

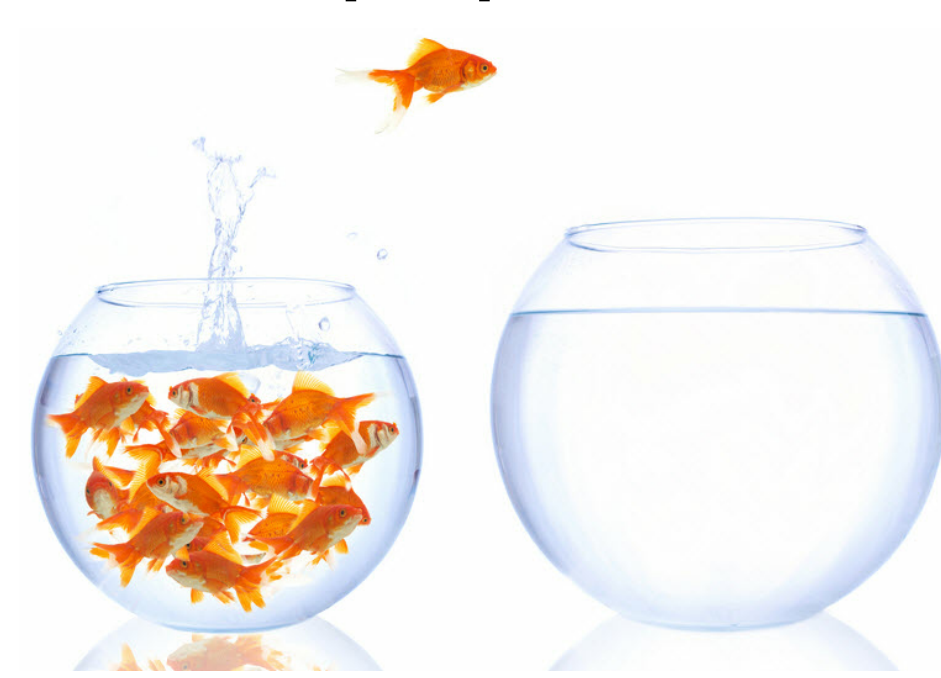
# Range expansions favor the evolution of cooperation

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## Motivation

Natural populations often undergo range expansions



Western corn rootworm

Grey, ME, et al.  
*Ann. Rev. Entomol.*, 54:  
303-21 (2009)

Butterflies

Pateman, RM, et al.  
*Science*, 336:  
1028-1030 (2012)

Modern humans

*National Geographic* (2008)

**Definition:** A range expansion is an increase in the geographical area in which a species is found

How do range expansions shape the evolution of cooperation?

**Definition:** Cooperation is the act of providing a benefit to others at a cost to yourself

How is cooperation maintained in the face of defectors?

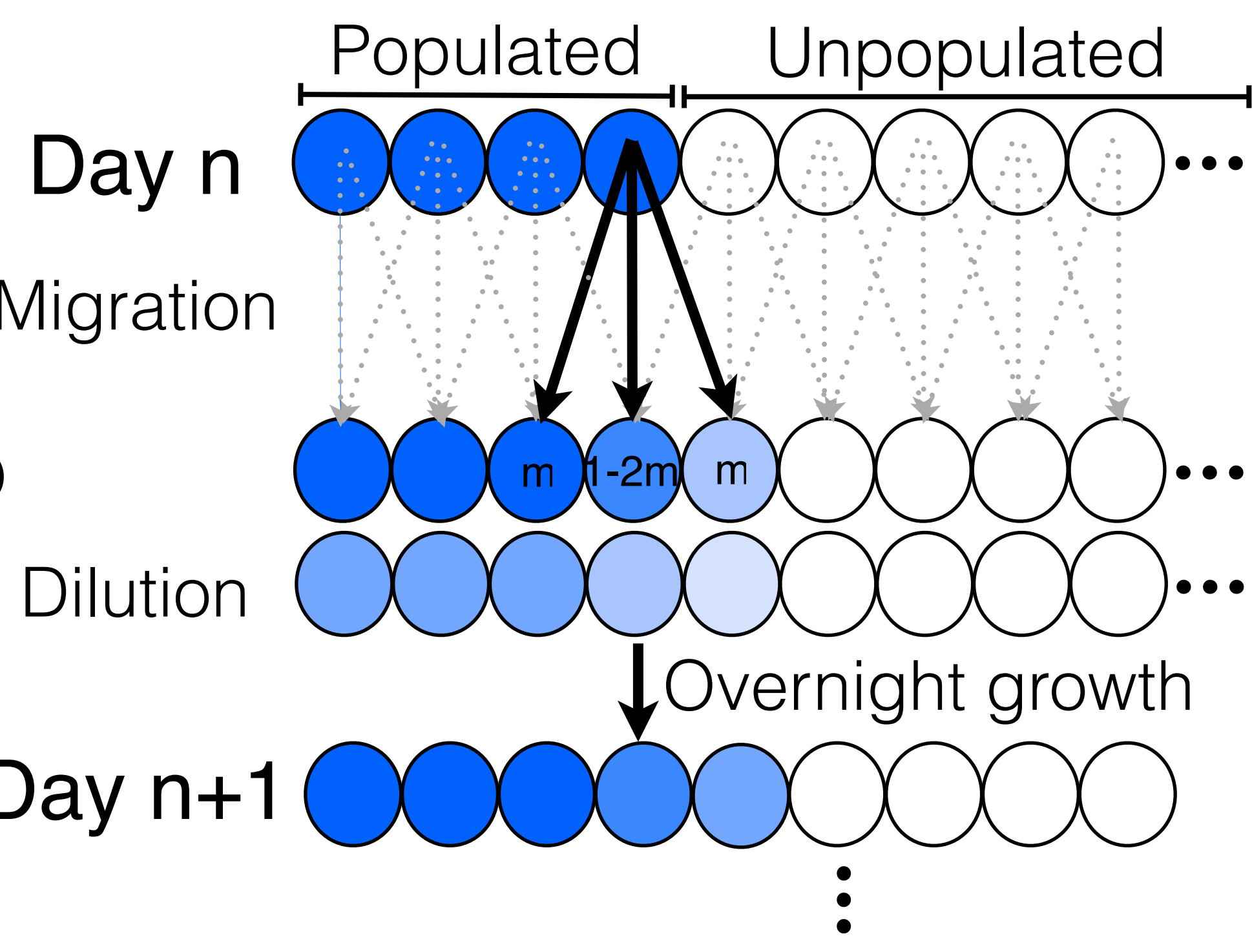
## Approach

Cooperators

sucrose → glucose  
(lose 99% of glucose produced to neighboring cells)

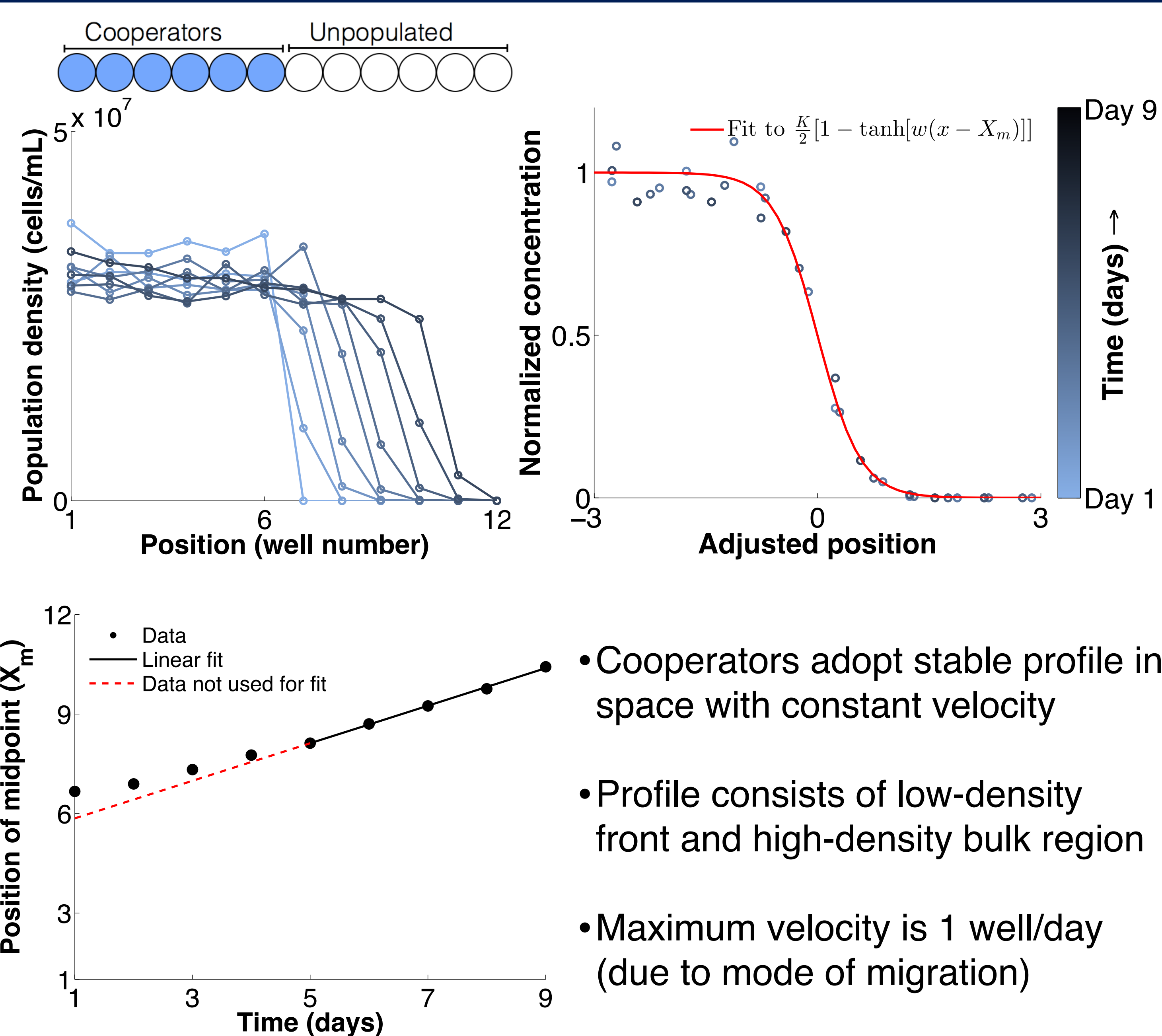
Defectors

sucrose → glucose

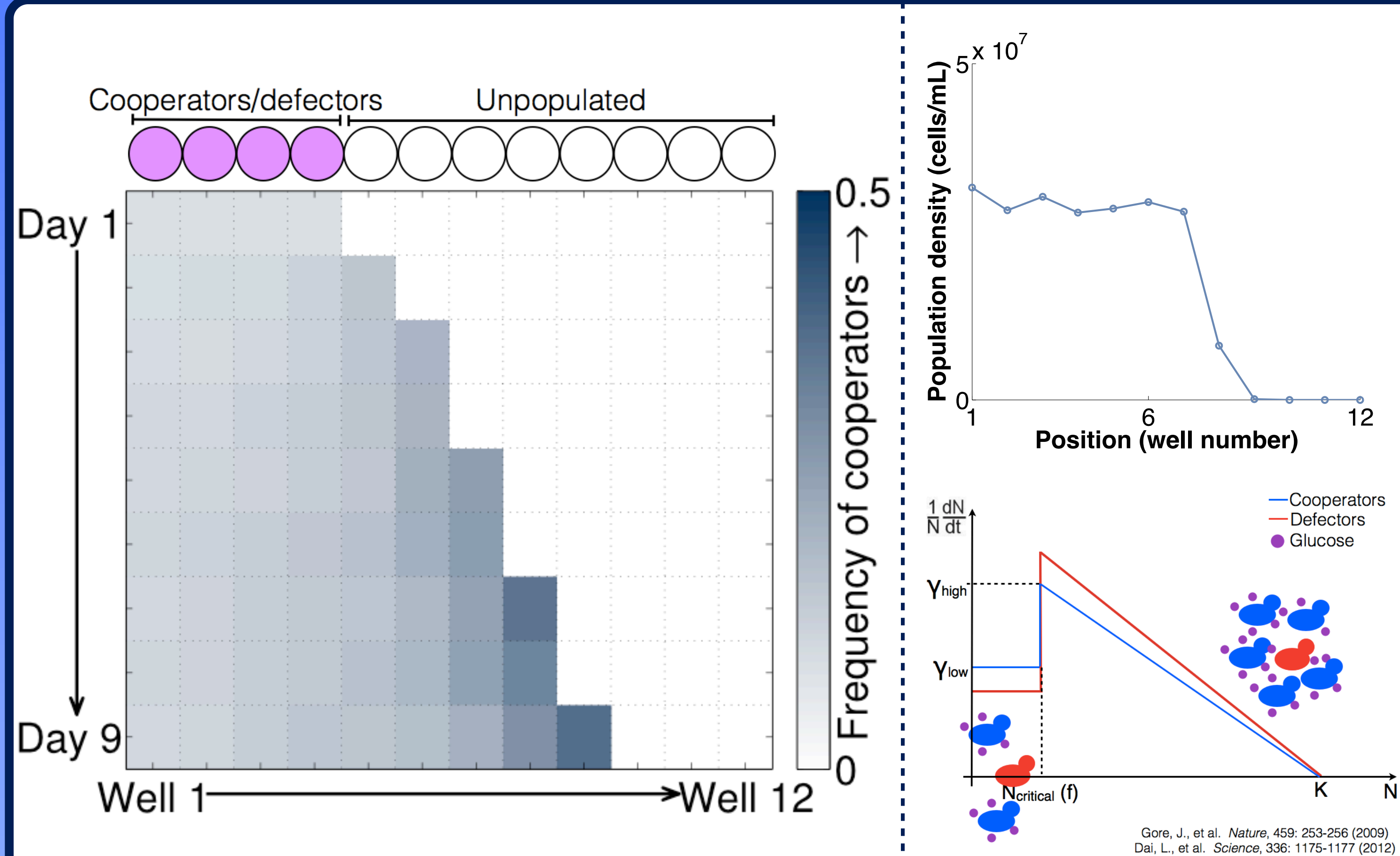


## Results & Discussion

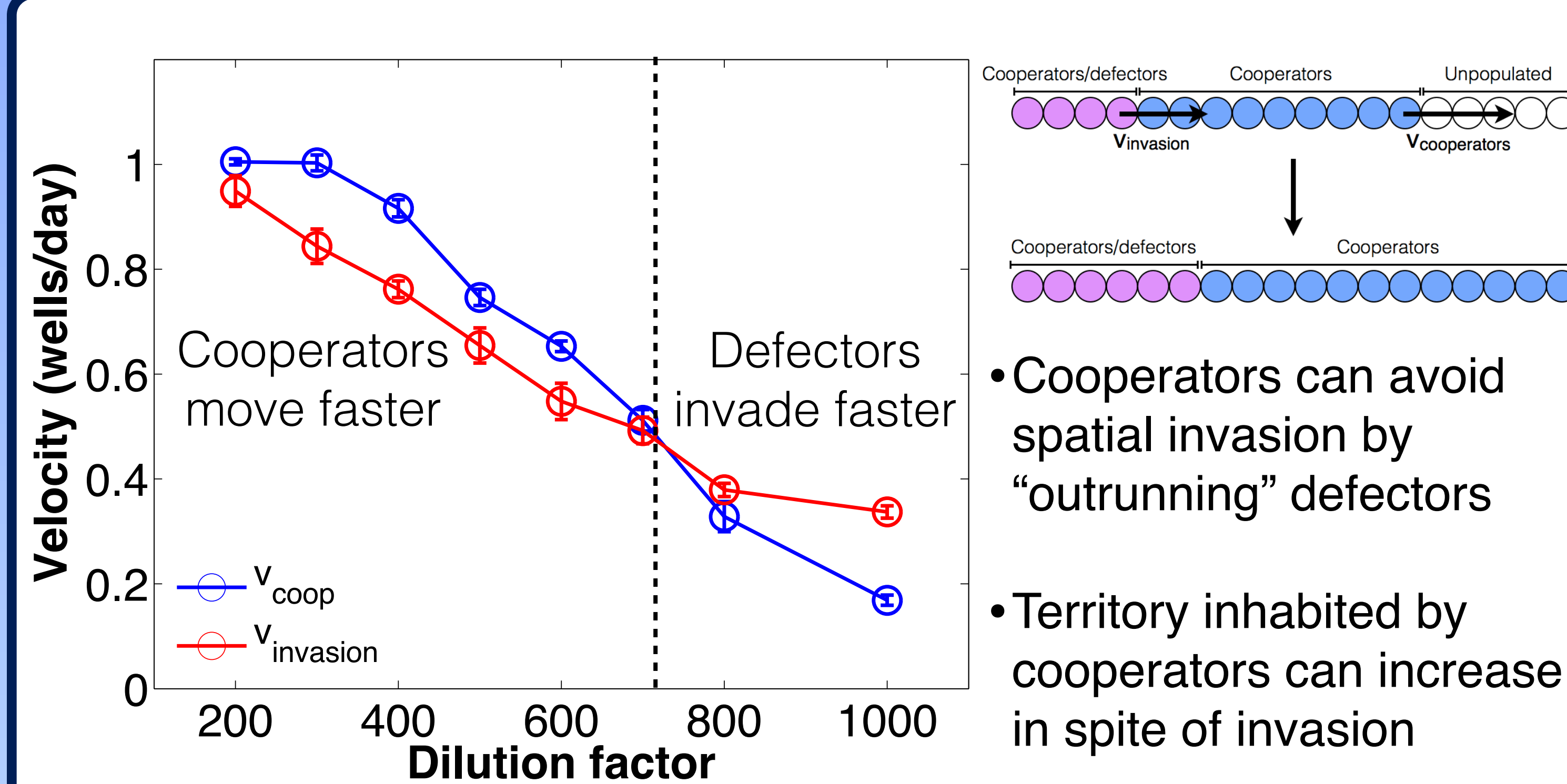
### Cooperators move as traveling waves



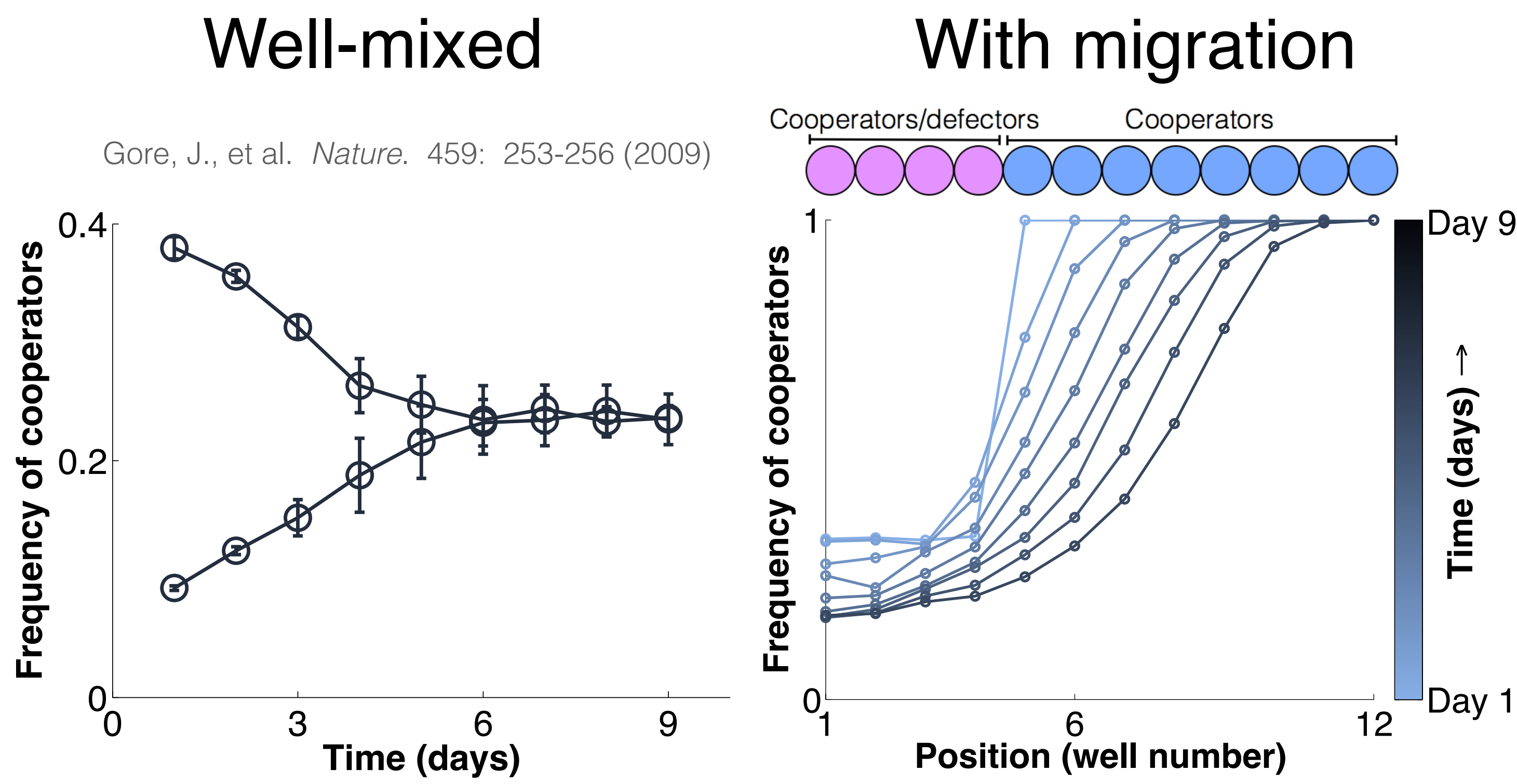
### Cooperation is enriched on the front



### Cooperators can “outrun” defectors



### Defectors invade as a genetic wave



## Acknowledgements



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