Host traits, identity and ecological conditions predict consistent flea abundance & prevalence on free-living California ground squirrels

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Super-spreaders key in disease transmission

SARs patients in Beijing

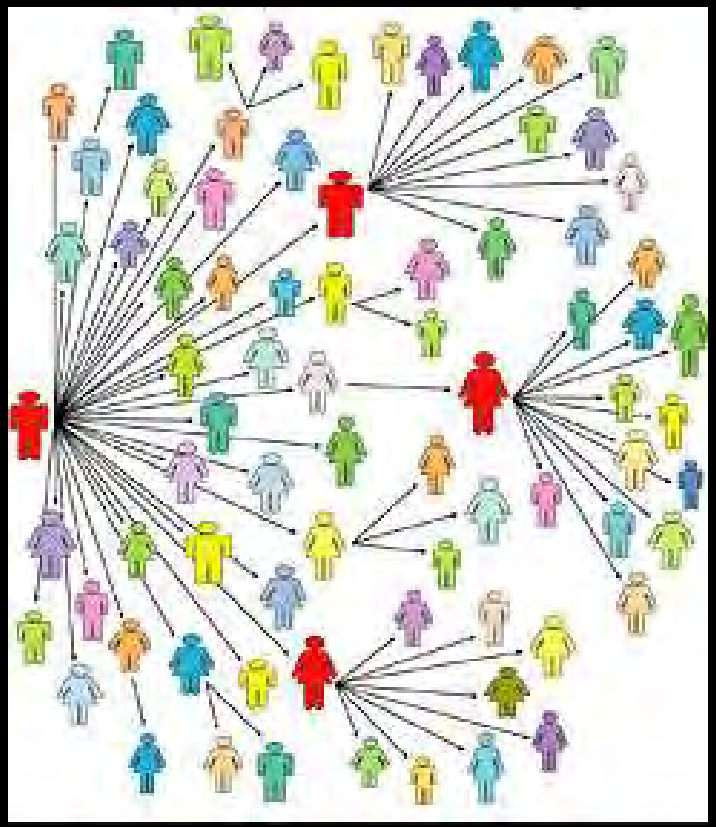
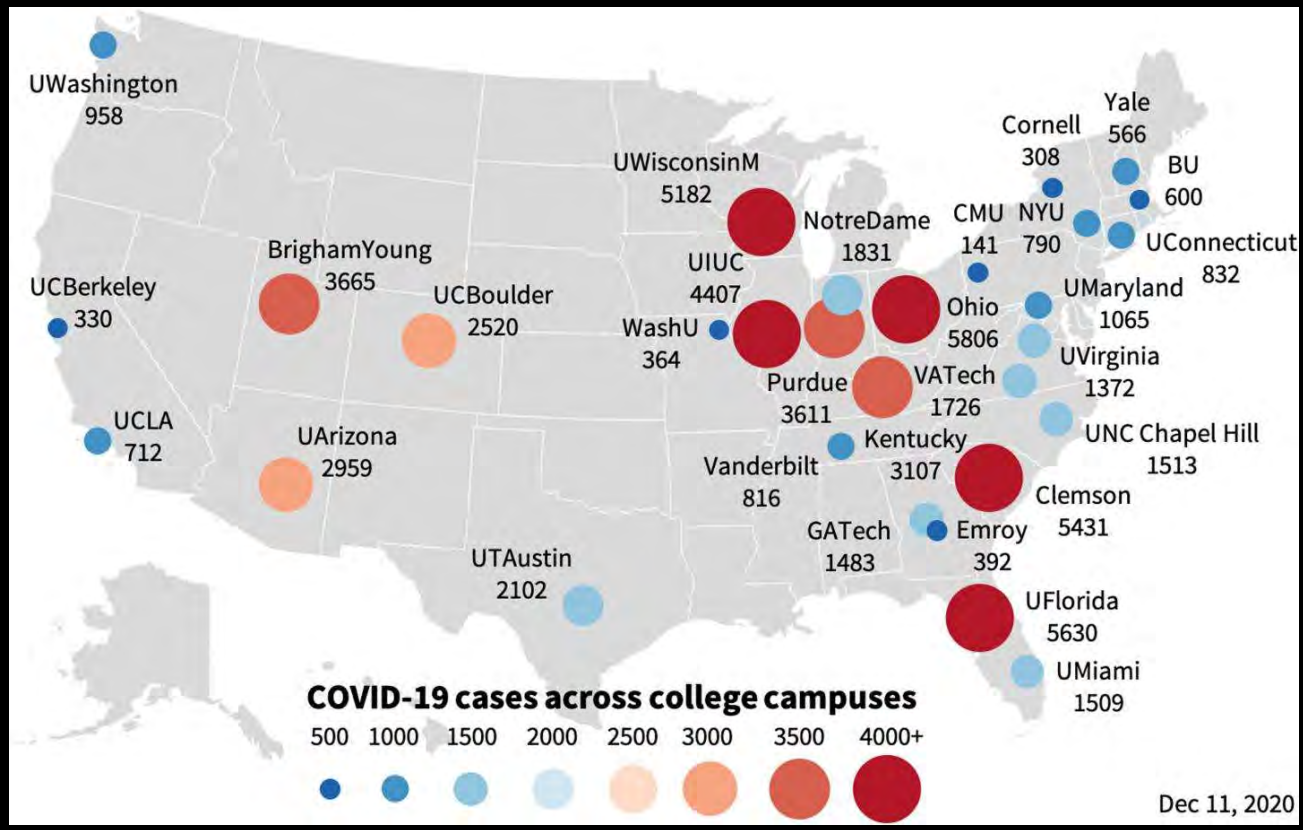


Image: *James Lloyd-Smith, UCLA*

Spread of COVID-19 at colleges



Courtney et al. 2021, Comput. Methods. Biomech. Biomed. Eng.

Host hetergeneity in parasite loads for animals over time?

Mouse lemur endoparasites

(Zohdy *et al*. 2017, Anim. Behav.)

Host hetergeneity in parasite loads for animals over time?

Sleepy lizards ticks

(Payne *et al*. 2020, *Oikos*)

Host hetergeneity in parasite loads for animals over time?

California ground squirrel fleas (Smith *et al*. 2021, Int. J. Parasitol.)

Major complex for epizootic plague in Western U.S.

California ground squirrels & its two flea species:

- *Oropsylla montana*
- *Hoplopsyllus anomalous*

Smith *et al*. 2016, Mammalian Species

California ground squirrels of ecological importance

- *Ecosystem engineers*
- *Major prey species*

Smith *et al*. 2016, Mammalian Species

California ground squirrel consistent individual variation

- *Degree of sociability*
- *Stress physiology*
- *Risk-taking behavior*

Smith *et al*. 2018, Phil Trans., Hammond *et al*. 2019, J. Mamm., Holding *et al*. 2020, Toxins

Research questions

1) Does host age, sex, day & habitat predict flea loads?

2) How do abiotic factors shape on-host flea abundance?

3) Are flea loads on individual hosts consistent over time?

Long-term Behavioral Ecology Project at Briones Regional Park, Contra Costa County, CA (2013-present)

Automated year-round weather data

Long-term Behavioral Ecology Project at Briones Regional Park, Contra Costa County, CA (2013-present)

Ortiz *et al*. 2019, Behavioral Ecology Sociobiology

Live-trapping of marked individual hosts (2013-2019)

Data: 2,797 captures of 803 squirrels (42,358 fleas)

Research questions

1) Does host age, sex, day & habitat predict flea loads?

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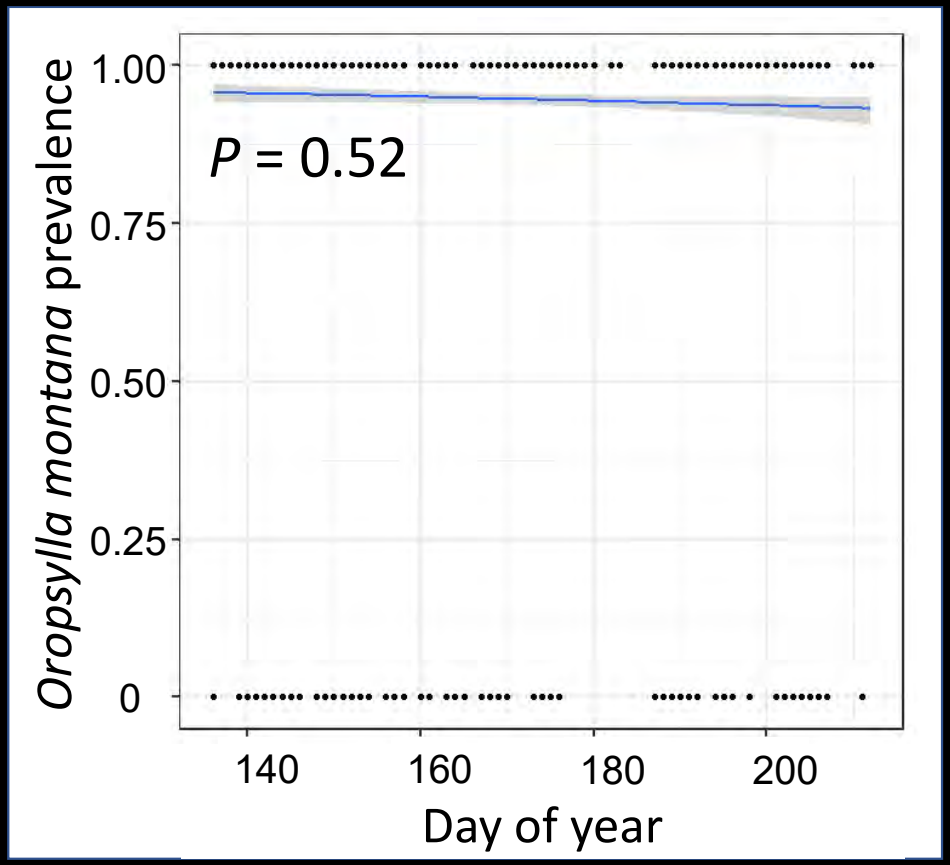
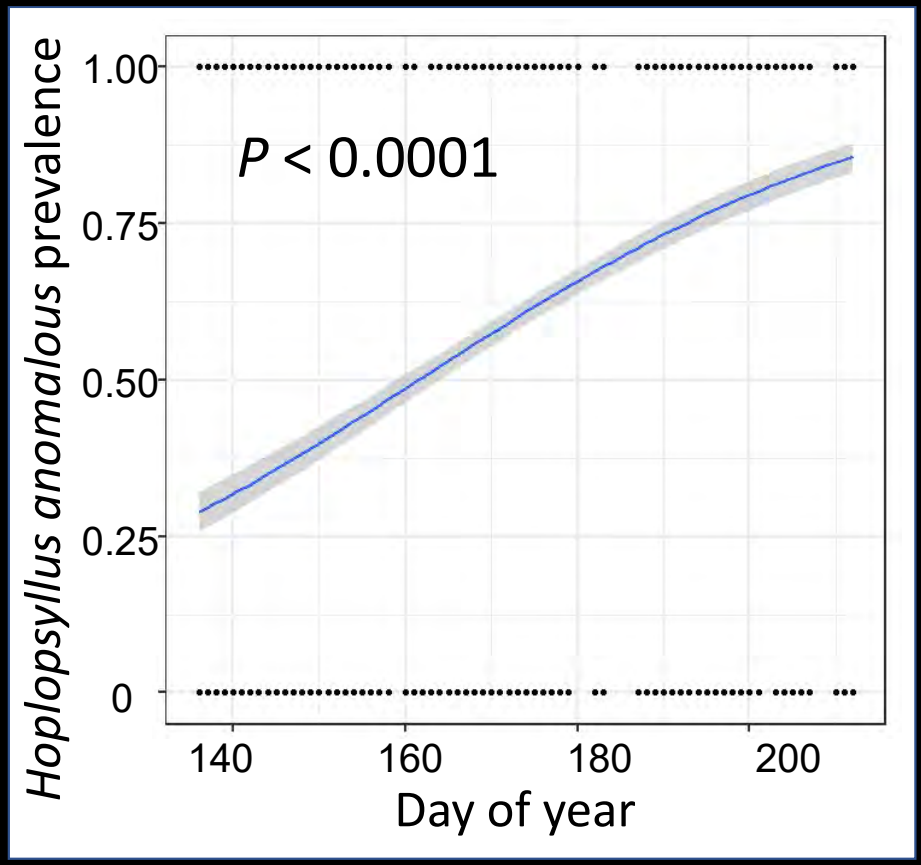
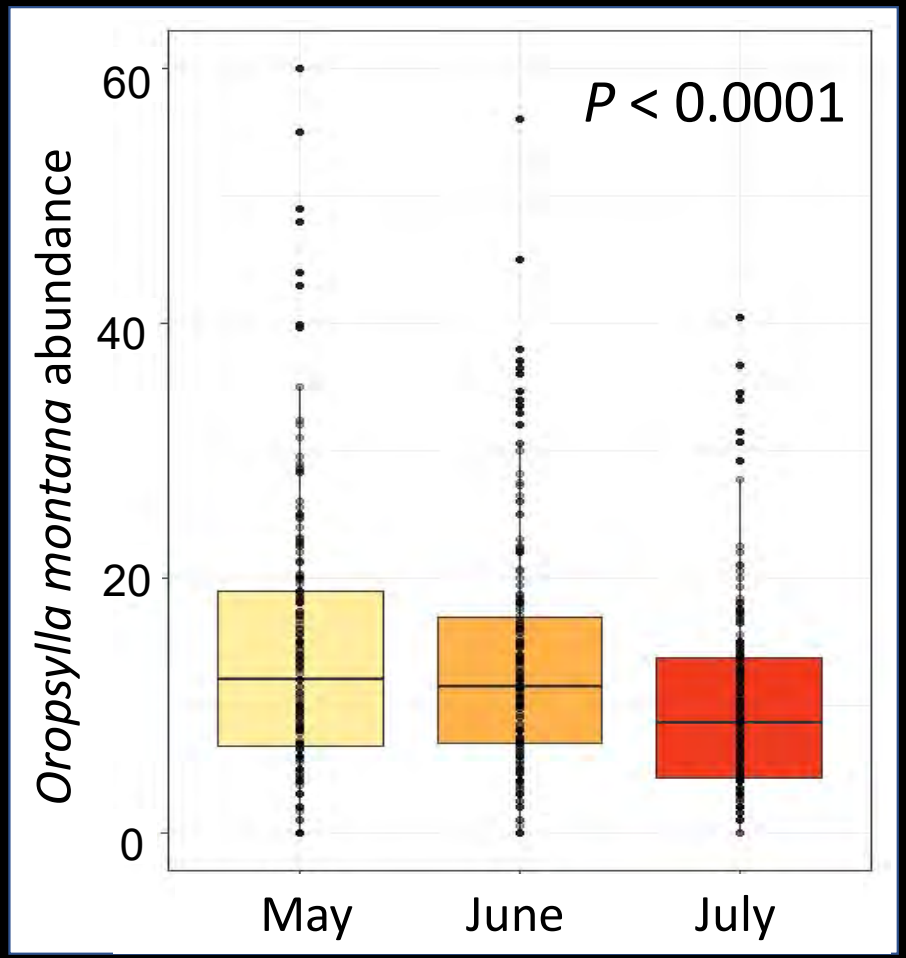
Prevalence of two flea species on hosts

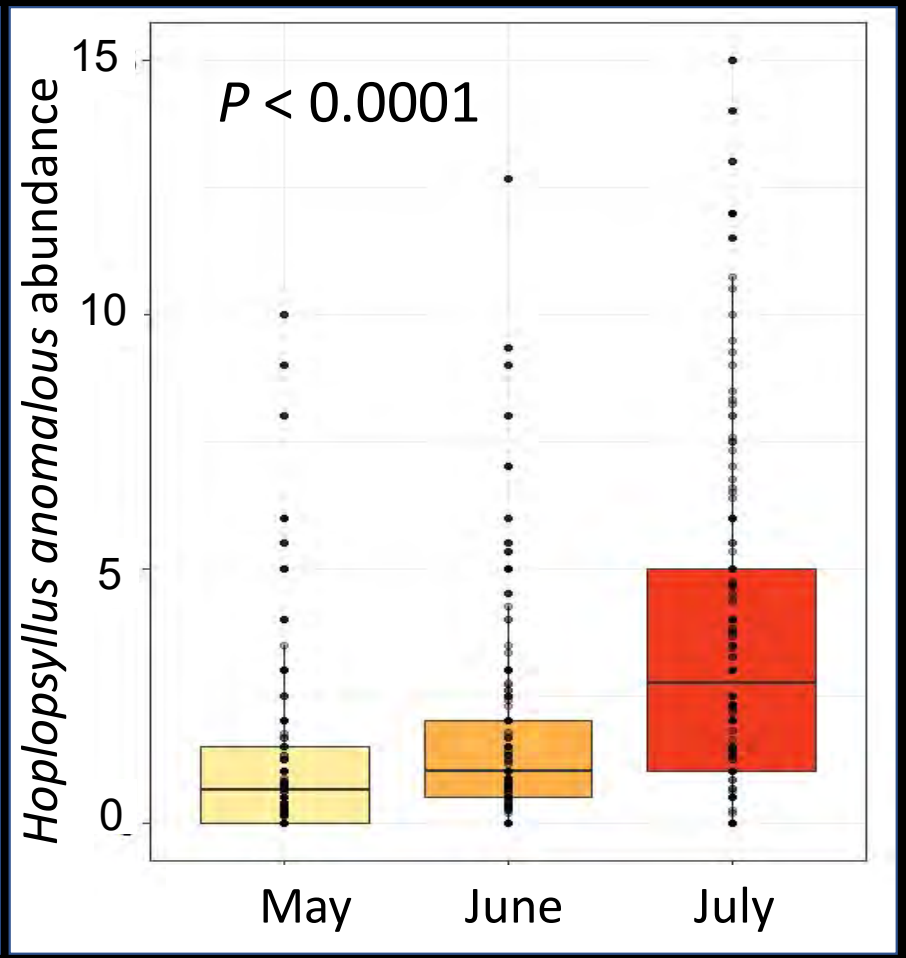
- *O. montana* on most hosts all summer
- *H. anomalous* less prevalent, increases over time





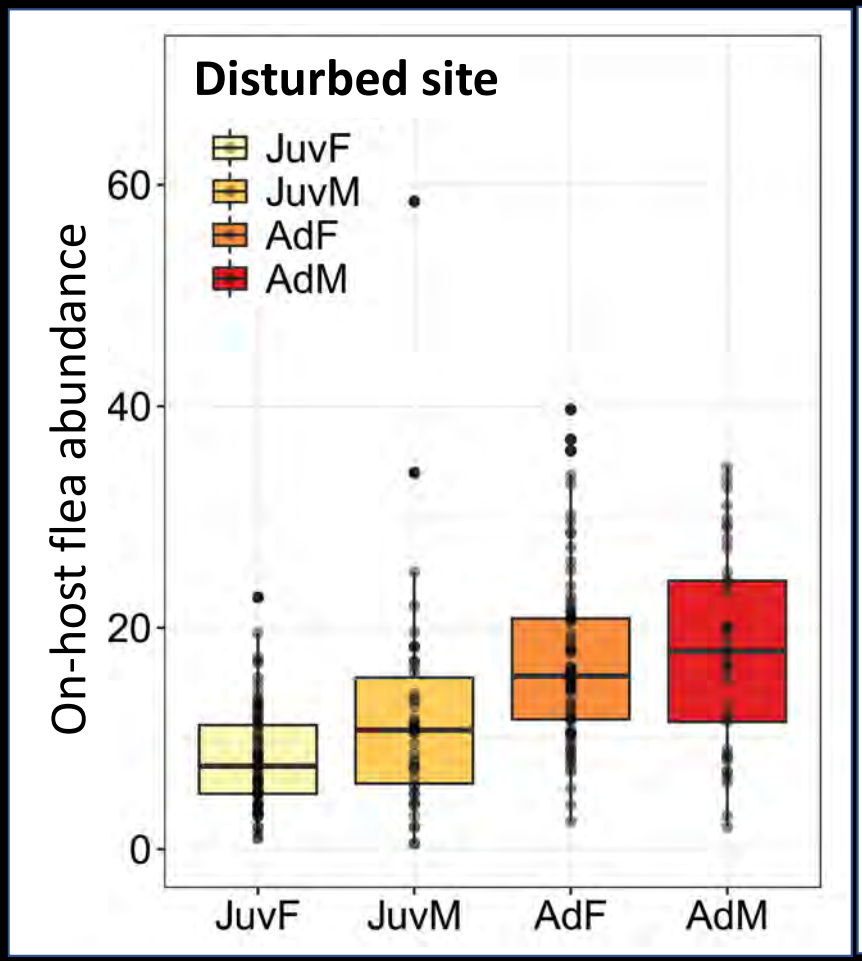
Opposing trends for flea species across summer

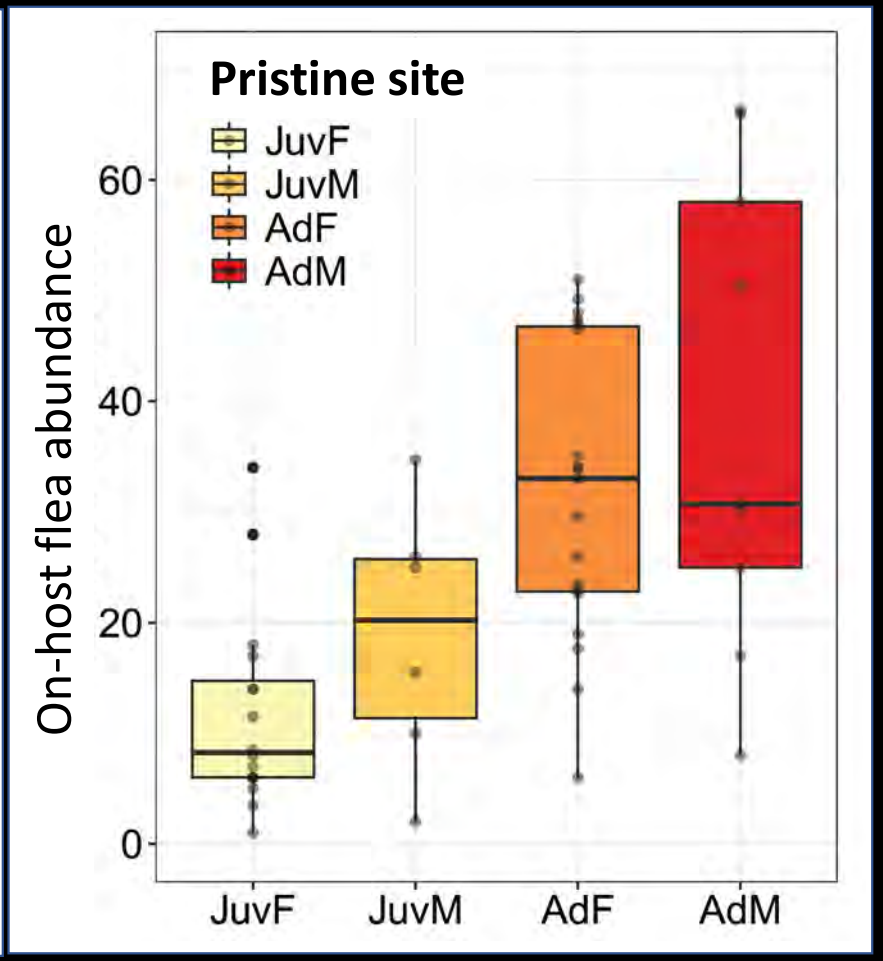




Flea abundance varies w. host age, sex, & habitat

- most fleas on adult male hosts, especially at pristine site





Sex: $P < 0.01$

Age*site:
$P < 0.01$

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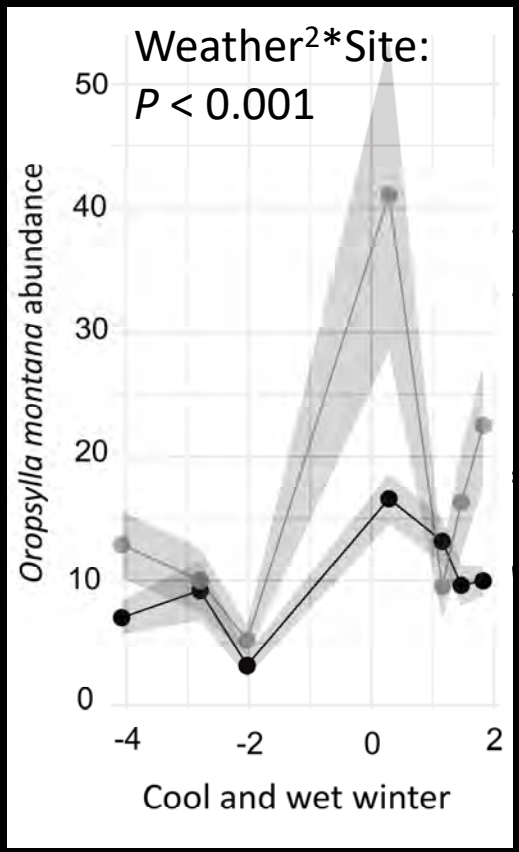
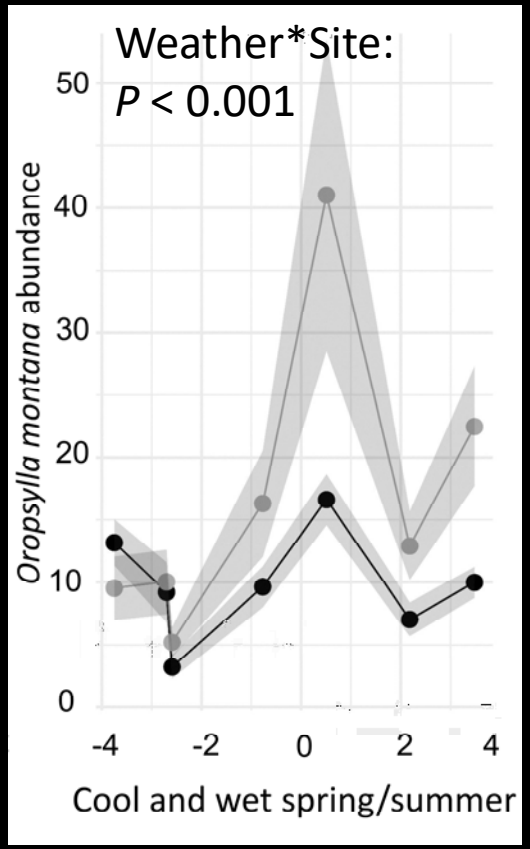
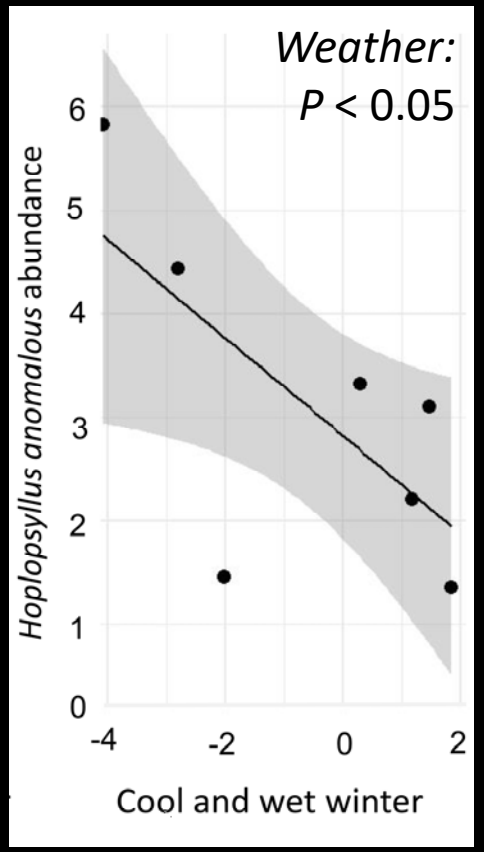
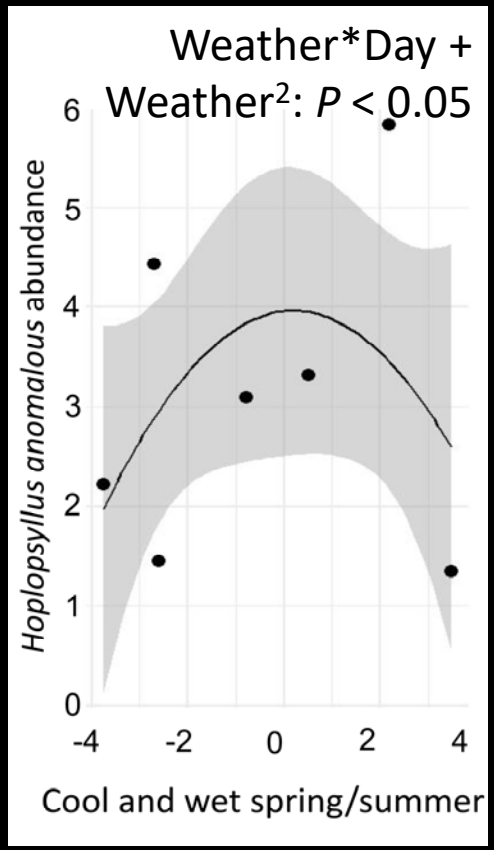
Different responses to cool & wet conditions (PCs)

- common flea most abundant in intermediate weather
- rare flea most abundant after warm/dry winters









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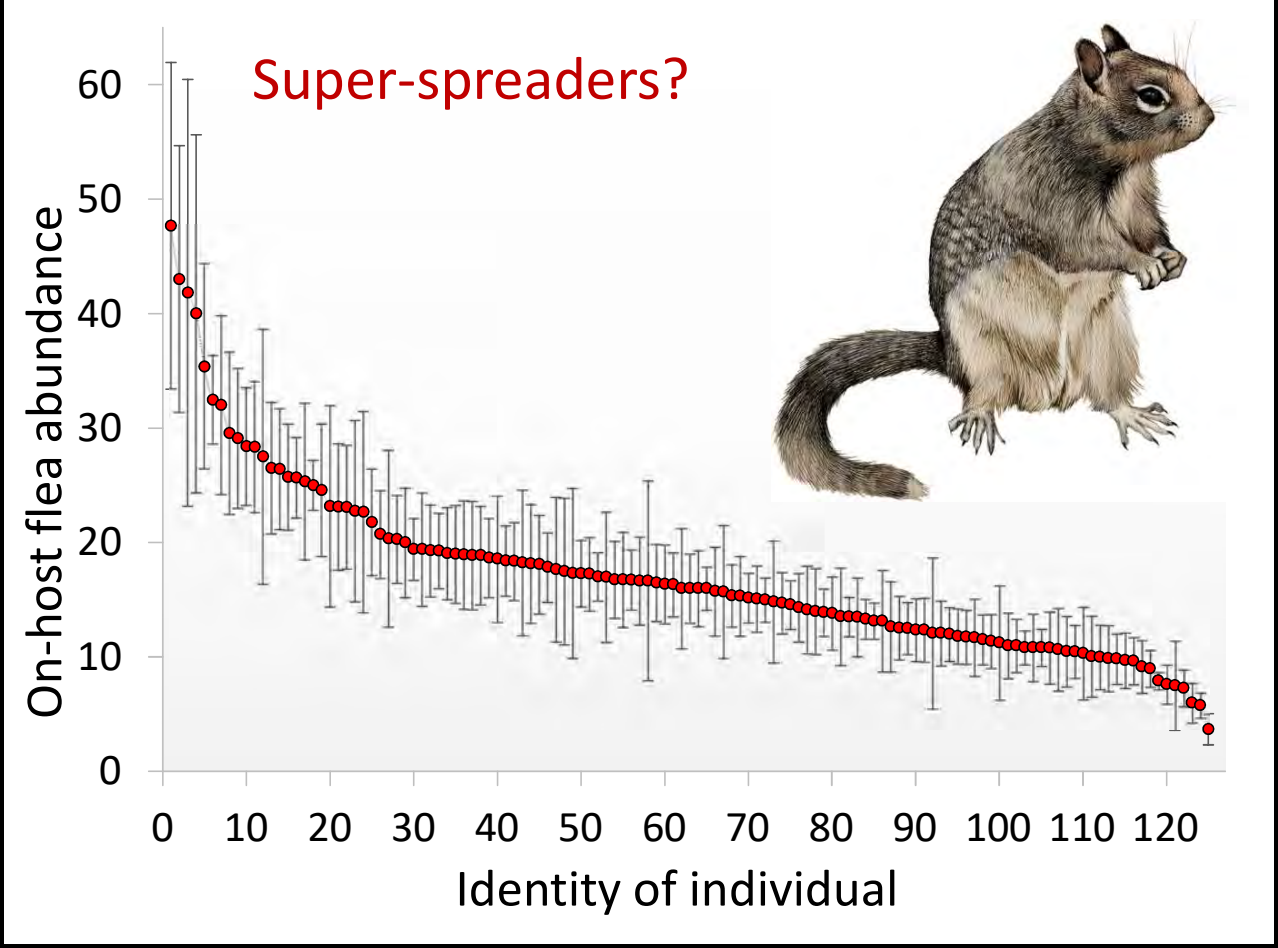
Repeatable flea loads on hosts over time

- flea abundance & community stability repeatable



1. On-host abundance (total)

Identity in GLMM: $X^2 = 2795$

Repeatability: 0.24, $P \leq 0.0001$

- O. montana abundance

Identity in GLMM: $X^2 = 3259$

Repeatability: 0.20, $P \leq 0.0001$

- H. anomalus abundance

Identity in GLMM: $X^2 = 5355$

Repeatability: 0.26, $P \leq 0.0001$

2. Flea community stability

Identity in GLMM: $X^2 = 125$

Repeatability: 0.74, $P \leq 0.0001$

Conclusions

- Multiple determinants of parasites in native mammal
- Individual hosts varied consistently over time in fleas
- Host heterogeneity - implications for disease transmission



Acknowledgements

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