

# Do coevolving parasites maintain genetic variation?

## A tale of spatial variation in infection, susceptibility, and sex

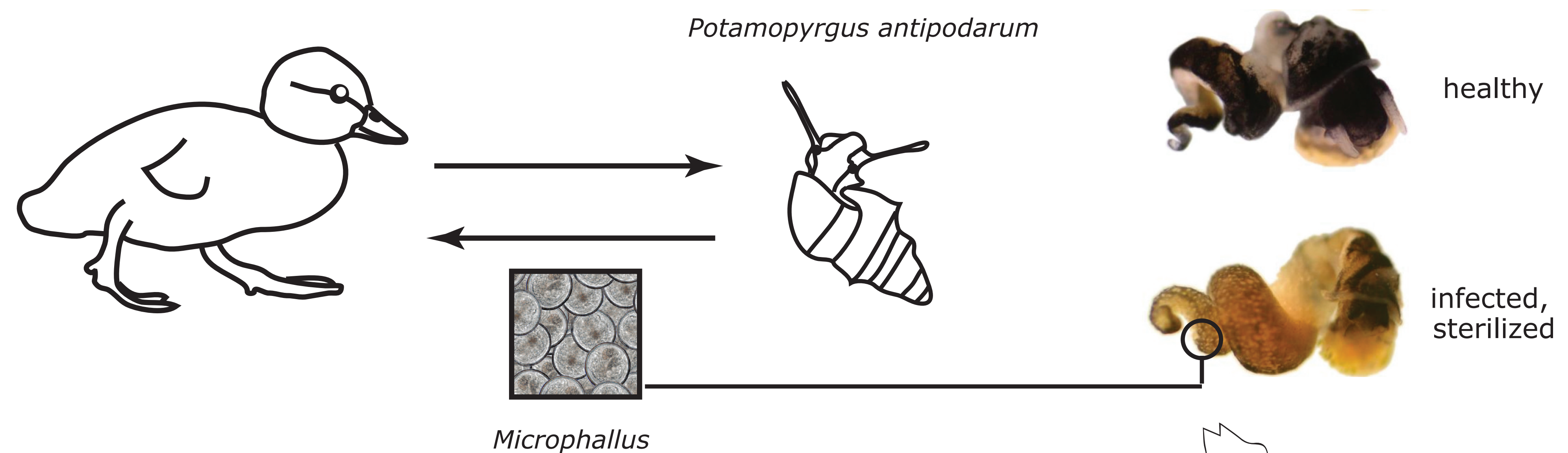
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### The problem

Sexual reproduction is costly relative to cloning, yet it's rampant in nature

**The Red Queen Hypothesis** says that genetically variable (sexual) lineages are maintained by coevolving parasites



### Sex varies in space

Obligately sexual and asexual snails coexist in Lake Alexandrina



Lake Alexandrina Scenic Reserve in New Zealand; photo by Jukka Jokela

- Sites vary in frequency of sexual snails ( $p < 0.001$ )

- Increasing to north and east

Latitude:  $p = 0.006$

Longitude:  $p = 0.002$

Lake average

asexual

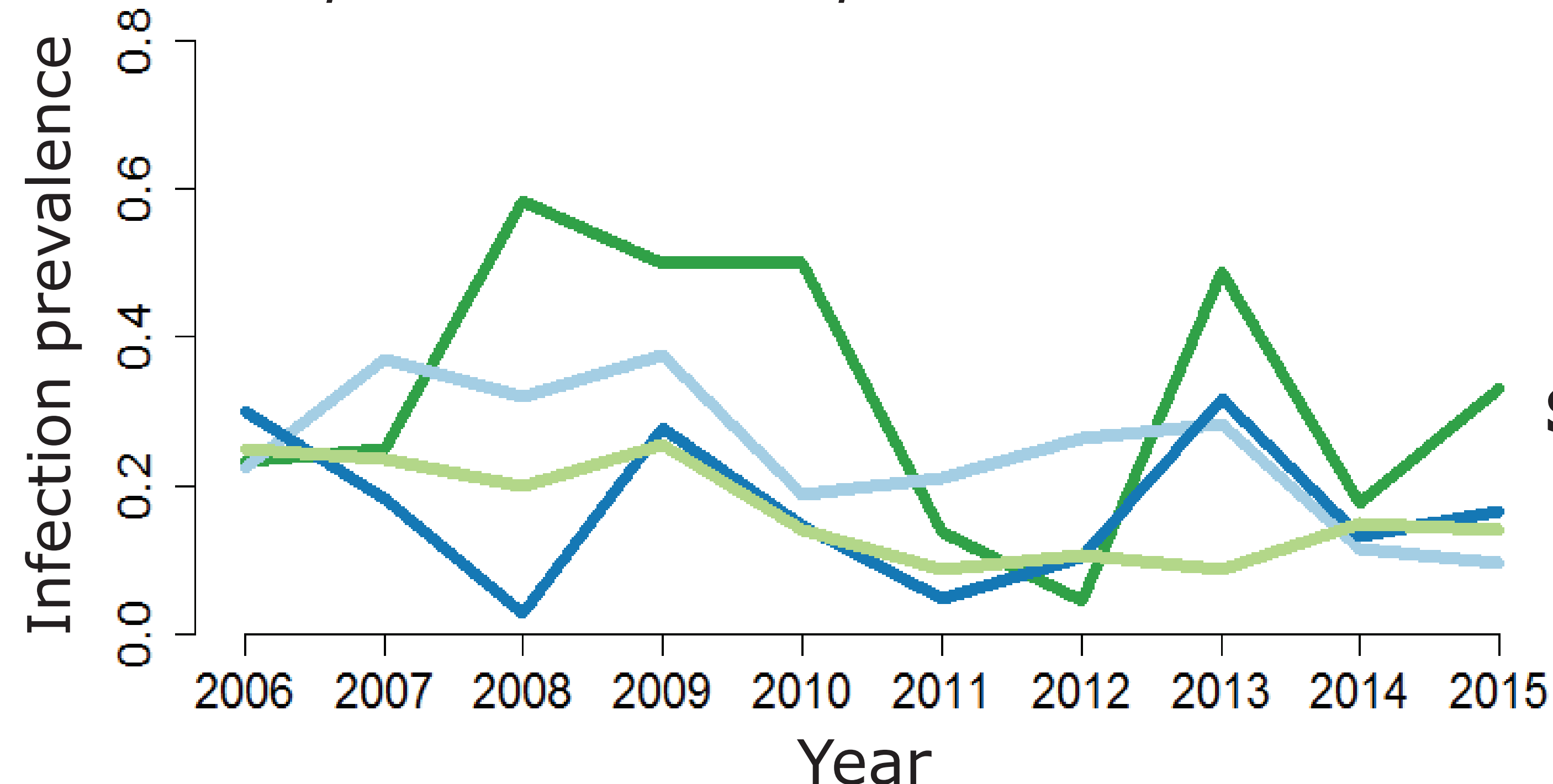
sexual

1 km

### Parasitism varies in space

#### Field prevalence

representative sample: 4 eastern sites



#### << Field prevalence

- varies with year ( $p < 0.001$ )
- and site ( $p < 0.001$ )
- no spatial gradient, nearby sites are distinct

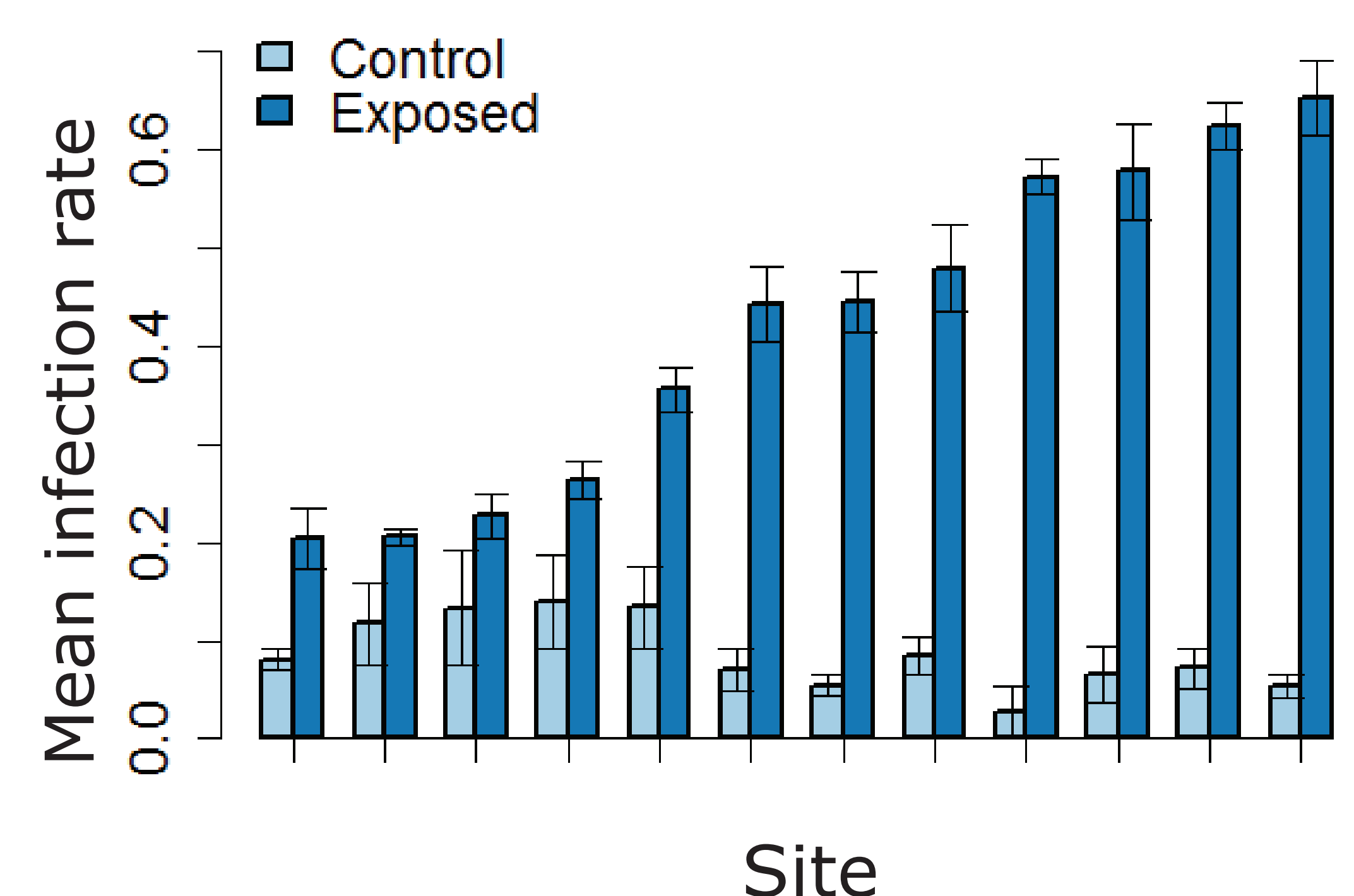
#### Susceptibility >>

- infection rate in lab exposure
- varies with site ( $p < 0.001$ )
- increasing to north and east

Lat:  $p = 0.004$

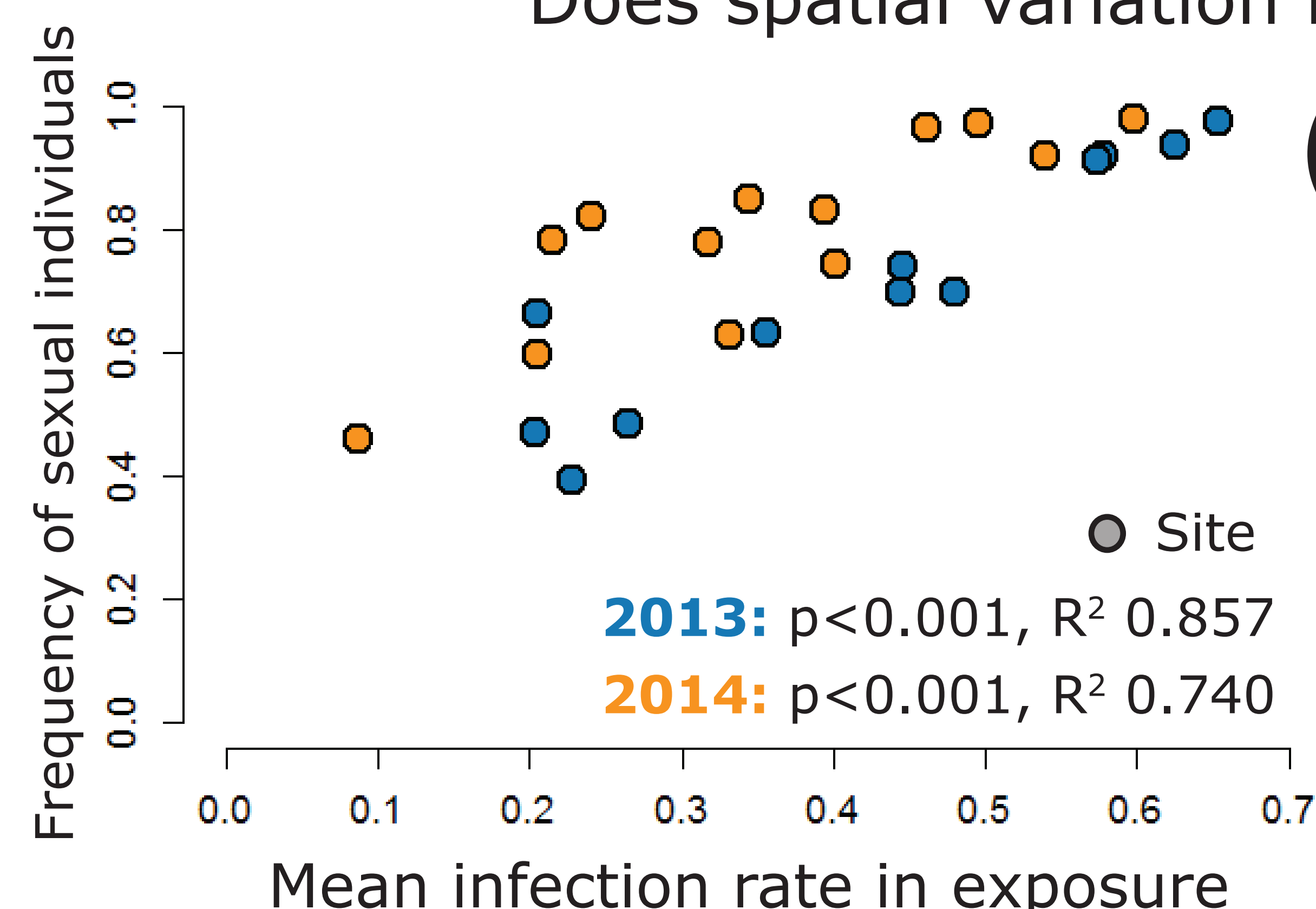
Long:  $p = 0.003$

#### Susceptibility, 2013



### The test

Does spatial variation in coevolving parasites explain the spatial variation in sex?



Yes!

#### The cline in sex arises from variation in susceptibility

- Independent of space: lat/long + proximity explain no added variation
- Genetically variable offspring of sexual females have a fitness advantage where hosts are most susceptible to coevolving parasites.
- Sex is not explained by variation in prevalence, which reflects both susceptibility (i.e. coevolution) + the environment (data not shown)

**Coevolving parasites maintain genetically variable sexual lineages**

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