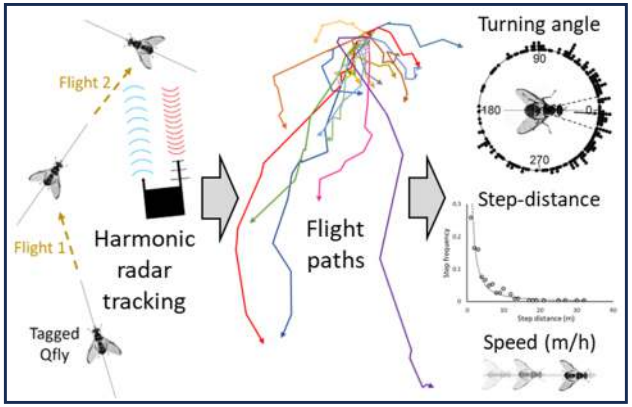

Harmonic radar tracking of tephritid fruit flies:

Individual fly observations, movement parameterization, and modeling

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APHIS

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Australian Centre for International Agricultural Research

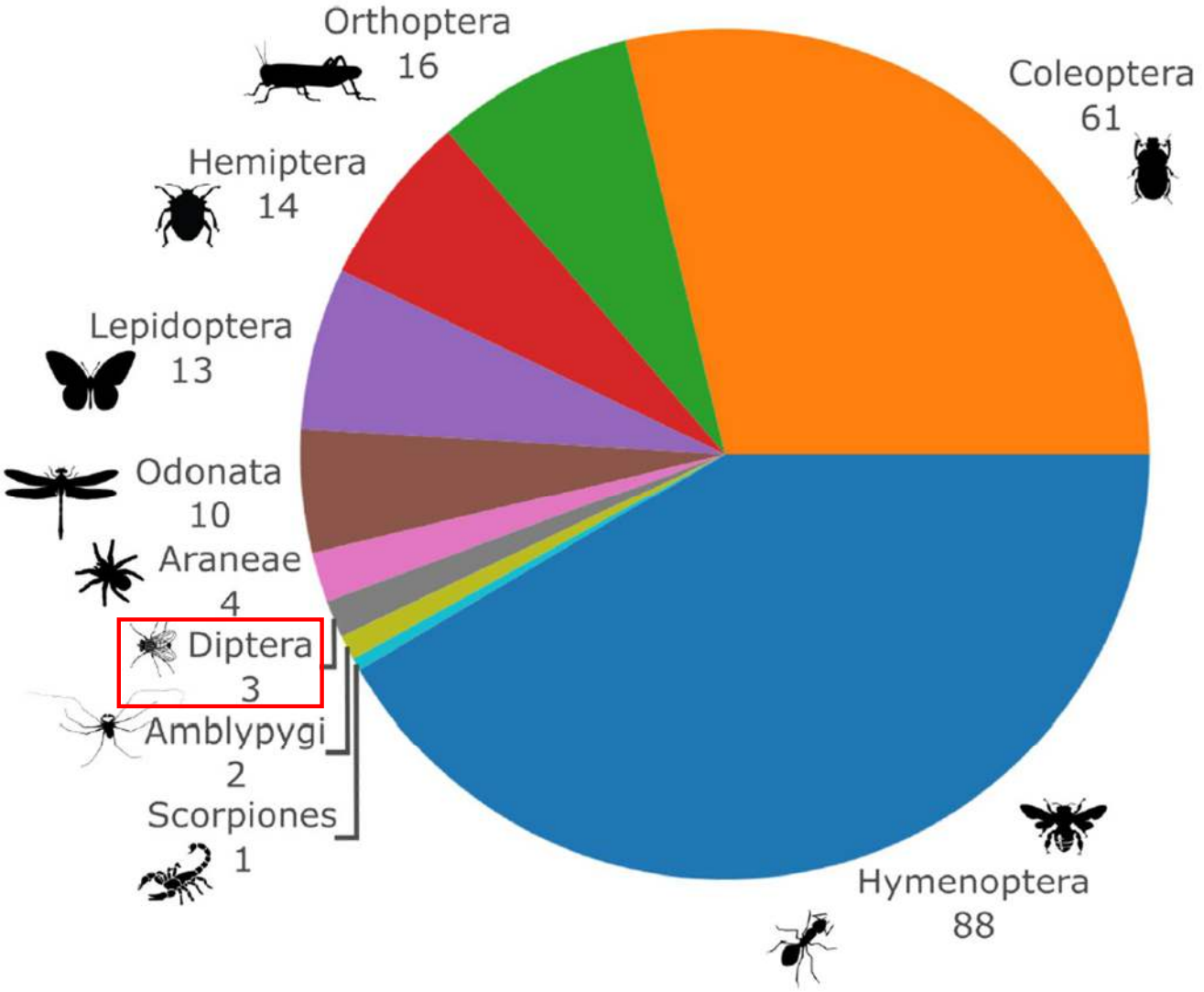
Introduction

- Insect movement important
- Studying movement difficult
  - Mark release recapture
  - Tethered flight (flight mill)
  - Tracking
    - Mammals, birds, fish, insects ✓ ✓ ✓ ?

Outline

- Tephritid harmonic radar
  - Developing nitinol tags
  - Tracking methods/results
  - Modeling

Tracking insects

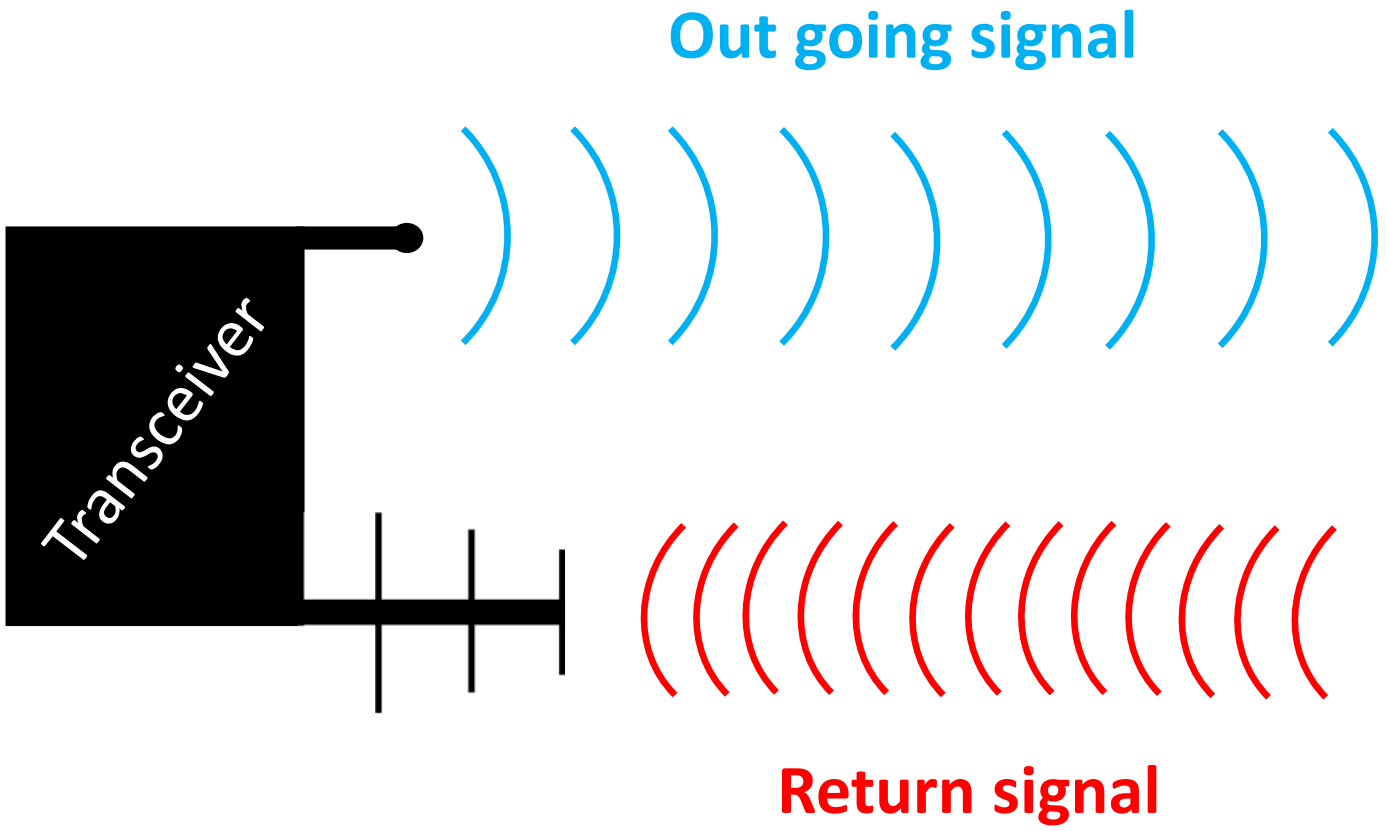


Predominantly radio telemetry

Batsleer et al., 2020

Tracking insects

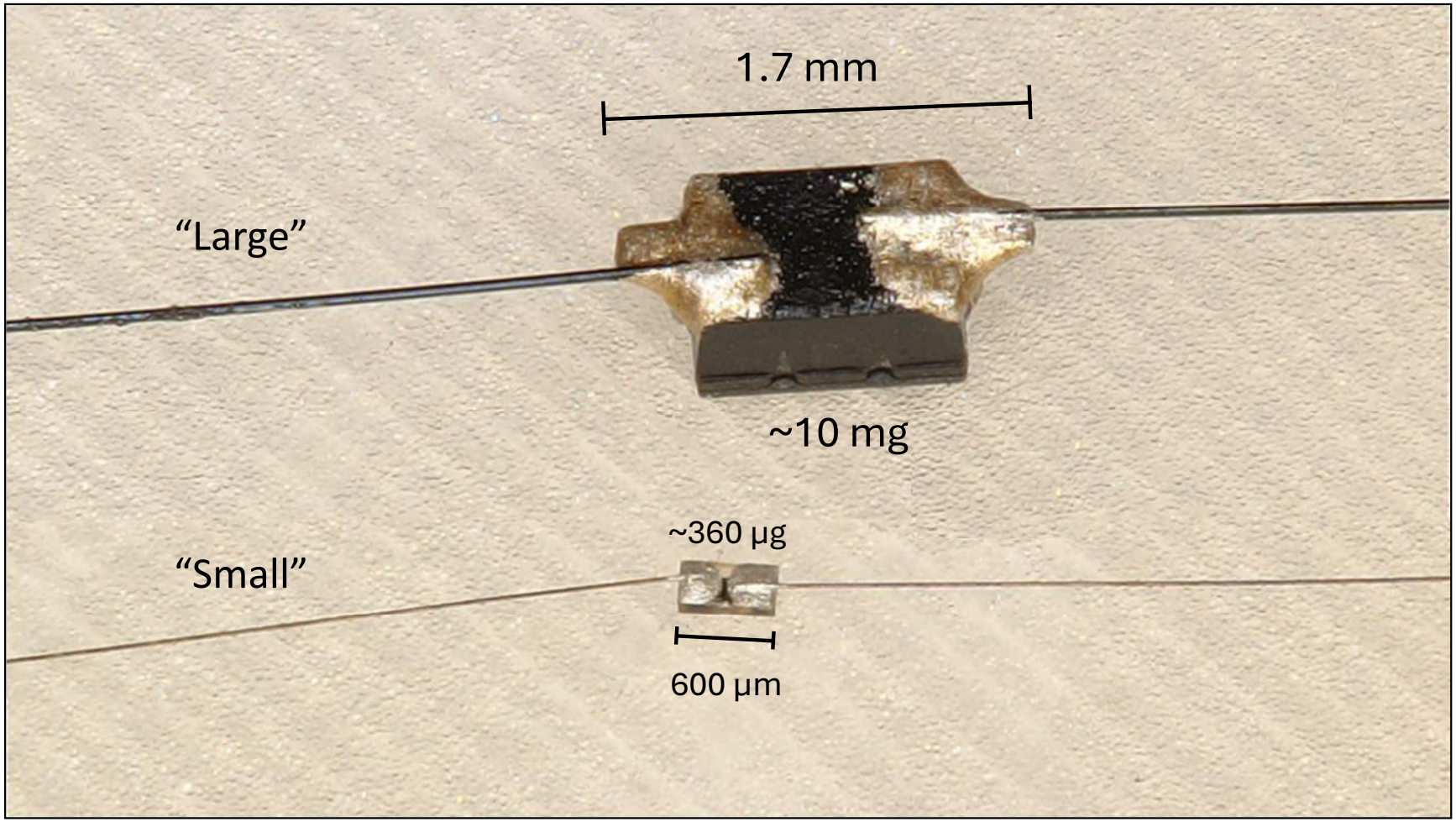
Harmonic radar



(inexpensive, no battery, no ID)

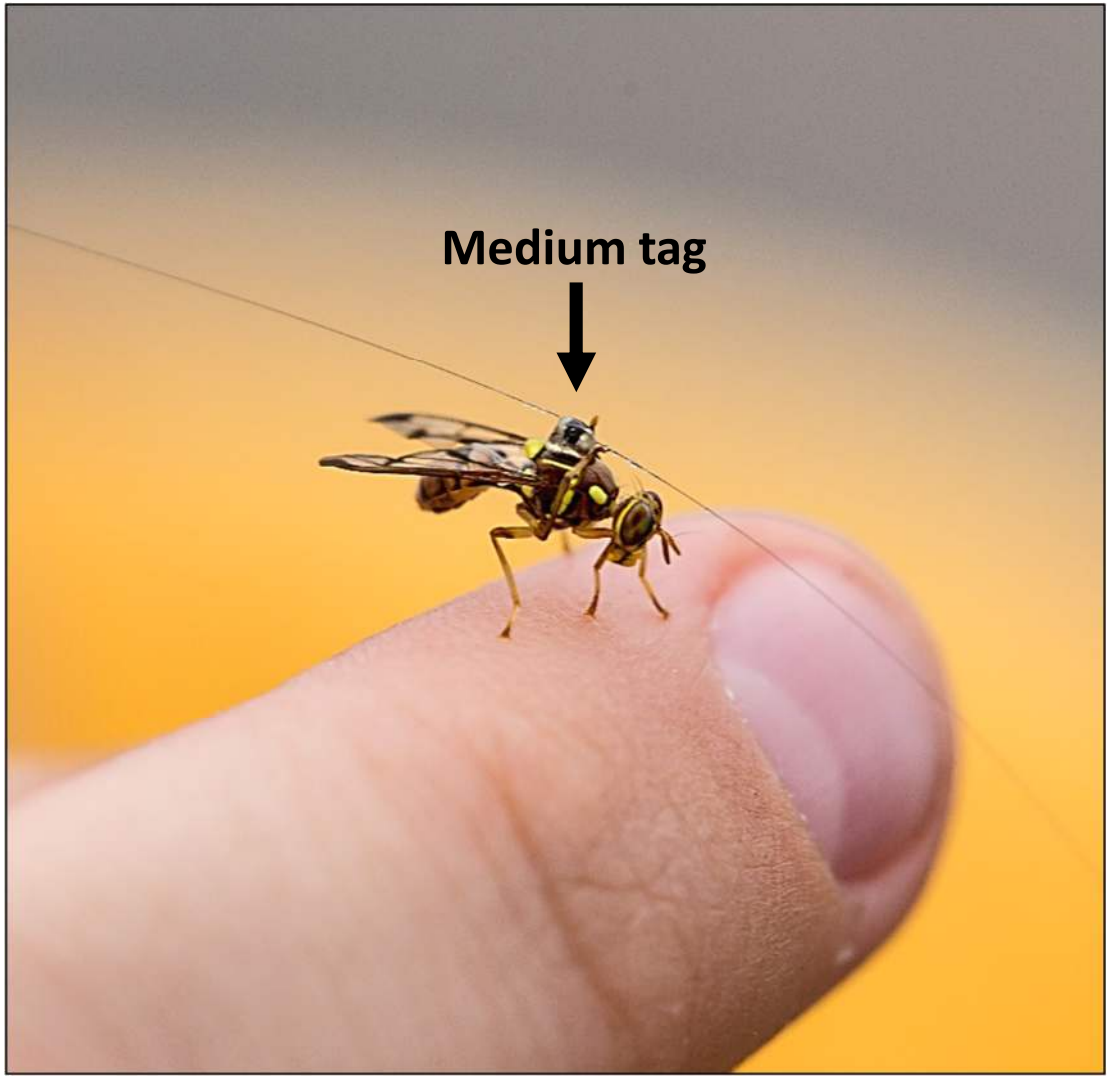
How to video

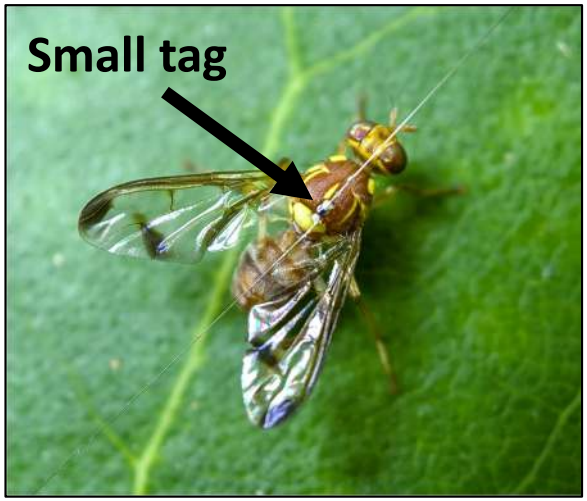
Tag development

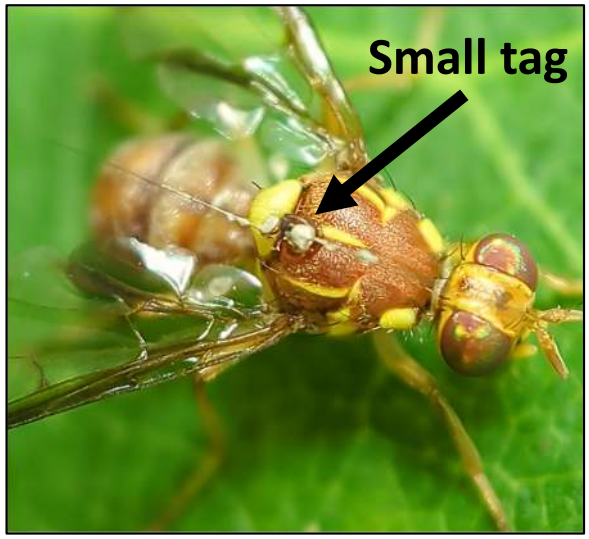


- Nitinol wire
- Schottky diode
- Silver paint/epoxy

Tag development







Field experiments

Tracking individual flies

Papaya – prodded

Papaya – over time

Papaya – natural movement

Open field

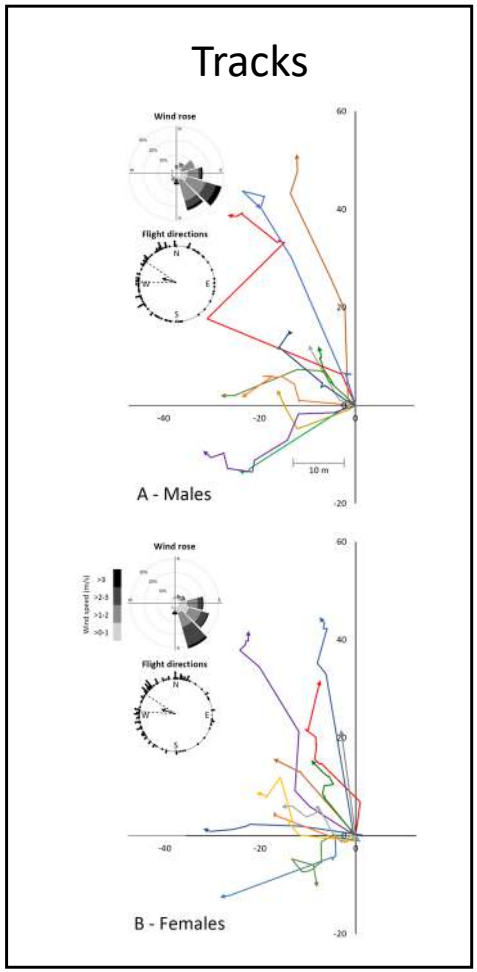
- Step-distance
- Turning angle
- Speed

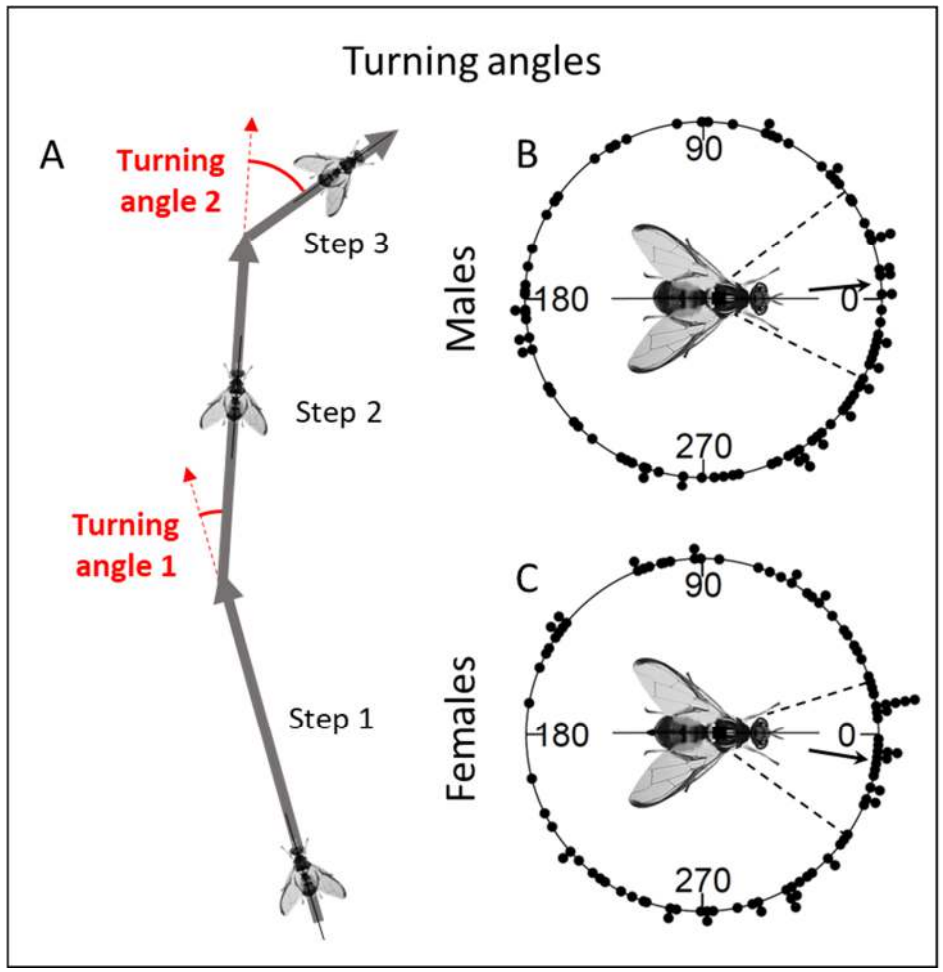
Papaya field – **prodded**

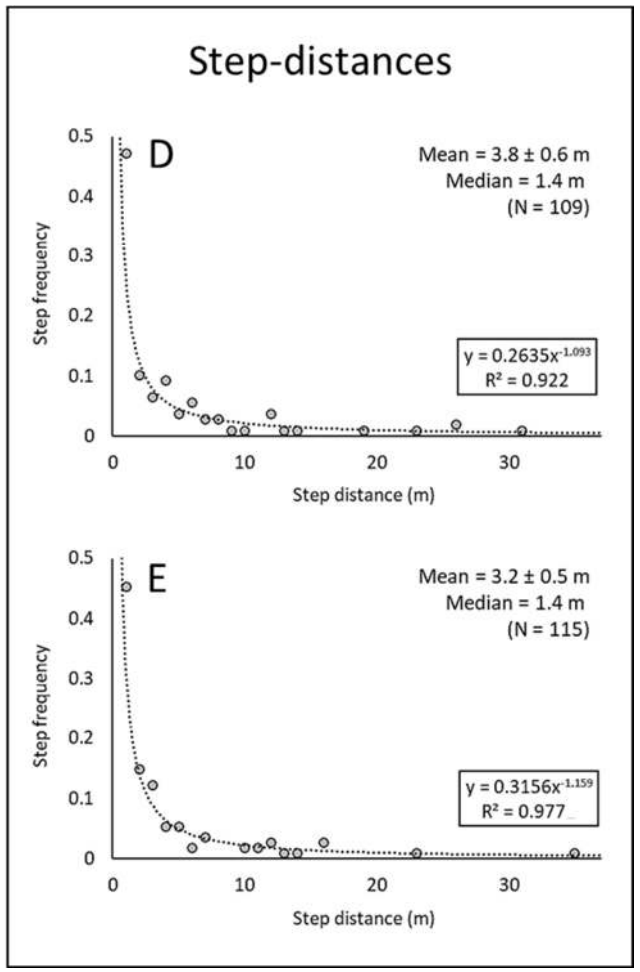
- Release/track/mark
- Wait 5 minutes
  - If no move, poke
- 10 step target

Papaya field – **prodded**

Bactrocera jarvisi (colony flies)



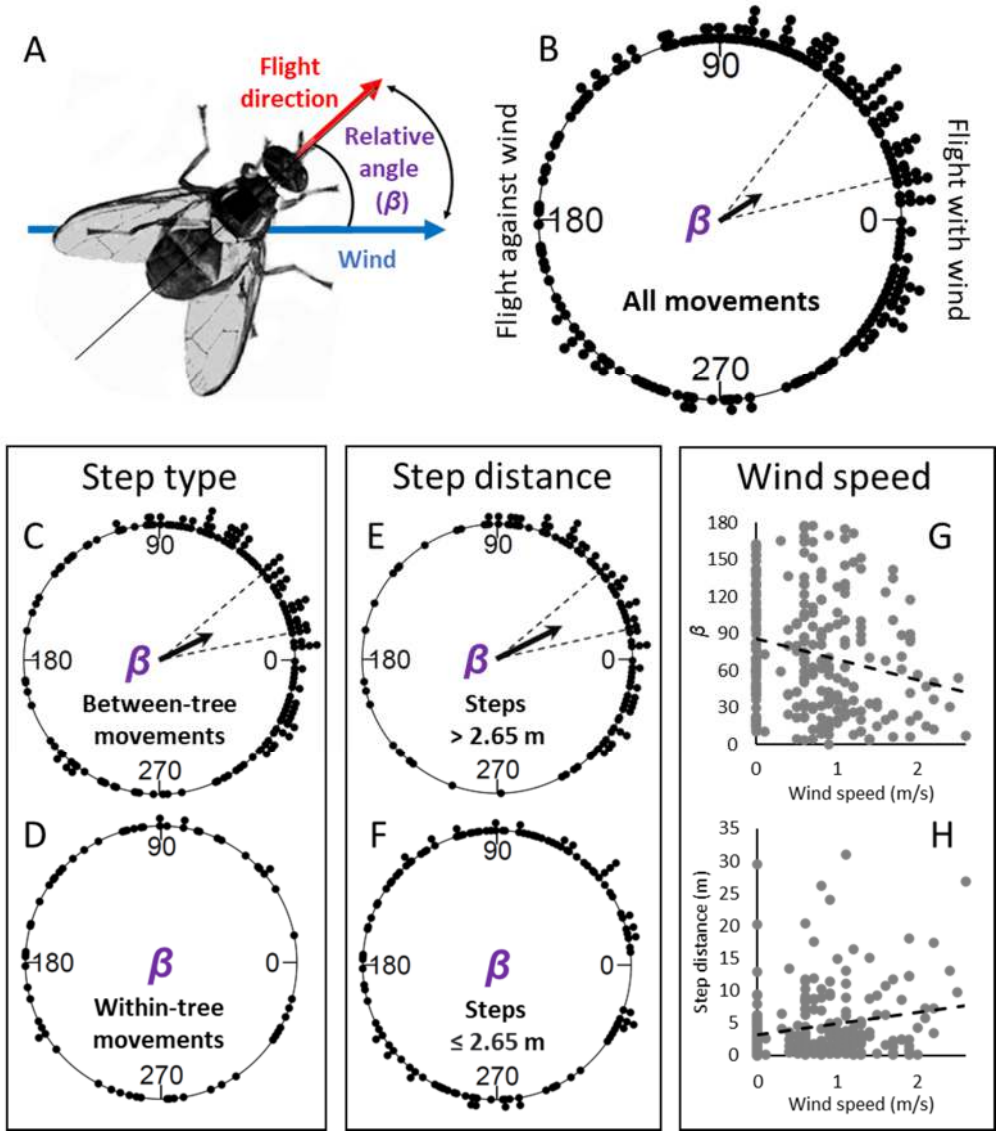




Welty Peachey et al., 2024

Papaya field – **prodded**

Bactrocera tryoni (wild flies)

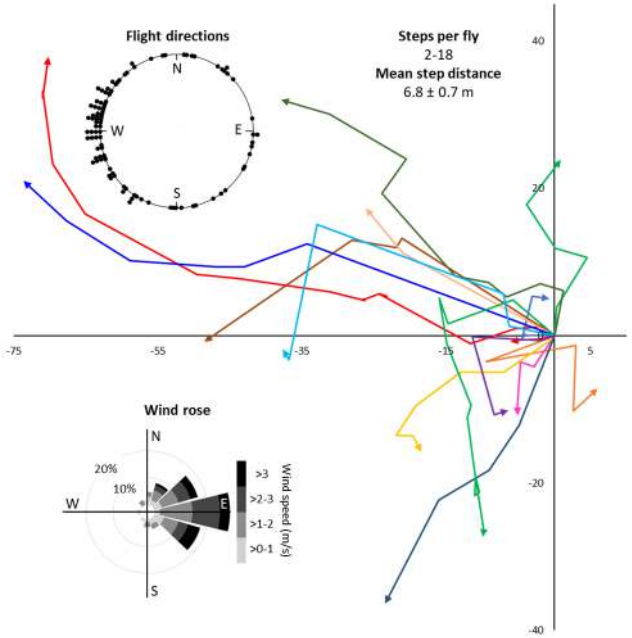


(in review) Moses et al., 2024

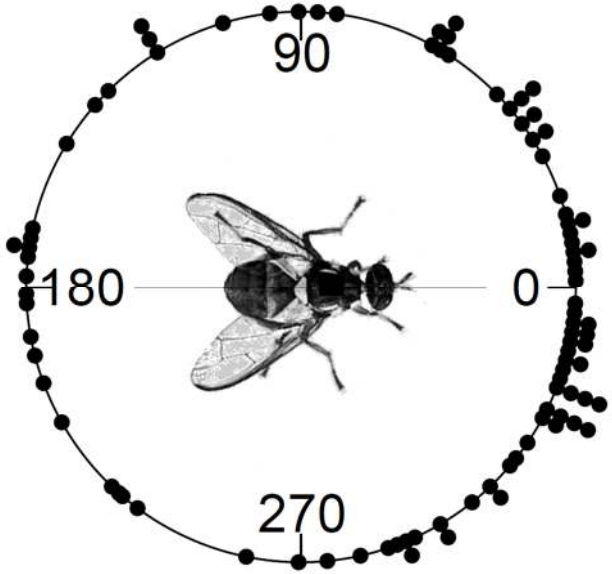
Papaya field – **natural movmt**

Bactrocera tryoni (wild flies)

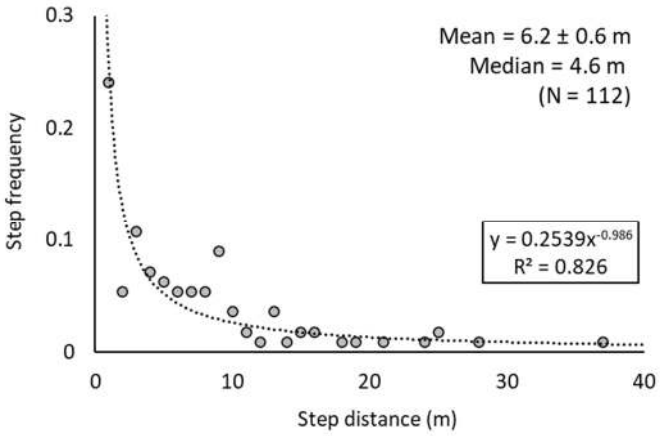
Tracks



Turning angles



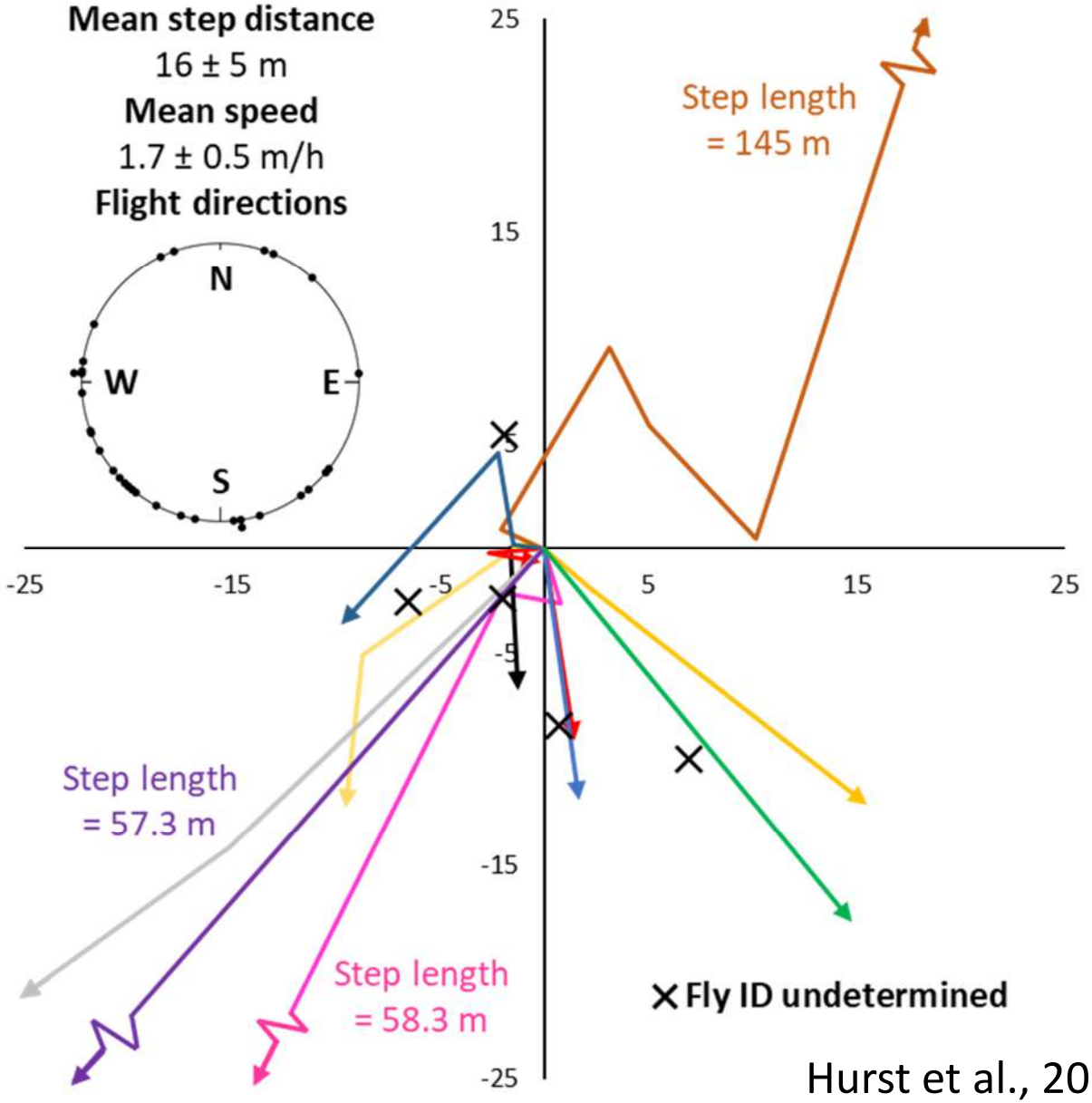
Step distances



Speed = 16 ± 3 m/h

Papaya field – **over time**

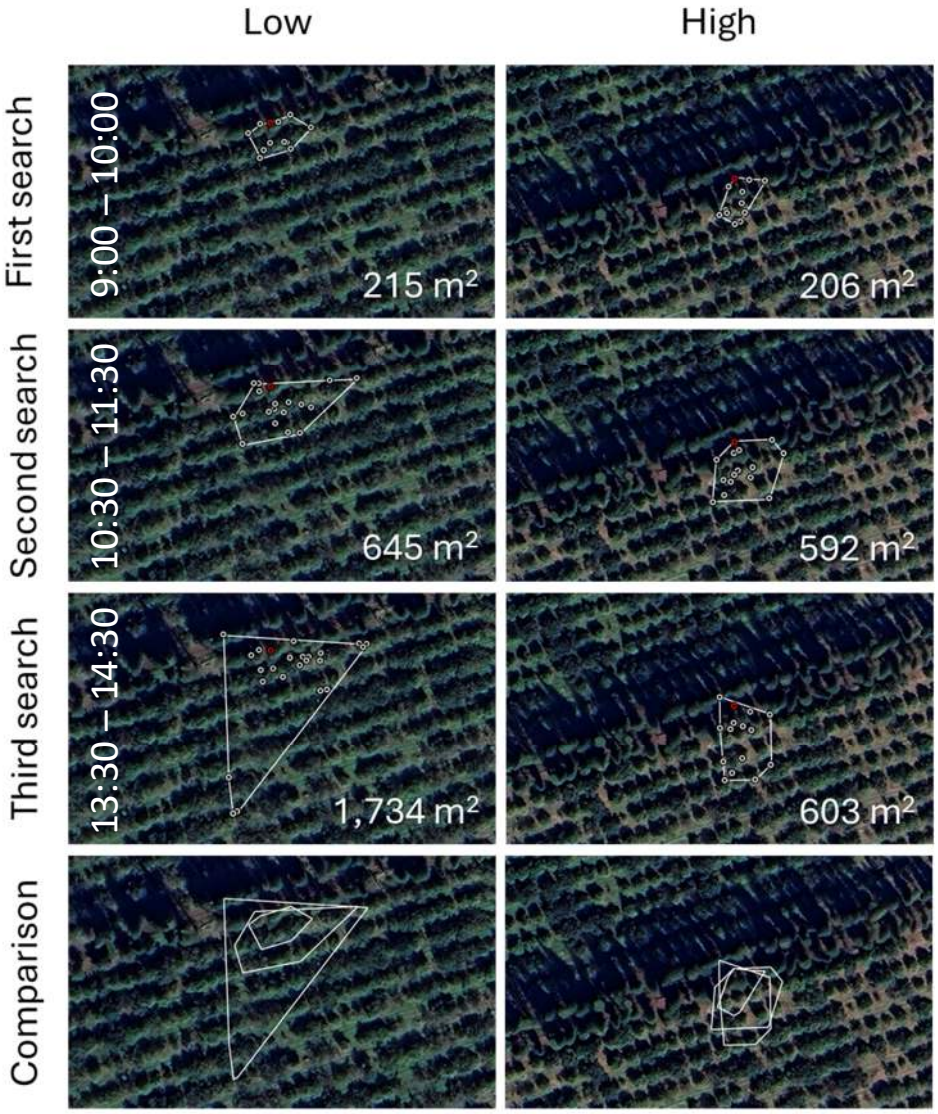
- Flies released and tracked twice daily

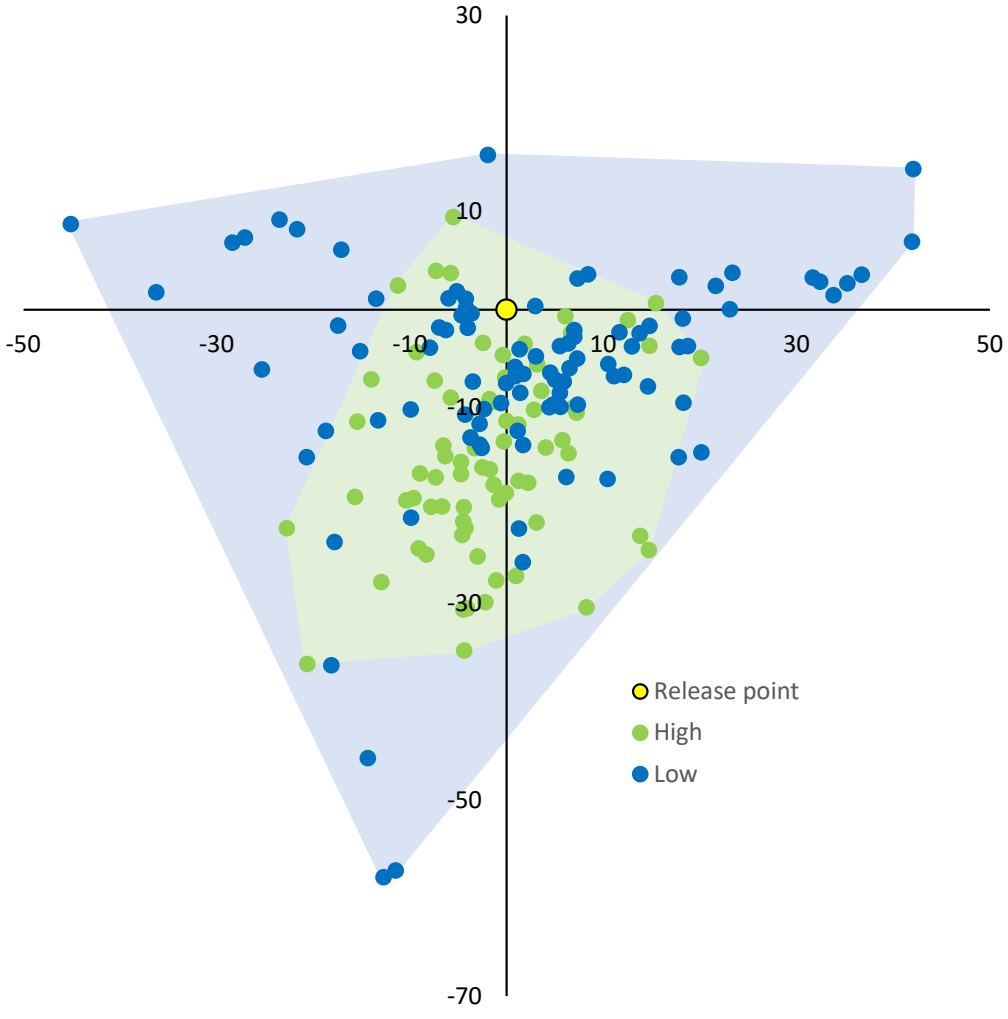


Hurst et al., 2024

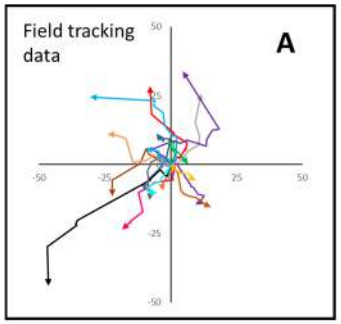
Mac nut – **over time**

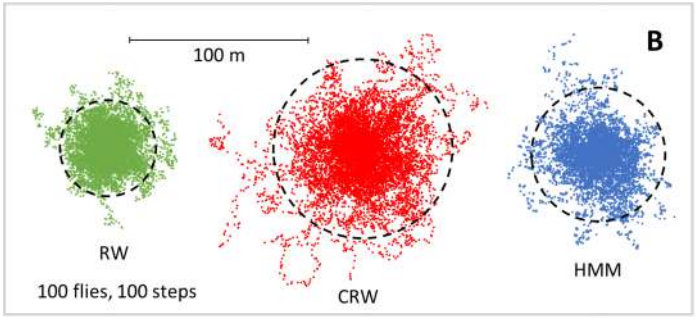
Cuelure MAT – ‘mass’ tagged fly releases

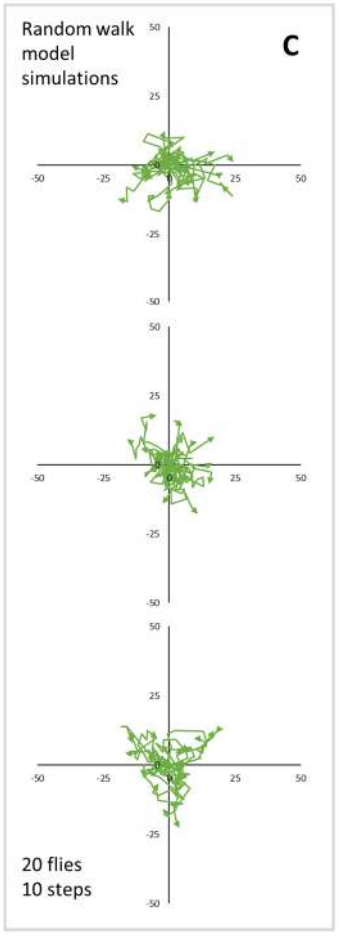


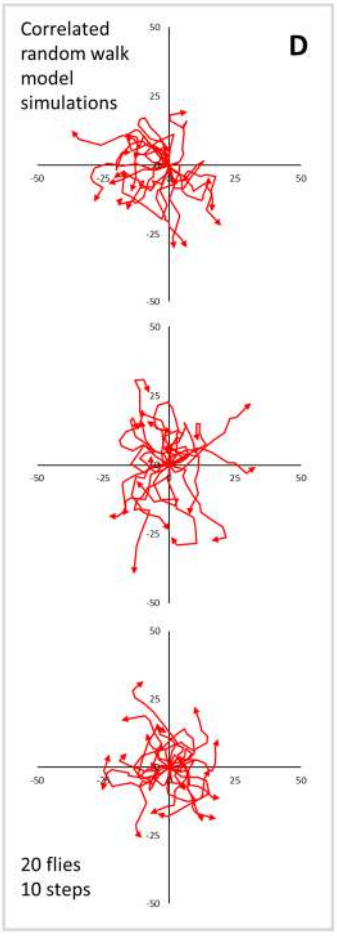


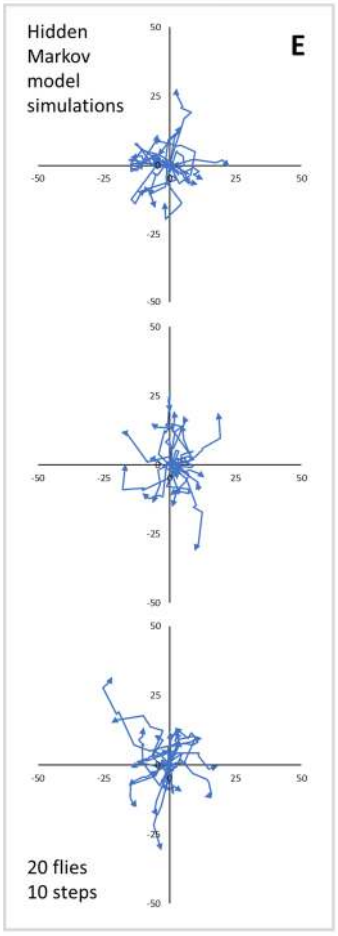
Papaya field – **modeling**

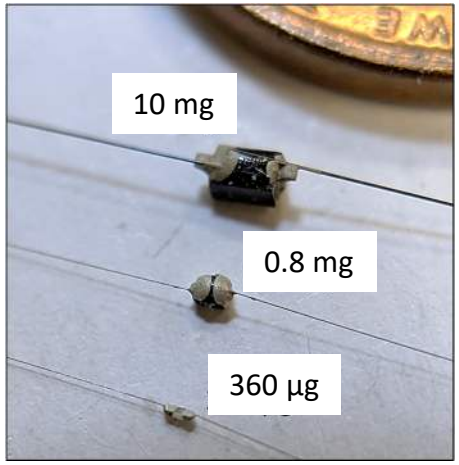






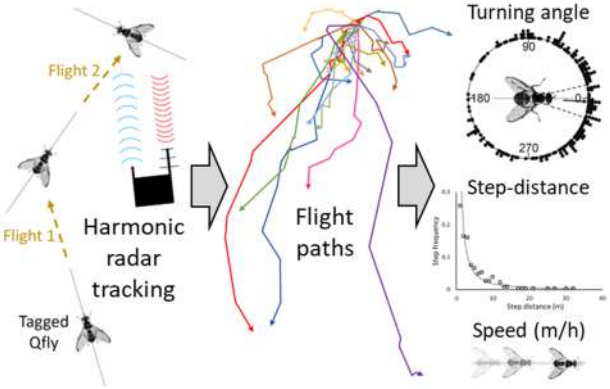


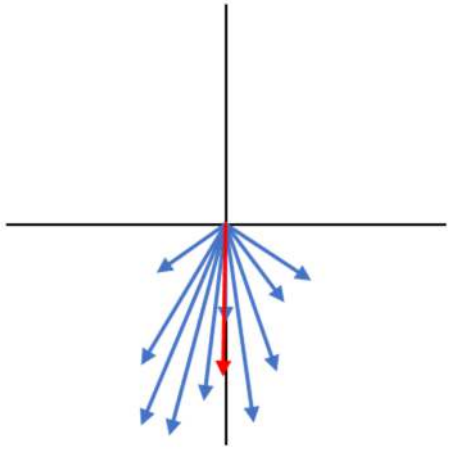


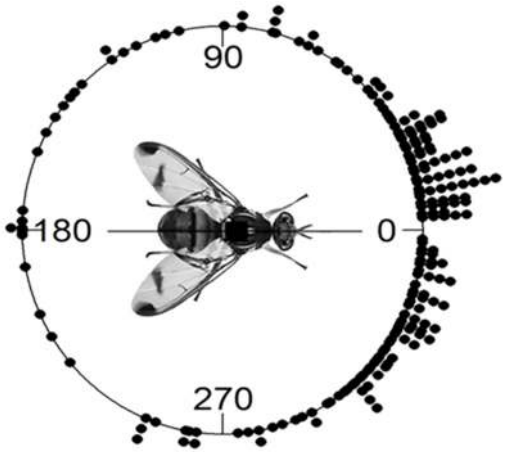


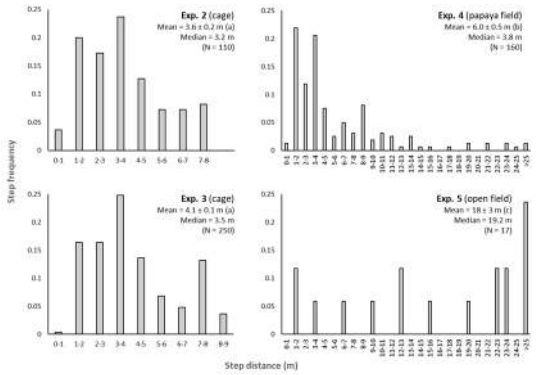
Conclusions

- Accessible
  - Tags and tracking with undergrads
- Inexpensive
  - Tags (several dollars)
  - Transceivers (~$5-8k)
- Tracking
  - Best for in-field movements (hundreds of m)
  - Not great for migration
- Modelling
  - Control & incursions









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Questions? Thoughts?

How to video