Identification of host-derived attractants and repellents for improving *Culicoides* management on deer farms

Emma N.I. Weeks, Salvador A. Gezan, Jordan A. Vann, Sandra A. Allan

Introduction

- Vector borne diseases such as EHDV and BTV transmitted via bloodfeeding
- Virus replicates in *Culicoides* and is injected into host with saliva
- Prevention of biting would prevent transmission
- How can you prevent biting?

Introduction

- Bloodfeeding insects, such as *Culicoides,* use cues to find their food source
- Temperature
- Humidity
- Sound/vibrations
- Chemical cues

Introduction

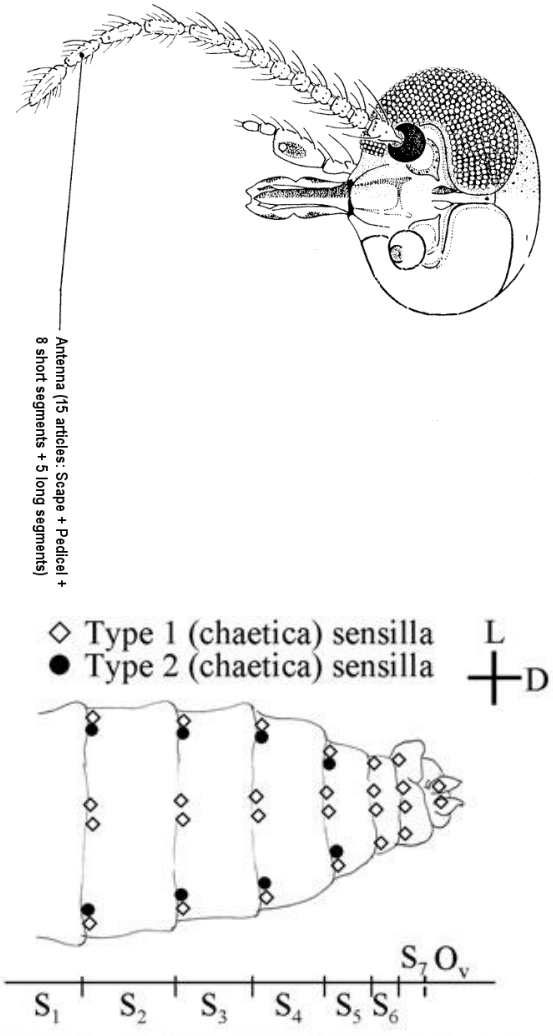
- Cues can be:
  - Long range detected over a distance
  - Short range detected in closer proximity
  - Contact

Chemical cues

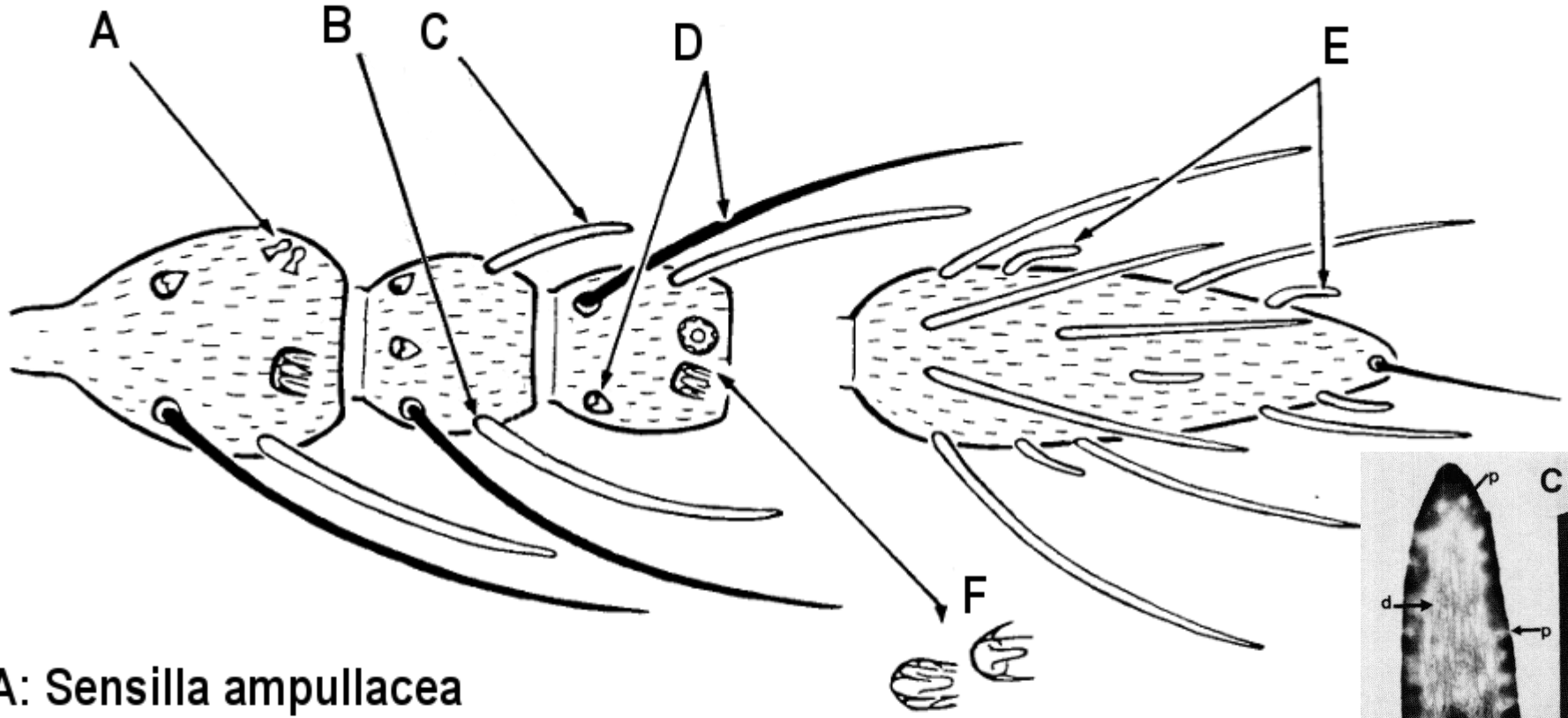
- Chemicals used in communication are known as semiochemicals
- Pheromones are between individuals of the same species, e.g. sex pheromones
- Allelochemicals are between individuals of different species, e.g. host location cues (kairomones)

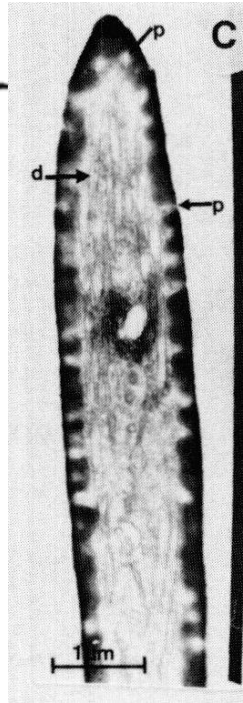
Chemical detection

- Detected by insect using specialized hairs (sensilla)
- Antennae
- Maxillary palps
- Abdomen!
  - Host location
  - Oviposition



Chemical detection





A: Sensilla ampullacea

B: - trichodea long

C: - trichodea short

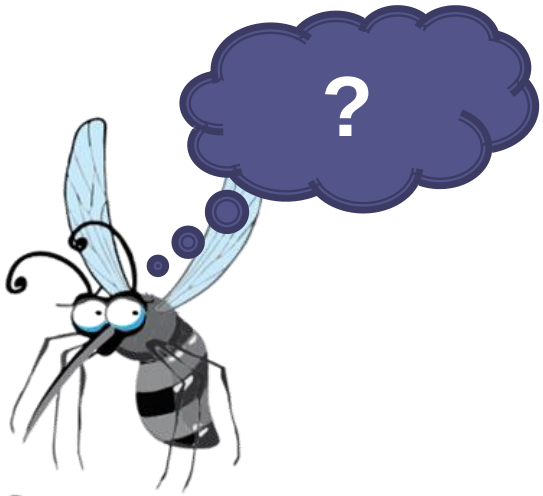
D: - chaetica

E: - basiconica

F: - coeloconica

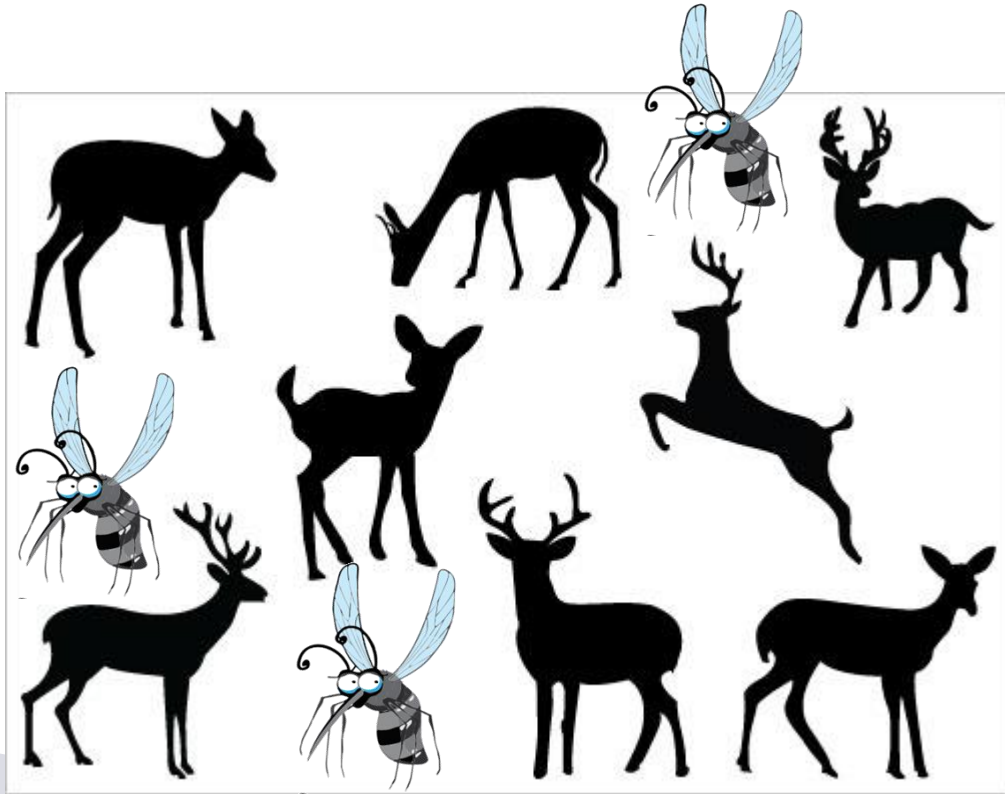
Behavioral manipulation

- Sex pheromone traps – attract males/females
- Aggregation traps – work for both sexes – used in forests.
- Mating disruption – use of sex pheromone to confuse insects – used in orchards.
- Repellents – turn a host into a non-host
- Host odor traps – addition of host odors to traps, such as carbon dioxide
  - Increase attractiveness
  - Decrease cost/labor



Host and non-host

- All hosts are not created equal!
- Most bloodfeeding insects have a feeding preference for certain species, breeds or individuals
- Example: are you bitten by mosquitoes?



Repellents (non-host)

- Tsetse flies transmit sleeping sickness.
- The flies avoid waterbuck and feed on buffalo or ox.
- Odor from waterbuck was found to be highly repellent to flies.

Repellents (non-host)

- Repellent chemicals used to impregnate plastic and placed into a collar.
- 1,500 cows in the trial.
- Collars impregnated with odor protected livestock from sleeping sickness!
- Reduced costs for medication.
- According to reports doubling milk production!

Attractants (host)

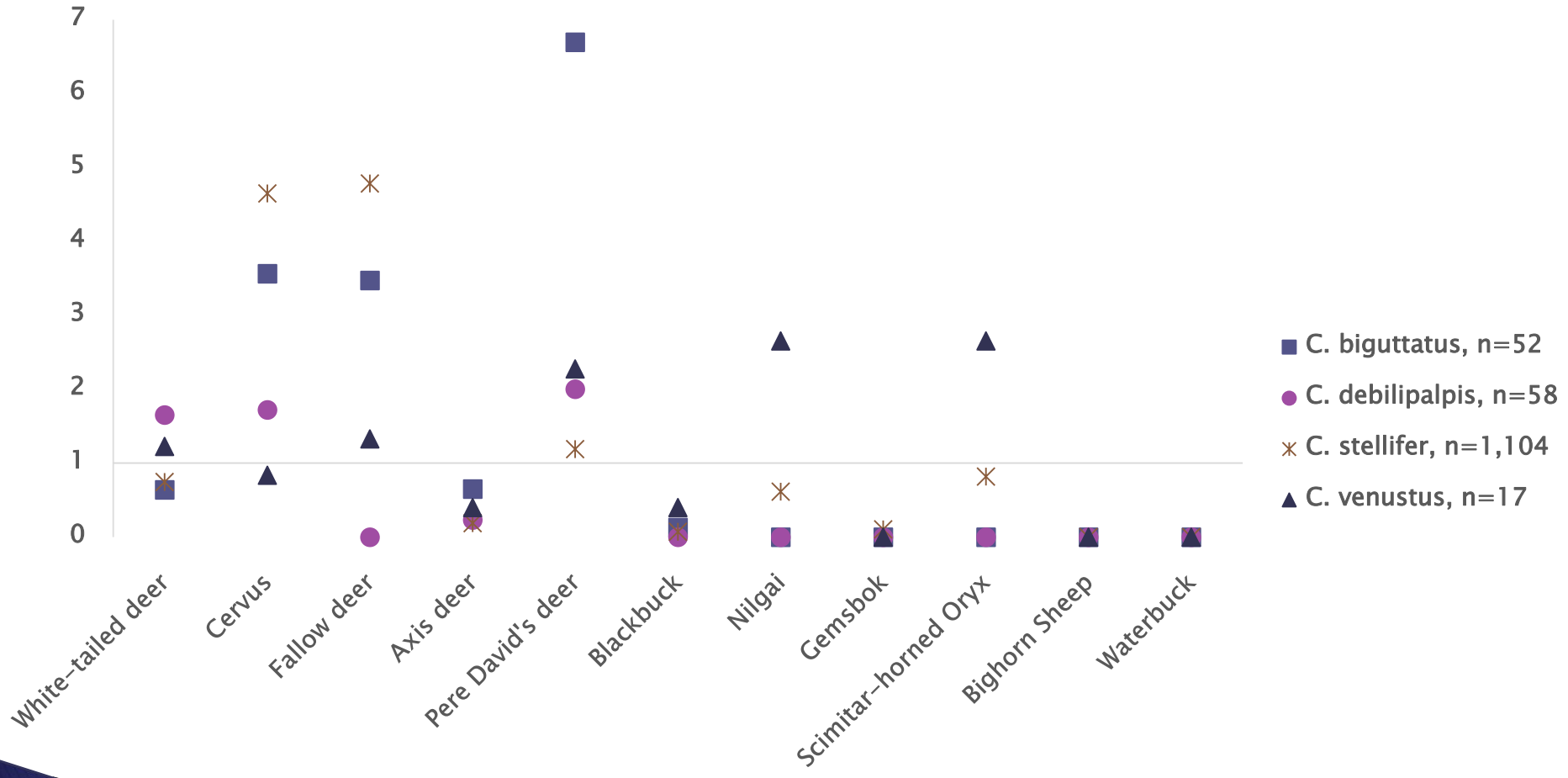
- Three main uses:

1. Surveillance/monitoring pest or pathogen prevalence
2. Mass trapping to reduce population
3. Intervention evaluation

Attractants (host)

- European *Culicoides* vectors
- Host odor chemicals found to be detected by the antennae and attractive
- Chemicals used to enhance trapping
- What about North American *Culicoides* vectors feeding on deer?

Host choice in *Culicoides* in FL



McGregor et al. unpublished

Host choice in *C. stellifer*

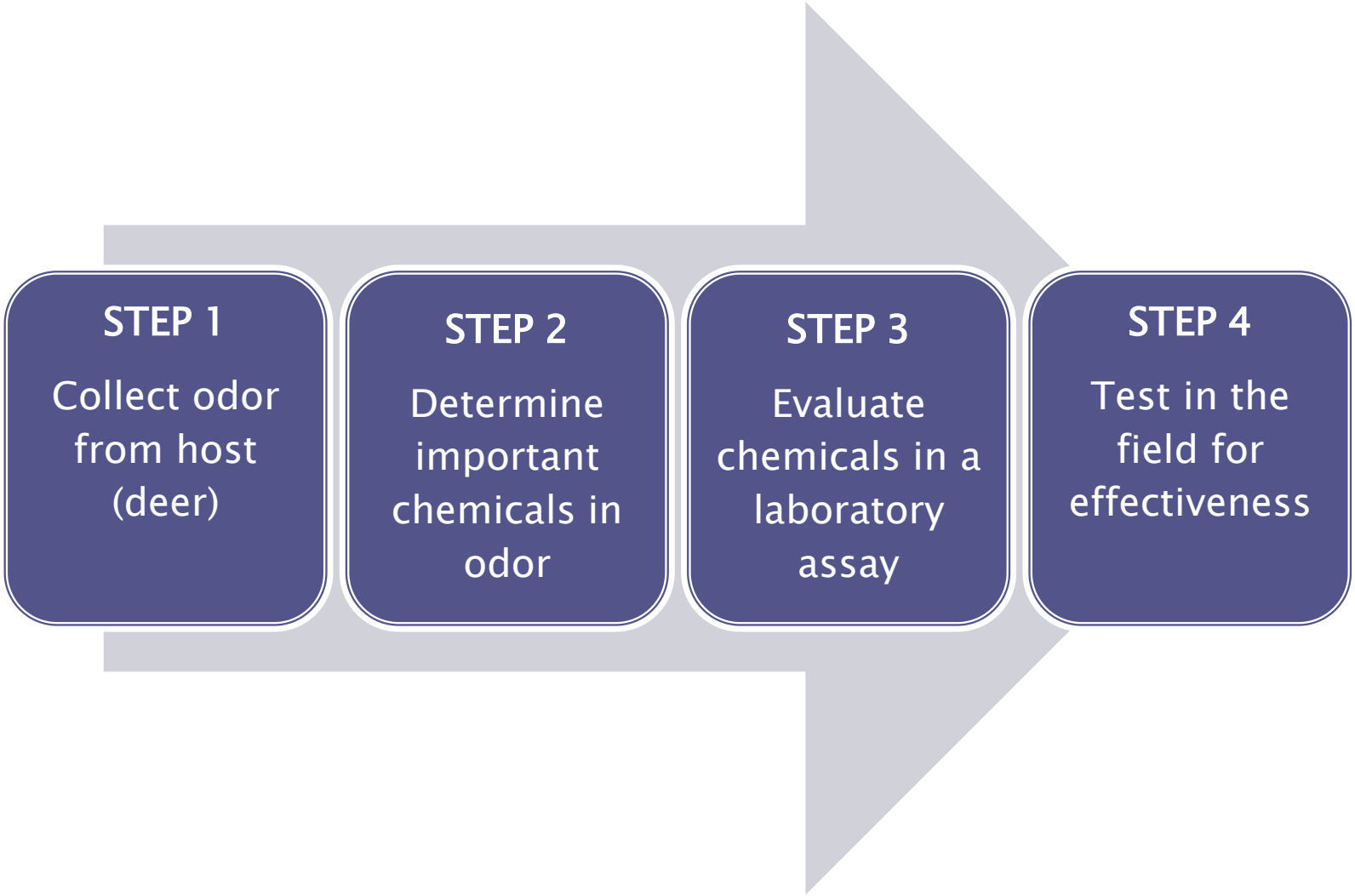
n=1104

McGregor et al. unpublished

Objectives

1. To evaluate the influence of host odor on host preference and blood feeding.
   - Host vs. non host
   - Northern vs. southern WTD
   - Male vs. female WTD
2. To determine the chemical cues involved in host location.

Proposed methods



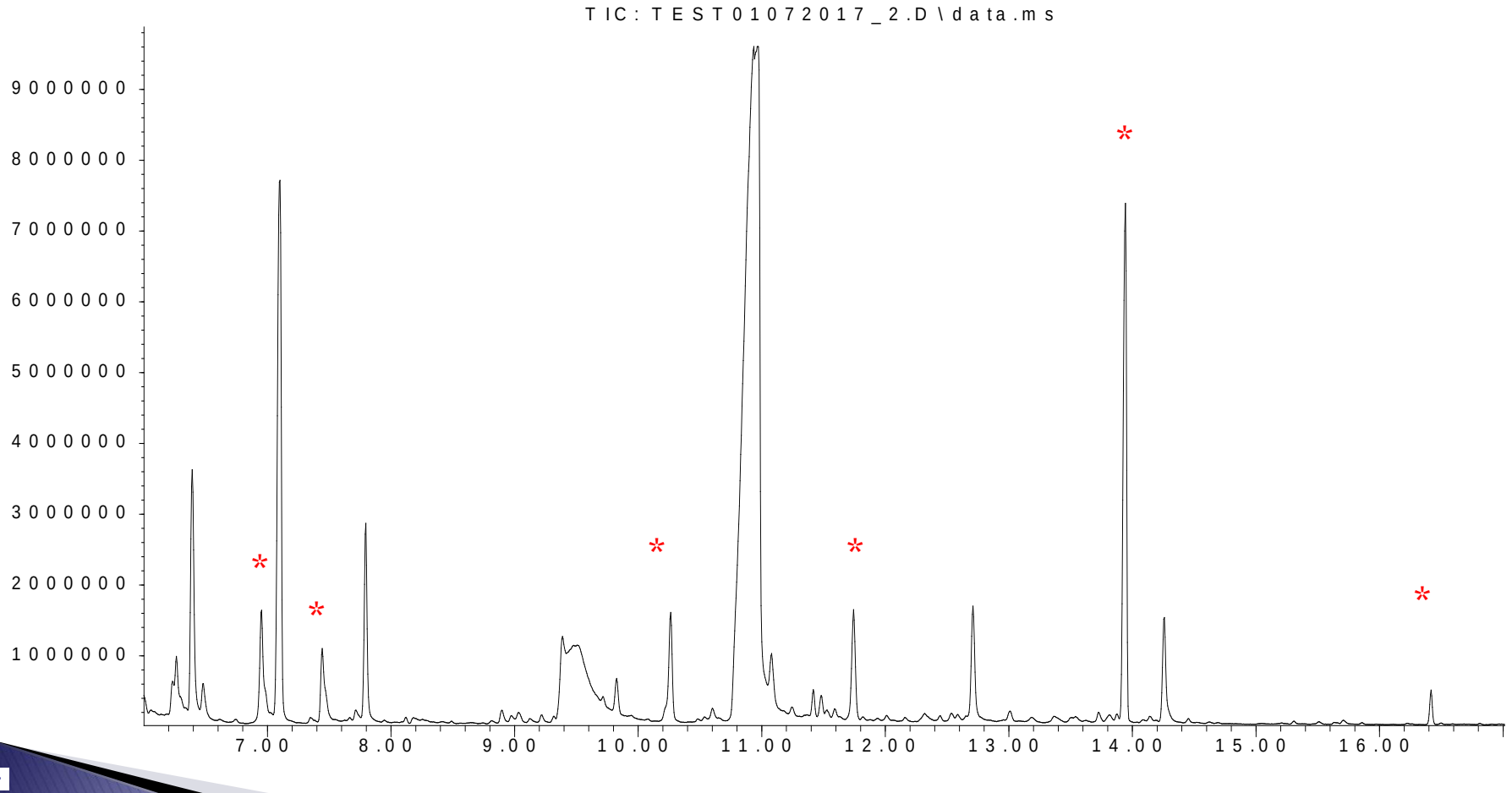
Step 1: Collect odor

- Passive collection
  - Headspace collection
- Active collection
  - Gauze or hair?

Step 1: Collect odor

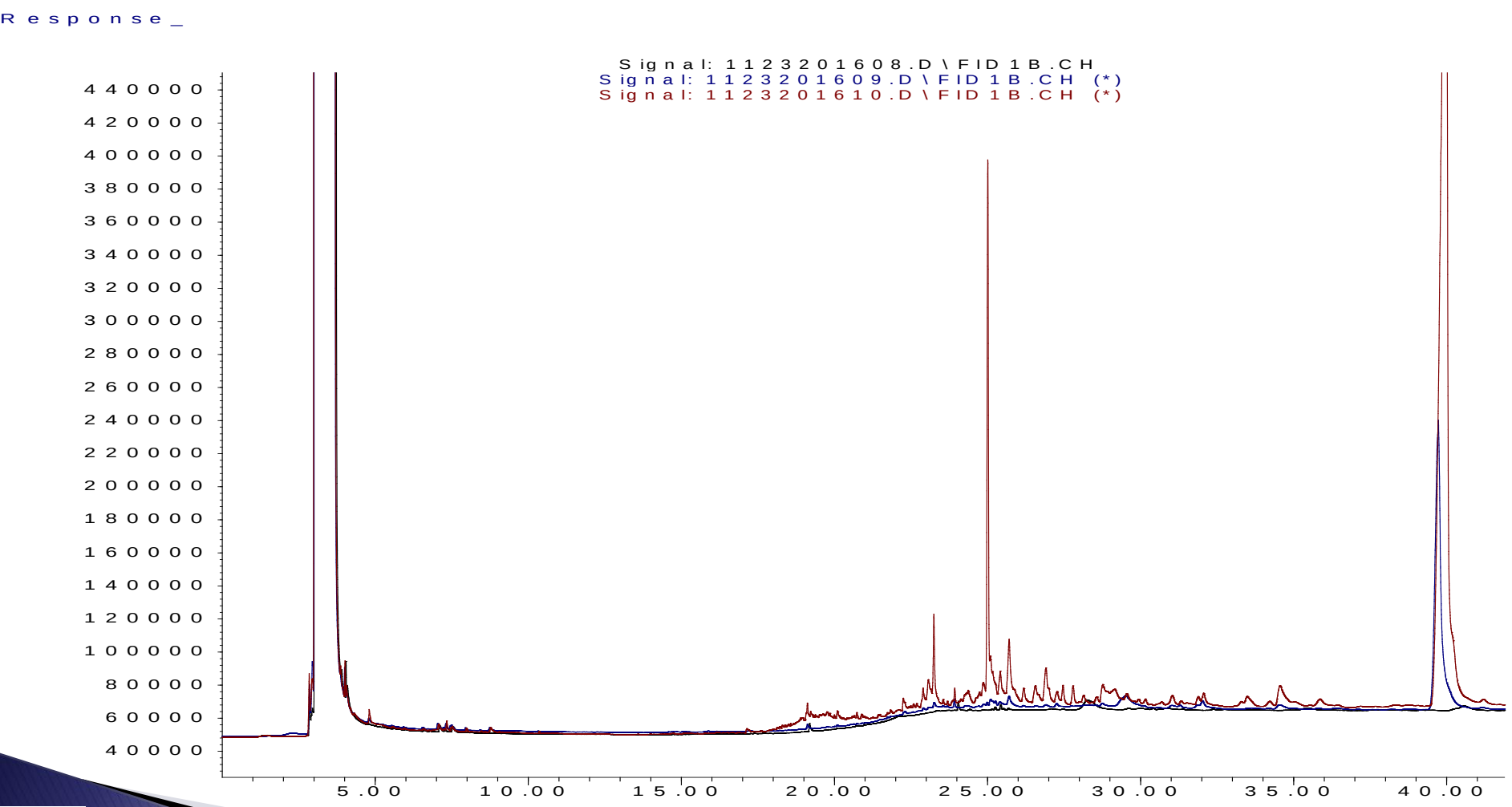
- Only WTD to date
- Passive collection – 6 animals
- Active collection – 50 animals
  - Males and females
  - Back and belly
  - Ranch and breeding pens
  - Off-ranch

Results: Step 1 – passive



* Deer specific chemicals

Results: Step 2 – active



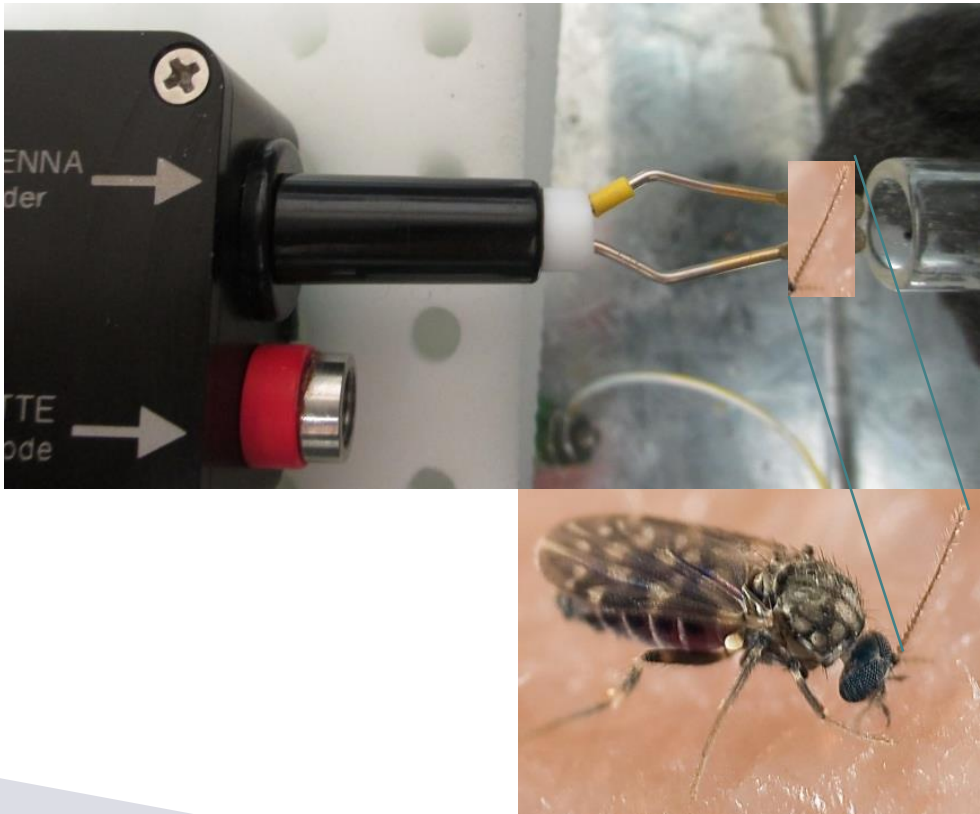
Conclusions

- Possible to collect deer-specific odor
- Passive sampling
  - Samples very dilute
  - Testing a new system – a belt-type device
- Active sampling
  - Gauze better than hair
  - Back has stronger odor than belly
  - Midges bite the belly!

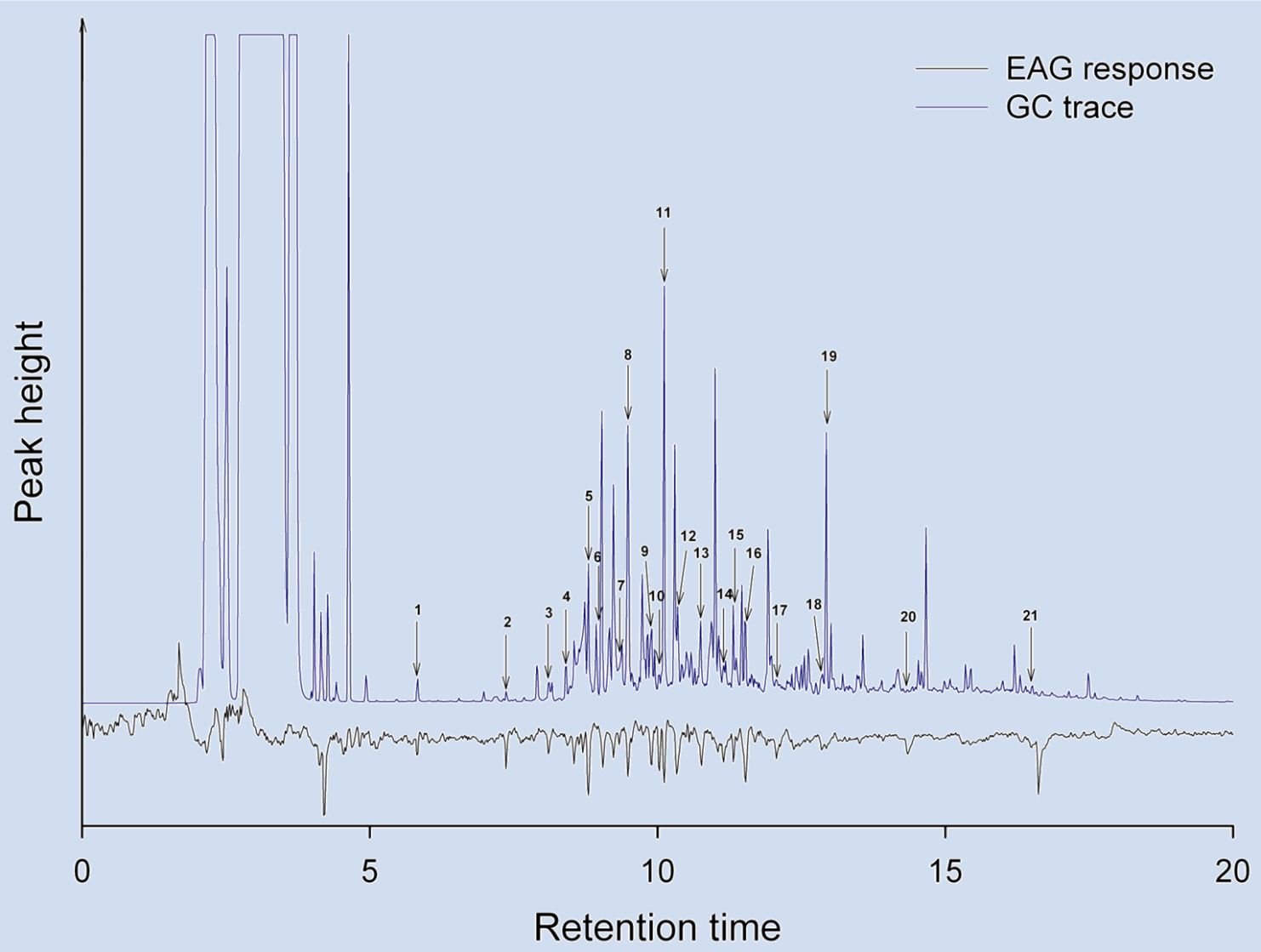
FUTURE WORK!

Step 2: Determine chemicals

- Solvent extracts
- Gas chromatography (GC)
- Electroantennography (EAG)
- Coupled GC-EAG

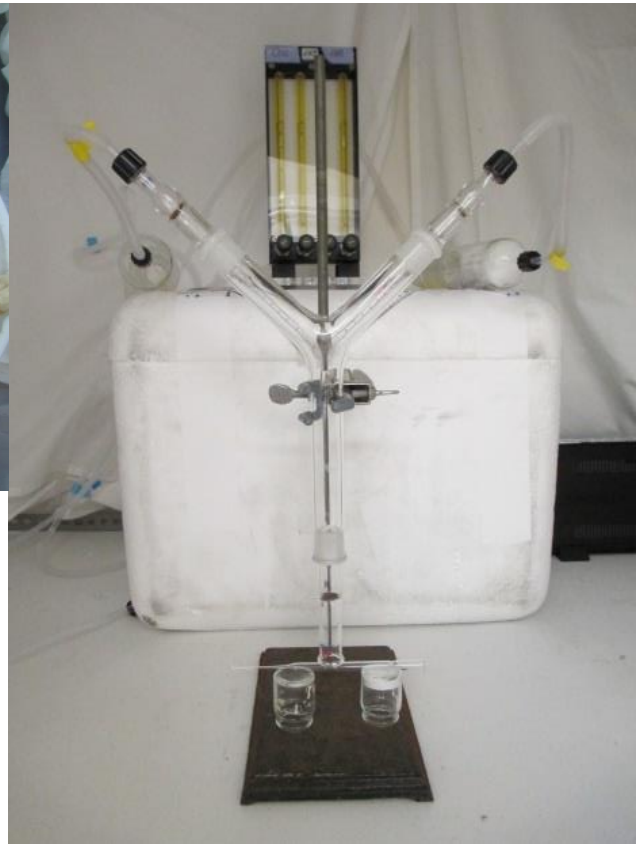


Step 2: Determine Chemicals



Step 3: Test chemicals in lab

- Behavioral bioassays
  - Feeding assay
  - Y-tube olfactometer



Step 4: Test chemicals in field

- Add to traps and measure differences in effectiveness
- Deer collars, tags?

Summary

- Deer specific volatiles are present and will be identified.
- Attractants could be incorporated into a trap for monitoring or population suppression.
- Repellents could be used in collars or tags to protect valuable animals.
- Push-pull system could reduce biting rate.
- Less biting will lead to less nuisance biting and less disease transmission.

Acknowledgments

- The CHeRI team!
- Nathan Burkett-Cadena, Bethany McGregor
- Katherine Sayler, Carisa Boyce, Morgan Walker
- Jason Blackburn and the off-ranch team
- Laura Harmon
- The deer and deer farmers of FL

UF | UNIVERSITY of FLORIDA

USDA ARS Agricultural Research Service CMAVE

UF | IFAS Research UNIVERSITY of FLORIDA

CHeRI

ANY QUESTIONS?

Emma Weeks
Email: eniweeks@ufl.edu