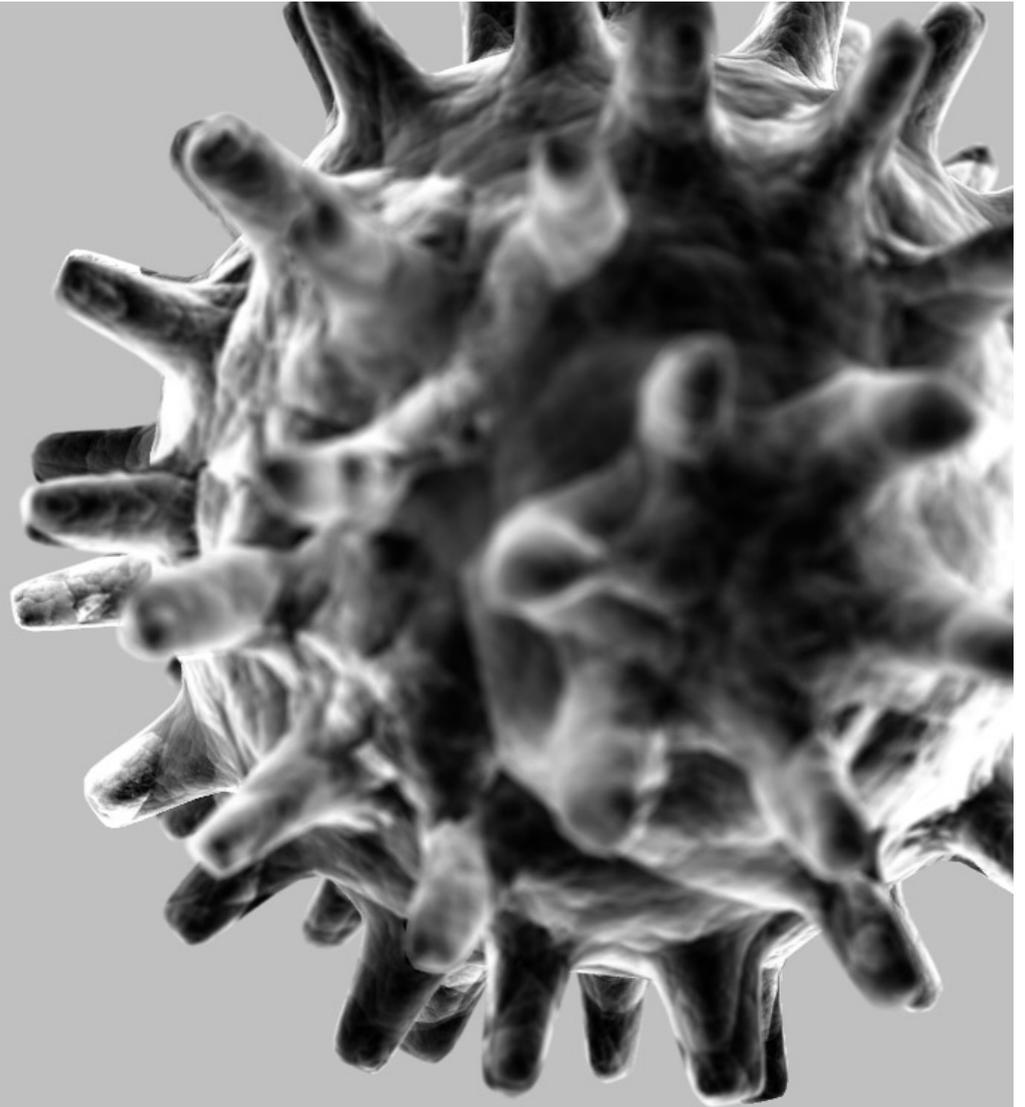


Possibilities and pitfalls of expanded host range mutations



Siobain Duffy

@DuffyLab

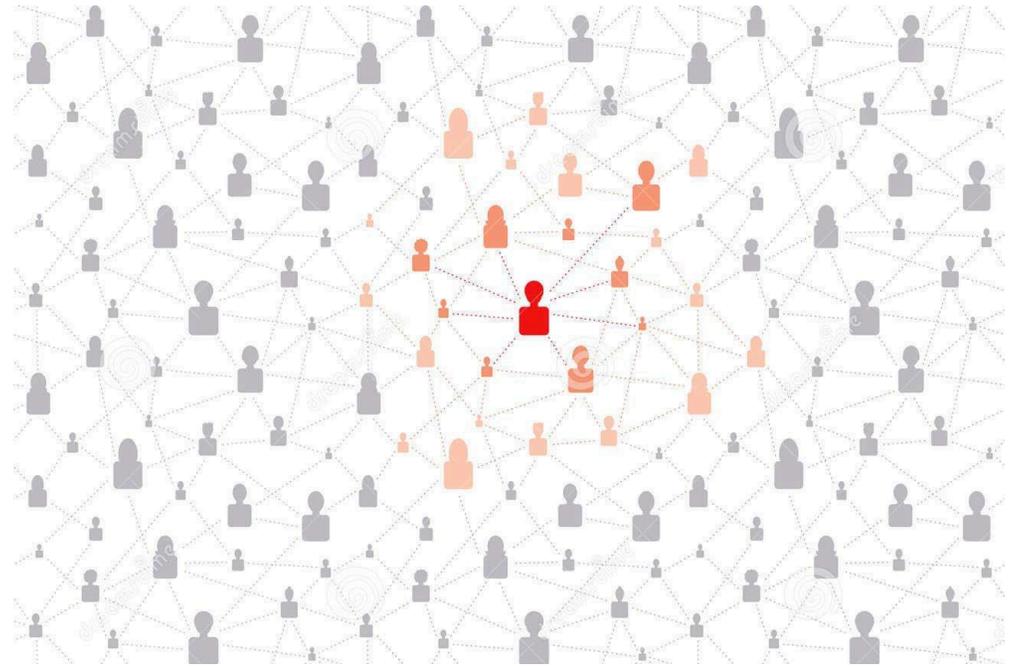
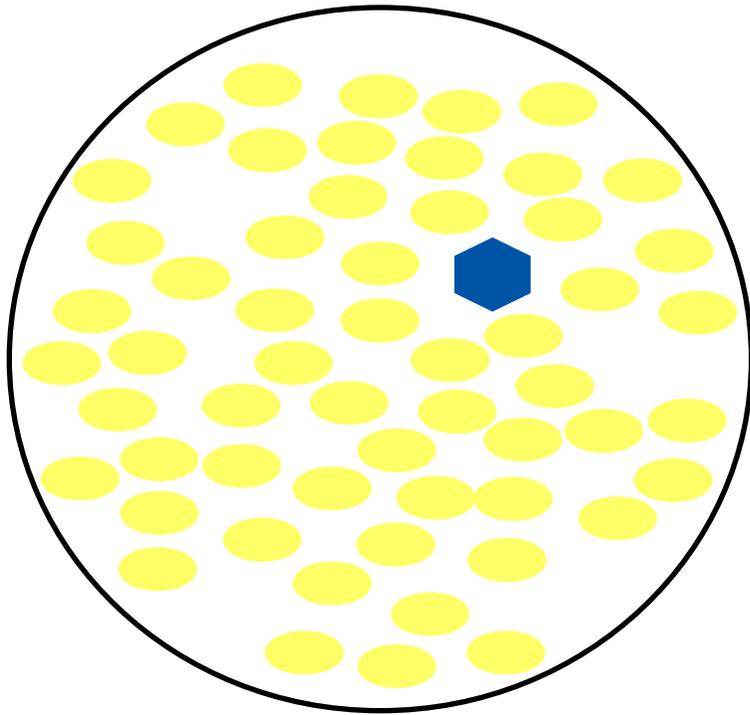
9/18/19



RUTGERS

School of Environmental
and Biological Sciences

“life” can be pretty good for a virus





MERS VIRUS



 **AbledALERT™** Global

OUTBREAK: 'Contorted With Pain' Virus 

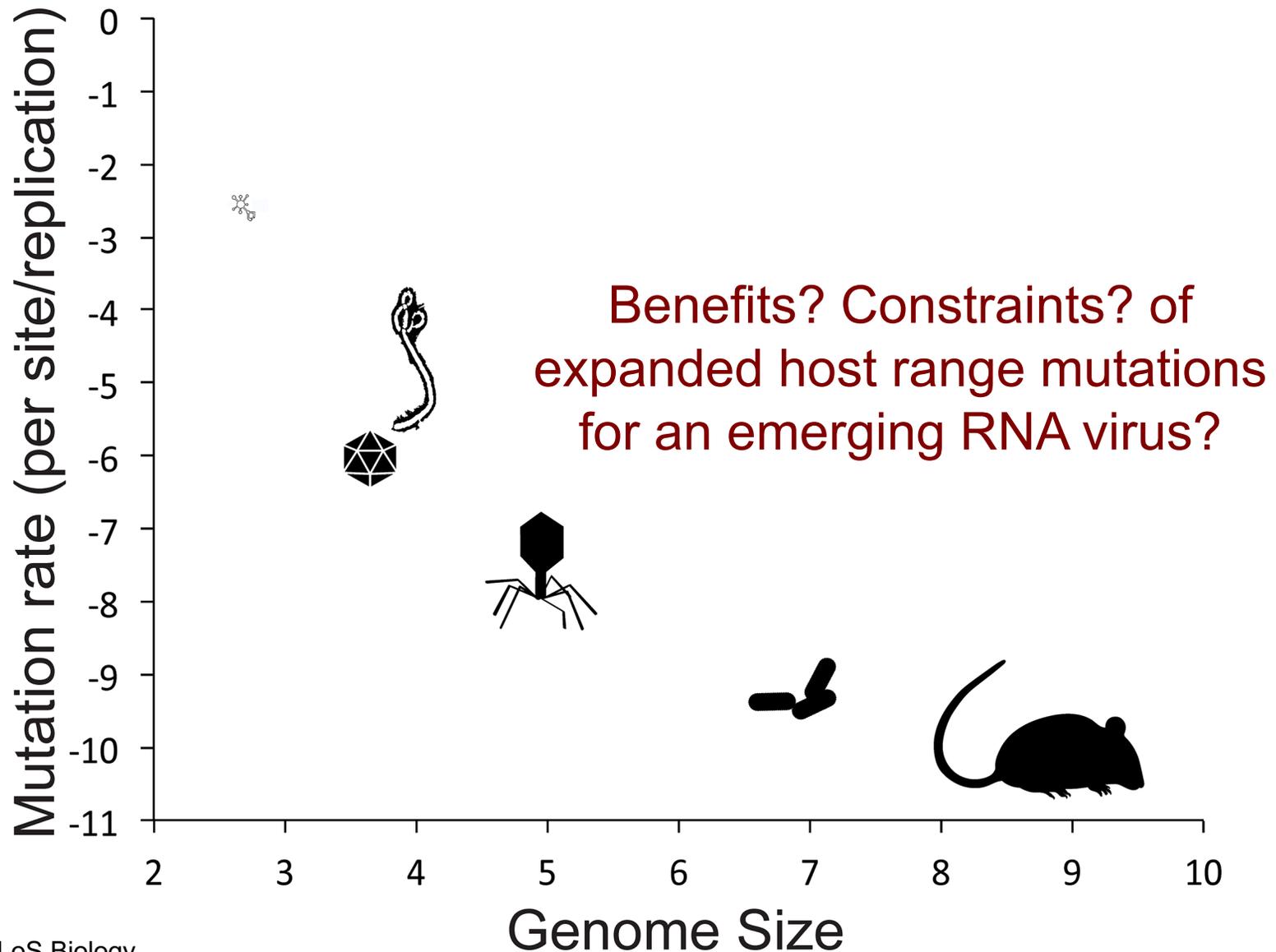
OFFICIAL WARNING TO BRITS
SHRUNKEN HEAD
VIRUS: DON'T
GET PREGNANT

BY STEPHEN WHITE
BRITS visiting countries hit by Zika have been warned against having babies over fears they could be born deformed.
Experts told men returning from the Americas, where the virus linked to tots with small heads is raging, not to have unprotected sex. One said: "Postponing pregnancies is wise."
FULL STORY: PAGES 4&5

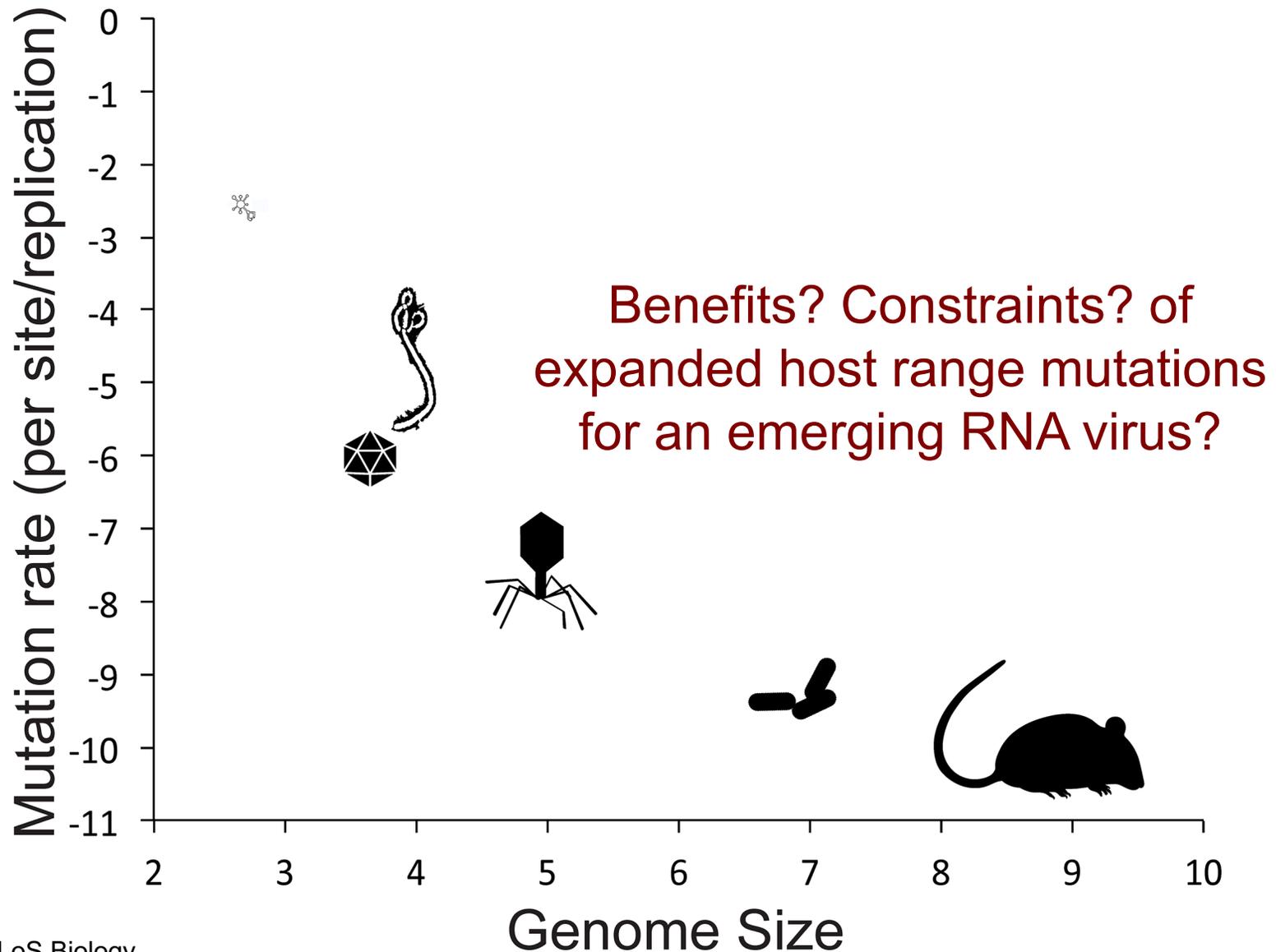


Gov alert for tourists who have been to Zika disease areas

Viruses can have high mutation rates

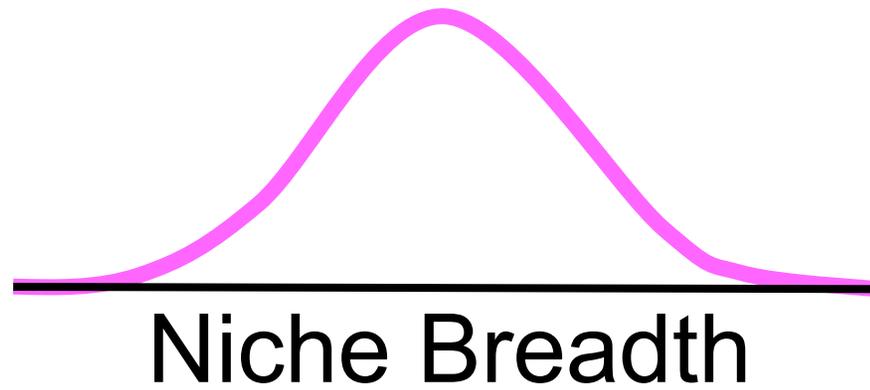


Viruses can have high mutation rates

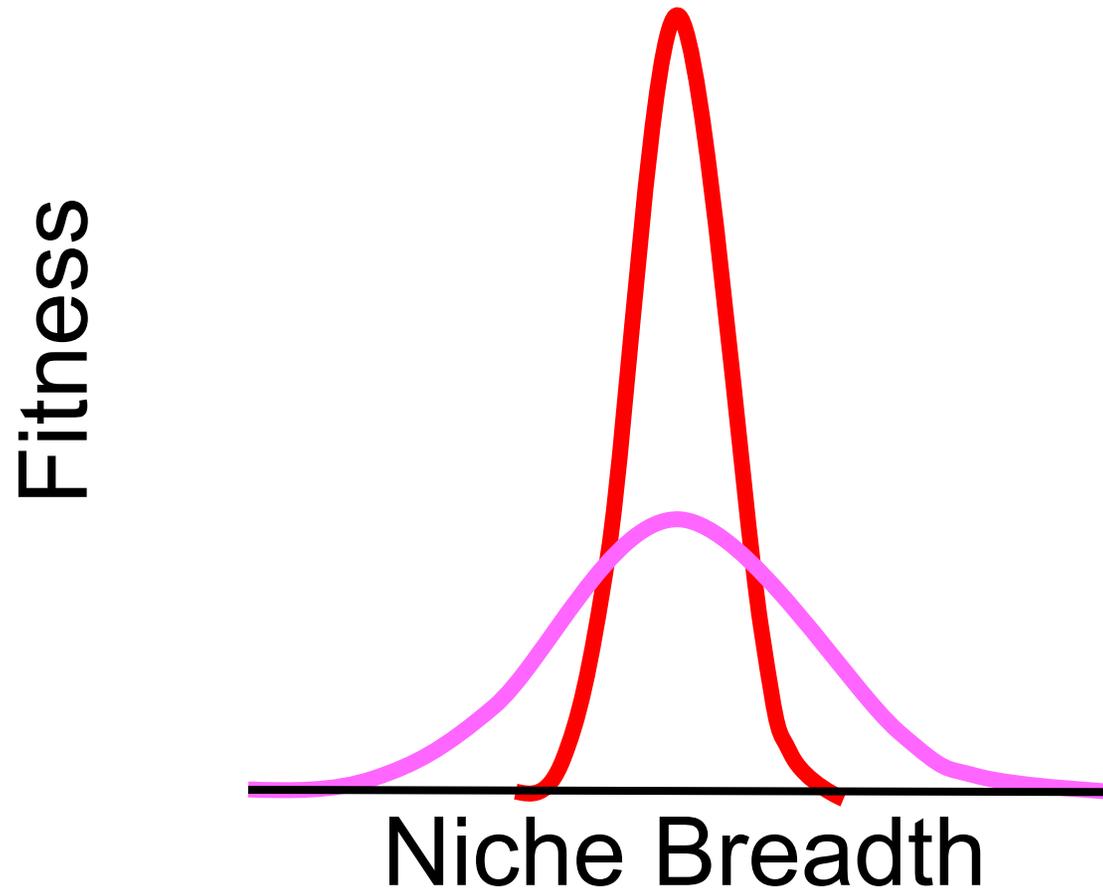


Jack-of-all-Trades

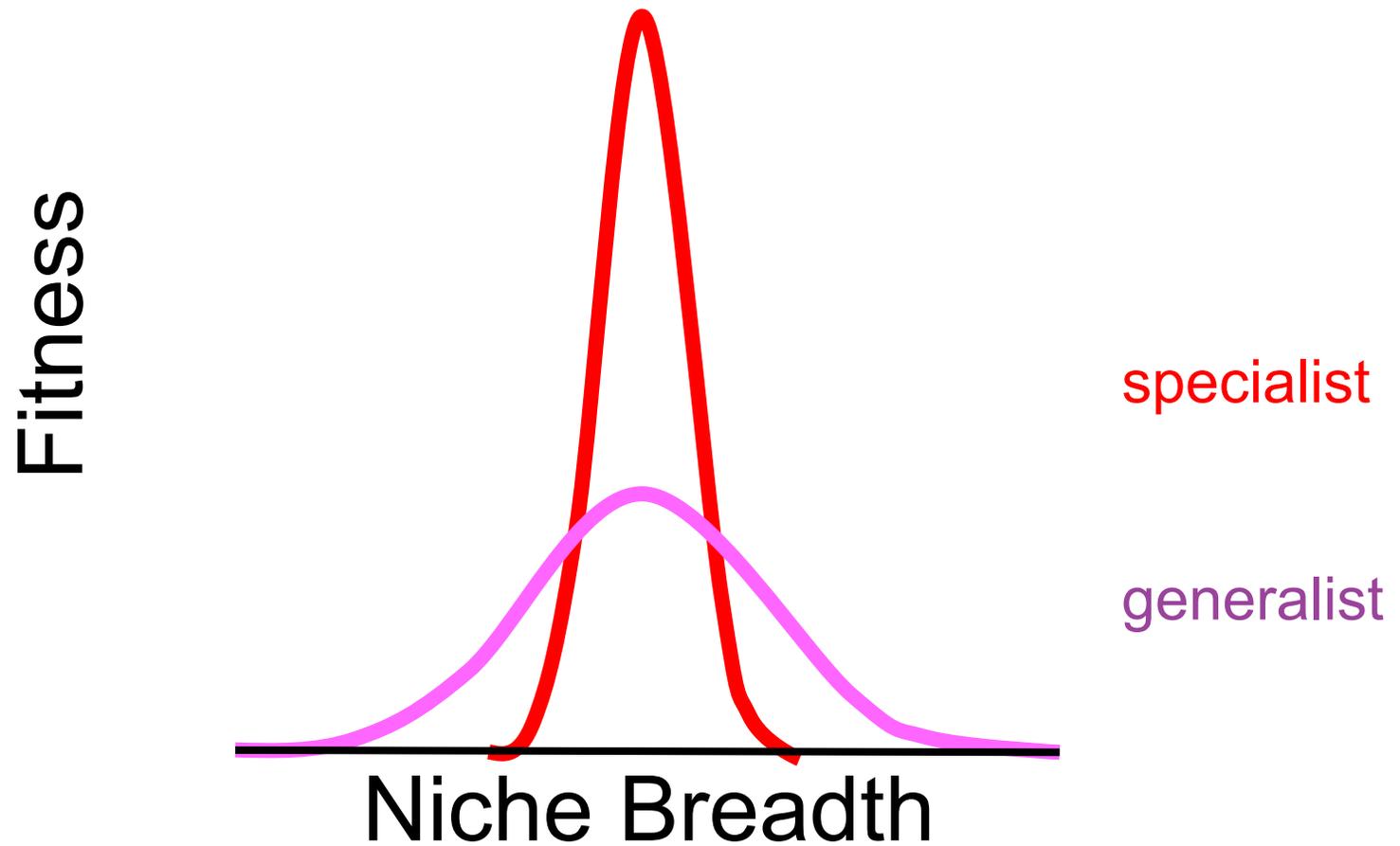
Fitness



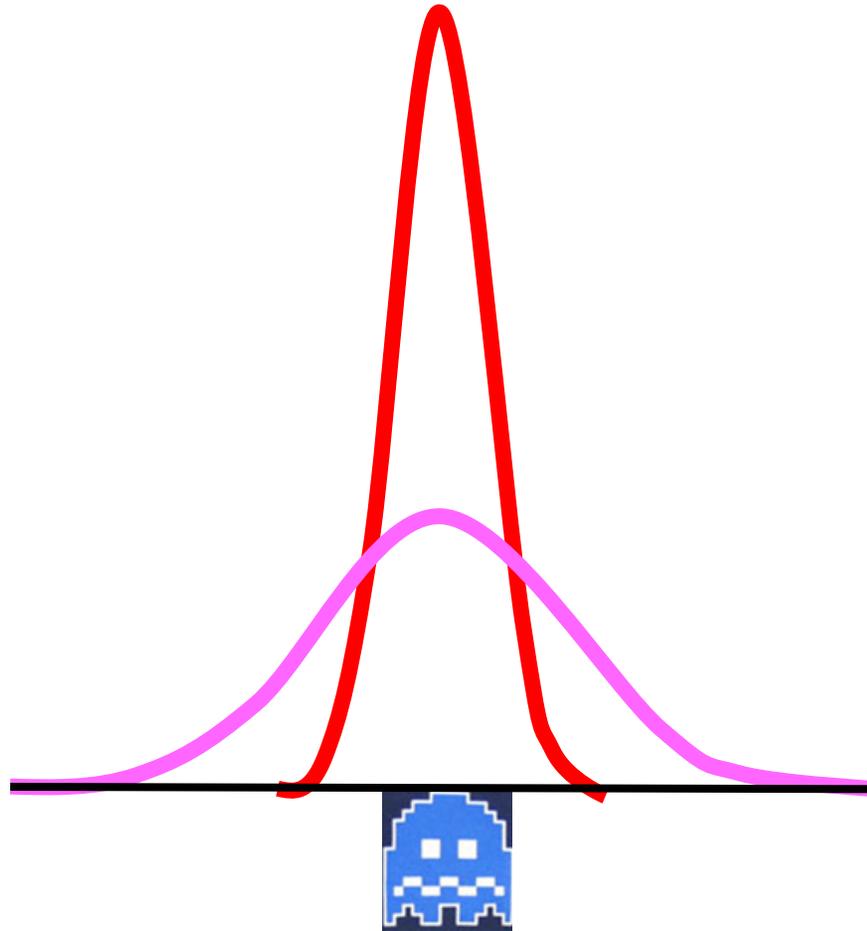
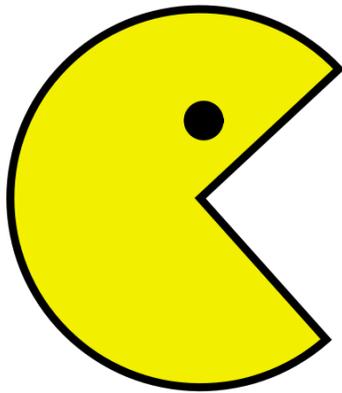
Jack-of-all-Trades



Jack-of-all-Trades is a Master of None



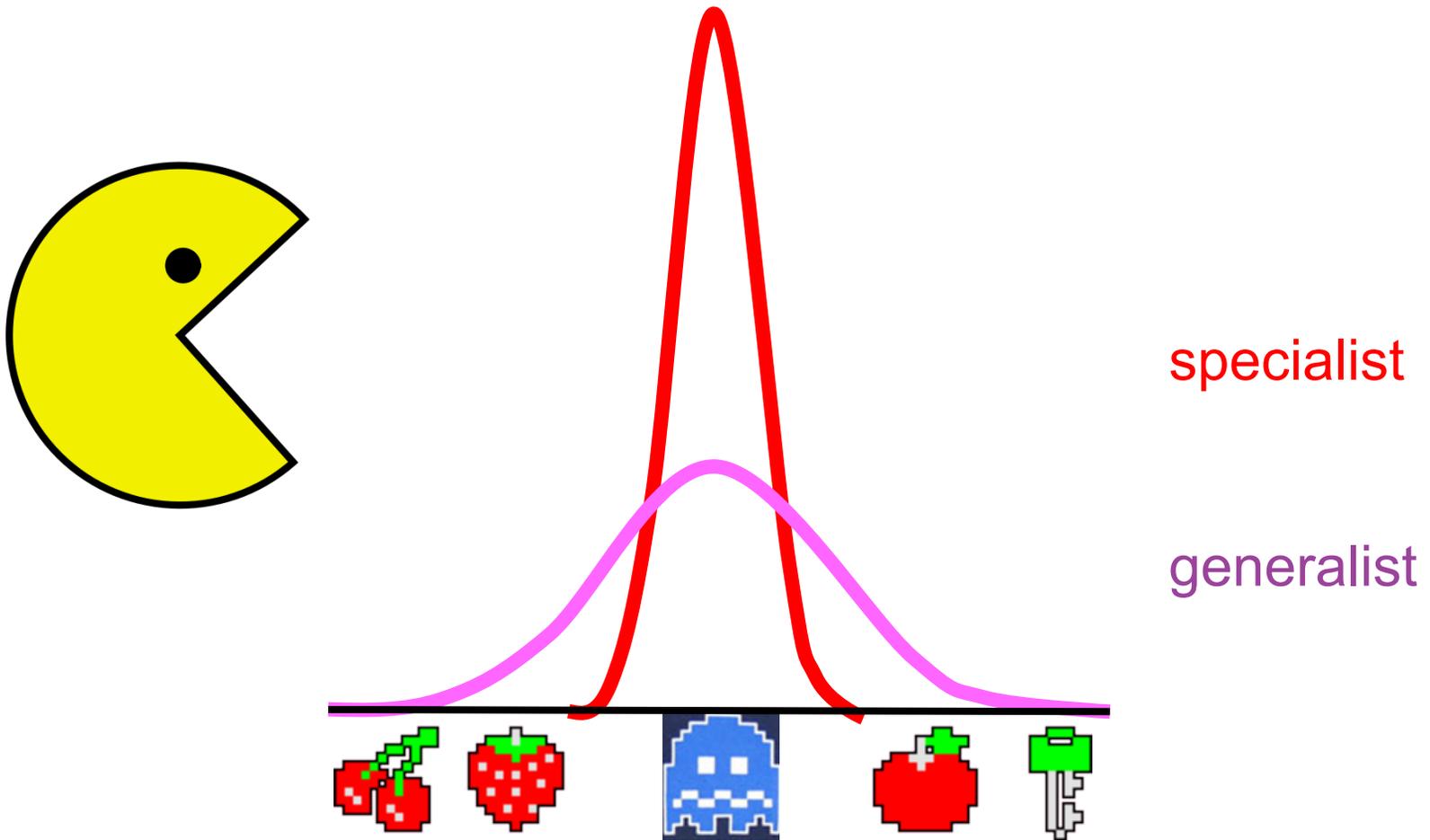
Jack-of-all-Trades is a Master of None



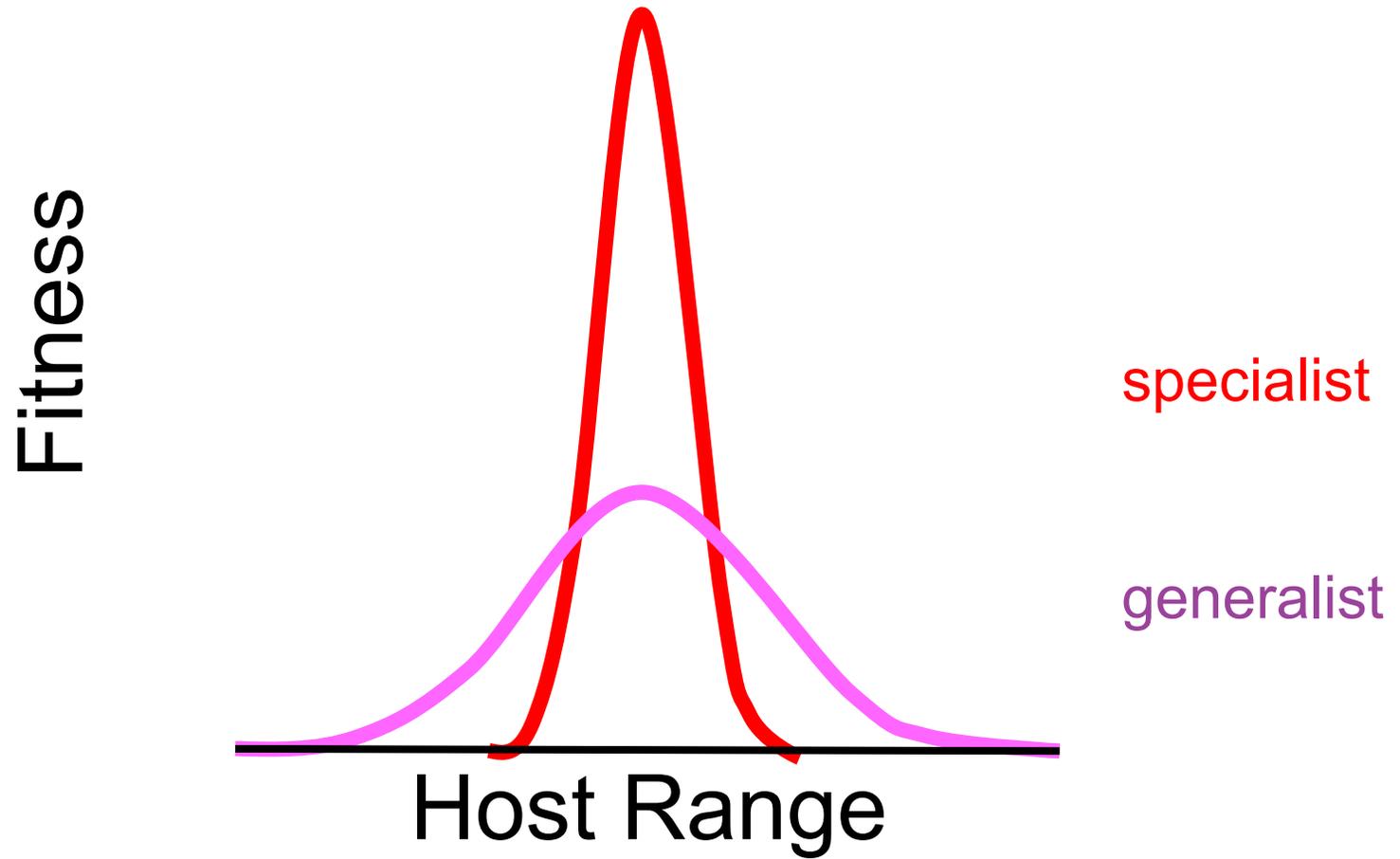
specialist

generalist

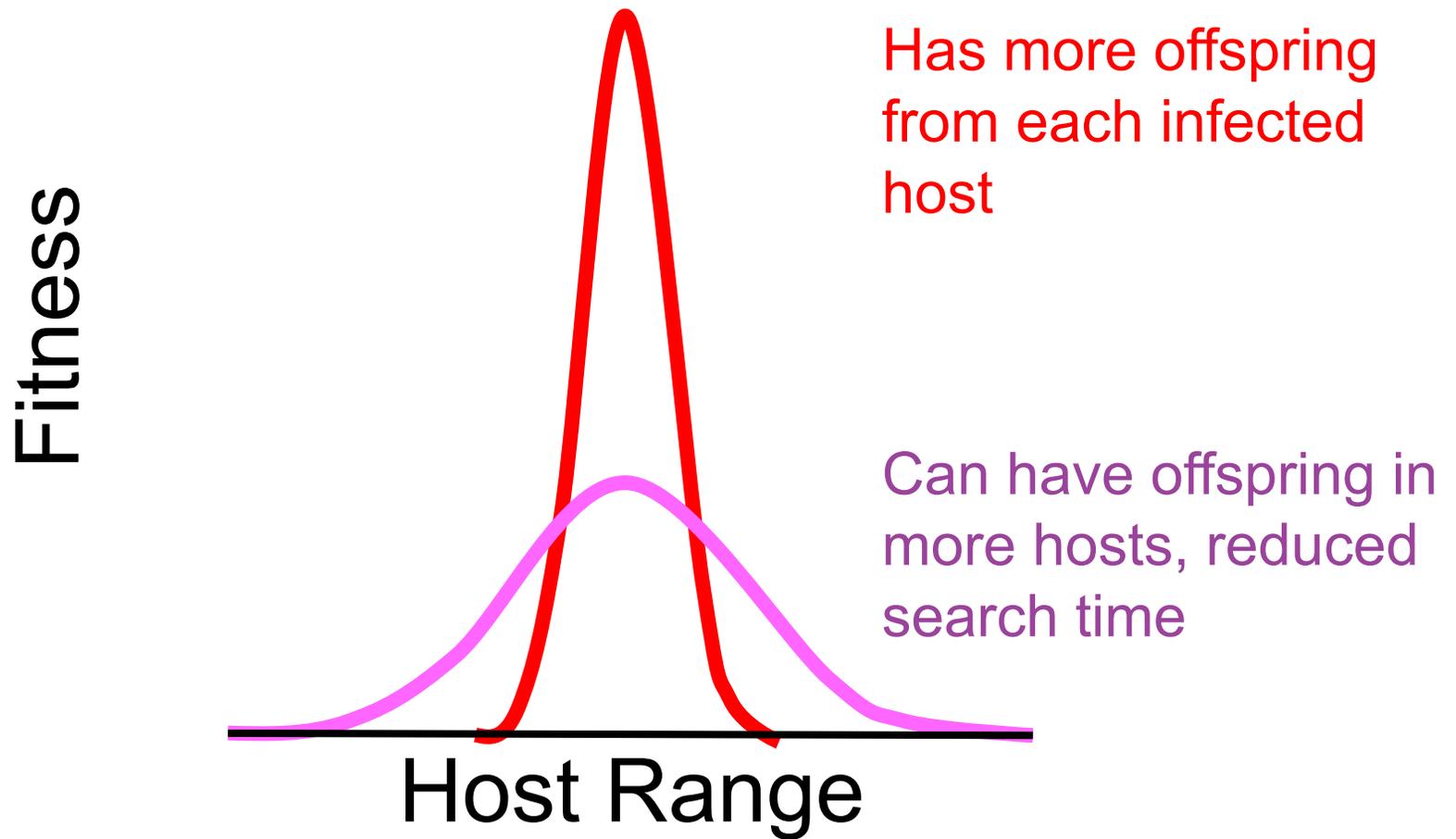
Jack-of-all-Trades is a Master of None



Jack-of-all-Trades is a Master of None

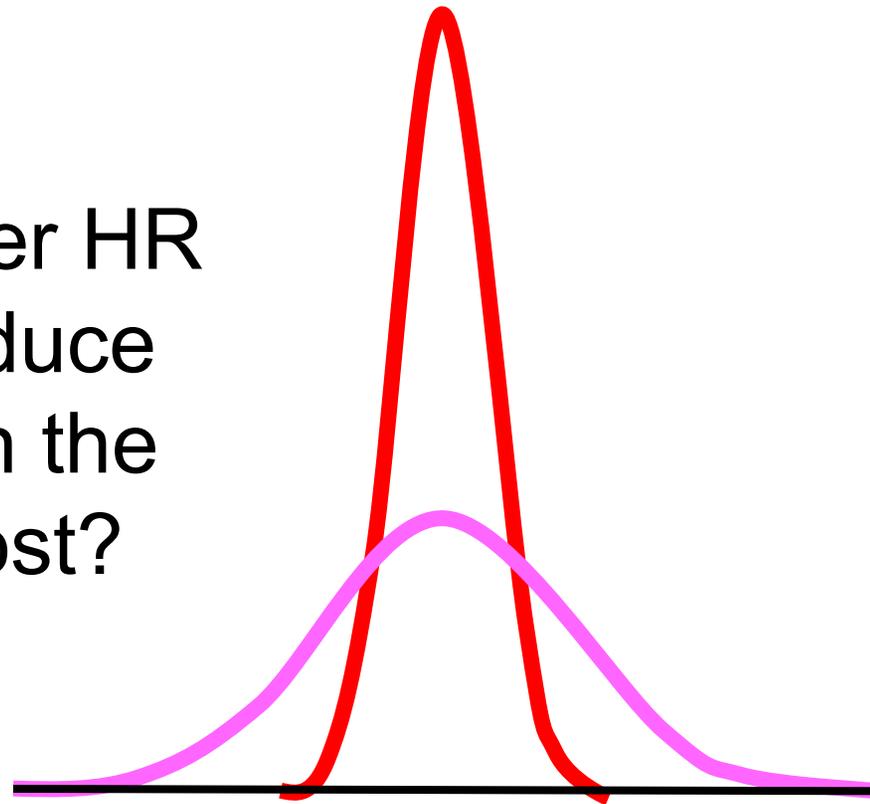


Jack-of-all-Trades is a Master of None



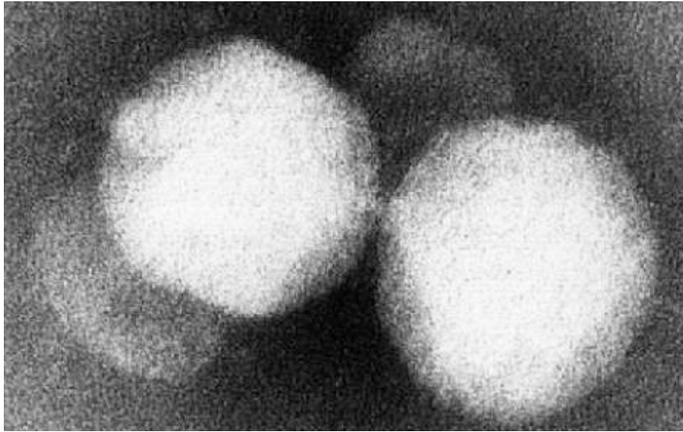
Jack-of-all-Trades is a Master of None

Will a larger HR
range reduce
fitness on the
usual host?



specialist

generalist

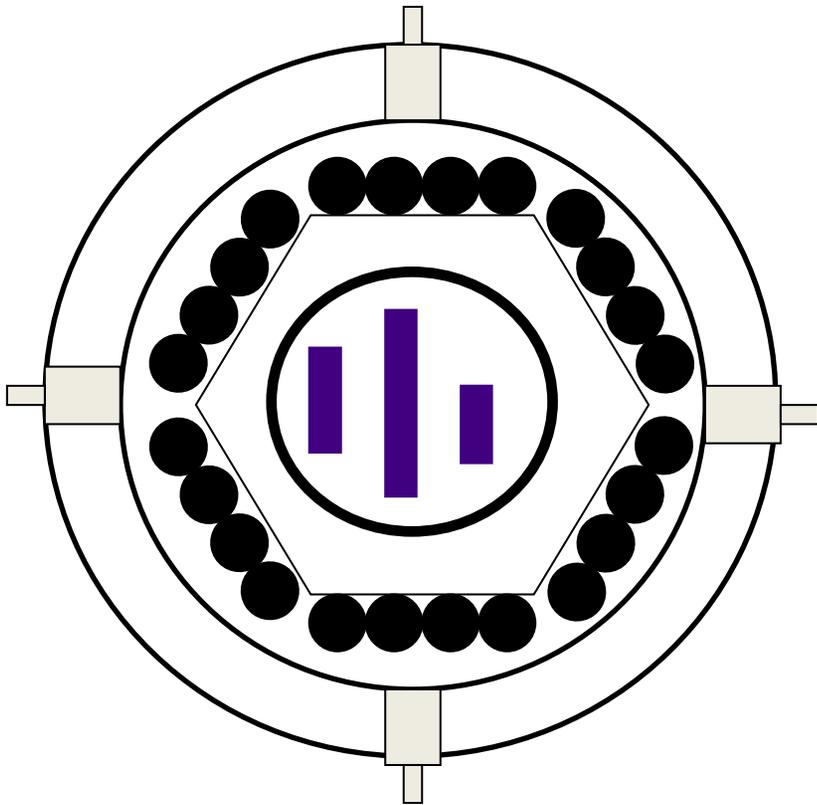


Phage $\phi 6$

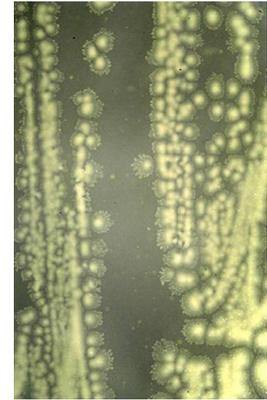
Like eukaryotic virus

13 KB

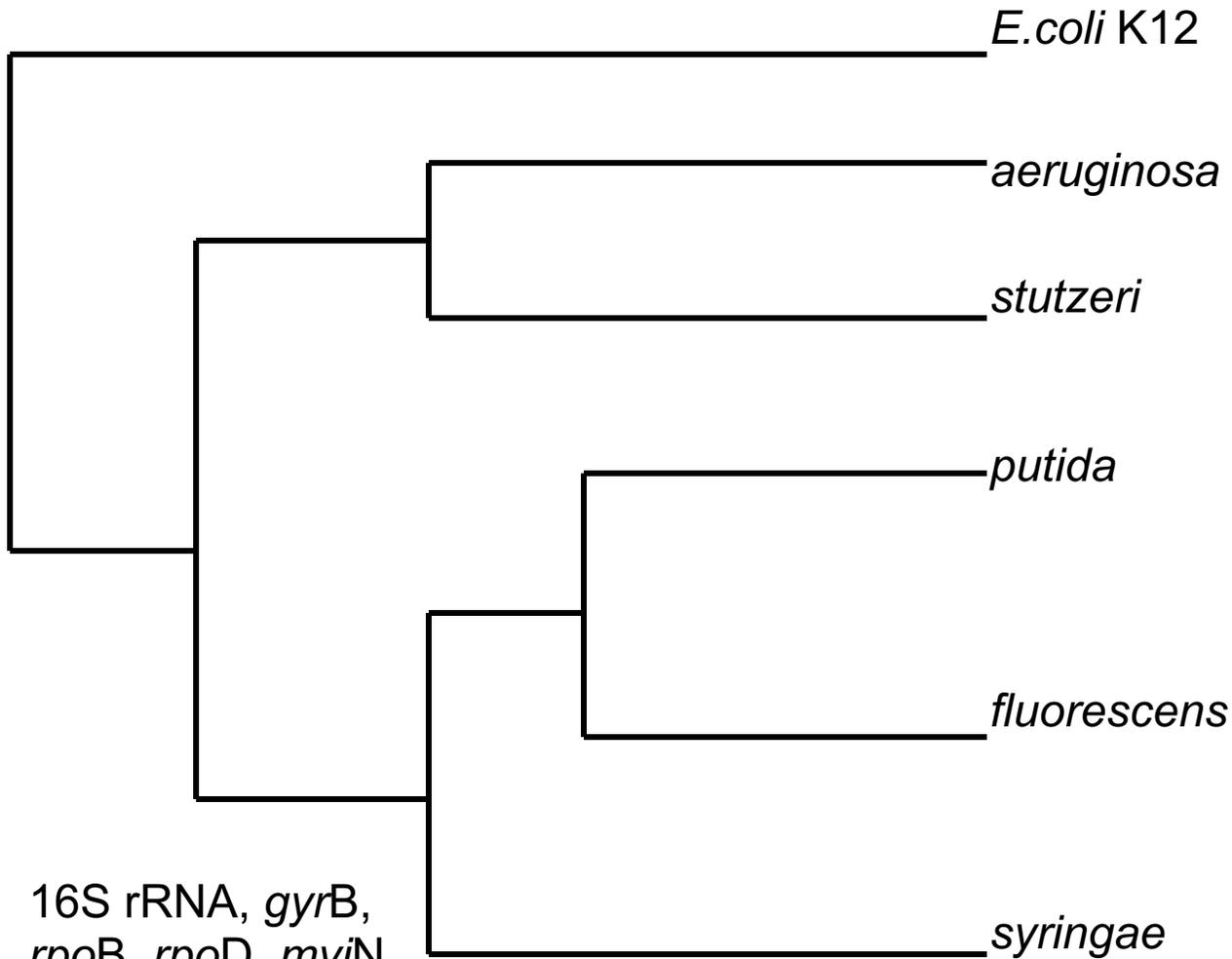
$\mu = 2 \times 10^{-6}$ mut/bp/rep



Pseudomonas Phylogeny



P. pseudoalcaligenes
ERA



P. syringae pv
phaseolicola

P. syringae

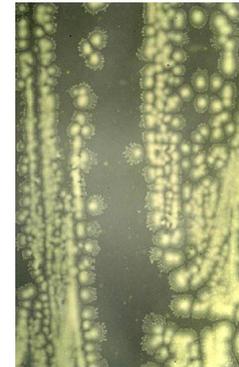


atrofaciens

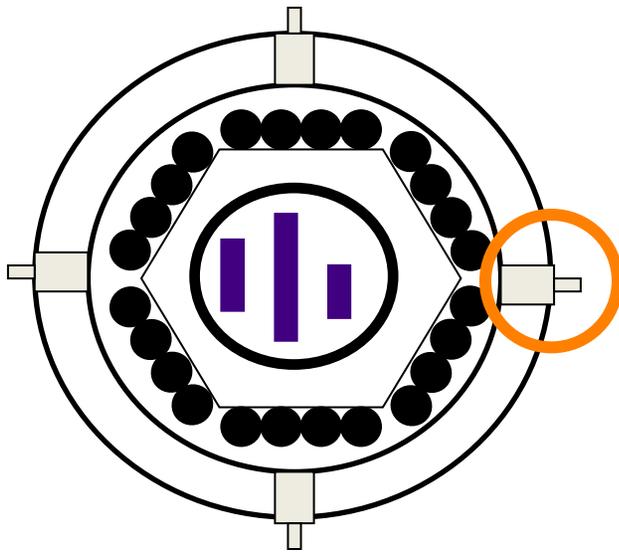


tomato

P. pseudoalcaligenes



ERA



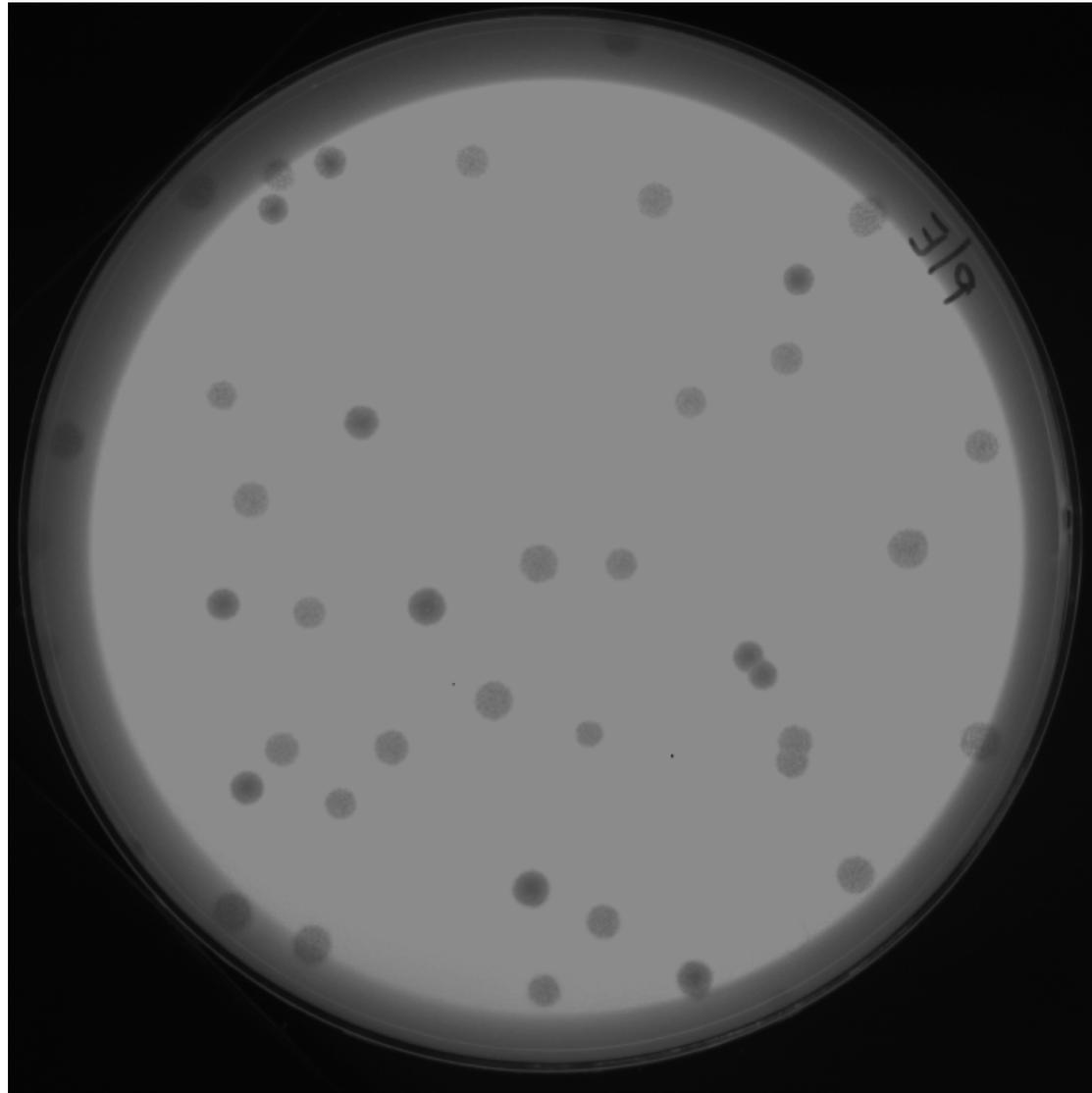
9 Mutations

3 **A** & E

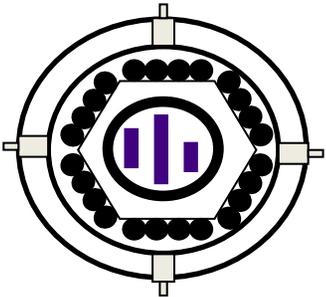
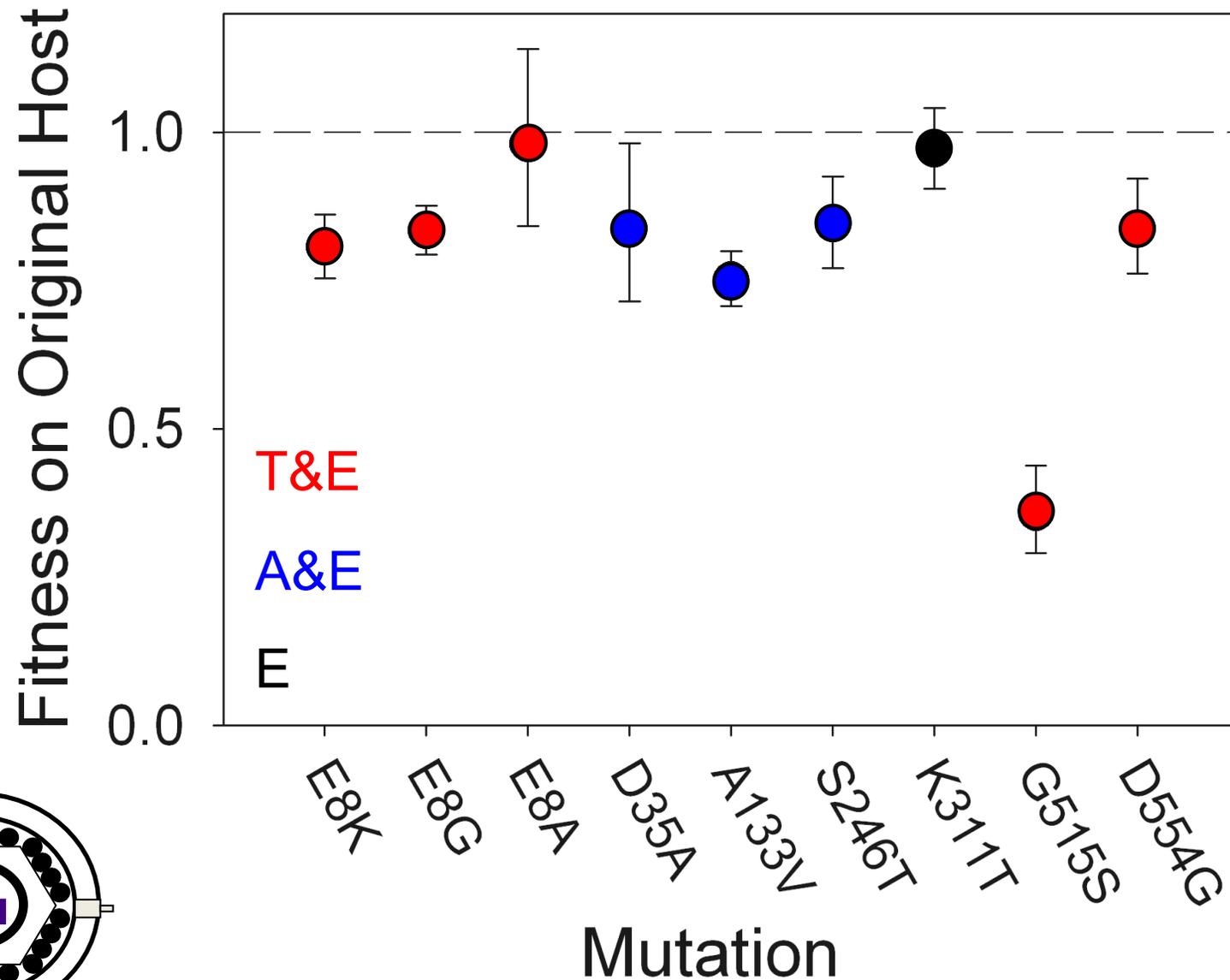
5 **T** & E

1 E

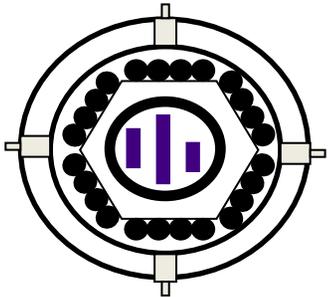
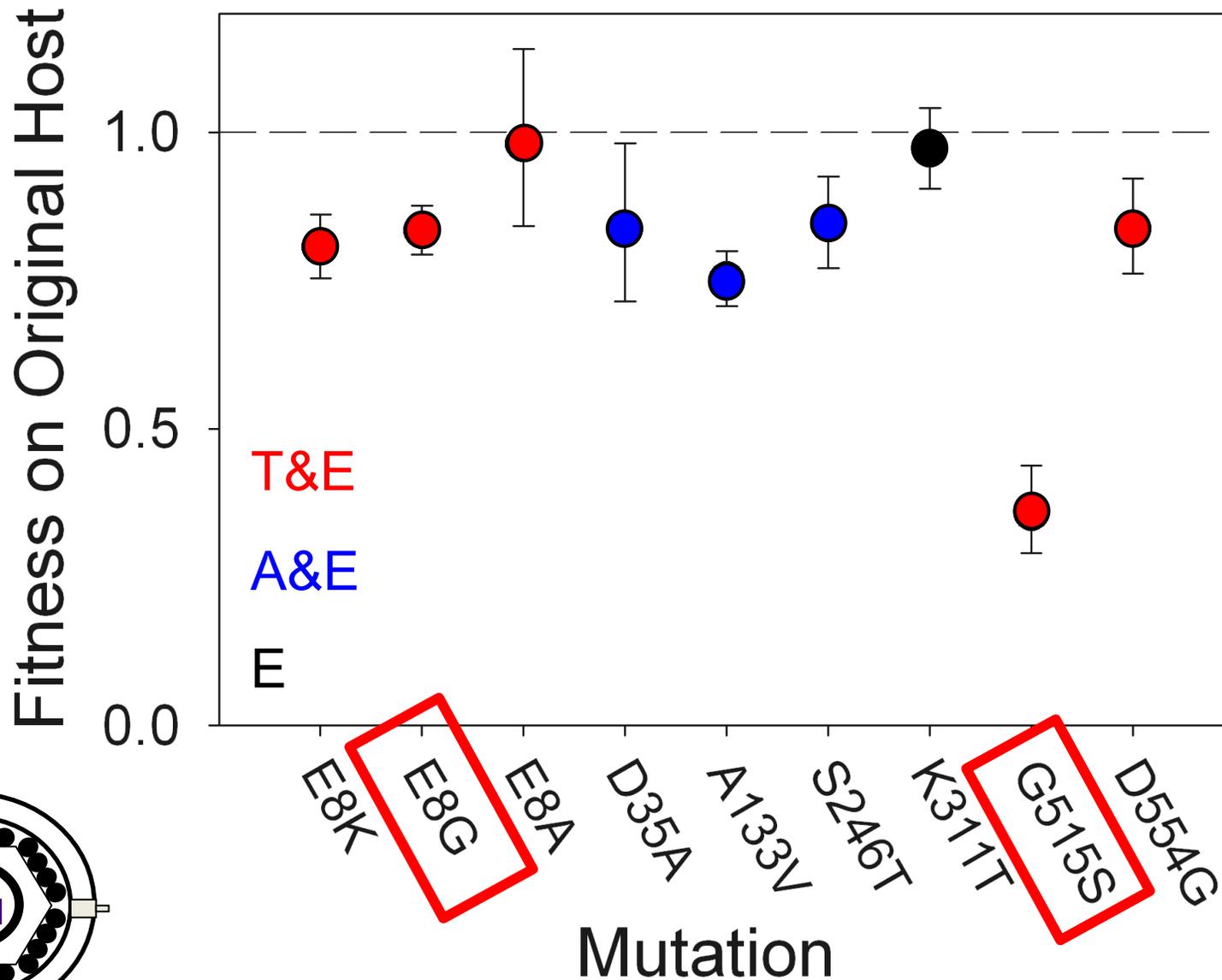
Fitness = 24h Competition



Cost of phi6 expanded HR



Cost of phi6 expanded HR



How does one HR mutation affect subsequent HR mutations?

E8G, G515S infect P, T&E

WT infects P

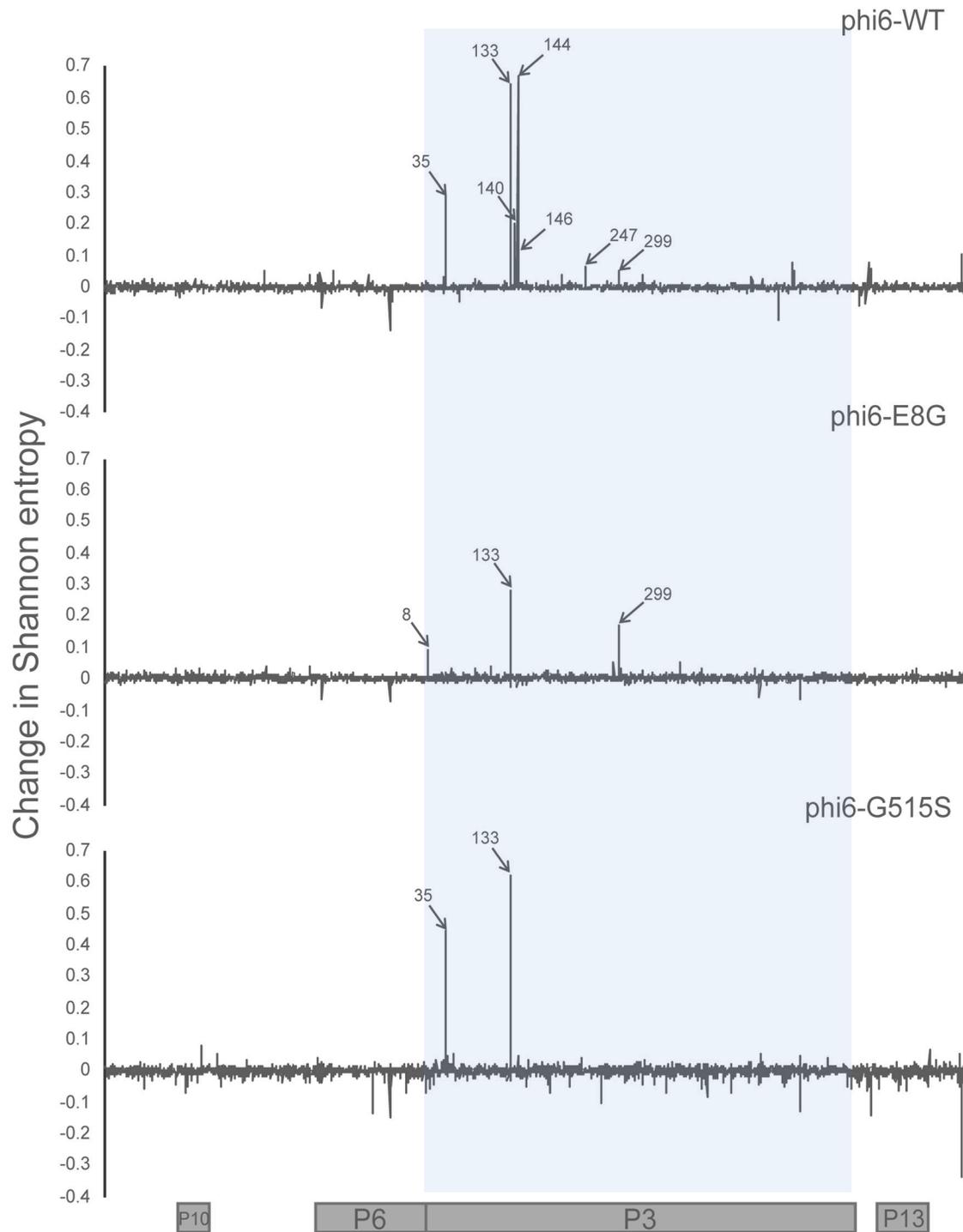
How does one HR mutation affect subsequent HR mutations?

E8G, G515S infect P, T&E

WT infects P

Same ways of mutating to infect A?

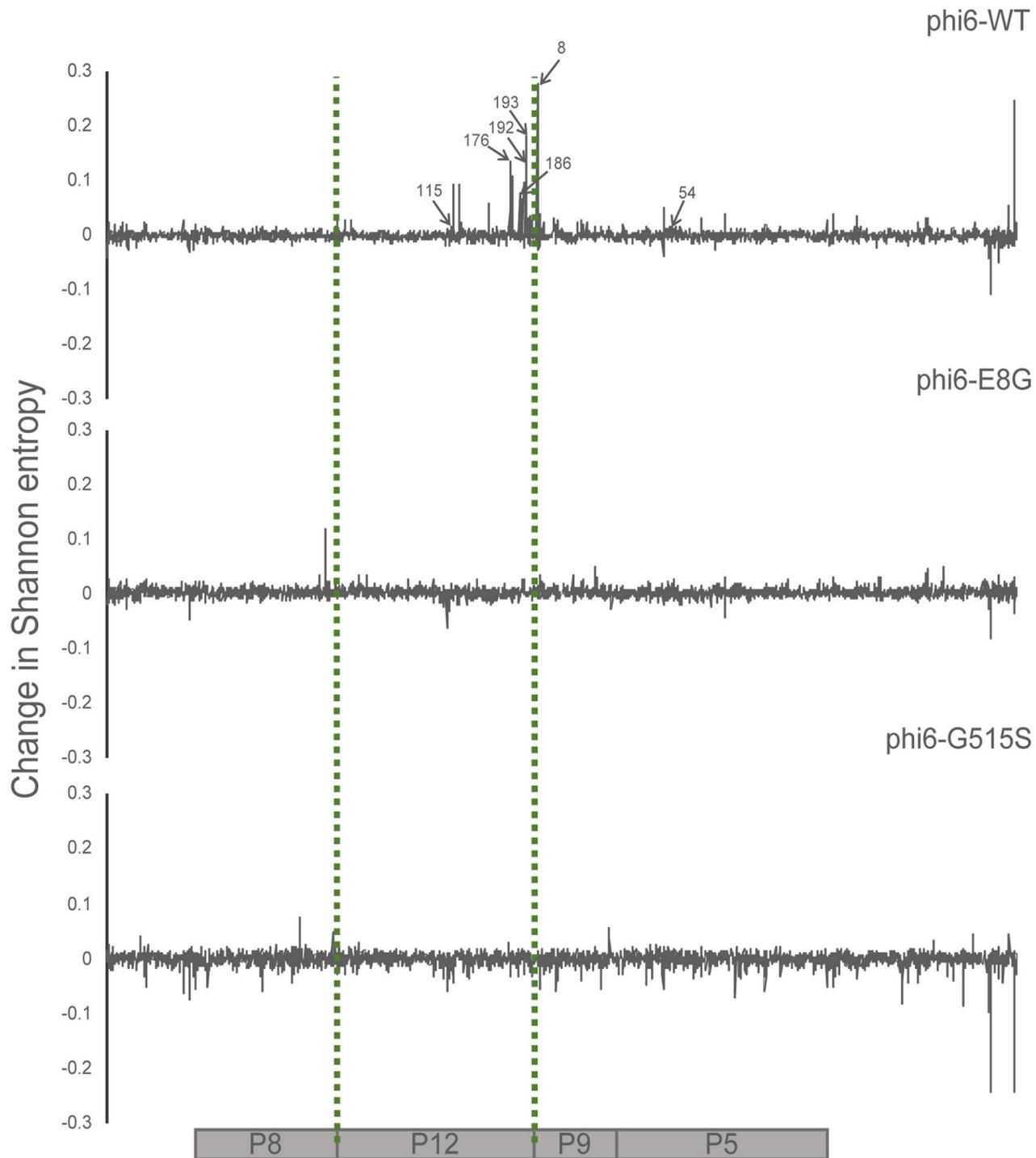




M segment

P3

WT has more



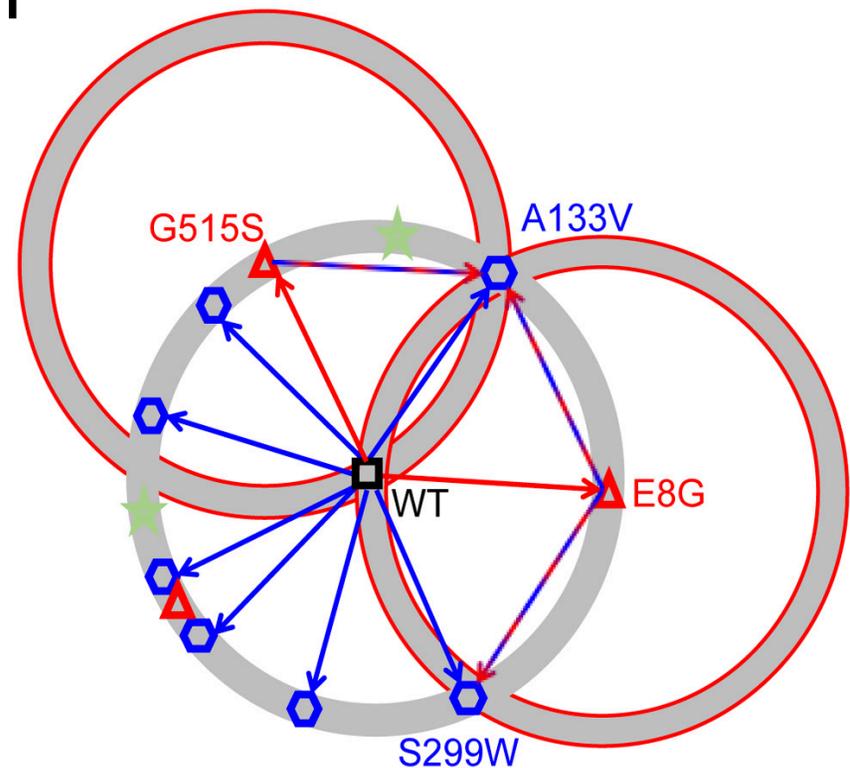
S segment

WT has more
HR mutations!

Epistasis among HR mutations

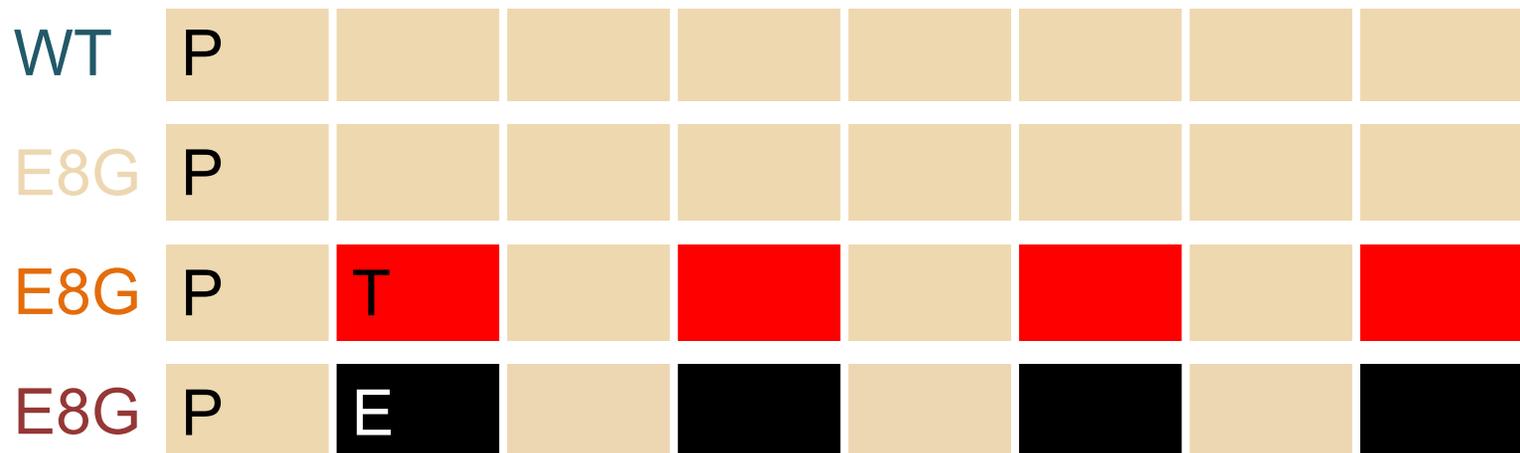
Protein structure?

Serial host shifting rarer



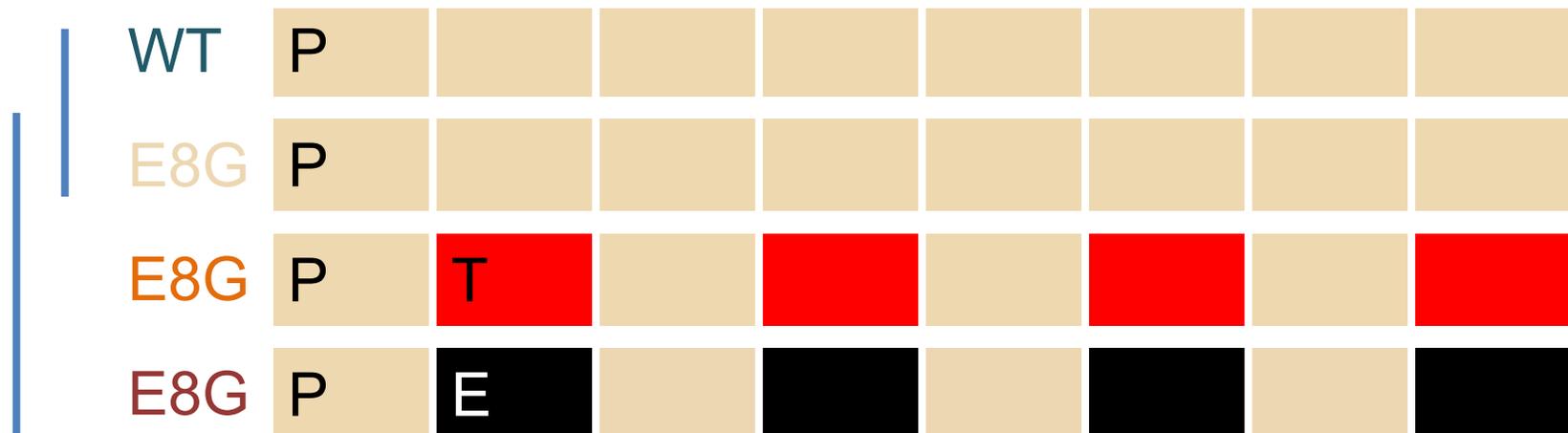
Generalists' evolution

30 passages

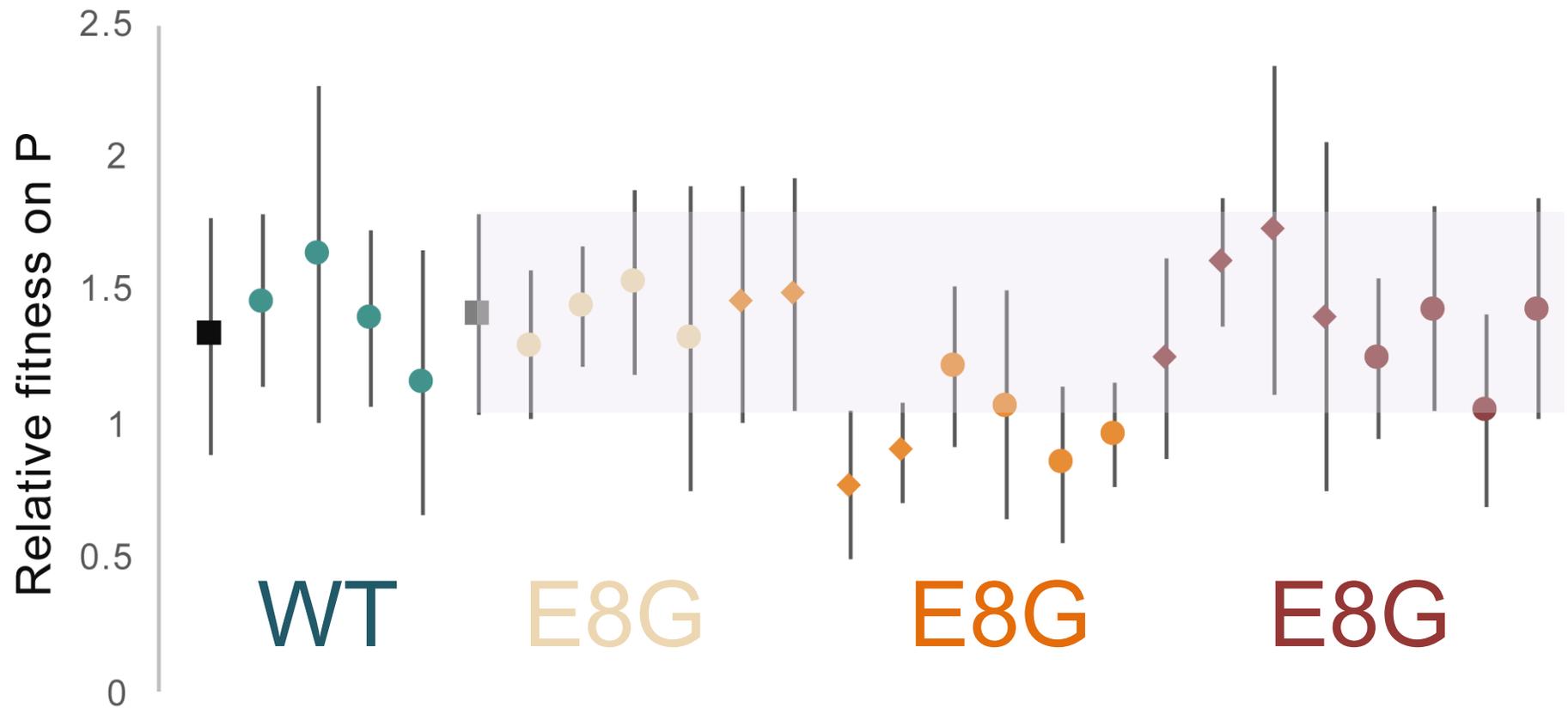


Generalists' evolution

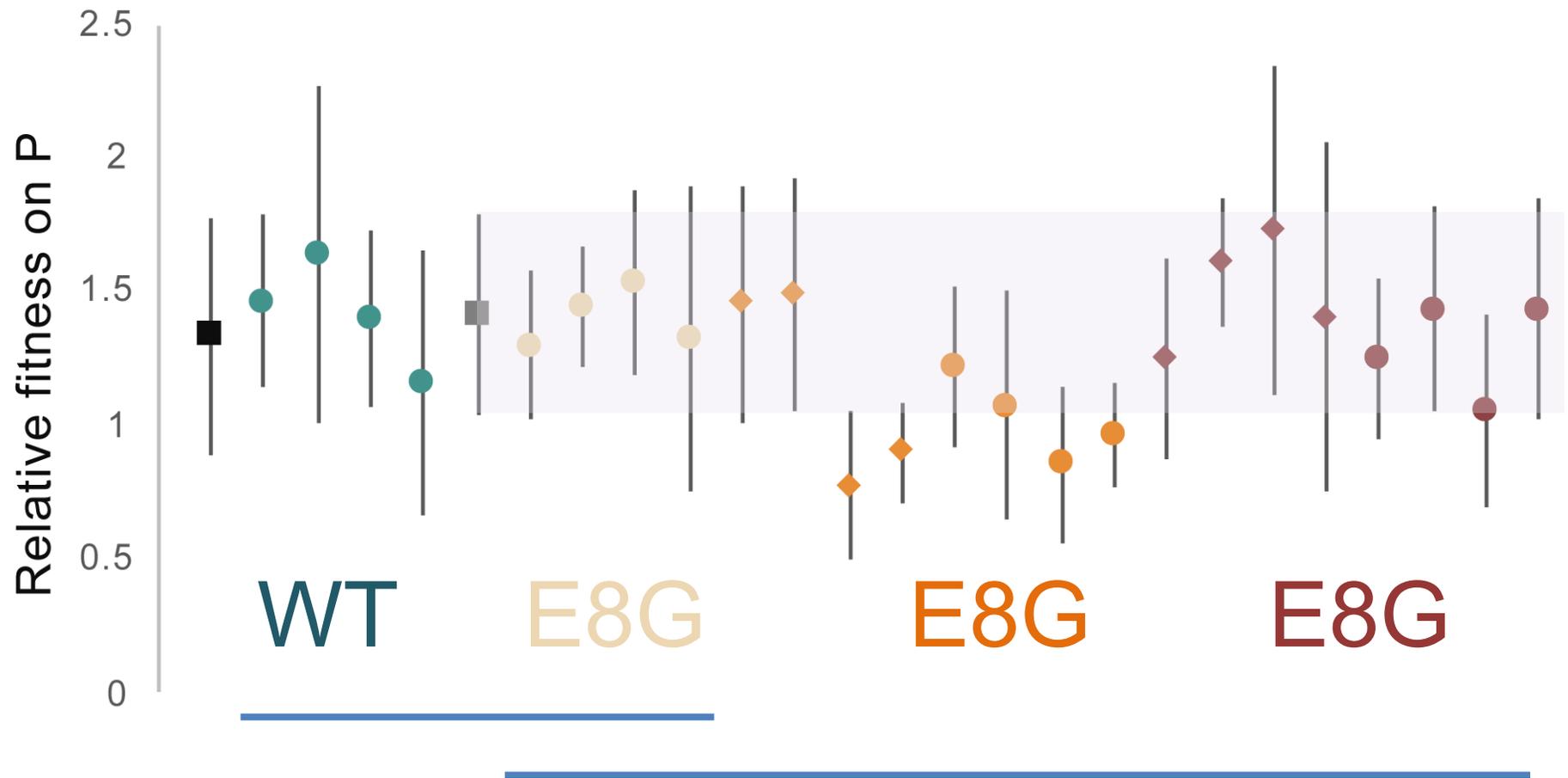
30 passages



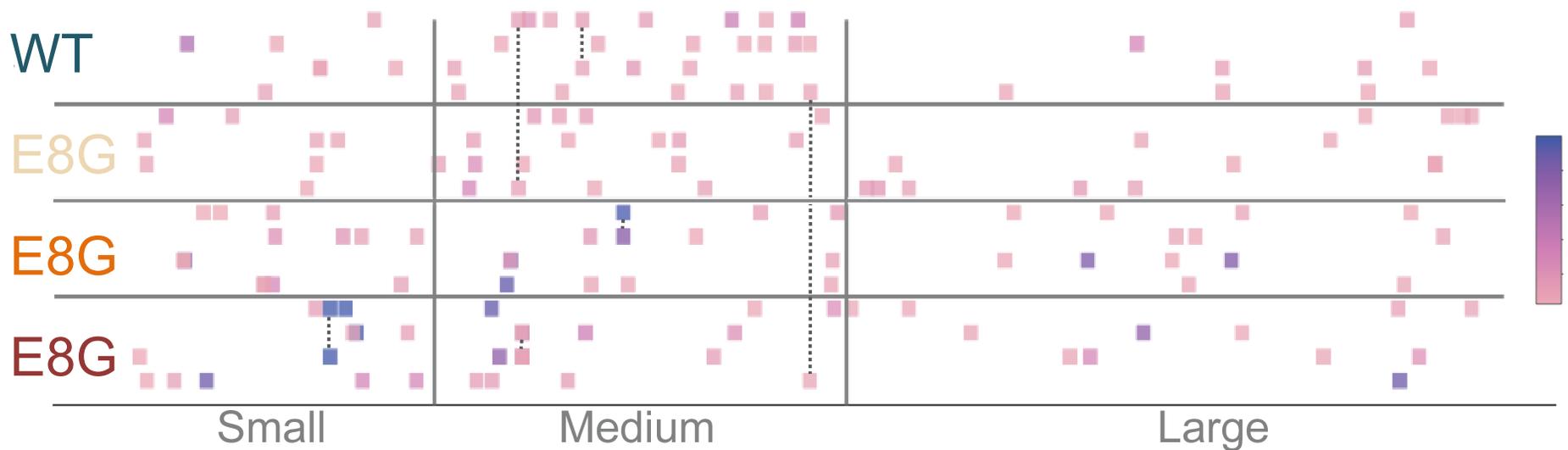
Generalism can hurt fitness on original host



Generalism can hurt fitness on original host



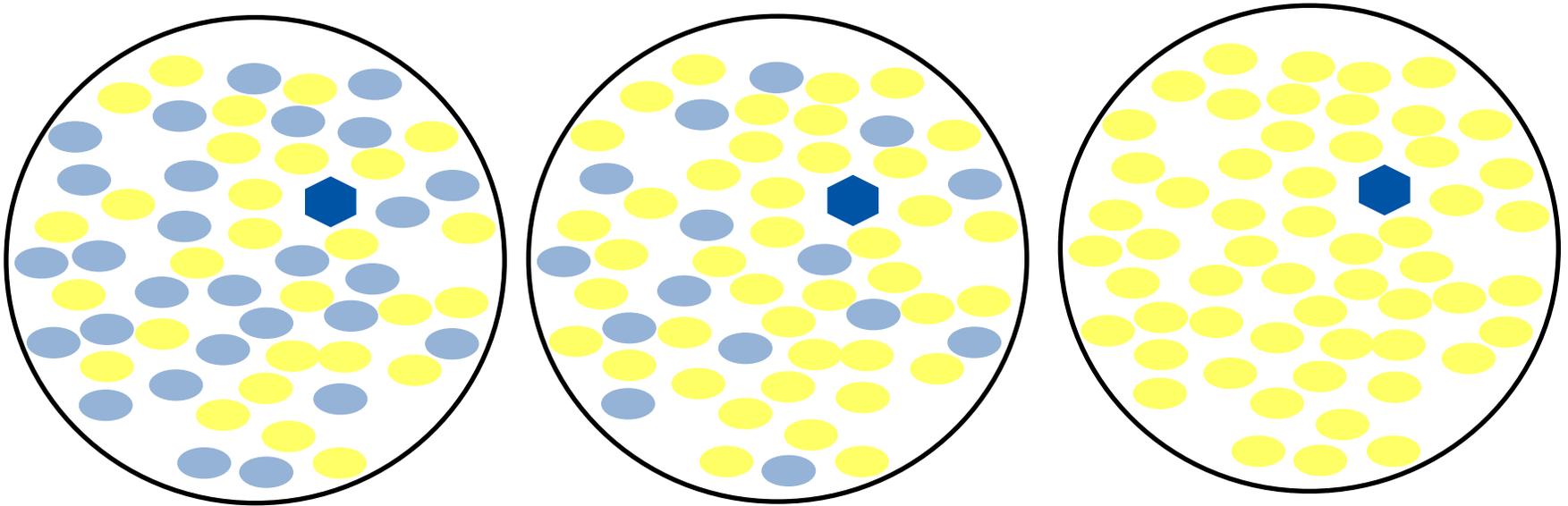
Generalist environments had stronger selection



HR expansion: + & -

Fitness and epistatic costs of HR mutations

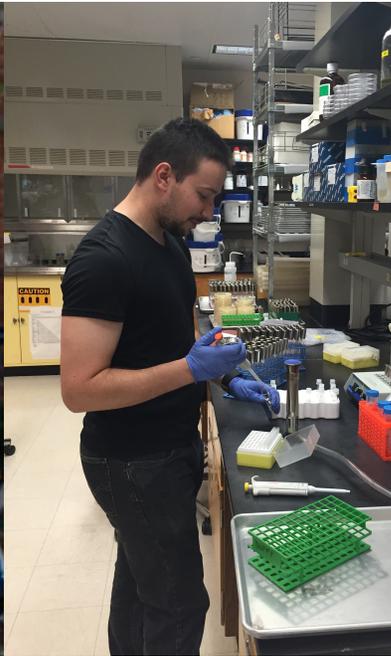
Which host(s) are around?



Lele
Zhao



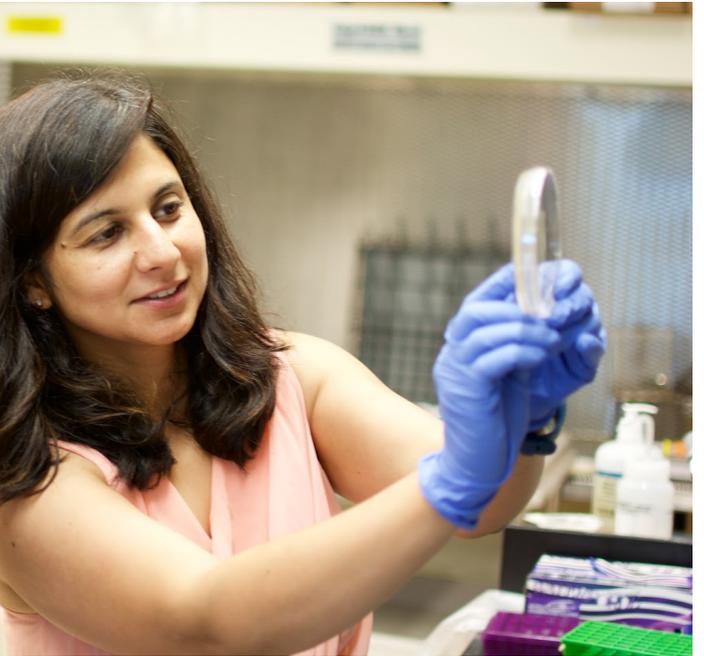
Dragos
Stemate



Alvin
Crespo



Mansha
Seth Pasricha



HHMI



RiSE at Rutgers
Research in Science and Engineering