Effectiveness of Citizen Scientist Dog Teams in Detecting Spotted Lanternfly (*Lycorma delicatula*) Egg Masses

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Introduction

SLF egg masses on a fence post

- Spotted Lanternfly (SLF) is an invasive species to the US.
- SLF's target grape vines, apples, and hops – causing an estimated $324 million / yr in damaged crops[1]
- Nymph and Adult SLF's do not fly well but are excellent hitchhikers.
- The most effective way to mitigate its spread is to detect the egg masses and eradicate them.
- **The purpose of this study is to evaluate the effectiveness of citizen scientist dog teams to reach standardized detection criteria and how best to manage and deploy such teams in the future.**

Methods

- SLF egg masses were harvested, and freeze-killed in a $-80^{\circ}F$ freezer.
- Training aids provided to teams were created out of fine mesh to contain the eggs.
- Limits of olfaction were studied at Texas Tech[2]
- Handler teams were recruited from around the US, those with prior nose-work experience were initially selected.
- Teams were geographically grouped under 1 trainer - lead. The lead monitored and assisted with training. No specific guidance or direction was given on methodology of training.
- The teams were evaluated with an odor recognition test (ORT), a field test (FE) then a deployment test over a period of 12-16 weeks.

½ g SLF eggs
5 cm
5 cm
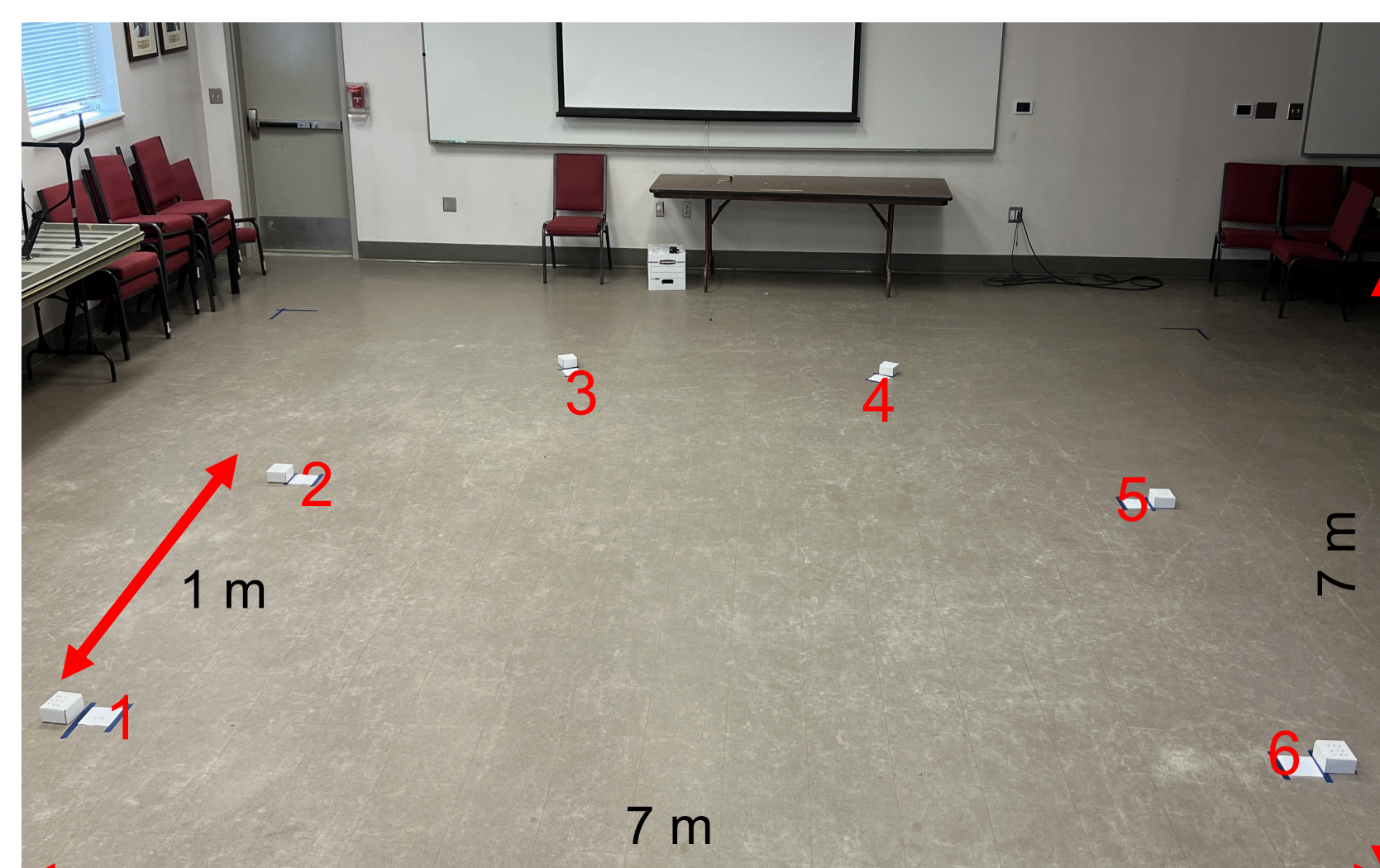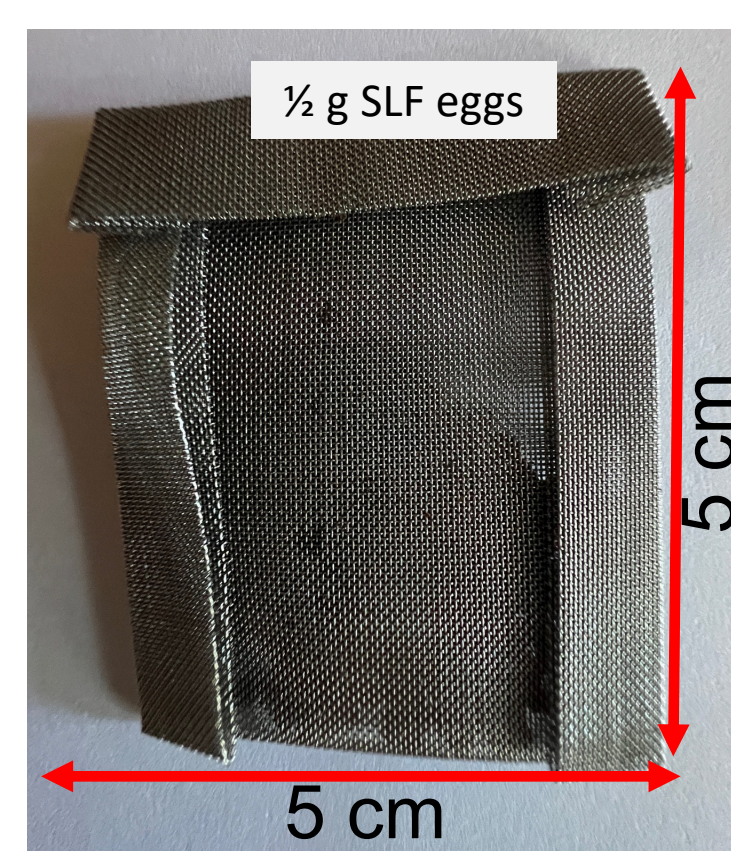
ORT Setup
- 10 trials
- Randomized odor positions
- 4 Version of odor positions
- 0 - 1 target odor
- 5 - 6 distracting odors
- 90 seconds per trial
- Must achieve 80%
- 3 opportunities
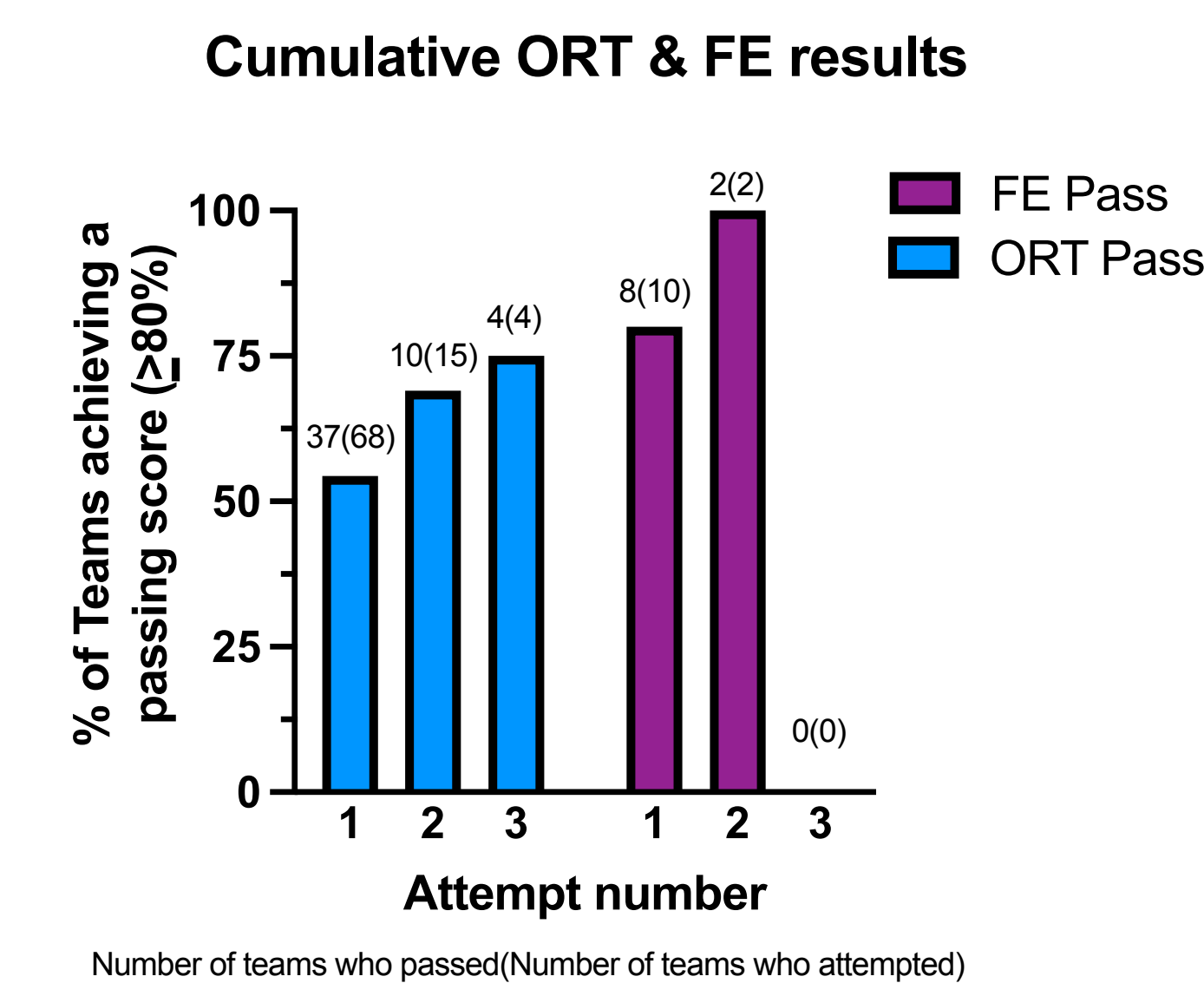
1 m
7 m
7 m
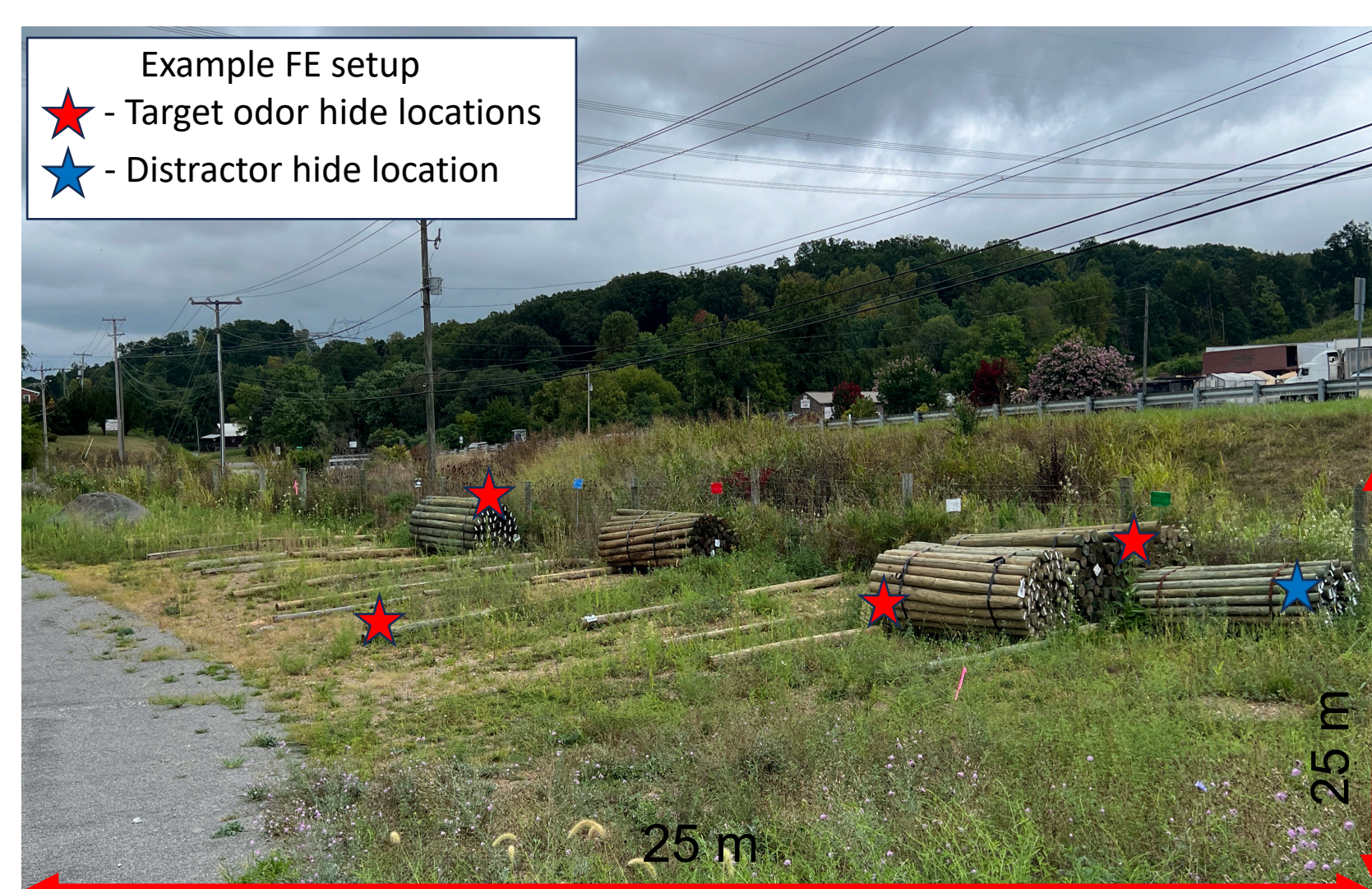
FE Setup
- 1 trail
- Lumber / shipping materials
- Randomized odor positions
- 3 – 5 target odors placed from ground level to 92 cm
- 1 placed distracting odor
- 300 seconds
- Must achieve 80%
- 3 opportunities

Example FE setup
★ - Target odor hide locations
★ - Distractor hide location

25 m
25 m

- Handlers completed 4 questionnaires & weekly training logs
  - Canine Behavioral Assessment & Research Questionnaire (CBARQ),
  - University of Lincoln Canine Frustration Questionnaire (CFQ),
  - University of Texas Canine Personality Questionnaire (CPQ)
  - Monash Dog Owner Relationship Scale (DORS)

Results

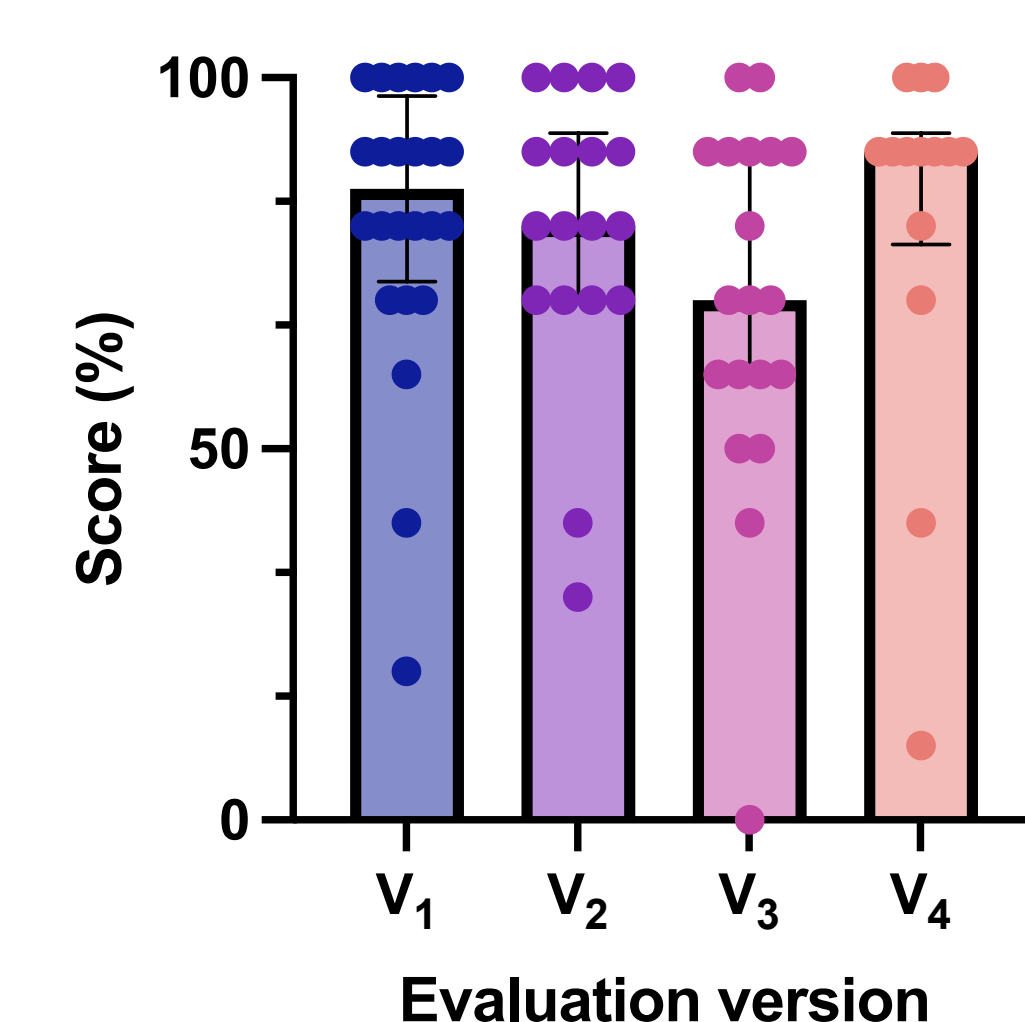### Study summary – May through October 2023

Initial call for participants - May 2023, via Social Media and a webinar.
998 interested parties have completed the application process.
91 teams initially began training between June and August, 8 teams withdrew after beginning training. An additional **130** will begin in October.

Cumulative ORT & FE results

- FE Pass
- ORT Pass

% of Teams achieving a passing score (≥80%)

37(68) 10(15) 4(4) | 8(10) 2(2) 0(0)
1 2 3 | 1 2 3
Attempt number

Number of teams who passed(Number of teams who attempted)

Study Map

Locations of the 13 groups in training
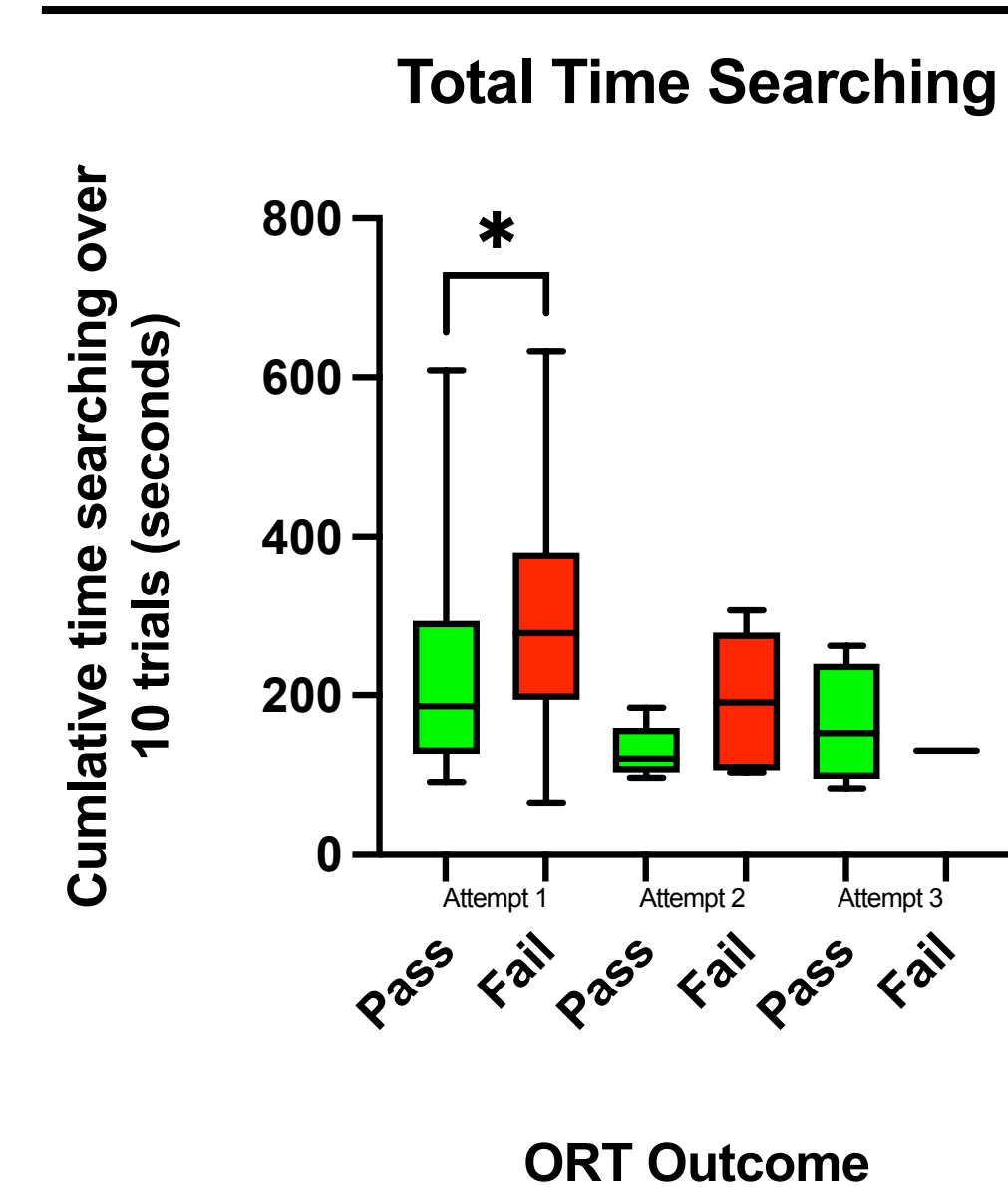Shaded areas are currently in the quarantine area

ORT Version comparison

- Teams are randomly assigned the version for odor placement
- Distracting odors – bark, grass, mesh, glove, empty box
- V_1-2 blank trials, V_2-2 blank trials, V_3-3 blank trials, V_4-1 blank trail
- A Kruskal-Wallis test was performed to evaluate if pass rates differed dependent upon ORT version used. T- statistic = 2.921, p = .4040,

ORT Evaluation version scores

Score (%)
V_1 V_2 V_3 V_4
Evaluation version

ORT Total time searching

Total Time Searching

Cumulative time searching over 10 trials (seconds)
Attempt1 Pass Fail | Attempt2 Pass Fail | Attempt3 Pass Fail

- 86 ORT's across all version
- Time recorded = cumulative 10 trials 'release to search' to handler called 'Alert'
- A Mann-Whitney test was performed to evaluate whether cumulative time searching differed with a pass or fail of the ORT. The results indicated that ORT_1, teams who failed, spent a significantly greater time searching than those who passed , p = . 00122

ORT Outcome

Predictive factors to ORT success

Variable	P value
β0	Intercept	0.5454
β1	Time searching	0.2013
β2	CBARQ train	0.1899
β3	CBARQ energy	0.7671
β4	CFQ overall	0.554
β5	DORS Owner relationship interaction	0.229
β6	DORS Percieved closeness	0.563
β7	DORS Percieved costs	0.2471
β8	Mean training time	0.9283
β9	DPQ Trainability	0.2751
β10	DPQ Controlability	0.4274

β0 β1 β2 β3 β4 β5 β6 β7 β8 β9 β10
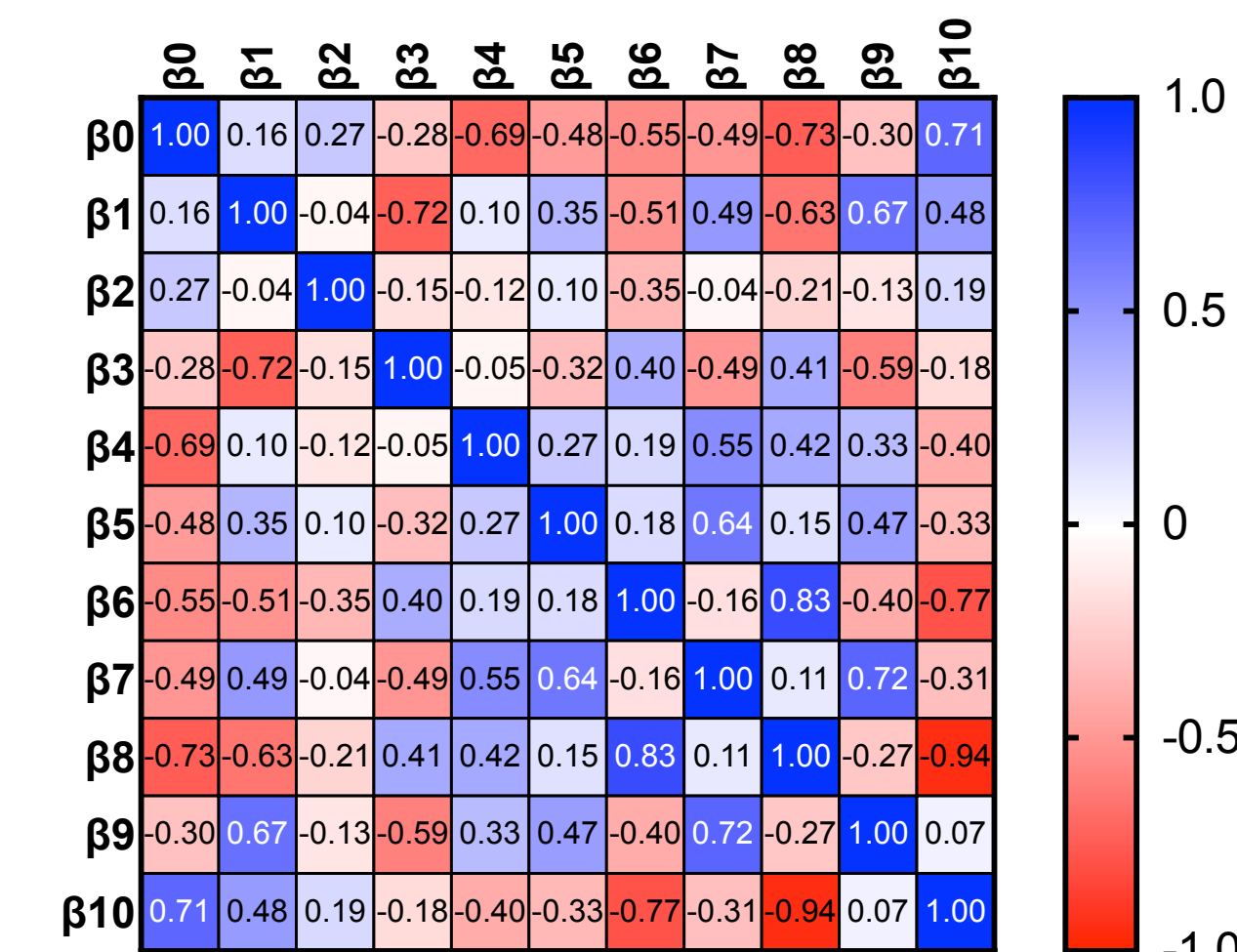
All data analysis is on an incomplete data set as the study is ongoing. Any evaluation not completed were excluded in this preliminary data set.
There are limited conclusion that can be drawn at this time.

Discussion

- This preliminary data set suggests that citizen science dog teams, when provided with a novel odor, can demonstrate a proficiency in detection capabilities in standardized blind odor recognition tests – of the 68 attempted ORT's 49 teams have passed (72%) and of the 10 attempted FE's, 10 have passed.
- Within ORT attempt #1, across all versions, 580 trials were completed. Of those, 461 had SLF odor (hot trials) and 119 had no SLF odor (blank trials). 85 of the 461 or 18% of the hot trials were failed. 53 of the 119 or 45% of the blank trials were failed.
- There does not appear to be a specific canine trait or personality type identified through the questionnaires that significantly predicts ORT success within this population of dogs already proficient at scent detection.
- Total time searching does appear to predict success, although it is unclear if this is due to accuracy of the dog in detecting, handler misinterpretation of dog behavior or handler influence on the dog behavior within the ORT.

Remaining questions

- How effectively will the dogs transition to live eggs?
- What are the factors affecting the team's ability to determine a blank trial?
- Are there human personality predictors to success in detection work?
- Are naïve dogs able to be trained to this standard?
- What are the mechanisms needed to administer this program long term with this and other invasive species.

References

1 *Spotted Lanternfly*. USDA APHIS | Spotted Lanternfly. (n.d.). https://www.aphis.usda.gov/aphis/resources/pests-diseases/hungry-pests/the-threat/spotted-lanternfly/spotted-lanternfly

2 Aviles-Rosa, E. O., Nita, M., Feuerbacher, E., & Hall, N. J. (2023). An evaluation of spotted lanternfly (*Lycorma delicatula*) detection dog training and performance. *Applied Animal Behaviour Science*, *258*, 105816. https://doi.org/10.1016/j.applanim.2022.105816

Acknowledgements