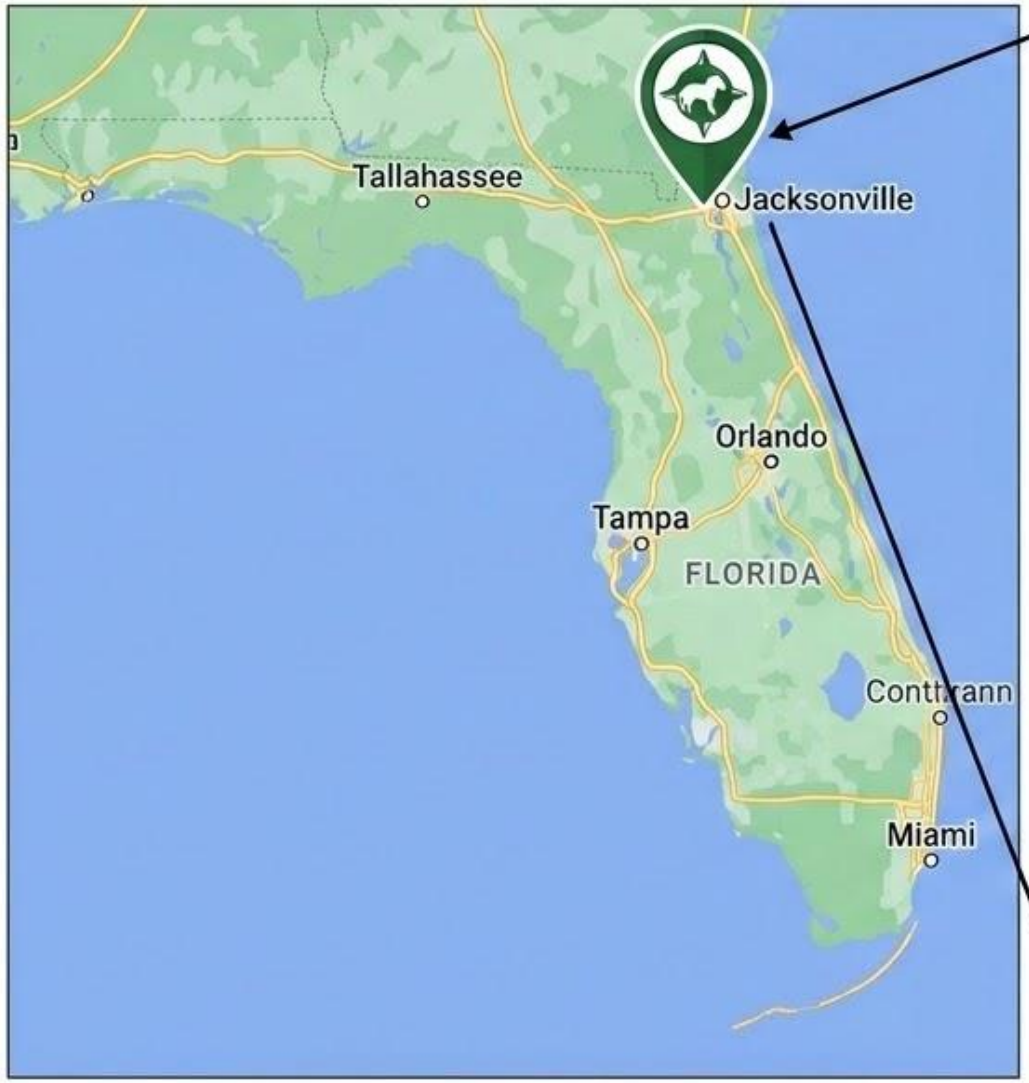
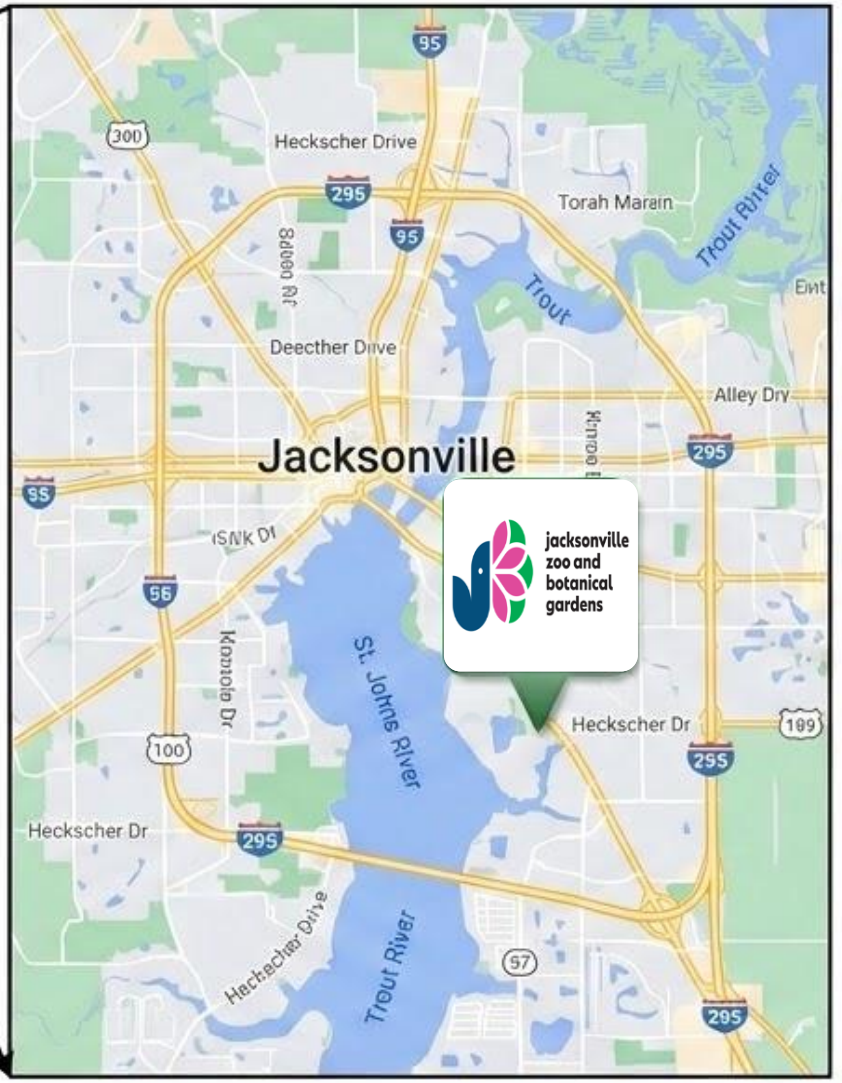
In2Care Usage in a Zoo Environment

Caroline Efstathion Card, PhD.

JACKSONVILLE ZOO AND GARDENS: LOCATION





jacksonville zoo and botanical gardens

LOCATION FEATURES

1. SITUATED IN NORTH FLORIDA
2. NEAR ST. JOHNS RIVER & TROUT RIVER
3. ACCESSIIBLE VIA I-95 & HEKSCHER DRIVE



Unique Mosquito Risks & Operational Challenges in Zoo Environments

- Sensitive species at risk: birds, hoofstock, primates, non-natives collections
- Threat of WNV, EEE, Dengue, and avian malaria
- High need for keeper and visitor protection/comfort
- Mosquito surveillance is often nonexistent or minimal
- Zoos have a fear of using chemicals near animals
- Larviciding is difficult due to water features, animal exhibit access, and time and education constraints
- Staff often have limited time, training, or interest in mosquito management



Why In2Care for Zoos?

- Provides targeted, low-chemical, low-visibility mosquito control
- Safe around sensitive species and public areas
- Requires minimal staff involvement
- Auto-dissemination reaches breeding sites staff cannot access
- Reduces both larval and adult mosquito pressure across complex zoo habitats
- Pest control can maintain traps rather than staff



In2Care® Mosquito Trap

Easy to use	Novel	Effective
User-friendly design, no power source needed, easy to assemble and maintain	A multi-impact mosquito control tool that uses mosquitoes to spread larvicides	Scientific field data shows effective kill of *Aedes* larvae & mosquitoes

- Larvicide auto-dissemination trap
- Designed for *Aedes aegypti* & *Ae. albopictus*
- Shown to be attractive to *Culex quinqs*
- Pyriproxyfen is the larvicide
- *Beauveria bassina*- fungus kills adults

- 10 traps per acre are recommended
- Refill every 4 weeks
- Top off at regular intervals



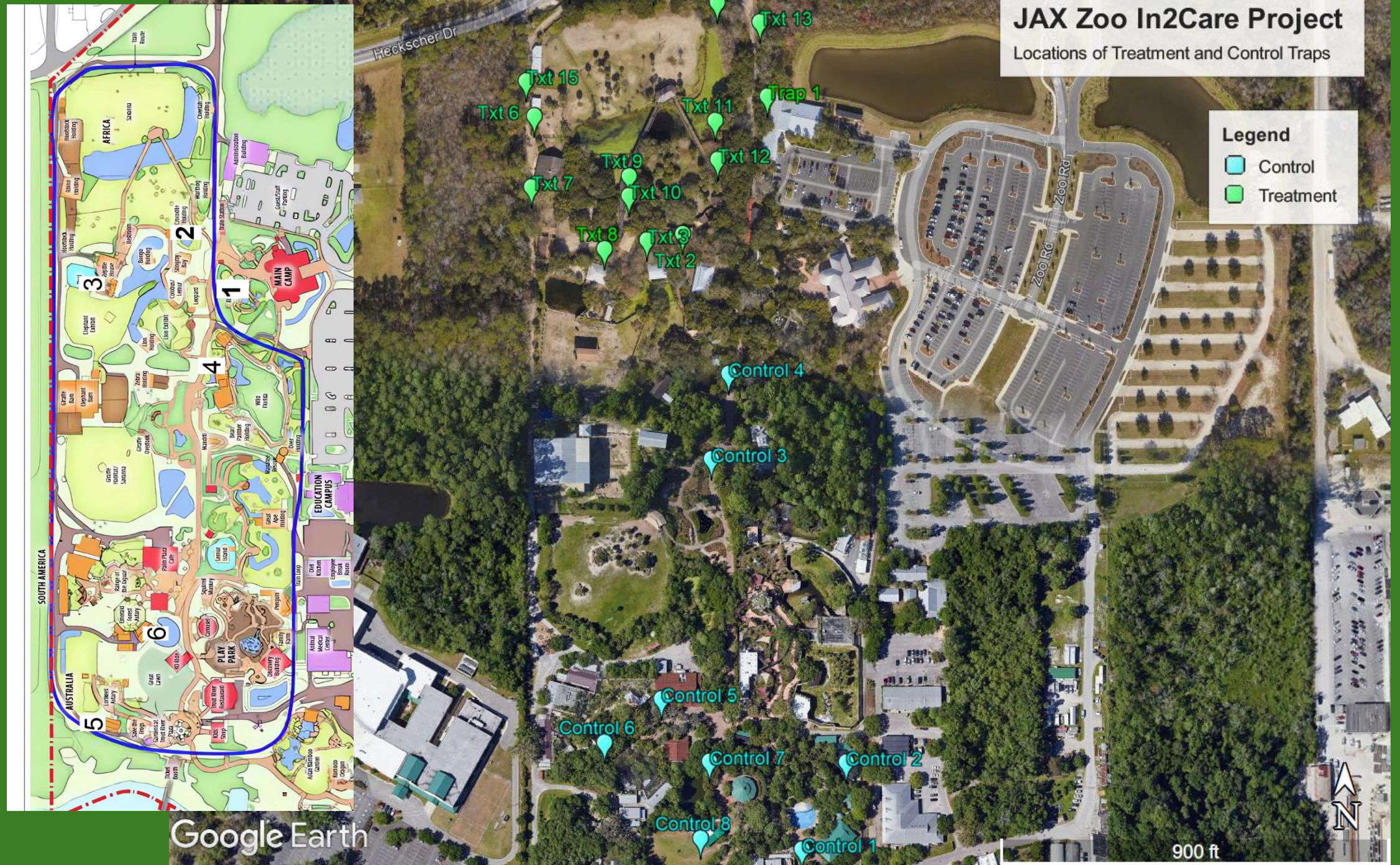

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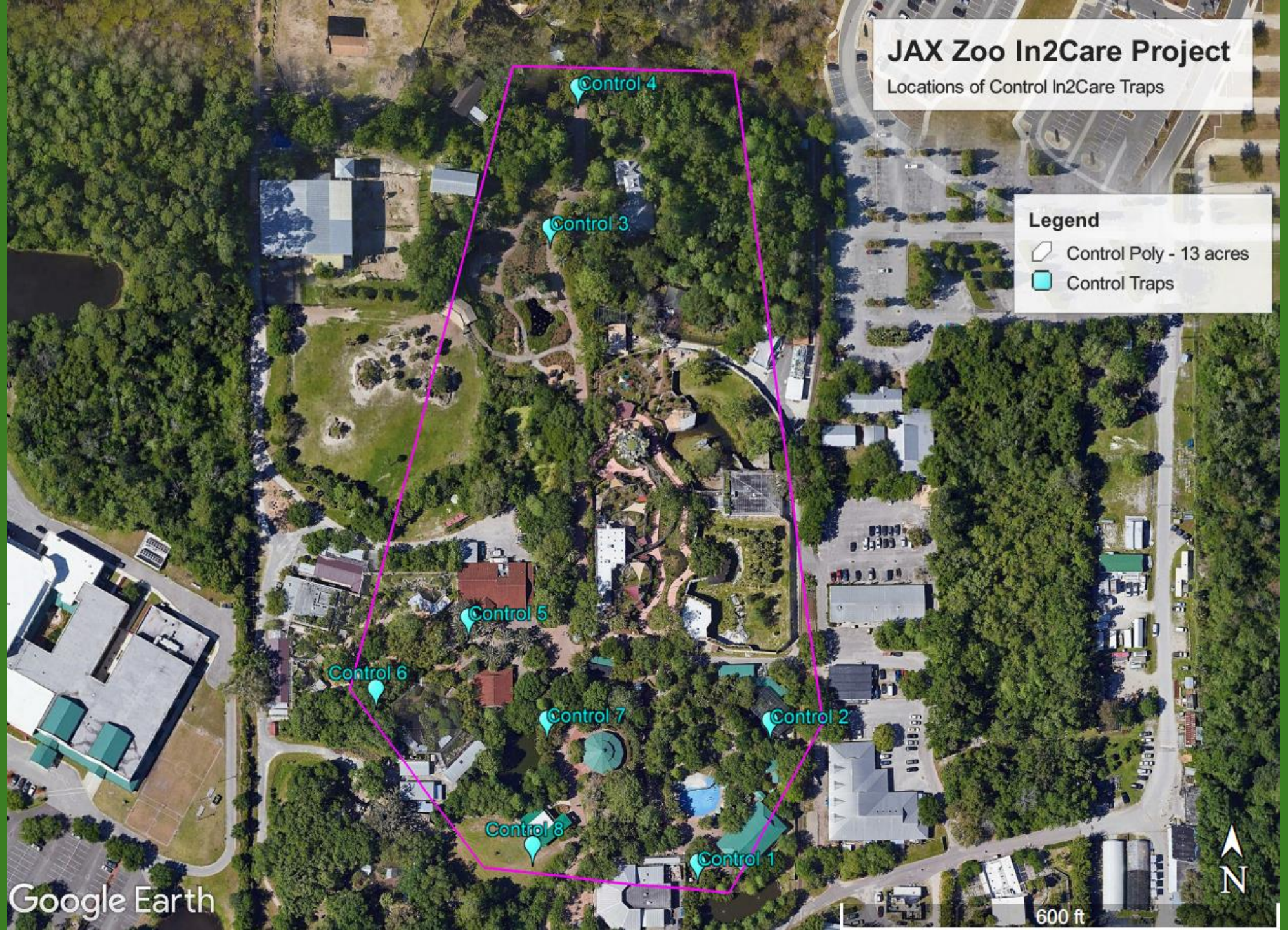

EXISTING ZOO
LEGEND
Visitor Path
Visitor Amenity Building
Holding Building
Admin/ Support Building
Animal Exhibit
Playground
Service
Parking
Off Exhibit Yard
Vegetated Buffer
Jurisdictional Wetland
Conservation Easement Wetland
Habitat Pond
Storm Water Treatment Pond
SOUTH AMERICA
AUSTRALIA
AFRICA
ASIA
PLAY PARK
EDUCATION CAMPUS
MAIN CAMP
1-River Valley Aviary
2-Greater Flamingo Exhibit
3-Elephant Plaza Aviary
4-Alligator Exhibit
5-RES1 Bird Holding
6-Caribbean Flamingo Exhibit
EXISTING ZOO SITE
± 120 ACRES
1 Acre

Project Design and Methodology



- 33 traps total
  - 15 on the treatment side
  - 8 on the control side
- Reset every 4-5 weeks
- Site Selection
  - Prioritized animal exhibits with known susceptibility to mosquito-borne diseases
  - Hidden from visitors
  - Placed near breeding-prone habitats (shade, vegetation, water features)
  - Zoo reality: traps cannot be placed inside exhibits, so uniform coverage is not possible
    - Placement must be optimized around these constraints


JAX Zoo In2Care Project
Locations of Treatment and Control Traps
Legend
Control
Treatment
Heckscher Dr
Zoo Rd
Txt 14
Txt 5
Txt 4
Txt 13
Txt 15
Txt 6
Txt 11
Trap 1
Txt 9
Txt 12
Txt 7
Txt 10
Txt 8
Txt 3
Txt 2
Control 4
Control 3
Control 5
Control 6
Control 7
Control 2
Control 8
Control 1
AFRICA
MAIN CAMP
EDUCATION CAMPUS
PLAY PARK
SOUTH AMERICA
AUSTRALIA
1
2
3
4
5
6
N
900 ft
Google Earth


JAX Zoo In2Care Project
Locations of Control In2Care Traps
Legend
Control Poly - 13 acres
Control Traps
Control 4
Control 3
Control 5
Control 6
Control 7
Control 2
Control 8
Control 1
Google Earth
600 ft
N


JAX Zoo In2Care Project
Locations of Treatment In2Care Traps
Legend
Treatment Poly - 7.5 Acres
Txt
Txt 14
Txt 5
Txt 4
Txt 13
Txt 15
Txt 1
Txt 6
Txt 11
Txt 12
Txt 9
Txt 7
Txt 10
Txt 8
Txt 3
Txt 2
N
300 ft
Google Earth

Monitoring and Data Collection

- Checked traps every 4-5 weeks from April to October
- Collected a 100 ml water sample from each trap and counted larvae present
- Treatment traps: reset mesh, added a new tablet, refilled or topped off water
- Control traps: topped off water only when needed
- Recorded adult mosquito activity (landing rates, resting adults, emerging)
- Compared monthly average larvae counts between treatment and control traps



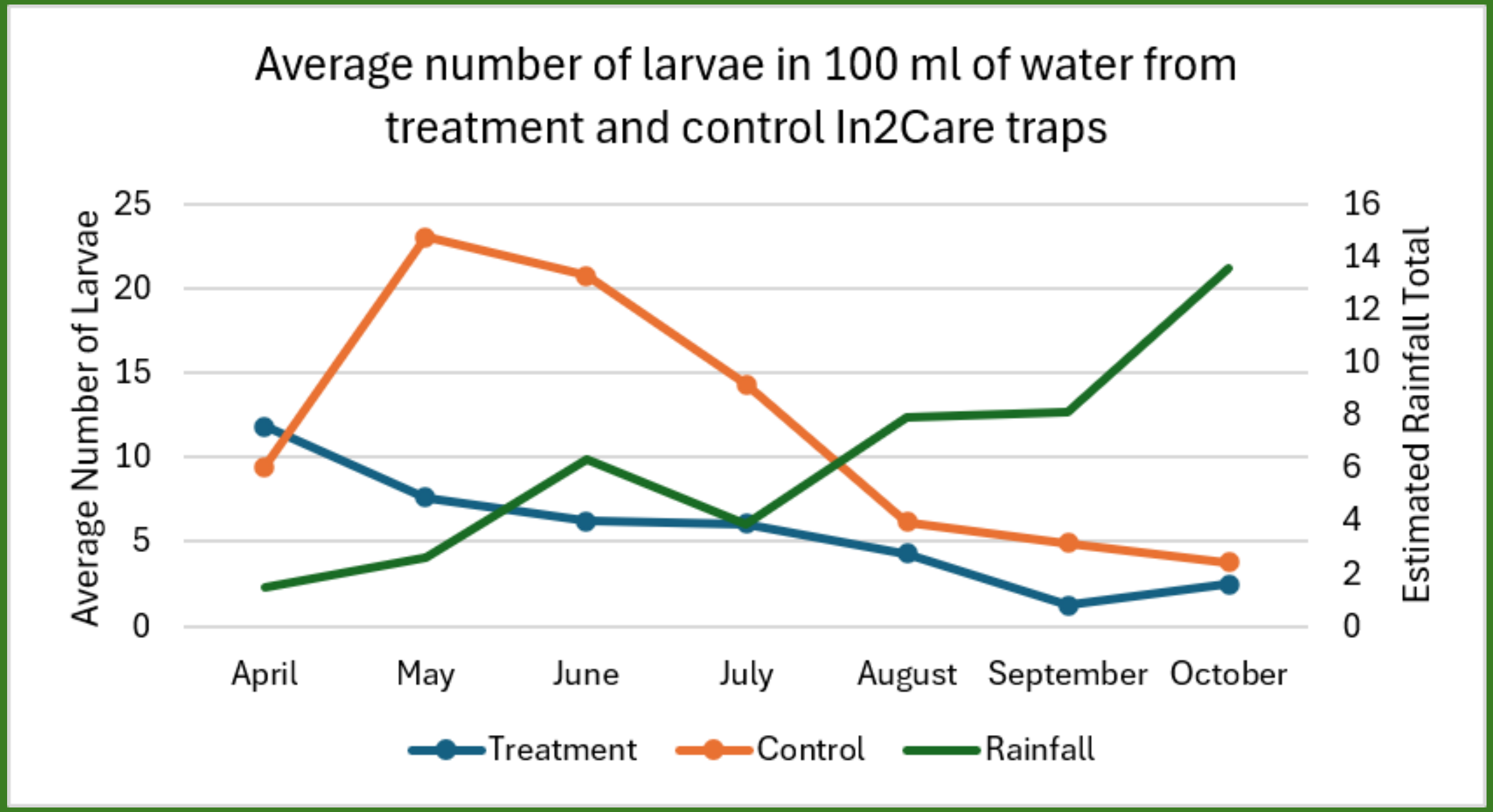


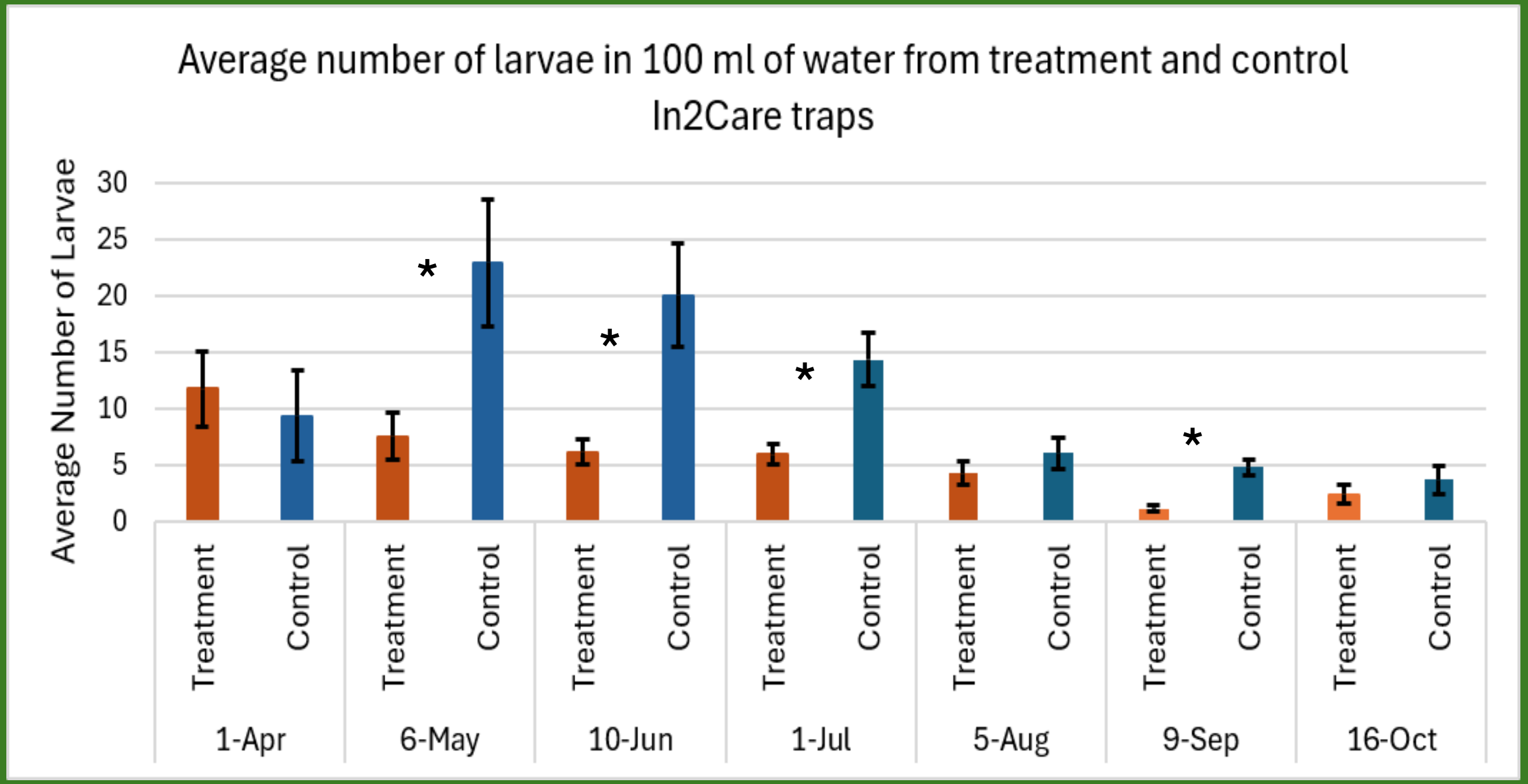


Statistical Analysis

- Differences between treatments were evaluated using a Mann–Whitney U test for comparisons
- Statistical significance was set at $\alpha = 0.05$




Average number of larvae in 100 ml of water from treatment and control In2Care traps
Average Number of Larvae
25
20
15
10
5
0
16
14
12
10
8
6
4
2
0
Estimated Rainfall Total
April
May
June
July
August
September
October
Treatment
Control
Rainfall



* Significant P≤ 0.05 Mann-Whitney U Test

In Conclusion

- The treatment zone consistently showed significantly lower larval counts compared to the control zone.
  - The exceptions are August & September
  - Highest rainfall
  - Increased oviposition sites outside of traps
- Overall, the pattern indicates that the In2Care system is producing a measurable and sustained reduction in mosquito larvae throughout the season.
- The goal of this project is not complete elimination of target vectors, but a meaningful reduction in mosquito pressure to lower the risk of mosquito-borne disease transmission to zoo animals, staff and visitors.



Next Steps

- The project remains ongoing, with additional months of larval surveillance to be collected.
- As the study concludes, additional data (adult trap counts, weather trends, and WNV activity) will further strengthen our understanding of seasonal mosquito dynamics and the long-term value of integrated control tools like In2Care.
- Run a Generalized Linear Model (GLM) to evaluate treatment impact while controlling for environmental variables.
- Proposed model structure: Larval count ~ treatment + rainfall + temperature + month.
- Prepare a full technical write-up.
- Develop a standardized In2Care Protocol for other zoos and wildlife facilities.



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