LeadingEdge

Bringing Technology and Science Together

Full Scale Operational Deployment of Unmanned Aircraft Systems for Multispectral Imagery, LiDAR, and Aerial Applications

Presented by: Bill Reynolds
Leading Edge Aerial Technologies, Inc.

Real World Operational Uses

Herbicide - Invasive Aquatic Weeds –
St. Johns River Water Management District, FL

Pheromone
Vineyard Management - Napa County, CA

LiDAR, Multispectral Imagery, Aerial Applications –
California State Parks

Herbicide
Invasive Weed
Solano
Invasive Weed and Right of Way Encroachment - Bartow, FL

Vector Control
Seminole County, Fl

TOPICS

Key Advantages of Unmanned Aircraft Systems (UAS)

PrecisionVision® Unmanned Aircraft PV35X and PV40X

Calibrating and Characterizing UAS for Aerial Applications

Key Advantages of UAS for Aerial Applications

Enhanced Safety for Ground Crews

Efficacy / Precision Applications

Accessibility

Efficiency

Environmental Footprint
Endangered Species, Sensitive Terrain, Fuel

LeadingEdge

PrecisionVision® Aircraft 40X & 35X

LeadingEdge

PrecisionVision® 35X UAS

Fully autonomous or manual flight modes
Flight plans created in the field or in any GIS system
Three payload systems (liquid, granular, ULV)
Payload weight capacity 25 pounds
Typical acres treated per minute 0.3 – 0.5
Many safeguards, low battery, lost link, spray override, obstruction avoidance, battery failsafe, GCS failsafe

LeadingEdge

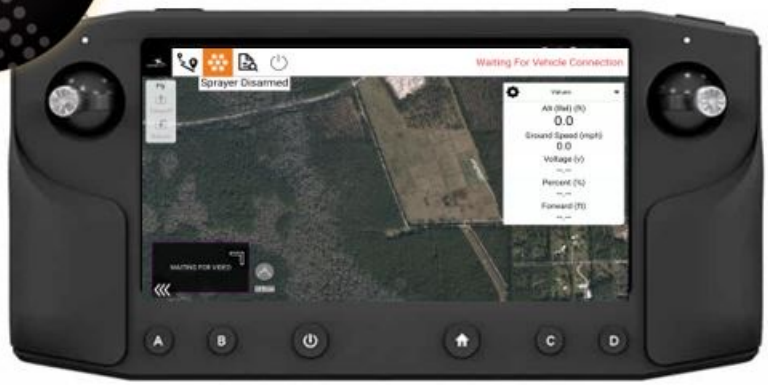
PrecisionVision® 40X UAS

Fully autonomous or manual flight modes
Flight plans created in the field or in any GIS system
Three payload systems, liquid, granular and ULV
Payload weight capacity 40 pounds
Typical acres treated per minute 0.5 - 0.7 liquid, 1.5-3 acres/min granule
Many safeguards, low battery, lost link, spray override, obstruction avoidance, battery failsafe, GCS failsafe

LeadingEdge

PrecisionVision Ground Control Station

- Pre-flight checks
- Flight planning
  - Points, path, polygon
- Treatment polygons
  - Import shapefiles
  - Save flight plans
- Application rates
  - Reside in material database
  - Swath
  - Speed
  - Application rate
  - Total spray time
- Material selection database
- Post-treatment log files
  - Shapefiles
    - Points
    - Swath



LeadingEdge

Real World Operational Uses of Drones

Noxious & Aquatic Weeds

LeadingEdge

Aquatic herbicide applications

St Johns River Water Management District-Brevard County, Florida

- Canal 90 ft x 4,800 ft
- Large trees line both sides
- UAS swath 16-20 ft
- Near residential area (noise, drift considerations)
- Target: Hydrilla, Water Lettuce, Crested Floating Heart

Why UAS? Relatively small acres, sensitive habitat, residential encroachment, affordable

Time savings 3-4 hours vs. two employees, airboat, loud, near neighborhood and 8-10 hr. day

Aquatic herbicide applications

St Johns River Water Management District-Brevard County, Florida

LeadingEdge

Aquatic herbicide applications Birds and Safety

St Johns River Water Management District-Brevard County, Florida

LeadingEdge

Real World Operational Uses of Drones

Pheromone Applications

LeadingEdge

Pheromone applications

Napa Valley, California 2022 Vine Mealybug

- Damage by the vine mealybug is like that of other grape-infesting mealybugs in that it produces honeydew that drops onto the branches and other vine parts and serves as a substrate for black sooty mold
- Biological control
- Organic methods

- Mating disruption – applying Checkmate Dry Flowable, one ounce to the acre, as applied at 3 GPA

* Checkmate is a product of Suterra, Inc. https://www.suterra.com/

Pheromone applications

Napa Valley, California 2022 Vine mealybug application of Suterra Checkmate DF

LeadingEdge

Pheromone applications Terrain Following Radar

Napa Valley, California 2022 Vine mealybug application of Suterra Checkmate DF

LeadingEdge

Real World Operational Uses of Drones; Imagery, Lidar, Aerial Applications

Noxious Weeds, California

LeadingEdge

Lidar Multispectral Imagery and Applications

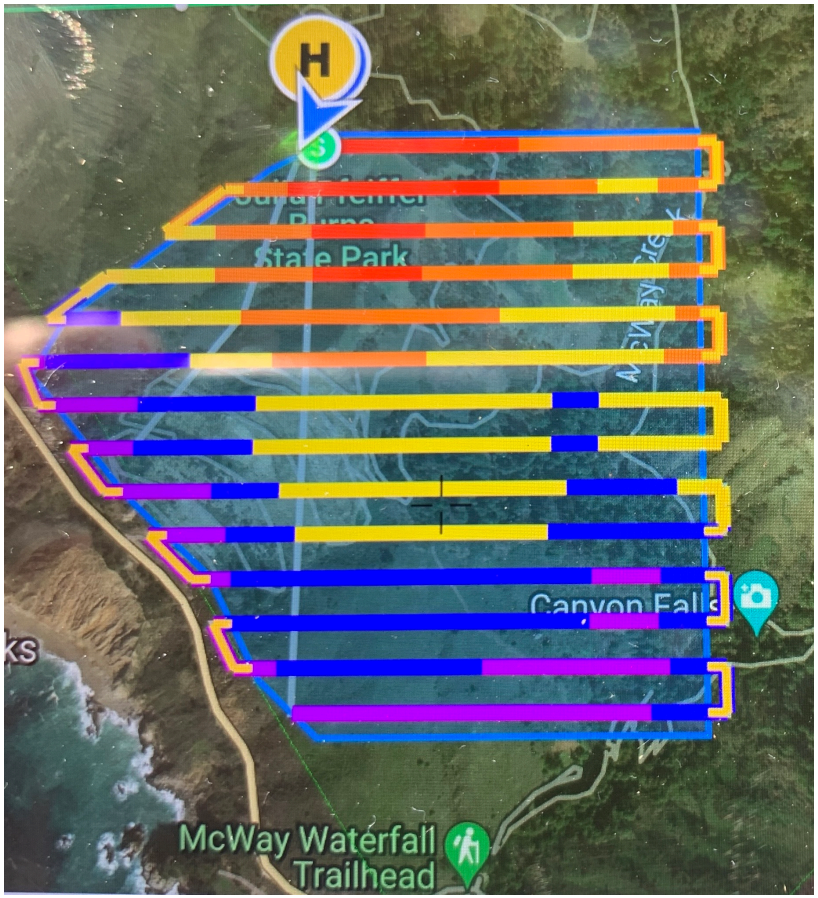
Invasive weed – Cortaderia jubata (Jubatagrass)

- After the 2020 fires in Big Sur, Julia Pfeiffer and Limekiln State Parks, Jubatagrass established itself along the coast
- 2022 Deployed Multispectral and LiDAR UAS services to identify the exact locations (3cm accuracy using RTK) of the Jubatagrass
- Spring of 2023 UAS aerial applications begin

LeadingEdge

Herbicide applications – Invasive Species

California Parks, Big Sur, California; Imagery & LiDAR flight planning



Herbicide applications – Invasive Species

California Parks, Big Sur, California; First target Jubadagrass

LeadingEdge

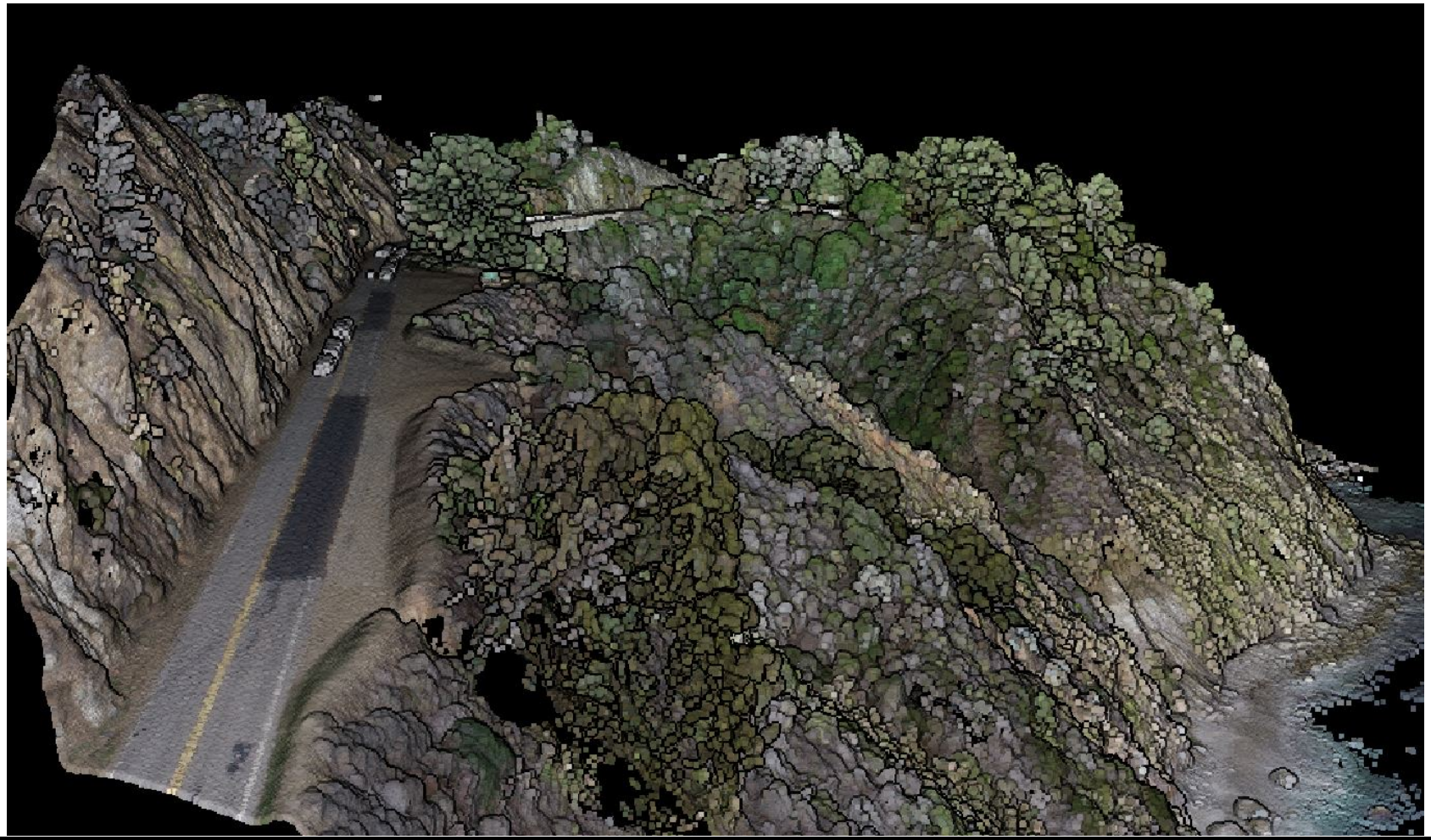
Herbicide applications – Invasive Species

California Parks, Big Sur, Ca.; First target Jubadagrass – only 1/3rd of park 943

LeadingEdge

Herbicide applications – Invasive Species

California Parks, Big Sur, California; First target Jubadagrass



LeadingEdge

Herbicide applications – Invasive Species

California Parks, Big Sur, California; First target Jubadagrass

LeadingEdge

Herbicide applications – Invasive Species

Solano Resource Conservation District, Solano, Ca.

Vision and Mission Statement

“Improve programs and services to provide the Suisun Marsh land-owners technical assistance in environmental permitting, habitat management, water control, and funding to ensure the wetland and wildlife values of the Suisun Marsh are sustained and enhanced”

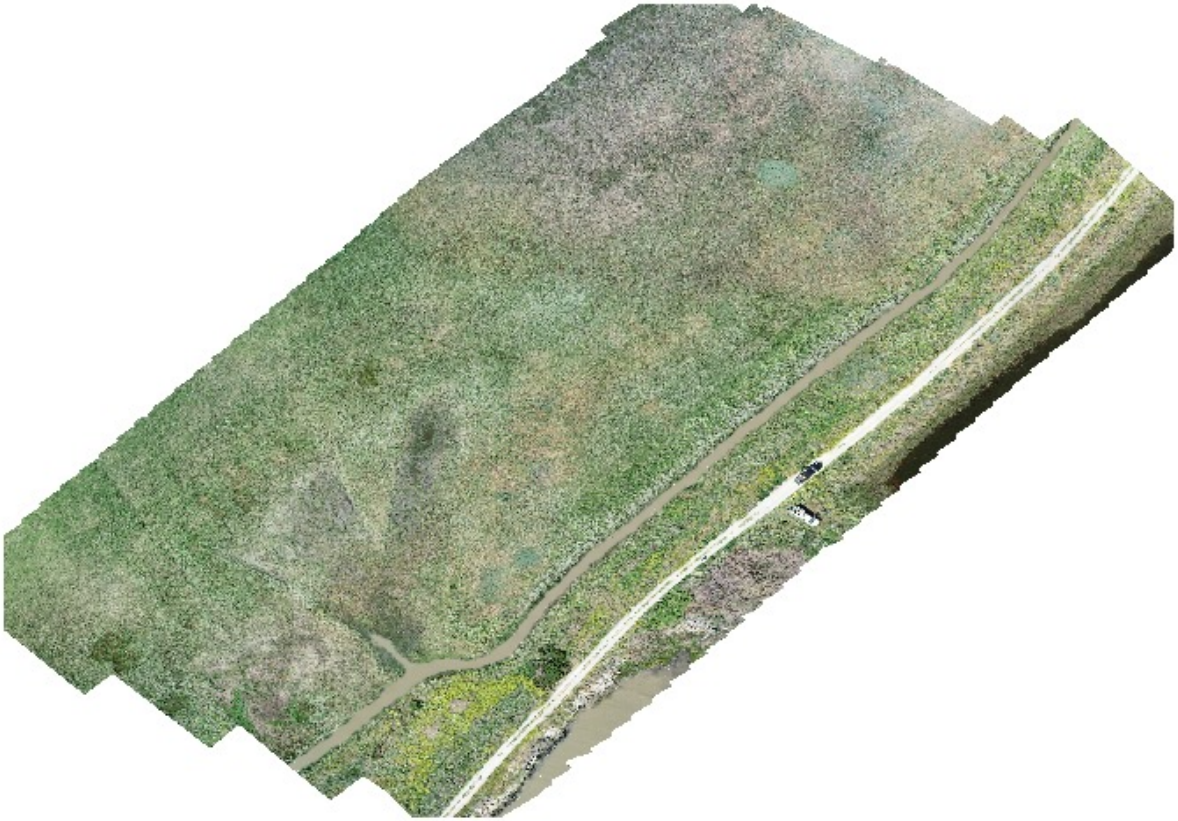
Invasive weeds:

Phragmites
Lepidium

LeadingEdge

Herbicide applications – Invasive Species

Solano Resource Conservation District, Solano, Ca.



LeadingEdge

Herbicide applications – Invasive Species

Solano Resource Conservation District, Solano, Ca.

LeadingEdge

Herbicide applications – Invasive Species

Solano Resource Conservation District, Solano, Ca.

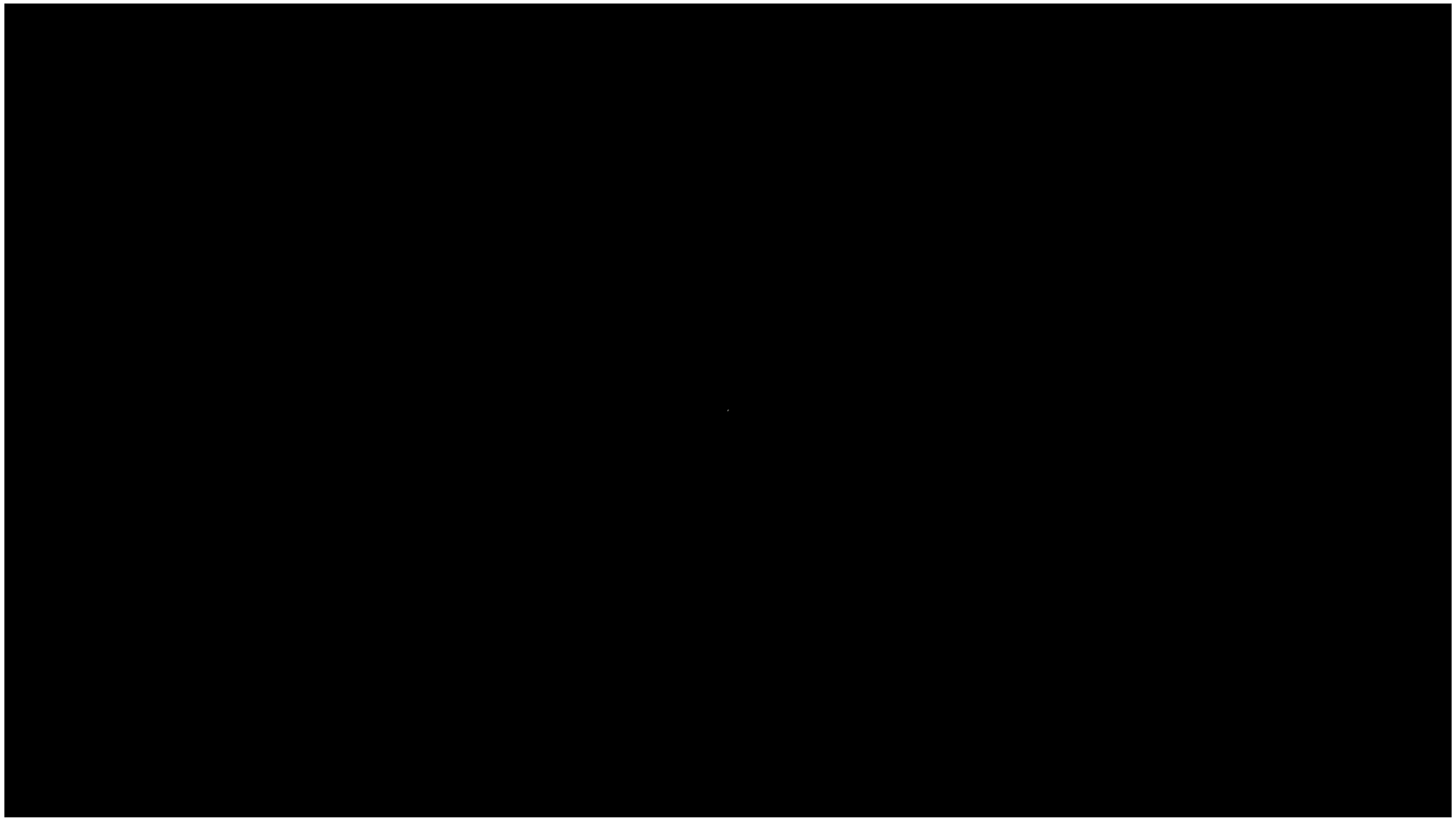
Real World Operational Uses of Drones; Precision Spot Treatment Weeds

USDA, Virginia Tech, Mississippi State, Univ. of Nebraska

LeadingEdge

PrecisionVision sub-centimeter spot spraying

USDA College Station Texas and Virginia Tech



LeadingEdge

PrecisionVision sub-centimeter spot spraying

USDA College Station Texas and Virginia Tech

LeadingEdge

Real World Operational Uses of Drones

Mosquito Control

LeadingEdge

Product Labels

“Rotary Aircraft”

Some states are placing UAS under umbrella of “Rotary Aircraft”

"Unmanned Aircraft”

Product Example: Altosid SR-20

For aerial application to terrestrial sites, apply by fixed wing or rotary aircraft. Apply at the rate of ¾ – 1 fluid ounce of product to acre diluted with water at a minium of a 1:1 mix ratio with water. Apply using ULV equipped and capable aircraft. Unlike ULV sprays targeting flying mosquitoes, it is important that spray droplets deposit in targeted areas. Target terrestrial areas where mosquitoes breed. These sites include tires, open containers, garbage bins, birdbaths, and gutters holding small amounts of water. Spray equipment must be adjusted so that the volume median diameter (VMD) produced ranges from 60 microns ($Dv_{0.5}$ < 60μ) to 100 microns ($Dv_{0.5}$ < 100μ), and that 90% of the spray is contained in droplets smaller than 200 microns ($Dv_{0.9}$< 200μ). Directions from the equipment manufacturer or vendor, pesticide registrant, or test facility using a wind tunnel and laser-based measurement instrument must be used to adjust equipment to produce acceptable droplet size spectra. Application equipment must be calibrated annually to confirm that nozzle flow rate(s) are accurate. Do not apply at altitudes below 100 feet unless using unmanned aircraft designed for low application heights. Apply when wind speed on the ground is ≥ 1 mph and ≤ 10 mph. Apply when wind factors promoting drift are low. For best results, use Global Positioning System (GPS) equipped aircraft.

LeadingEdge

Florida

Mosquito Larvae

Aedes infimatus
Anopheles crucians
Culex nigripalpus
Psorophora ferox

Altosid P35

Applied at
7 lbs./acre

Why UAS?

- Relatively small acres
- Sensitive habitat
- Residential encroachment
- Affordable

LeadingEdge

FLORIDA

Seminole County Mosquito Control

Site Type: Woodland freshwater
Acres Treated: 389.00 acres

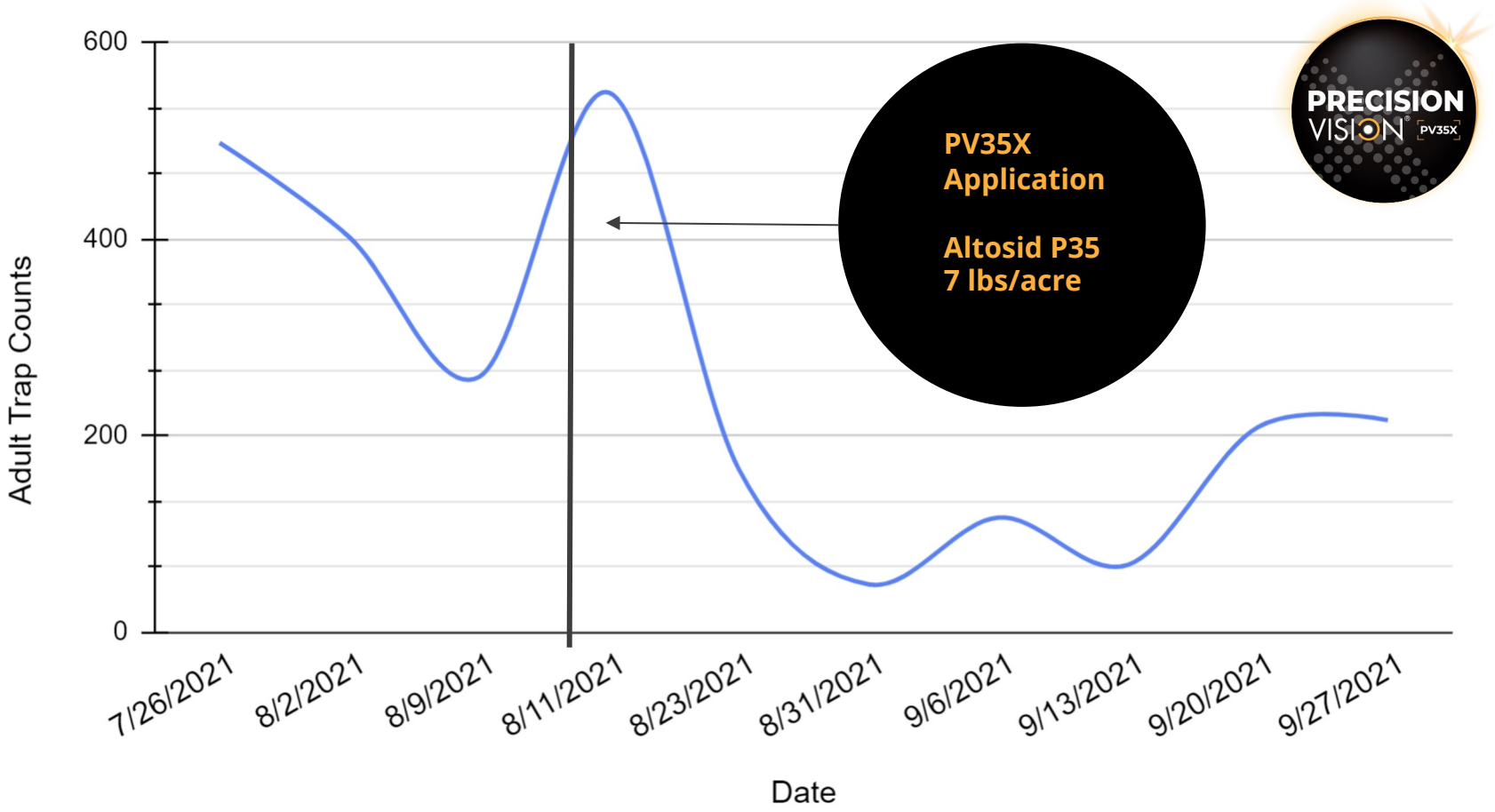
Application configurations:

PV35X, Granular Payload System
17 mph, Effective swath width 80’

Acres treated/minute: 2.75
Granular flow rate: 19.23 lbs./min

LeadingEdge

2021 Adult Mosquito Counts via CO2 Baited Trap Seminole County, FL



LeadingEdge

COLORADO Animas Co. Mosquito Control

Larviciding flooded pastures near Animas River

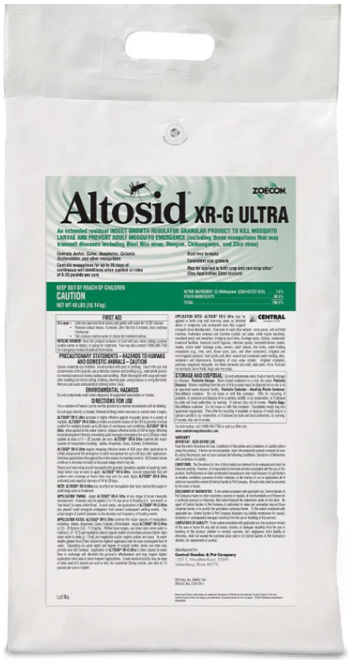
Larvicide and adulticide in corn fields

Delta MVCD

Larvicide Application

Mosquitoes

Culex tarsalis
Culex quinquefaciatus
Culex stigmatosoma



Altosid XRG Ultra

Applied at
10 lbs./acre

Why UAS?

- Needed to penetrate dense corn canopy
- Larval surveillance extremely difficult
- Residential habitat
- Affordable

LeadingEdge

LeadingEdge

Delta MVCD

Adulticide Application

Mosquitoes

Culex tarsalis
Culex quinquefaciatus
Culex stigmatosoma

Pyronyl™ 525 Concentrate

Pyronyl 525

Applied at
0.0025 lbs./acre
(0.8 oz/min)

Why UAS?

- Needed to penetrate dense corn canopy
- Residential habitat
- Affordable
- A manned contractor for aerial ULV has never been used by Delta

LeadingEdge

Delta MVCD
ULV application

Site Type: Corn fields

Acres Treated: Adulticide 160 & 82 acres

Application configurations:

- PV35X
- Micronair nozzles
- 75’ AGL release height @ 12 mph
- 300’ swath, 7.72 acres/min

Efficacy test:

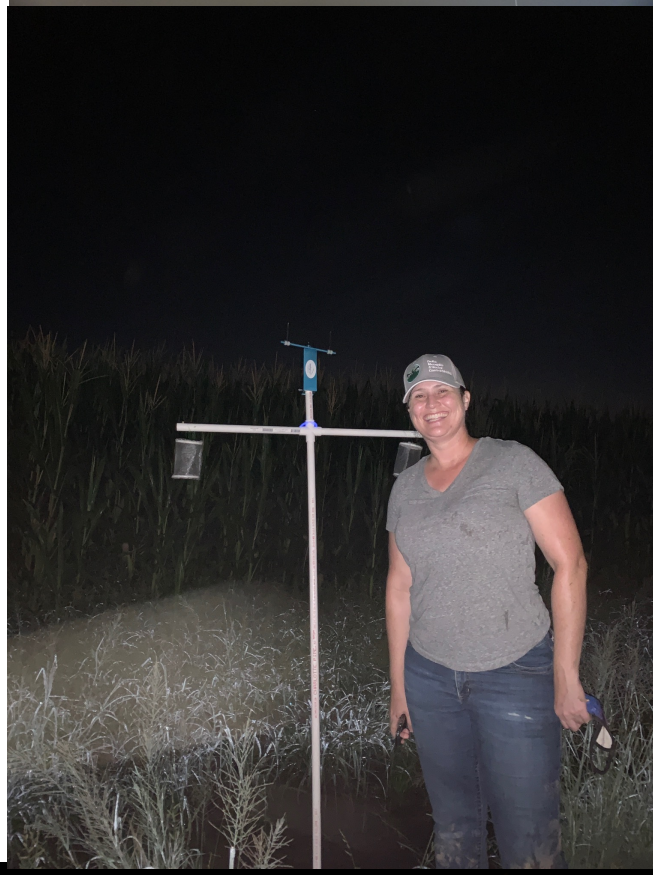
- 10 droplet collection stations
- 20-25 wild caught adult *Cx. quinqs.* in field cages at each station

LeadingEdge

Delta MVCD UAS Application Results:

Mosquito abundance: 50% reduction of adults in traps after first control treatments

- Continue to monitor trap counts for Altosid residual effectiveness*



West Nile infection rates:

- Definite reduction in treatment area of infected *Culex tarsalis* pools; some reduction in *Culex quinqs.**

(WNv MIRs were >20% in pools within corn field prior to UAS application)

**Data still under review*

LeadingEdge

Florida

Mosquito Larvae

Aedes infirmatus
Anopheles crucians
Culex nigripalpus
Psorophora ferox

Altosid P35

Applied at
7 lbs./acre

Why UAS?

- Relatively small acres
- Sensitive habitat
- Residential encroachment
- Affordable

FLORIDA

Seminole County Mosquito Control

Site Type: Woodland freshwater
Acres Treated: 389.00 acres

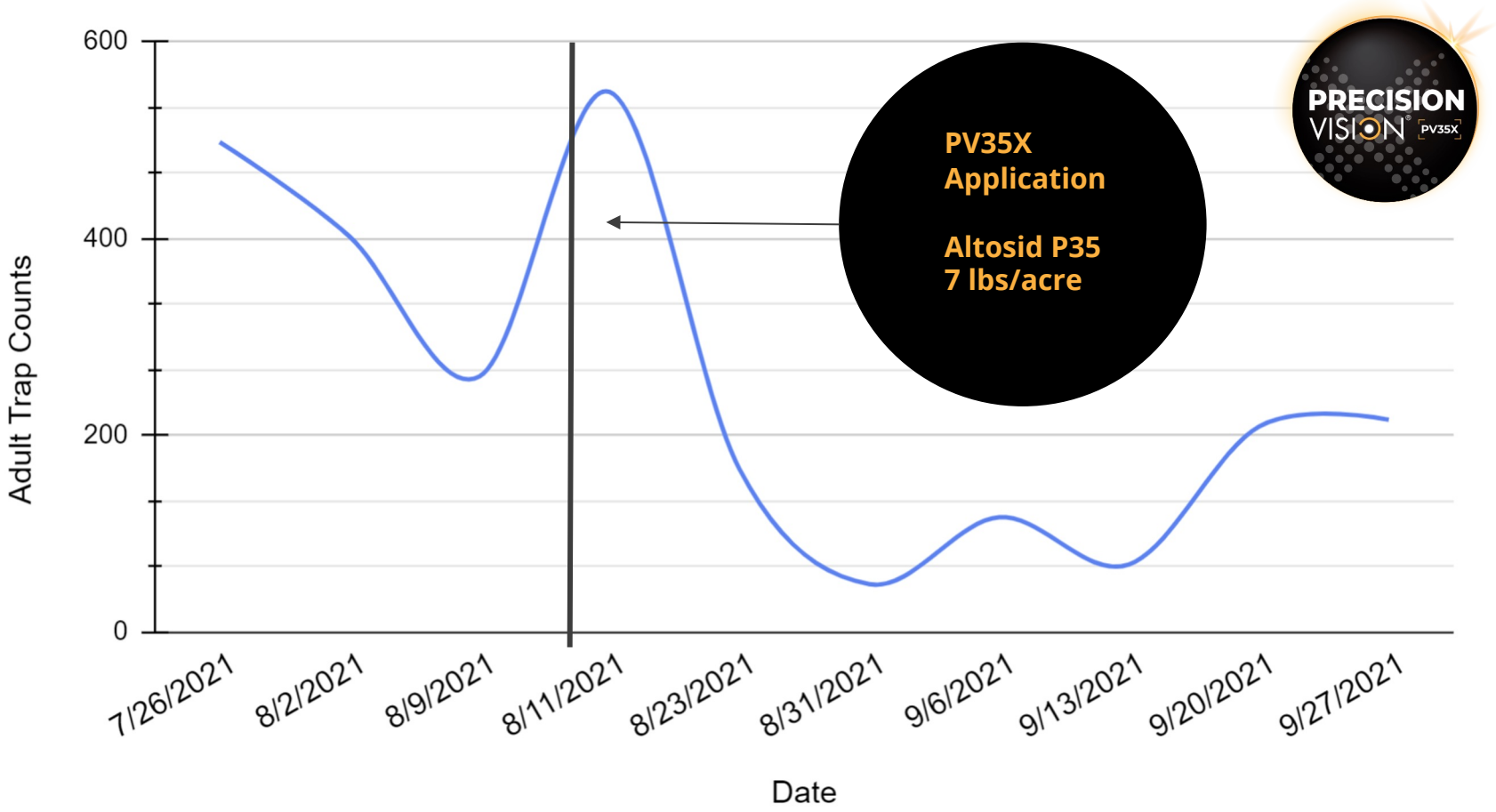
Application configurations:

PV35X, granular payload system
17 mph, effective swath width 80’

Acres treated/minute: 2.75
Granular flow rate: 19.23 lbs./min

LeadingEdge

2021 Adult Mosquito Counts via CO2 Baited Trap Seminole County, FL



LeadingEdge


Calibrating and
Characterizing UAS
for Aerial Applications
LeadingEdge

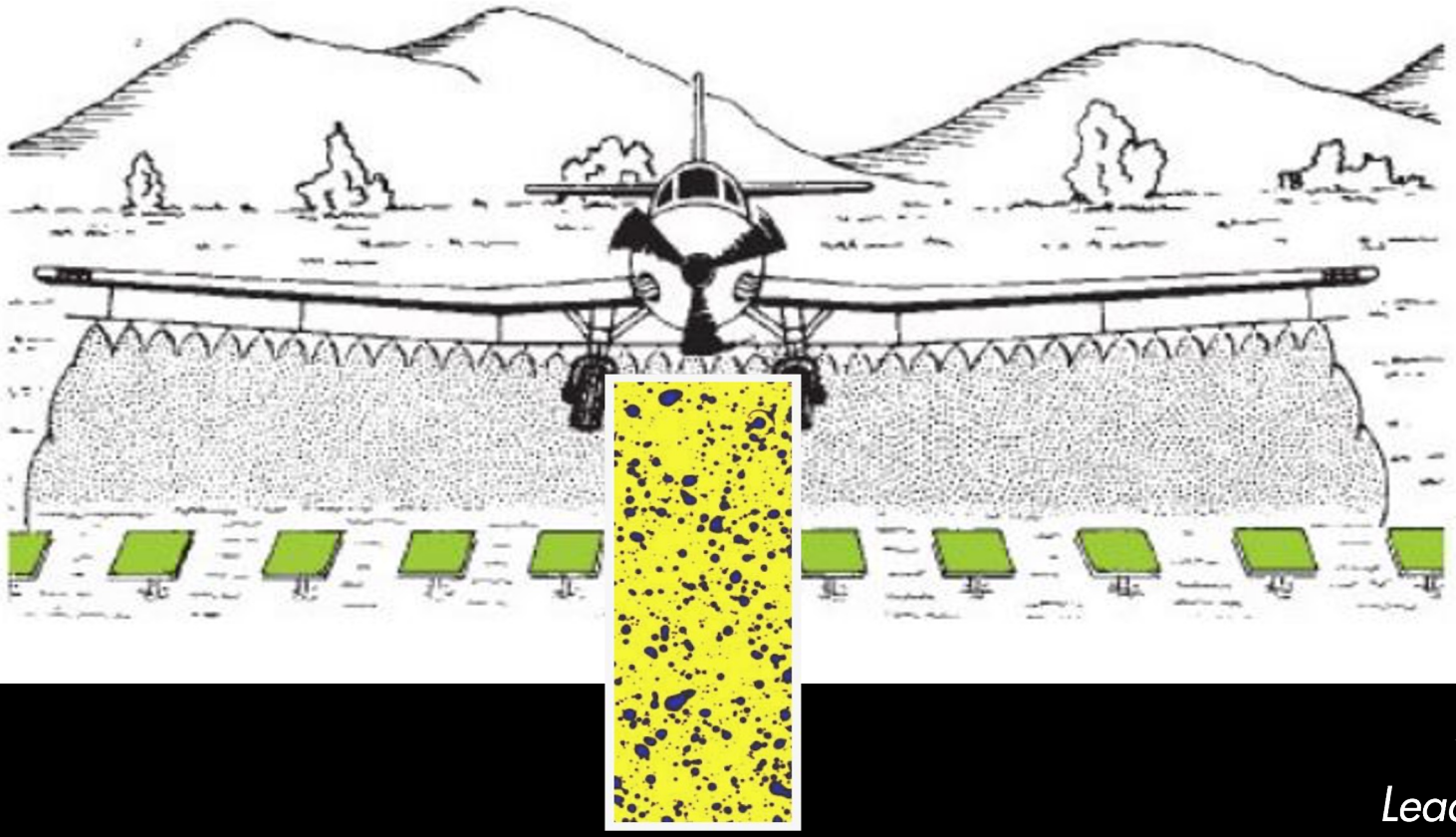
For liquid-based swath analysis of an aircraft, several sampling methods are deployed

Common examples include:

	Droplet Spectrum	Volume
Water sensitive cards	x	x
Kromekote cards	x	x
Mylar cards		x
String method		x
Cascade impactor	x	x

Sampling media are aligned in an array

- Perpendicular to the aircraft's flight line
- Equal spacing between the sampling media
- Equal number of sampling media across the swath
- 3 flow rate tests prior to swath analysis flight



Sampling drone spray perpendicular to wind & flight line

Mosquito Control Research (DOD Deployed War Fighter Protection Program)

- One spray run into the wind at 3, and one at 9m with the wind
- Application height 4m AGL
- Assumed swath width of 5.5m
- 6 - TTI11005 TeeJet nozzles
- Liquid Bti applied at 12 fluid oz/ac (bioassay work)

LeadingEdge

LeadingEdge

Collection stations along flight path

- Larvae added to cups to test for dose response
- Water sensitive cards give droplet densities and sizes
- Mylar cards test for concentration of product

LeadingEdge

We can help you make unmanned aerial systems an important part of your operations!

LeadingEdge

Thank You

Cody Cash ccash@leateam.com 813-928-0634
Bill Reynolds breynolds@leateam.com 407-468-0008

Leaaerialtech.com

LeadingEdge
Bringing Technology and Science Together

LeaTeam.com

LeadingEdge
AERIAL TECHNOLOGIES

LeaAerialTech.com