

Redistribution, dispersal, foraging, and reproduction of *Trissolcus japonicus*

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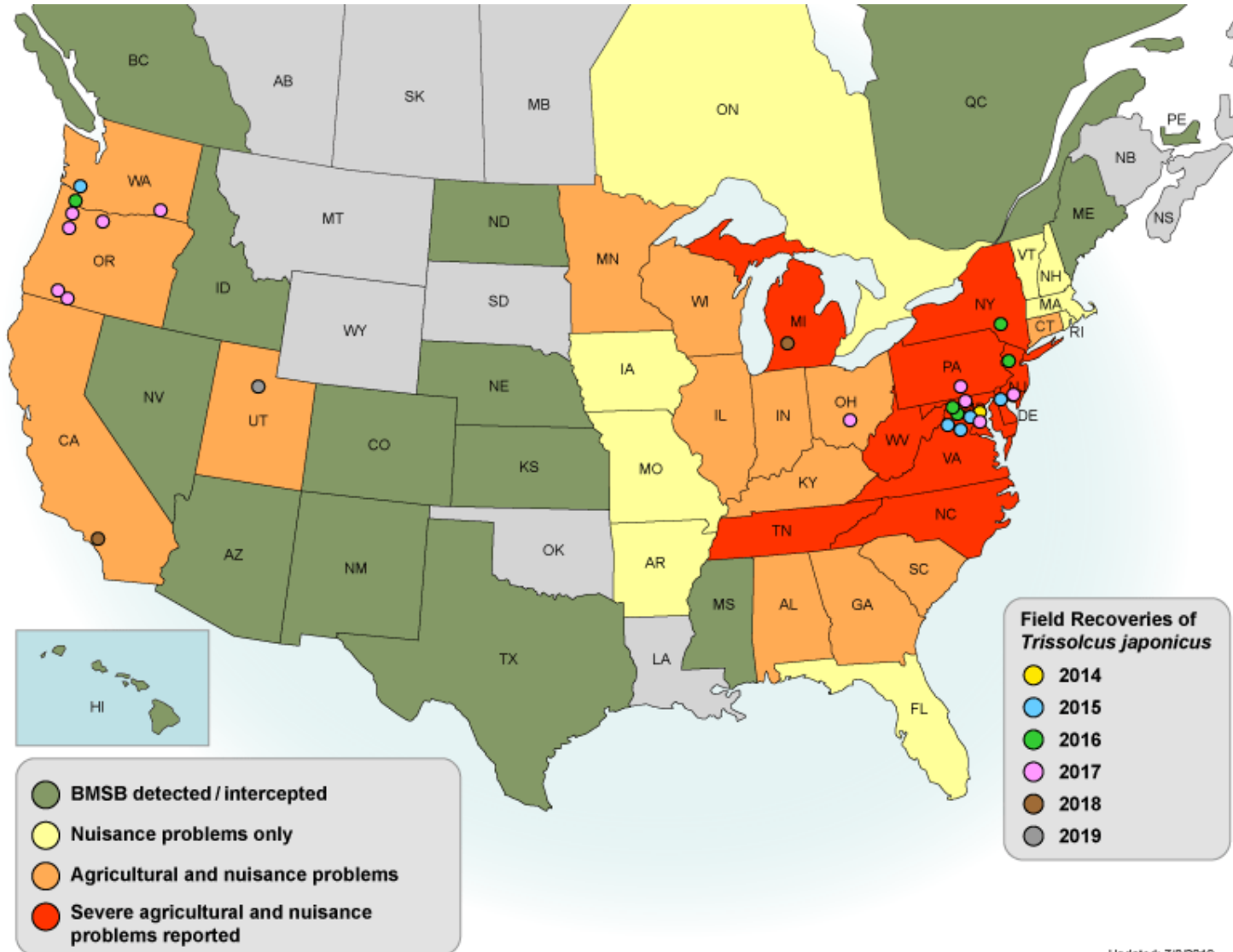
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Trissolcus japonicus in North America



Geographic range is increasing, but local population densities remain mostly low.

Why?

Population growth = birth - death + immigration - emigration

Haplodiploidy

Egg + sperm = female offspring

Egg + no sperm = male offspring



How long do parasitoids live?

Males: 59 wasps

Females: 162 wasps

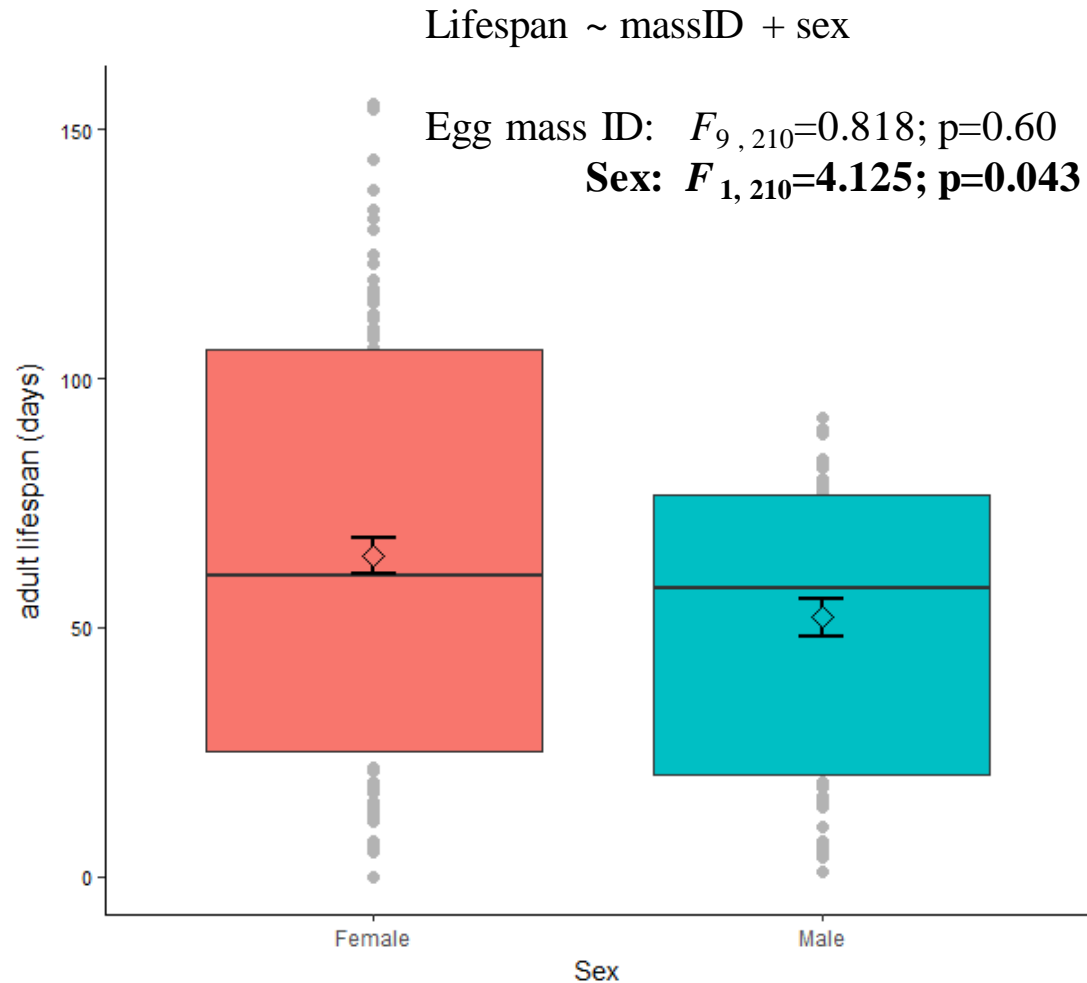
Min lifespan: <1 day

Max lifespan: 155 days

Mean difference in lifespan:

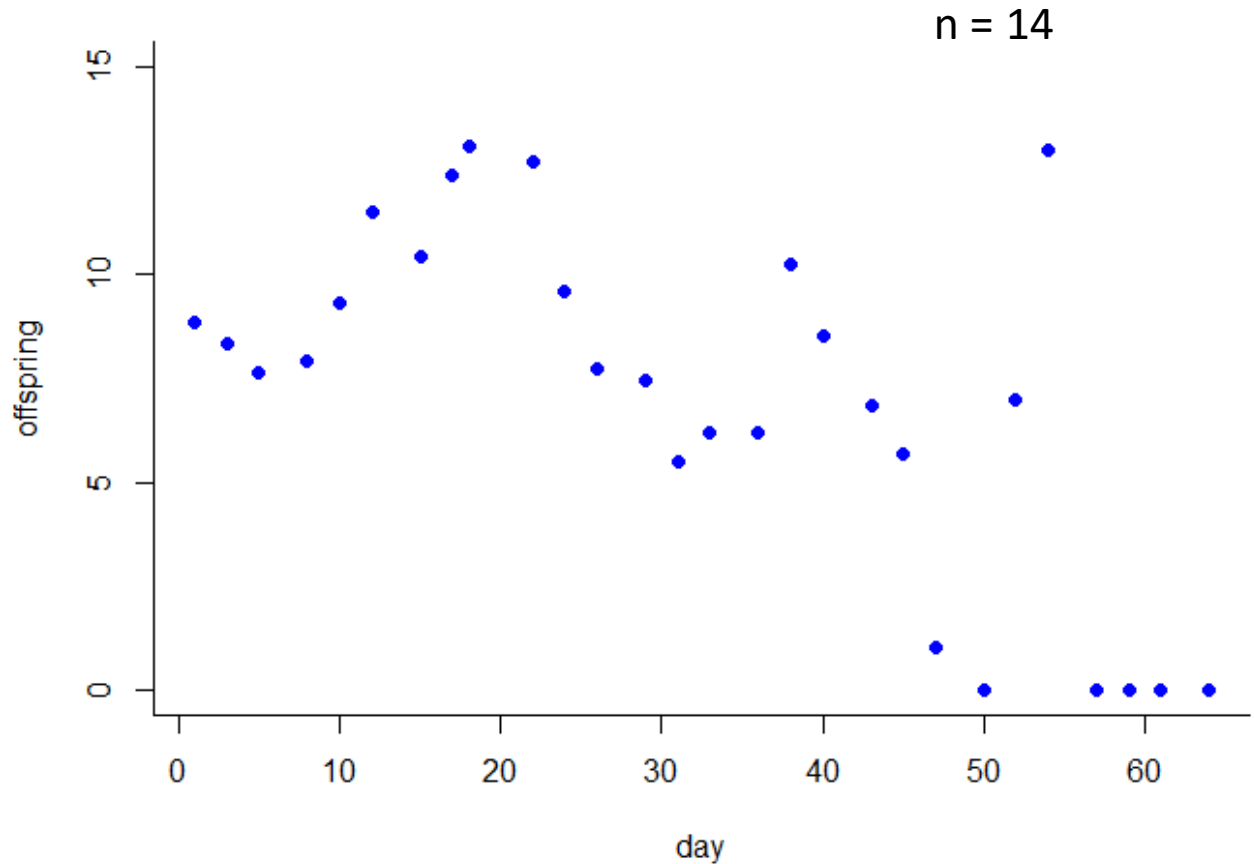
Female (64.4 days) - male

(52.0 days) = 12.4 days



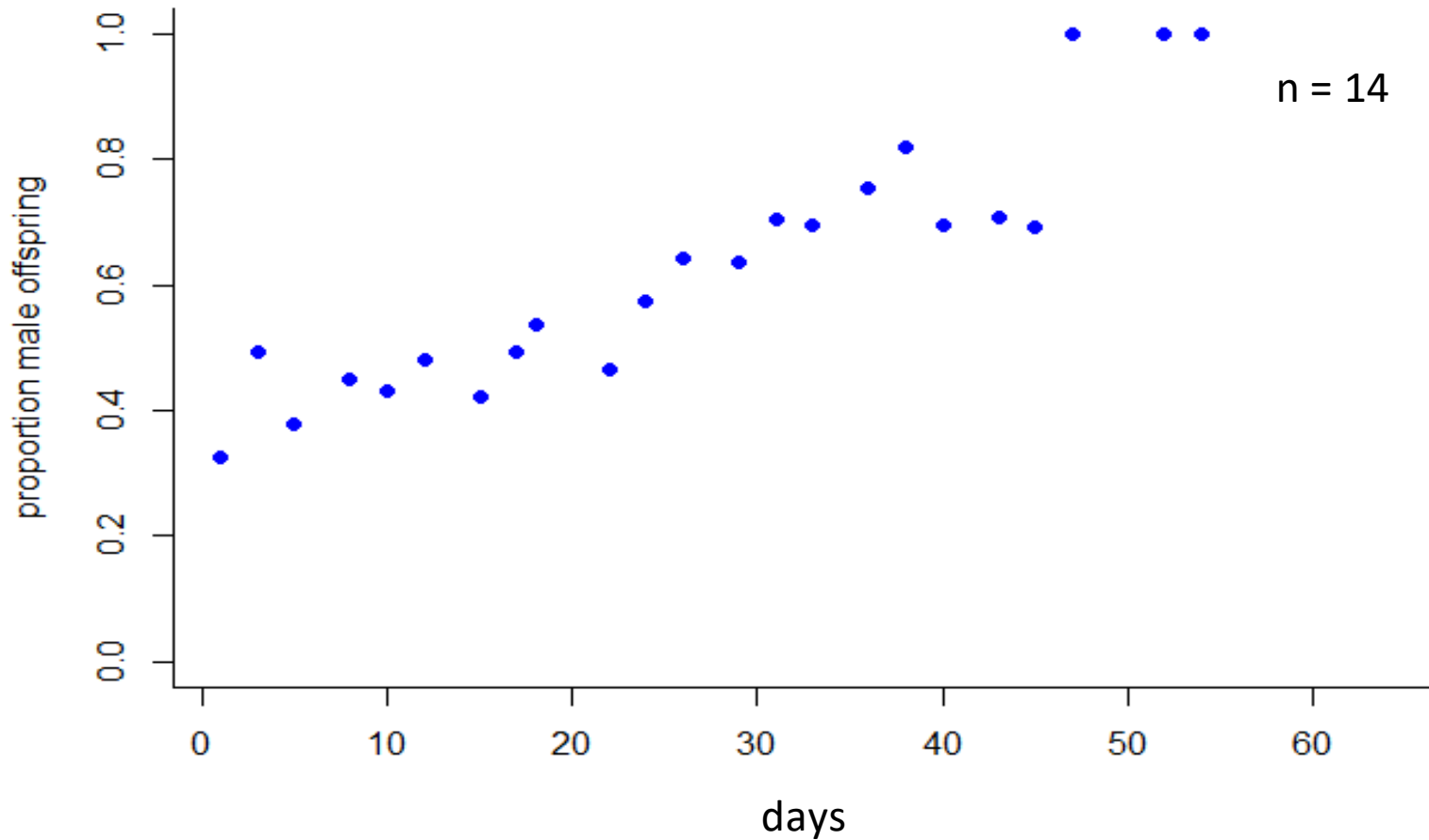
How many babies does *T. japonicus* make?

Mated females were exposed to egg masses every Mon, Wed, and Fri until they died. Females were only mated once.



Average lifetime reproduction = 152 offspring

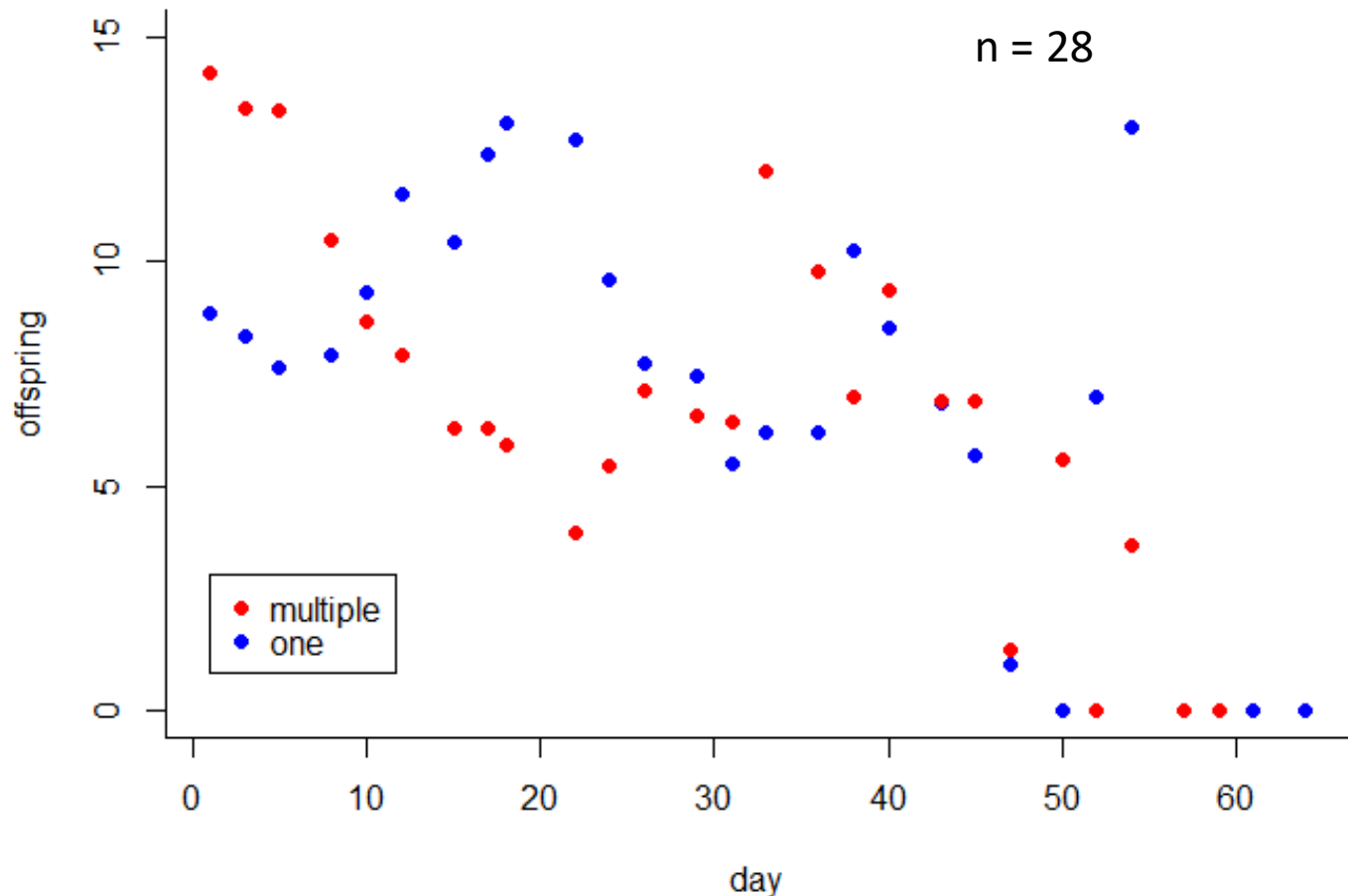
Proportion males



**Average lifetime reproduction = 89 daughters + 63 sons
41% male**

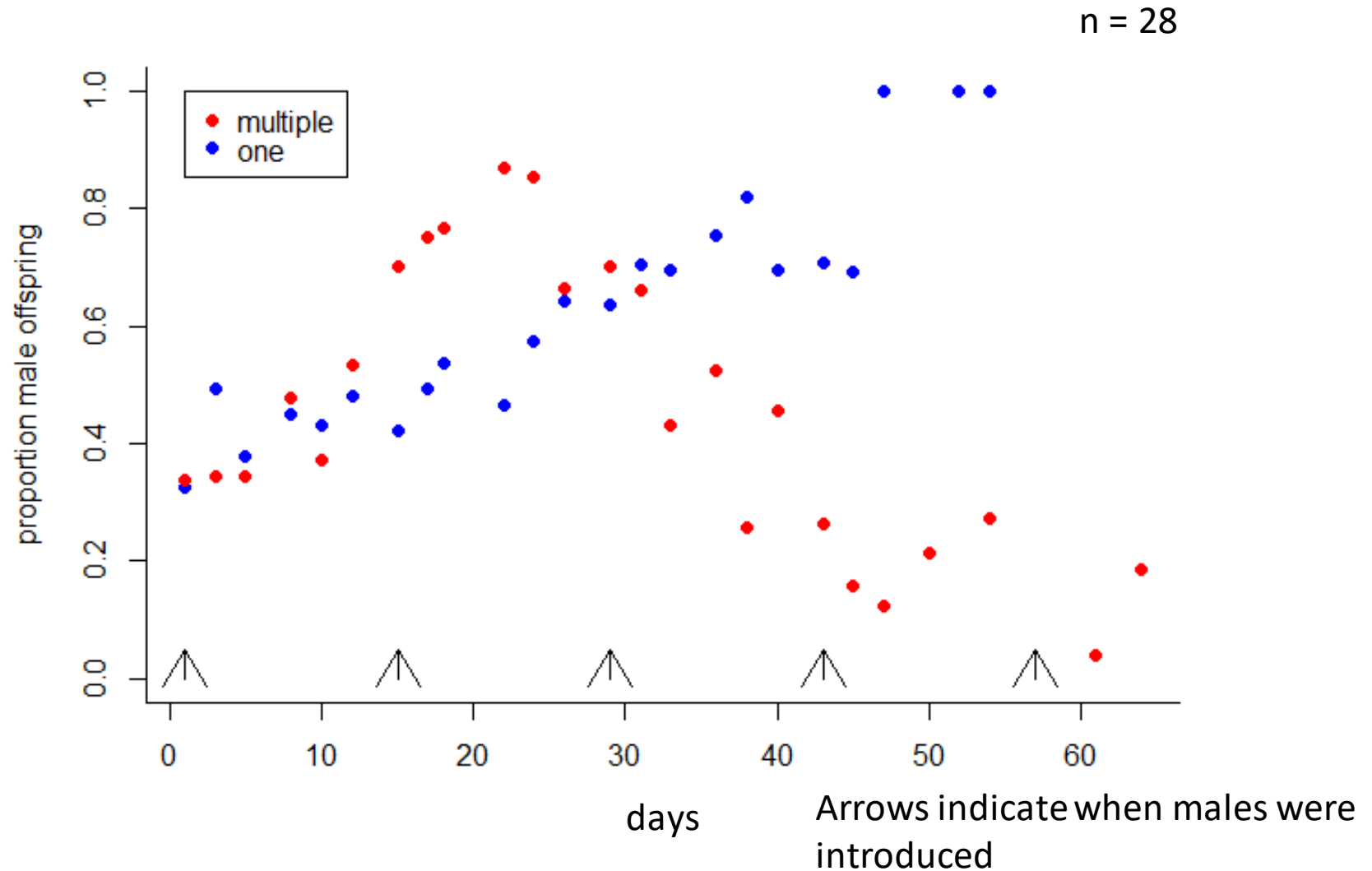
Reproduction and sperm limitation

Mated females were exposed to egg masses every Mon, Wed, and Fri until they died. Blue indicates singly mated females. Red indicates females that were exposed to males multiple times (every ~2 weeks)



Added males for 24 hours every 2 weeks

Reproduction and sperm limitation



Parasitoid redistribution and the effects of release numbers

- *T. japonicus* is establishing across a broad geographic range
- However local population densities are quite variable
- Redistribution efforts may increase spread, local density, and biological control impact

What is the optimal release strategy??

- Opportunity to study colonization processes



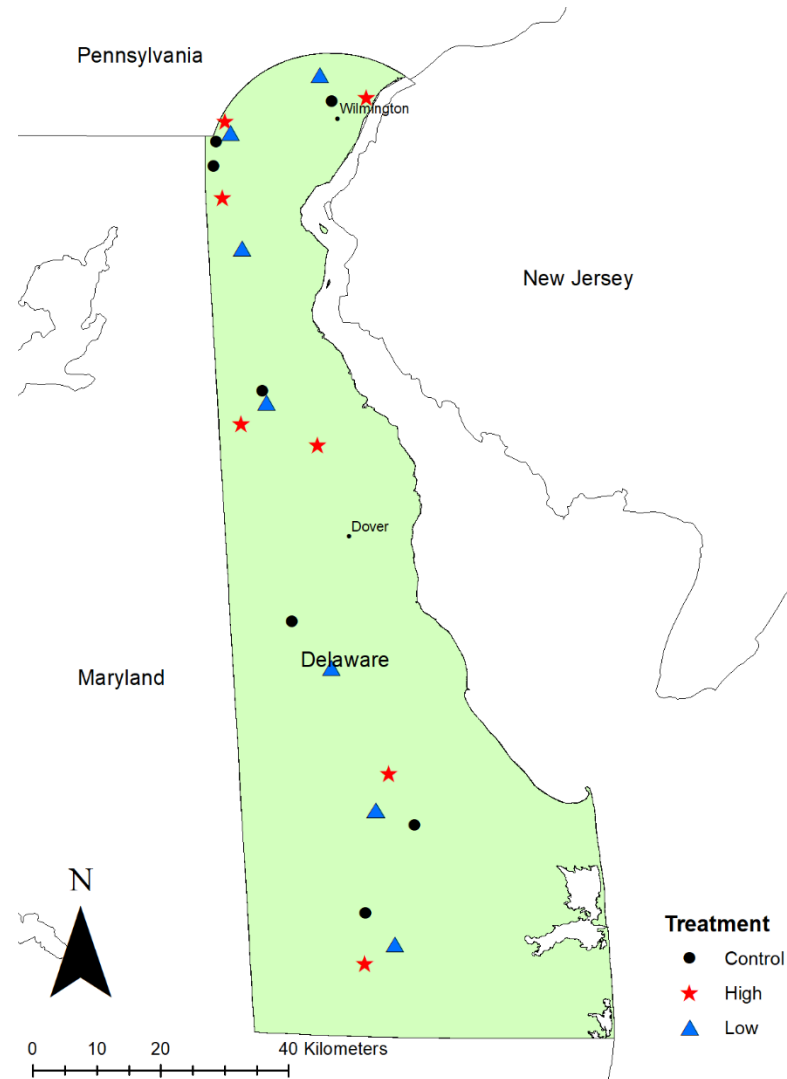
Delaware redistribution

High release: 15-20 parasitized egg masses *per release*, i.e. about 400 female wasps

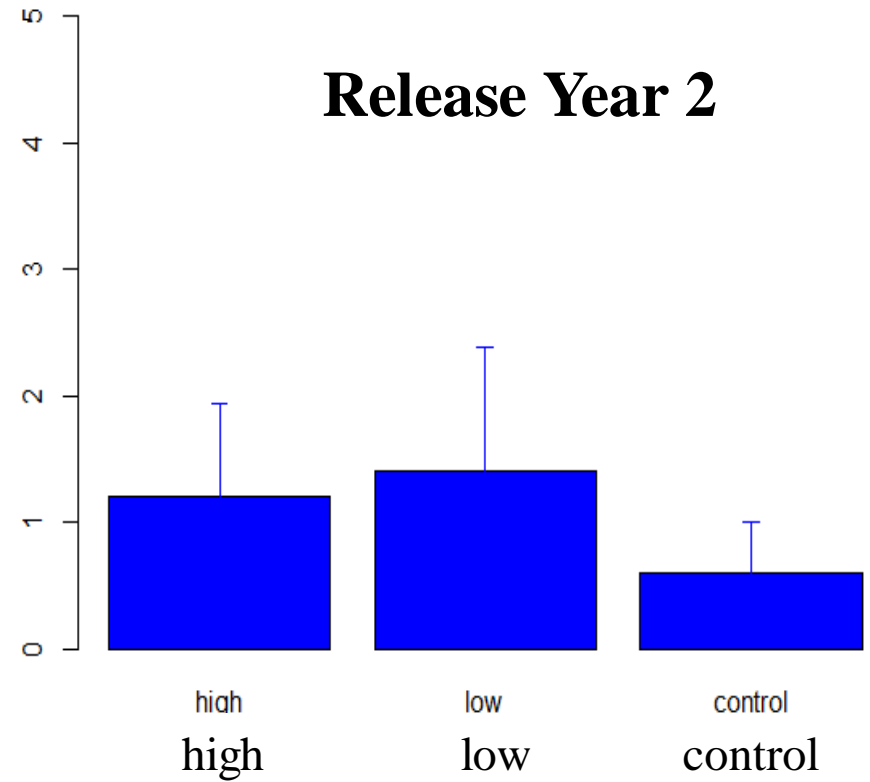
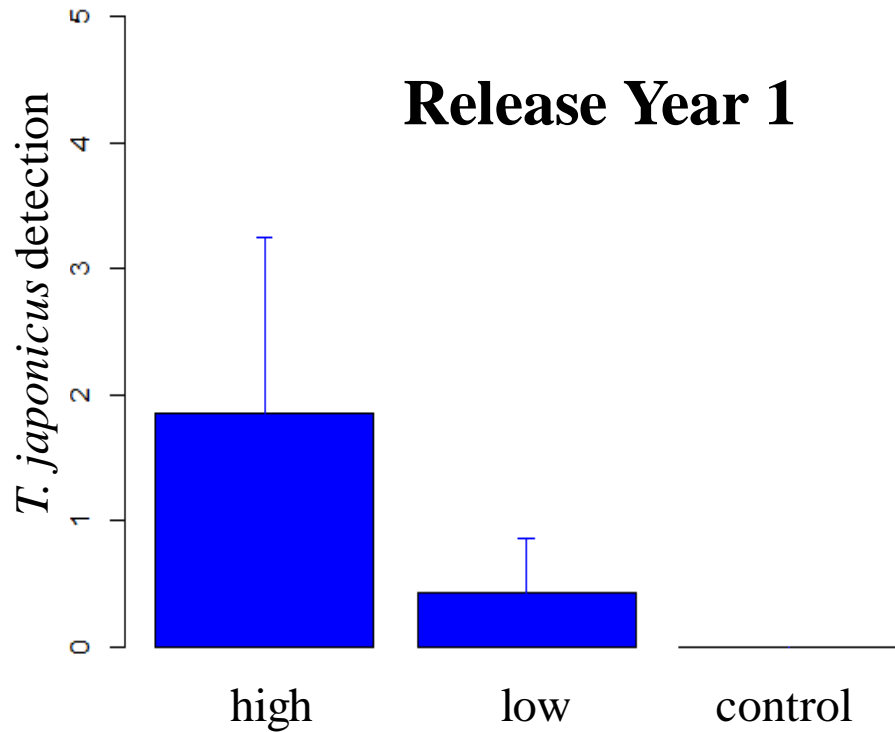
Low release: 1-2 parasitized egg masses *per release*, i.e. about 40 female wasps

Control: no released wasps

- Minimum separation of 2 km between release locations
- Randomized complete block design
- All release sites were forested habitat edges



Delaware redistribution



Multistate redistribution efforts

Trissolcus japonicus redistribution is ongoing in...

Delaware – Kaser, Tatman, Owens & Hoelmer

Maryland – Shrewsbury & Potter

New Jersey – Girod, Hamilton & Nielsen

New York – Jentsch & Agnello

Michigan – Pote & Szucs

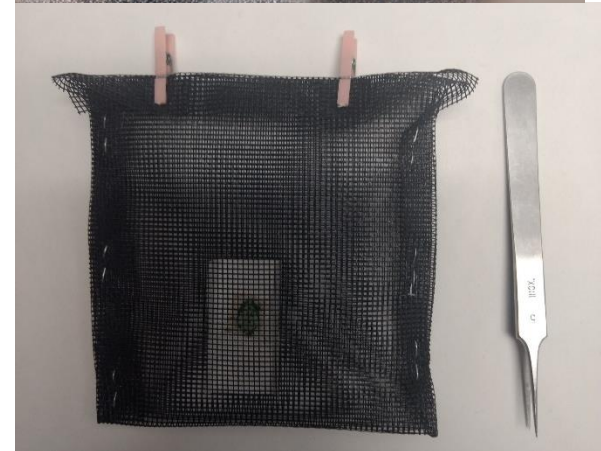
Ohio – Welty

Oregon – Wiman & Lowenstein

Virginia – Bergh & Quinn

Washington – Beers & Milnes

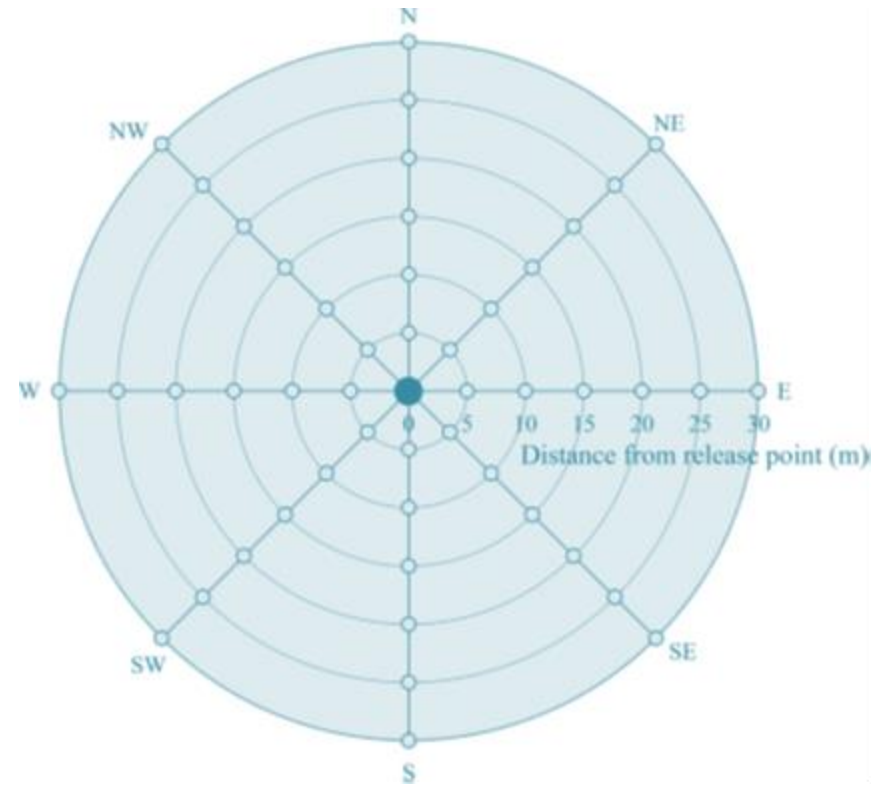
Others?



Why such low growth?

Population growth = birth - death + immigration - emigration

T. japonicus Dispersal



~1700 female adult wasps released

Half of trees exposed to BMSB adults (contact kairomone)

T. japonicus Dispersal

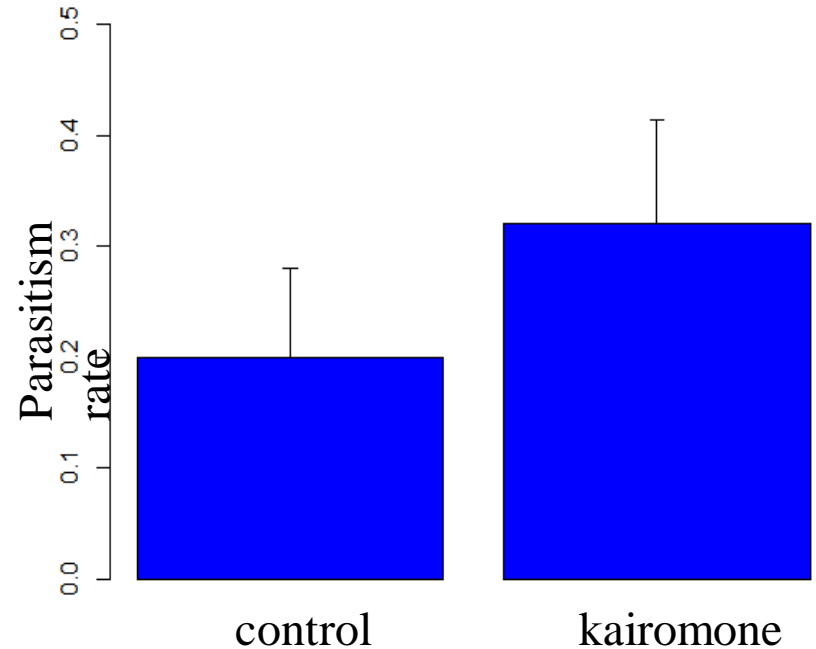
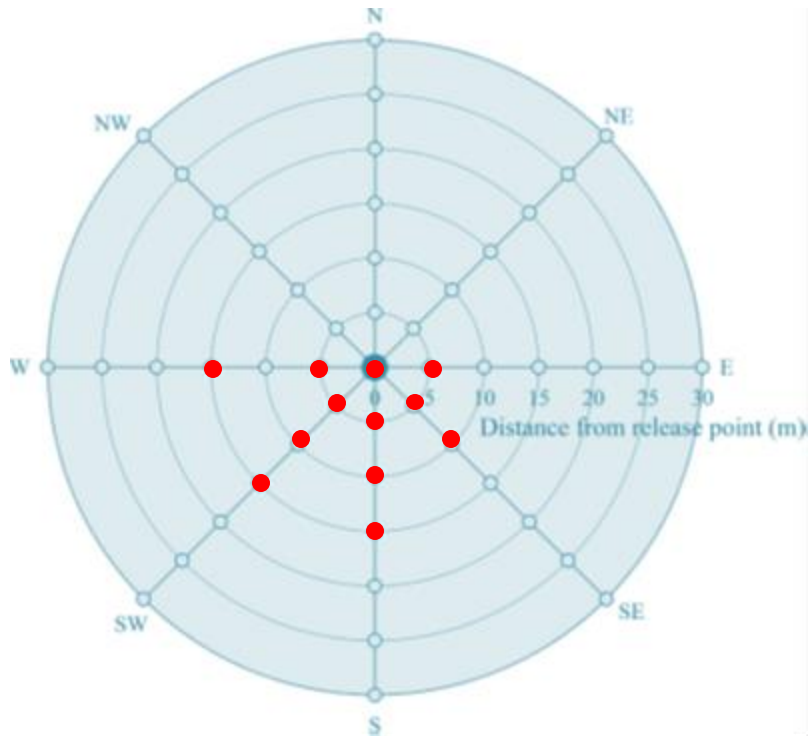
Logistic regression: Parasitism~Distance+Treatment+ Distance*Treatment

Distance: $P = 0.035$

Treatment: $P = 0.47$

Distance x Treatment: $P = 0.89$

26% parasitism
By 0.7% of females



Summary

- Parasitoids can be long-lived
- High reproductive output
- Sperm limitation might limit population growth under certain conditions (like low population density)
- Low *detected* population growth at release sites, thus far
- But *T. japonicus* is continuing to increase its geographic range
- High rates of dispersal may create a lag before local populations increase dramatically; though we can only speculate at this stage
- In China, parasitism is very high, and BMSB density is lower
- Should we continue to release and wait, or is there something different about the U.S. context that limits biological control capability?

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