# Detecting and Classifying Birds and Bats from Infrared Video:

## An Automated Technology to Support Offshore and Land-Based Wind Projects


Investigators:

- Shari Matzner
- Corey Duberstein
- Val Cullinan

Presented by:

- Andrea Copping
- Pacific Northwest National Laboratory


Pacific Northwest
NATIONAL LABORATORY

*Proudly Operated by* Battelle *Since 1965*

# Automated Technology

Pacific Northwest NATIONAL LABORATORY
*Proudly Operated by Battelle Since 1965*

## Goal:

- Reduce uncertainty around the potential risk to birds and bats from wind turbines.

## Challenge:

- Observing bird and bat activity in difficult to access locations.
- Make continuous observations over multiple diurnal cycles.

## Approach:

- Thermal video + **automated processing** is a cost-effective solution.

**Automated Processing:**

- Produces **reliable, verifiable** information from remotely-sensed data.
- Reduces the amount of data that must be stored, transmitted and reviewed by human experts.

# Technical Objectives



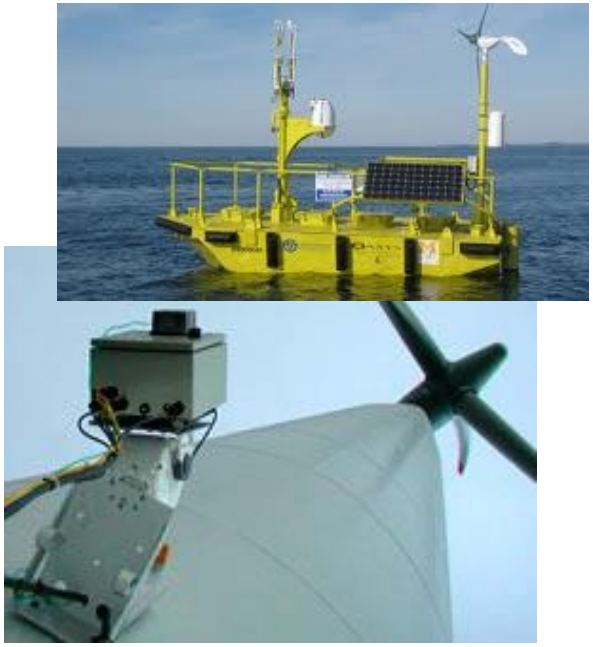
- Develop software to process video from a **single thermal camera** to automate the detection of birds and bats.
  - Abundance counts,
  - Passage rates,
  - Temporal activity patterns

- Develop models for:
  - Classification of flight paths
  - Classification of targets

# Application For Pre- and Post-Installation Studies

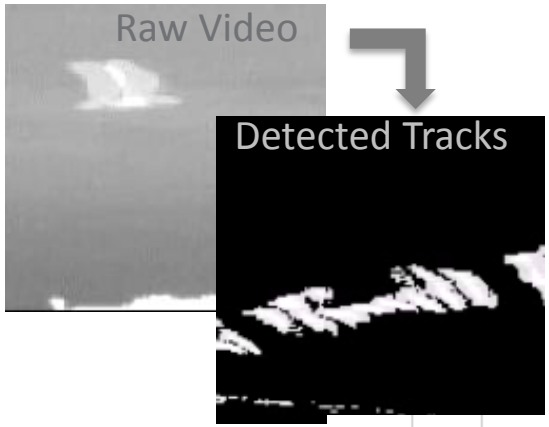
Pacific Northwest NATIONAL LABORATORY
*Proudly Operated by Battelle Since 1965*

## Use remote cameras to collect site data



## Process recorded video using our software

### ThermalTracker Software




Track Statistics

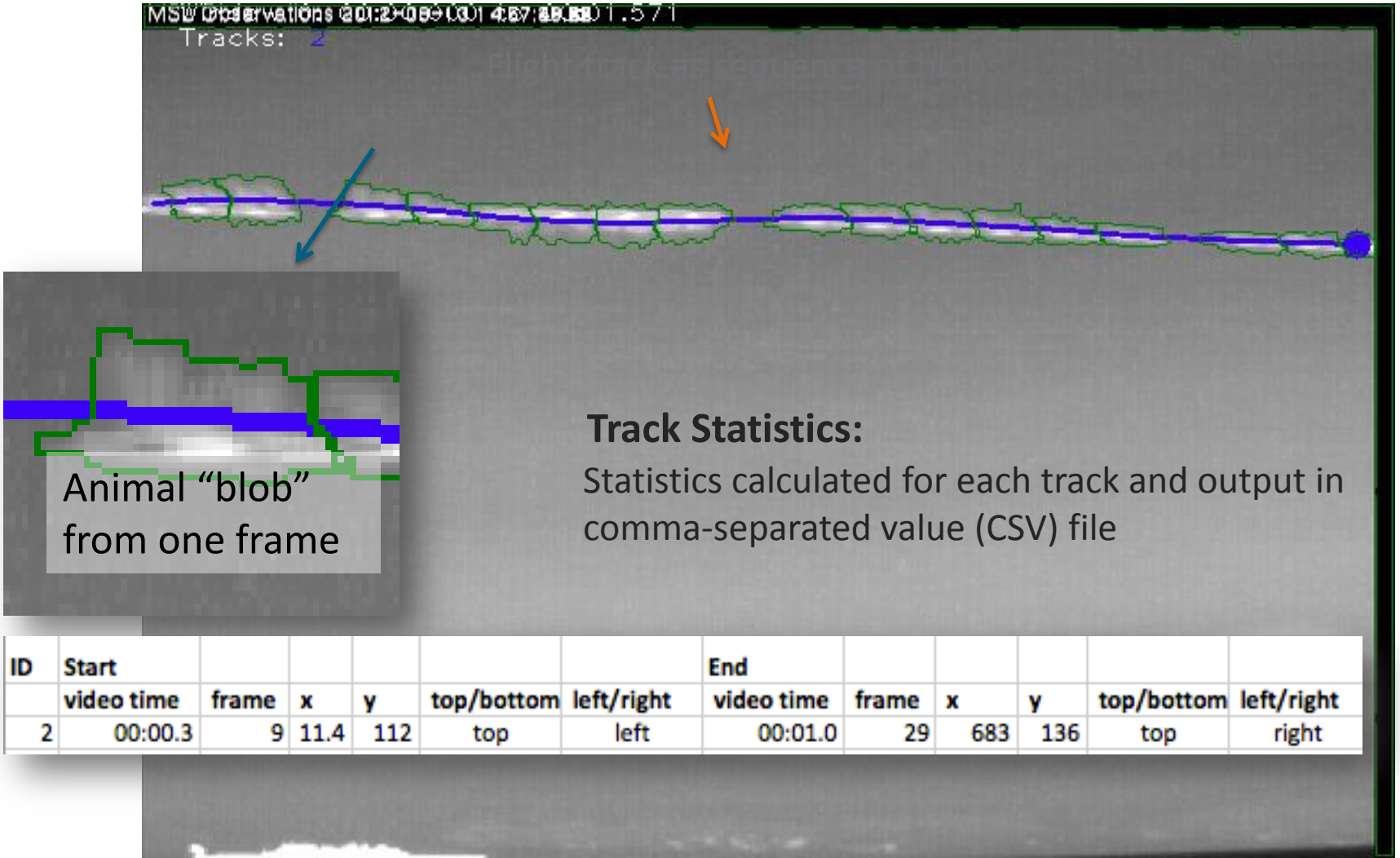
| Frames visible | Frame span | Sinuosity | Total distance (pixels) | Speed (pixels/sec) |
|---|---|---|---|---|
| | | | | mean |
| 44 | 73 | 1.49879 | 125.332 | 51.3688 |
| 11 | 16 | 2.13651 | 42.8128 | 80.0599 |
| 46 | 56 | 1.16832 | 447.369 | 239.023 |
| 14 | 21 | 1.51473 | 132.181 | 188.326 |
| 51 | 93 | 1.09578 | 162.364 | 52.2358 |


## Analyze results.

# ThermalTracker software extracts flight tracks.



A composite image of 300 frames (10 seconds of video at 30 frames per second) makes entire flight track visible.




**Track Statistics:**

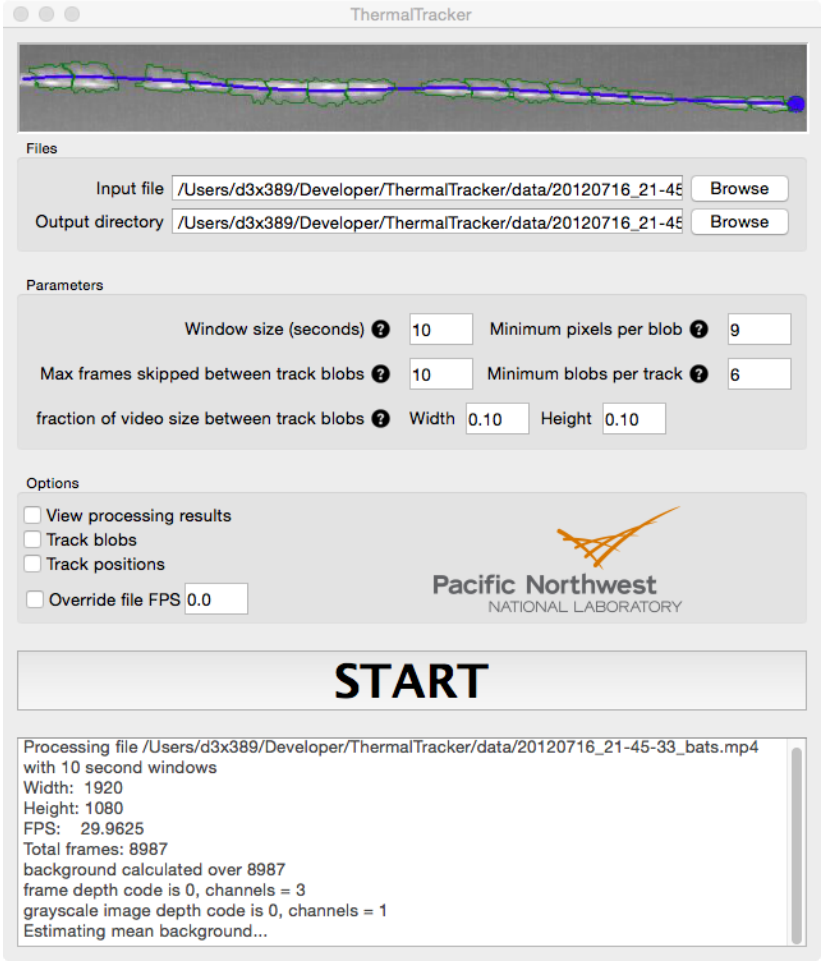
Statistics calculated for each track and output in comma-separated value (CSV) file

| ID | Start | | | | | | End | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | video time | frame | x | y | top/bottom | left/right | video time | frame | x | y | top/bottom | left/right |
| 2 | 00:00.3 | 9 | 11.4 | 112 | top | left | 00:01.0 | 29 | 683 | 136 | top | right |

# Open Source Software



- Available on request for Windows, Mac or Linux.
- Easy to use graphical interface.



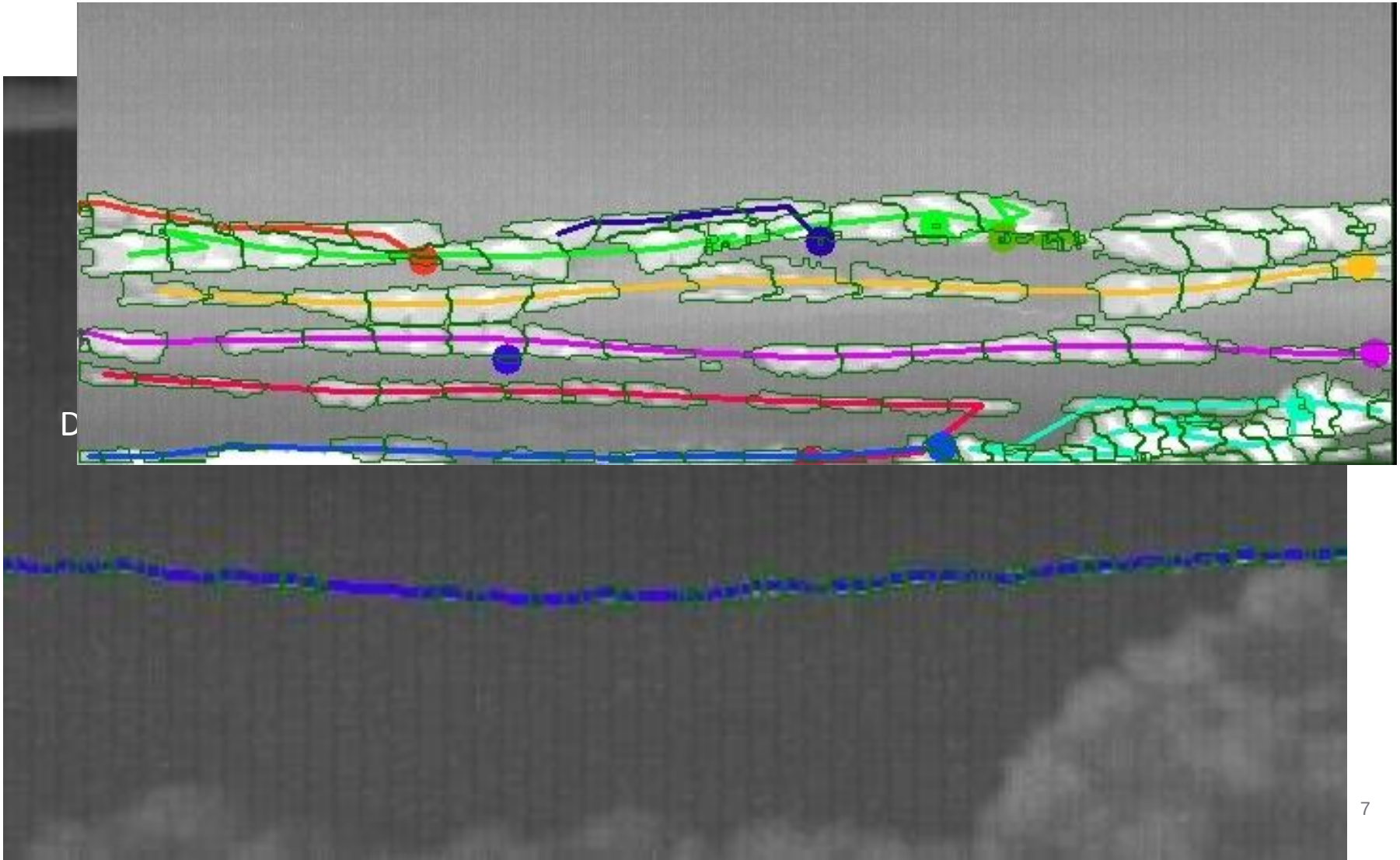

Works with video from any thermal camera.

User-selectable parameters tune performance.

# Count high density events and rare events

Pacific Northwest
NATIONAL LABORATORY
*Proudly Operated by Battelle Since 1965*

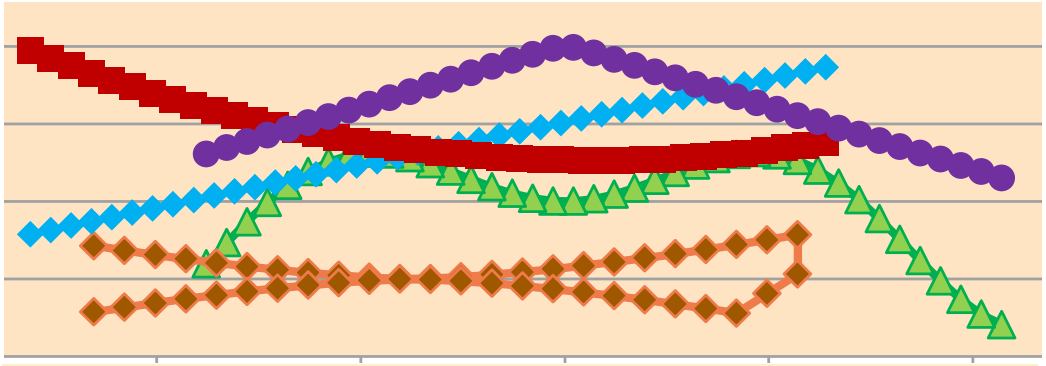
Multiple birds tracked and counted during feeding activity.



# Classification of Flight Tracks



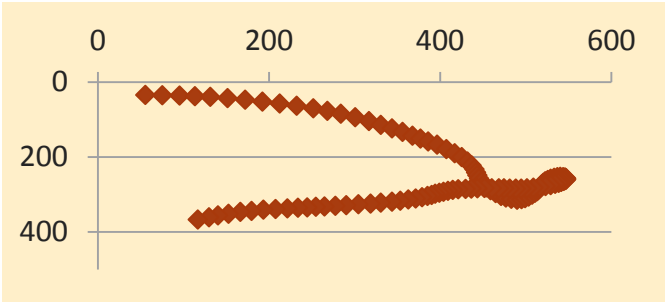
- Flight tracks extracted by ThermalTracker provide:
  - Direction of movement
  - Change in direction



**Can discriminate track type, infer behavior:**

- Linear = fly through
- Quadratic = smooth change in direction
- Sine wave = sinuous fly through
- Angled = sharp change in direction
- Turnaround = sinuous feeding

Example: Swallow foraging



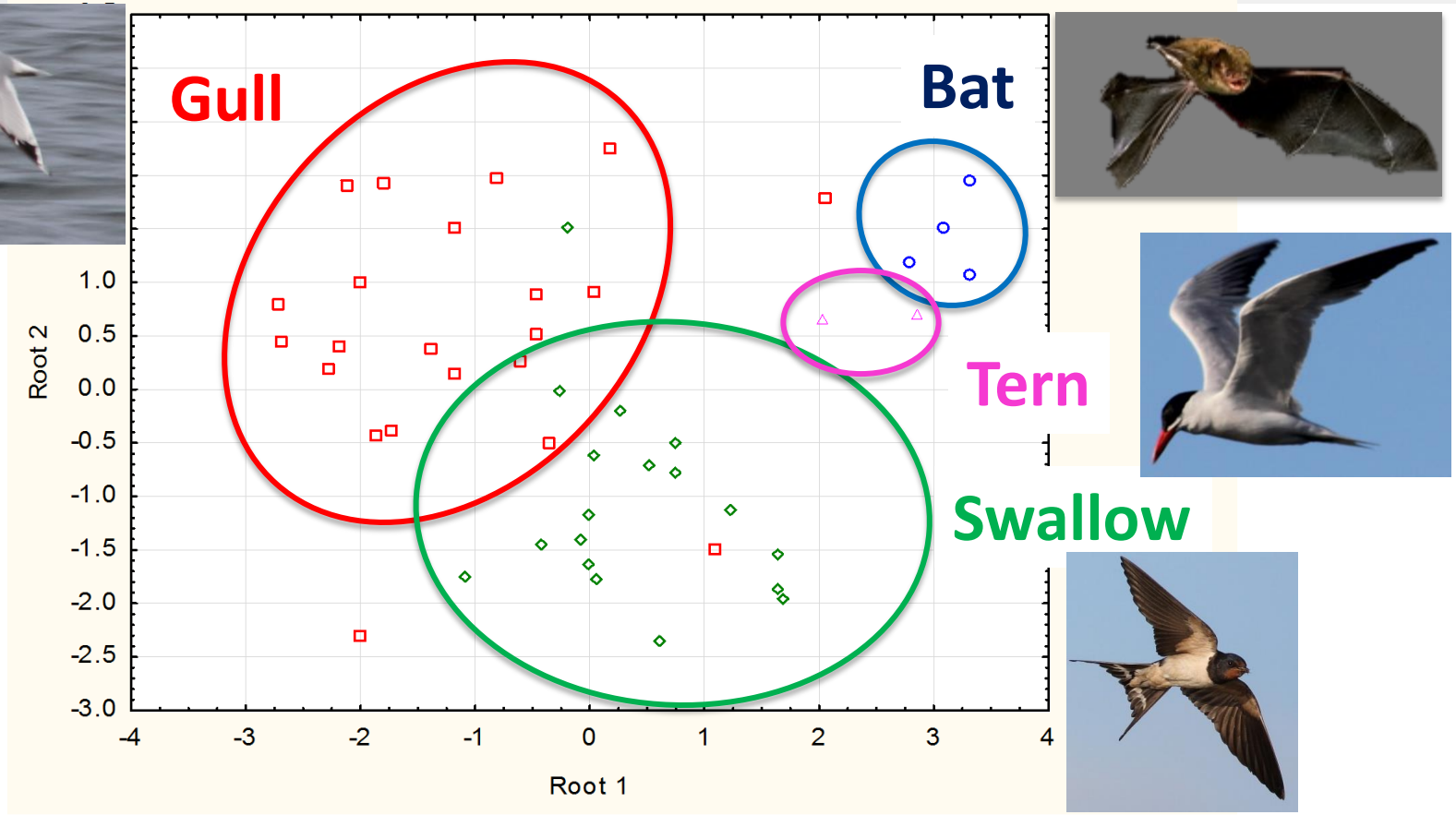
# Classification of Targets



- The Holy Grail:  Identify species of concern.

# Classification Using Flight Pattern

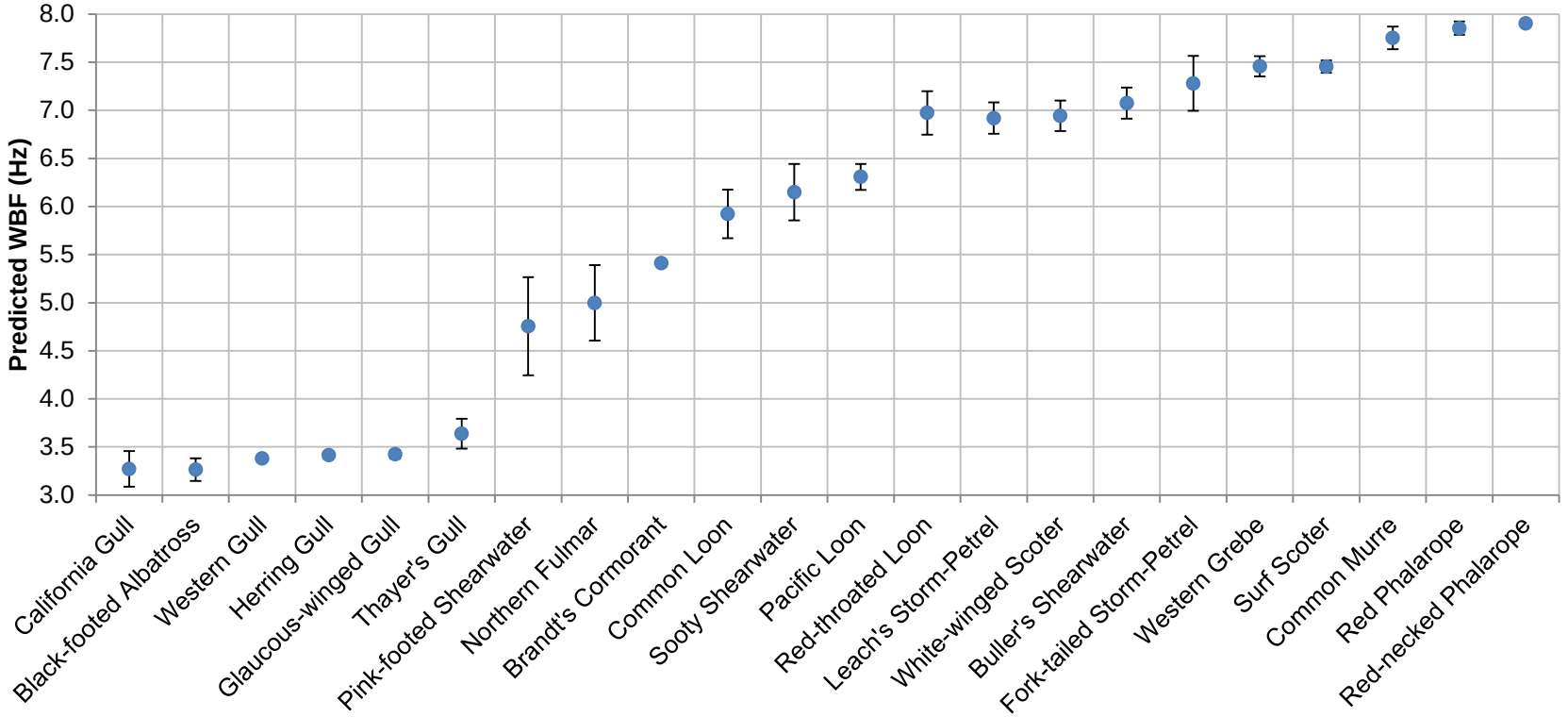




# Wing Beat Frequency As Discriminator

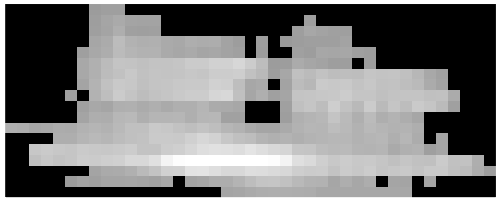
Pacific Northwest NATIONAL LABORATORY
Proudly Operated by Battelle Since 1965

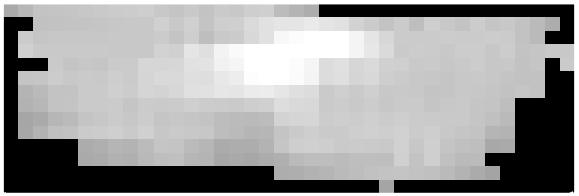
## Wing beat frequencies of North American Pacific Coast Species

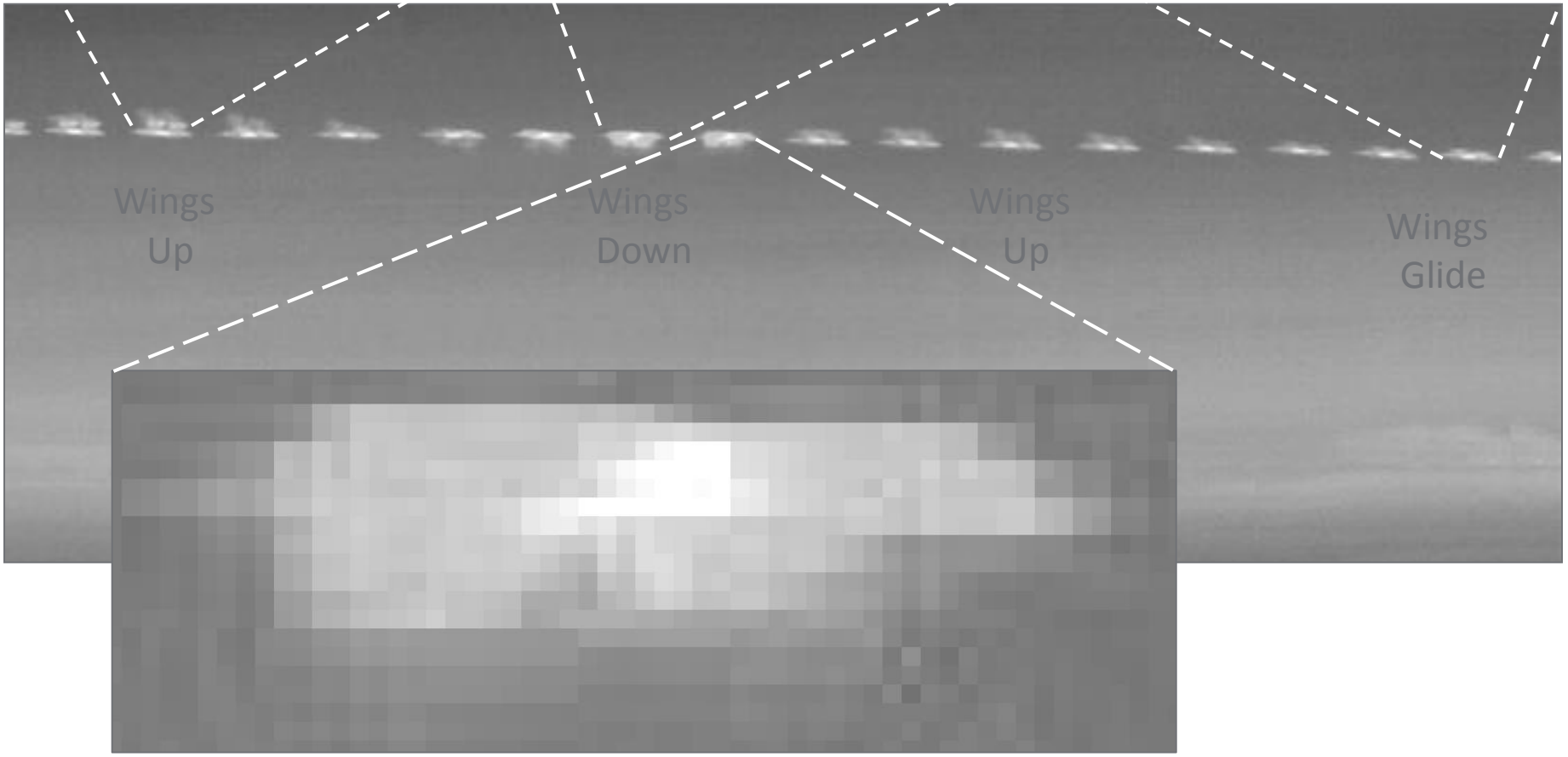


# Wing Beat Extraction from Thermal Video









# Summary



- Automated technology can help reduce uncertainty around risk to birds and bats from wind turbines.
- ThermalTracker software can be used to automatically process video to produce counts, passage rates and temporal patterns of activity.
- Extracted flight track data can be used to infer behavior, and to do limited classification of animals.
- Next steps include extracting wing beat frequency and developing more specific classification models.

# Thank you!

Pacific Northwest
NATIONAL LABORATORY
*Proudly Operated by* Battelle *Since 1965*

## Questions?


*Point of contact:*

Shari Matzner, Ph.D.
Research Engineer
Pacific Northwest National Laboratory
shari.matzner@pnnl.gov


Publications


V. I. Cullinan, S. Matzner, and C. A. Duberstein. Classification of birds and bats using flight tracks. *Ecological Informatics*, 27:55–63, 2015.

S. Matzner, V. I. Cullinan, and C. A. Duberstein. Two-dimensional thermal video analysis of offshore bird and bat flight. *Ecological Informatics*, 30:20–28, 2015.