED** – proportion of resources that can be translocated from one ramet through rhizomes

(0 and 0.1)

**SHARING RANGE** – length of integrator (10, 20 and 30)

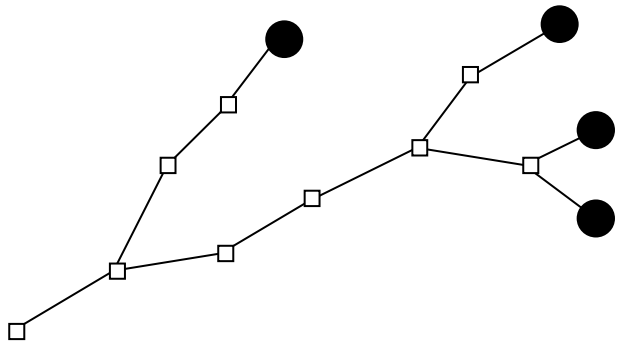
# Settings

**ARCHITECTURE**

- ramets only on the growing tip (replacement type)
- only terminal branching possible

**TRAITS**

- no translocation cost
- plants produce seeds



**INFECTION SPREAD**

- immediate

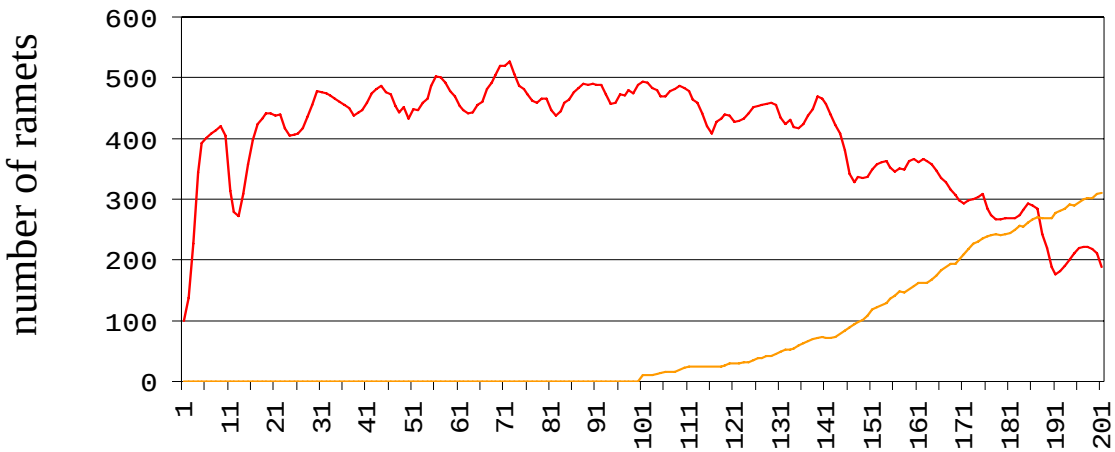
# First results

With the same numbers of splitters and integrators put into the simulation, the **integrator always wins** except when both infection rates and severity of the disease are very high

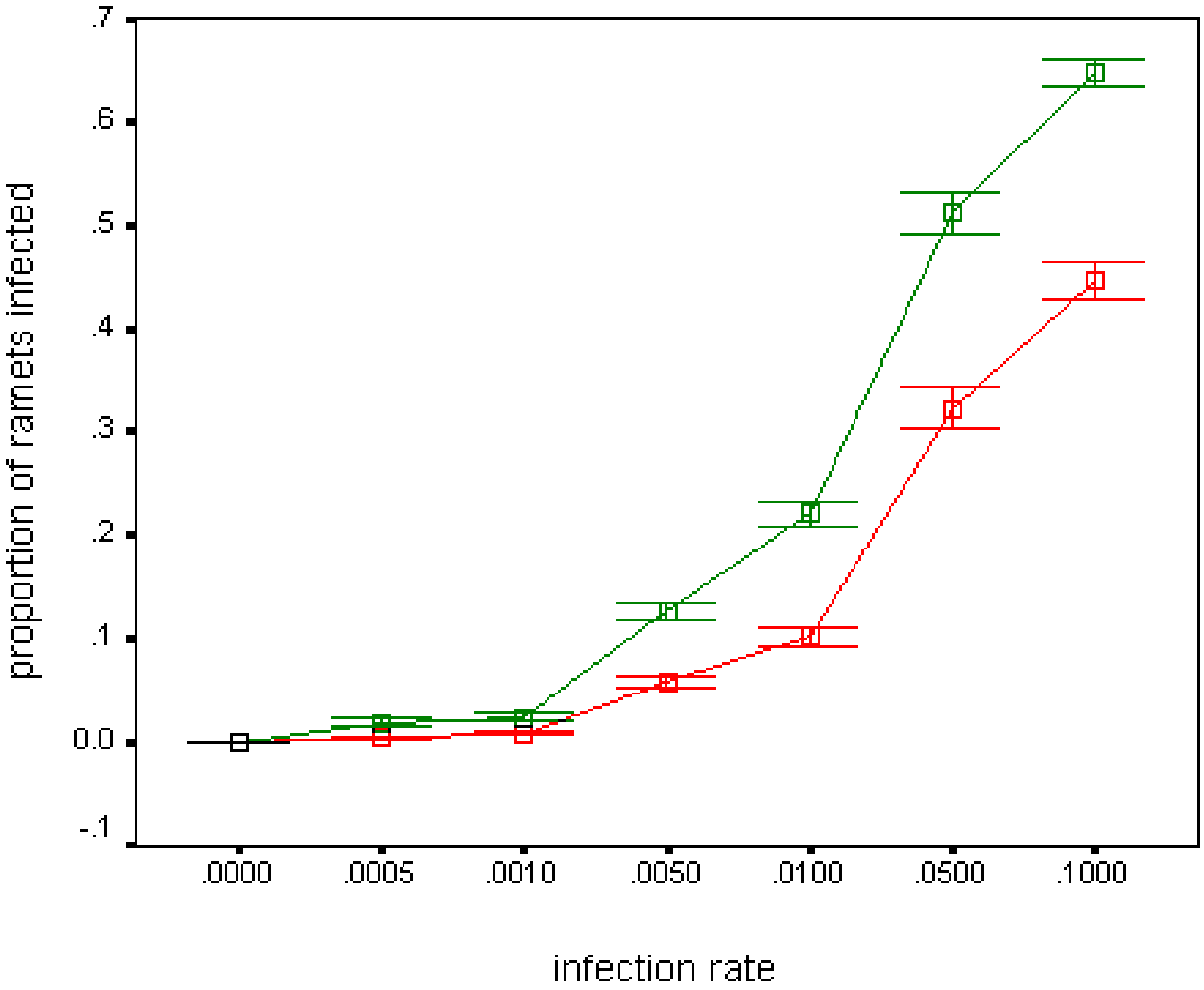
# Simulation

## COURSE OF SIMULATION

- **beginning** – start with 100 ramets of the splitter
- **after 100 steps** – 10 ramets of the integrator added
- **after 200 steps** – simulation stopped, numbers of ramets and infected ramets of both species were counted
- **20 runs**



# Results

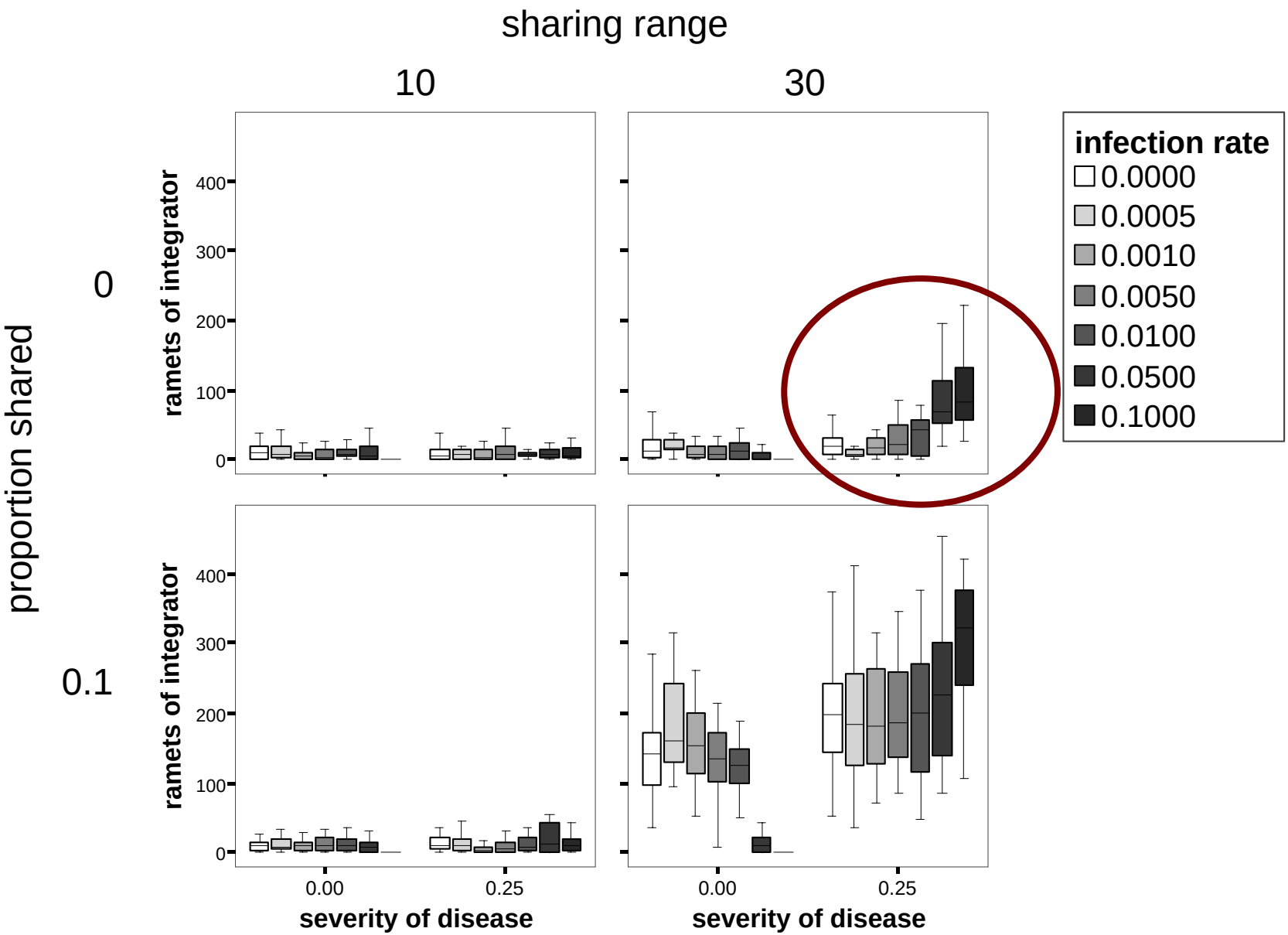



SPLITTER

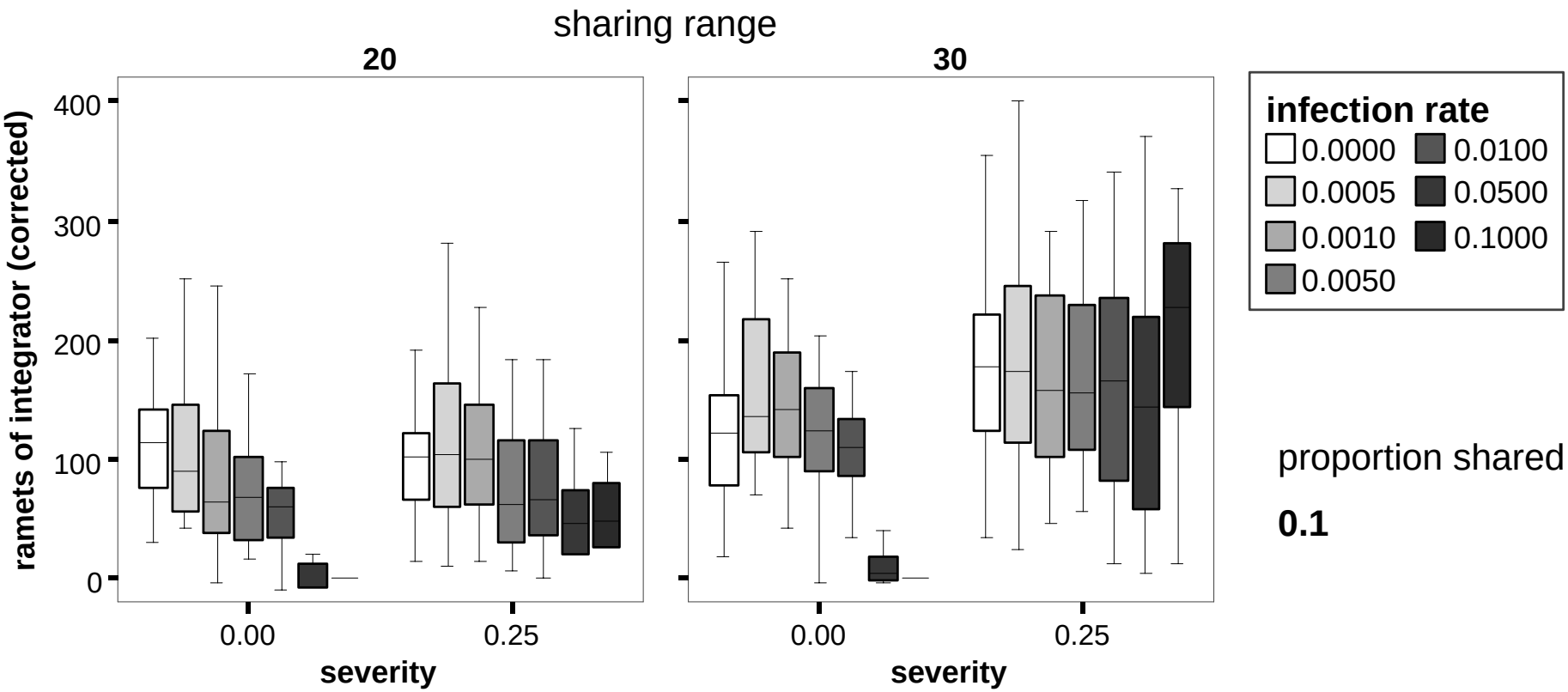
INTEGRATOR

severity **0.25**
proportion shared **0.1**

# Results


sharing range
10
30
proportion shared
0
0.1
ramets of integrator
400
300
200
100
0
0.00
0.25
severity of disease
infection rate
0.0000
0.0005
0.0010
0.0050
0.0100
0.0500
0.1000

# Results

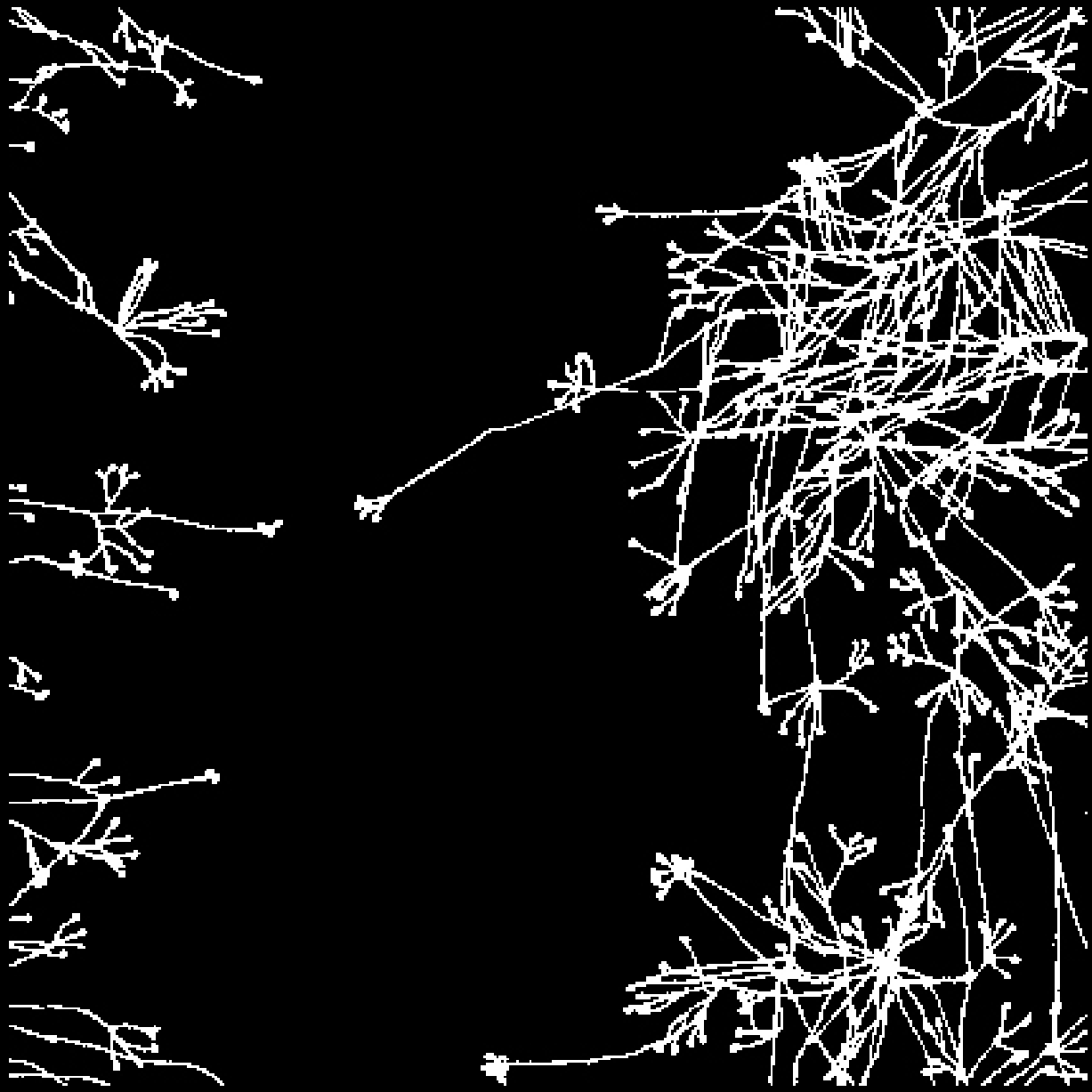



- with higher infection rates, integrator is less successful
- with longer interconnected system and mild disease, the integrator is more successful

# Conclusions

1. The more interconnected the clonal network is, the more the genet suffers from disease
   - NO – the integrator is generally better competitor due to better use of translocation ability, which compensates for the negative effect of the disease
   - the more, with longer network, the integrator deals with high infection rates better

2. With higher infection rates, the long networks are more influenced by the disease
   - YES – high infection rates give comparative advantage to the splitter, especially when severity of the disease is high



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