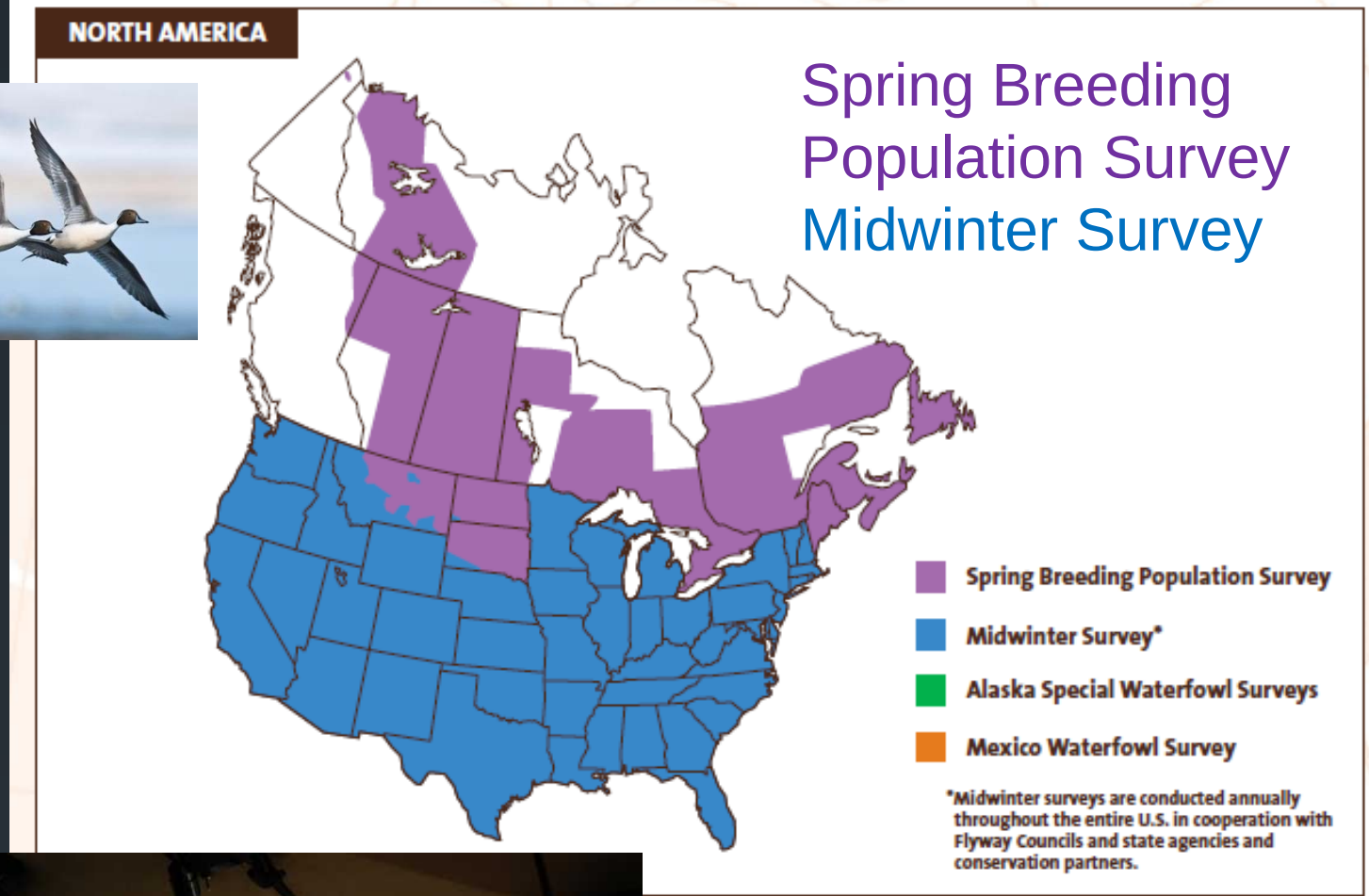
U.S. Fish and Wildlife Service Applications of UAS Technologies for Wildlife and Habitat Surveys

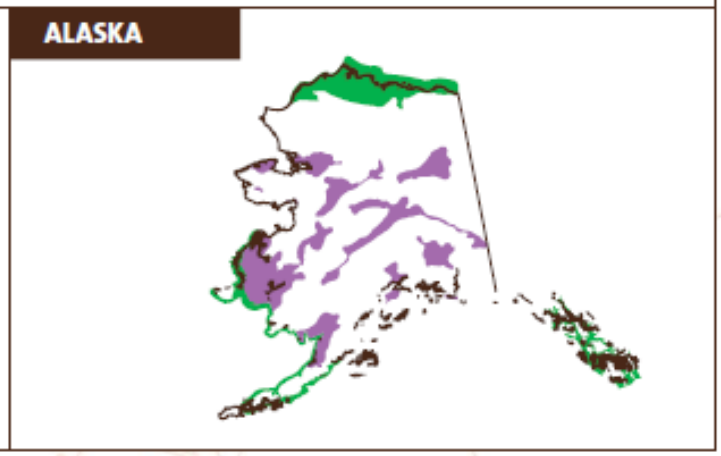
Orien Richmond, USFWS, Pacific Southwest Region
Refuge Inventory & Monitoring Initiative
Sharon Dulava, USFWS, Pacific Southwest Region
Refuge Inventory & Monitoring Initiative
Sue Thomas, USFWS, Pacific Region, Washington Maritime NWRC

U.S. Fish and Wildlife Service Mission

- *Working with others to conserve, protect and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people.*

Spring Breeding Population Survey
Midwinter Survey





Estimated current Service aviation expenditures

- Functions include: low-level wildlife surveys, radio tracking surveys, law enforcement surveillance flights, fire reconnaissance flights, etc.
- 18,000 to 20,000 flight hours per year (fleet and contract)
- $6.2 to 8.2 million per year (fleet and contract)
- 40 fleet pilots (most of which are dual function) and 47 fleet aircraft
- About 60% of the fleet assets are in Region 7 (Alaska).

Source: Mark Koneff, Chief, Migratory Bird Surveys Branch

Challenges with real-time aerial counts

- Accuracy of real-time visual counts depends on the species being counted, viewing conditions, land cover and observer experience.
- Accuracy diminishes rapidly as the number and density of birds to be counted increases.

Source: Bowman 2014

Source: Bowman 2014

Waterfowl survey plane crash kills two U.S. Fish and Wildlife Service biologists

JANUARY 20, 2010 | 11:10 AM

Two U.S. Fish and Wildlife Service biologists were killed Sunday when their survey plane crashed in Oregon.

Wildlife biologist mortality

- 91 job-related deaths of wildlife biologists were documented from 1937 to 2000
- 39 aviation accidents accounted for 66% of deaths
- Aerodynamic stalls and power-line collisions were the most significant causes of accidents for which information was available

Source: Sasse (2003)

Pilot waterbird surveys with the USGS National UAS Project Office

- Ruby Lake National Wildlife Refuge, NV
- Kern National Wildlife Refuge, CA
- Tomales Bay, Marin, CA

UAS pilot project questions

- Can waterbirds be identified to species from UAS imagery?
- What is the relationship between UAS altitude and disturbance behavior (e.g., flushing)?
- What flight altitude and sensor settings minimize disturbance and ensure adequate image resolution for waterbird ID?
- Can accurate waterbird counts be obtained with UAS?

Ruby Lake NWR
Ruby Lake National Wildlife Refuge
Ruby Lake
Y Pond
Google

Tomales Bay
Tomales
Tomales Bay
Marshall
Abbotts Lagoon
Inverness

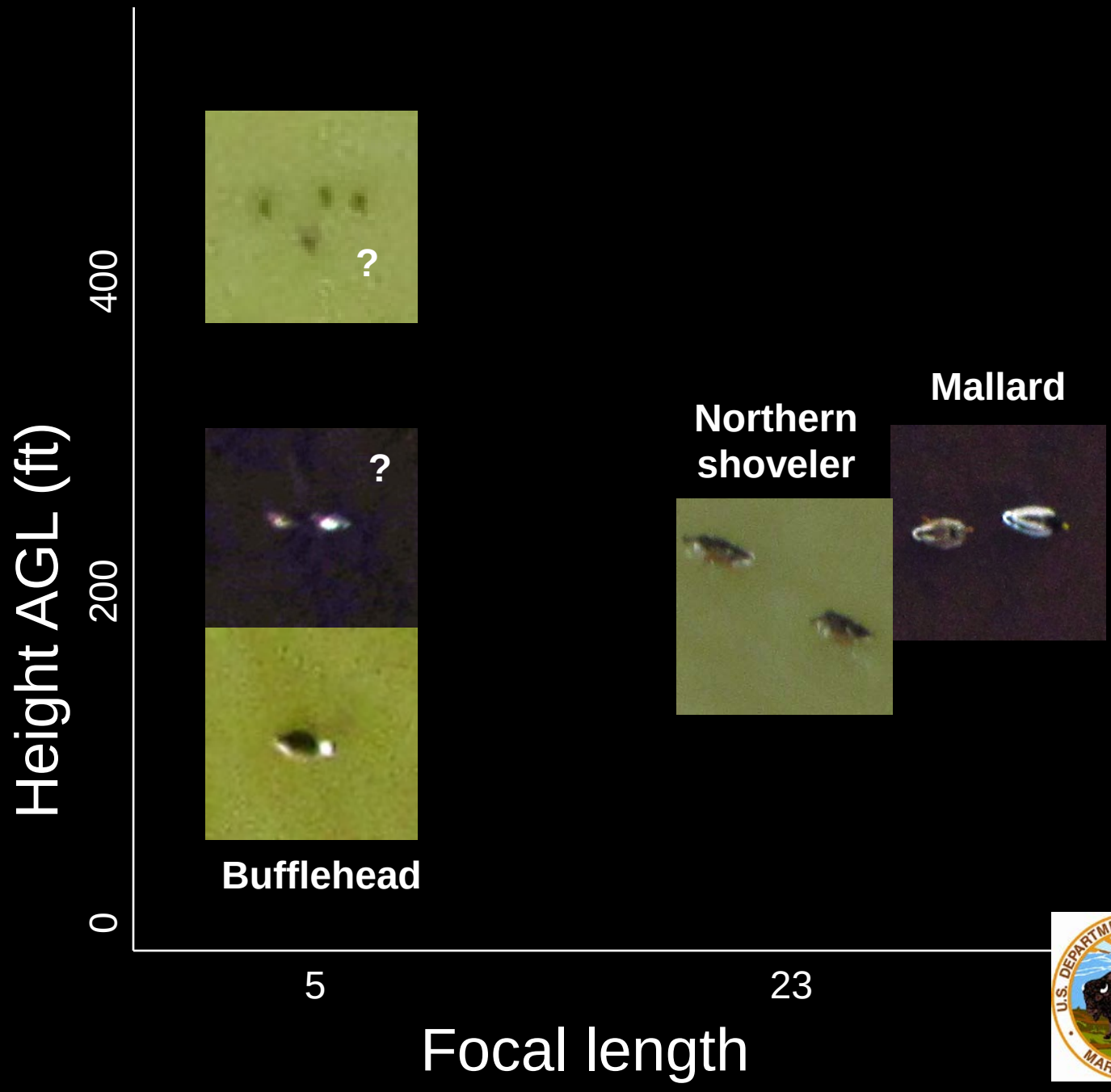
Kern National Wildlife Refuge
Kern NWR
Dairy Ave
Google

UAS systems

	RQ-11A Raven	RQ-16A T-Hawk
Power	lithium-ion battery	gas
Duration	60-90 min	47 min
Sensor	GoPro Hero3	Canon PowerShot 12.1 MP

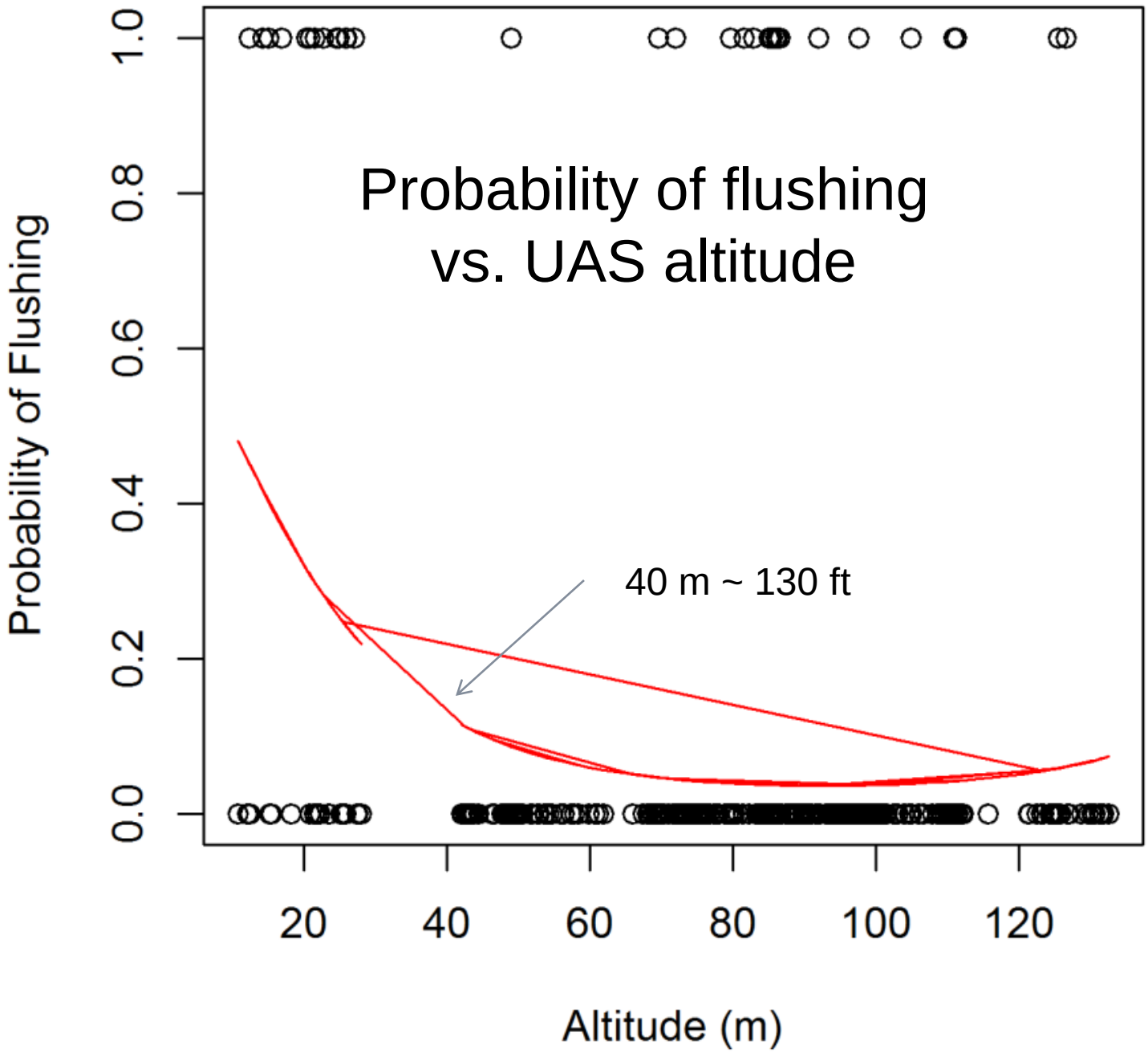
Findings

- Can waterbirds be identified to species from UAS imagery?


Height AGL (ft)
400
200
0
?
?
Bufflehead
Northern shoveler
Mallard
5
23
Focal length

Findings

- What is the relationship between UAS altitude and disturbance behavior (e.g., flushing)?

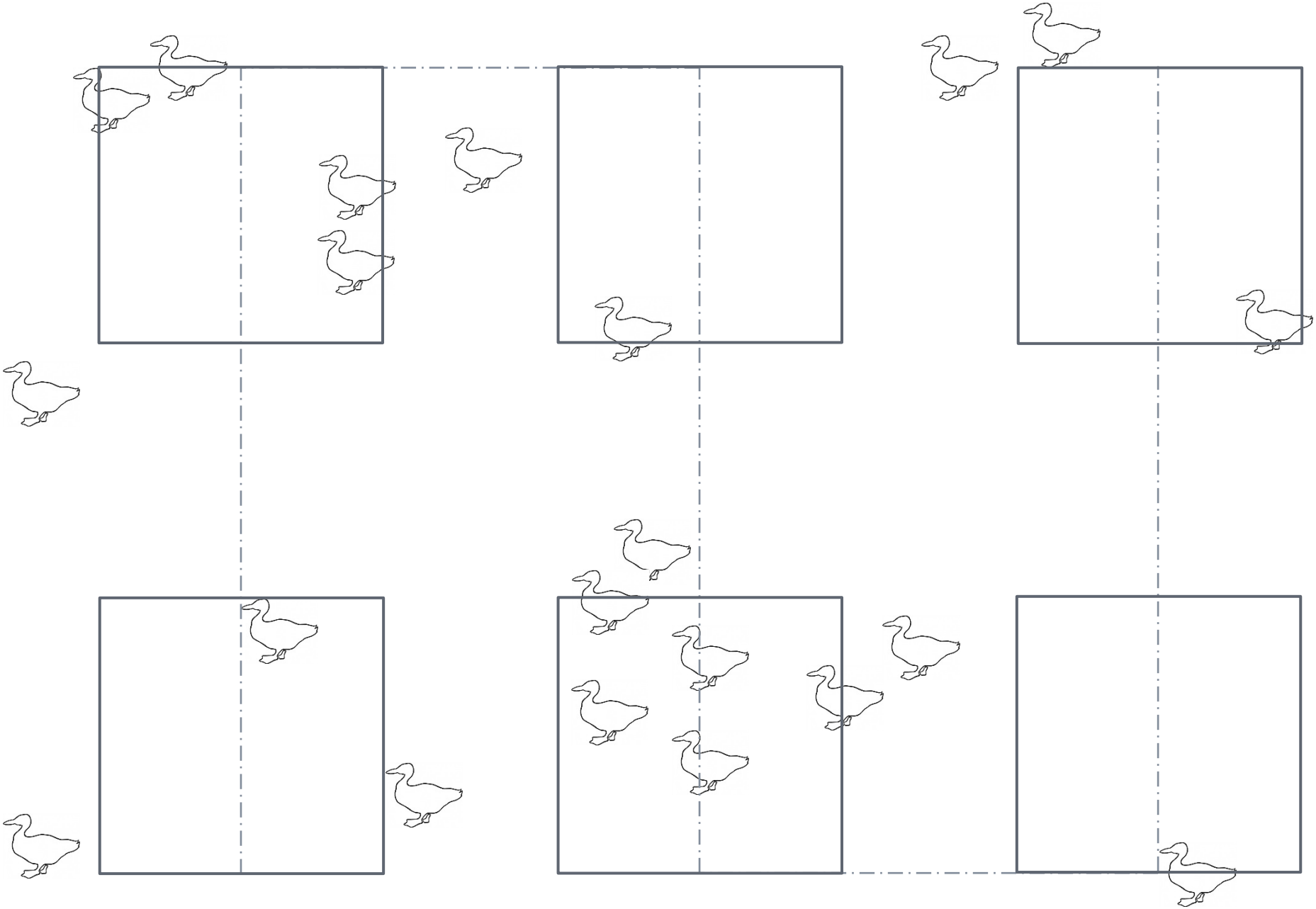

Probability of flushing
vs. UAS altitude
40 m ~ 130 ft
Probability of Flushing
0.0
0.2
0.4
0.6
0.8
1.0
20
40
60
80
100
120
Altitude (m)

Findings

- What flight altitude and sensor settings minimize disturbance and ensure adequate image resolution for waterbird ID?
  - >150 ft with >20 mm focal length
  - Need >2000 pixels on a duck's back
  - Effects of disturbance will vary by species and breeding vs. non-breeding

Findings

- Can accurate waterbird counts be obtained with UAS?
  - Mosaicking images over water is difficult
  - Imagery could be collected at higher elevations to reduce the number of images to stitch, but then species ID becomes a problem.



How to process all that imagery in a cost-effective way?

- USGS – developing online crowdsourcing project for updating structural data for National Map
- Tomnod – website for crowdsourcing image classification; used for search of missing Malaysian jetliner

CAUTION
KEEP CLEAR OF FAN

Take homes from the T-Hawk crash

- Safety plans are critical for minimizing risks
- UAS are aircraft; report any incidents immediately to DOI Aviation Management
- Operational control of aviation assets should be clearly delineated and rest with one agency

Conclusions

- The Raven and T-Hawk platforms are not suitable for large-scale waterbird surveys due to their limited duration and range.

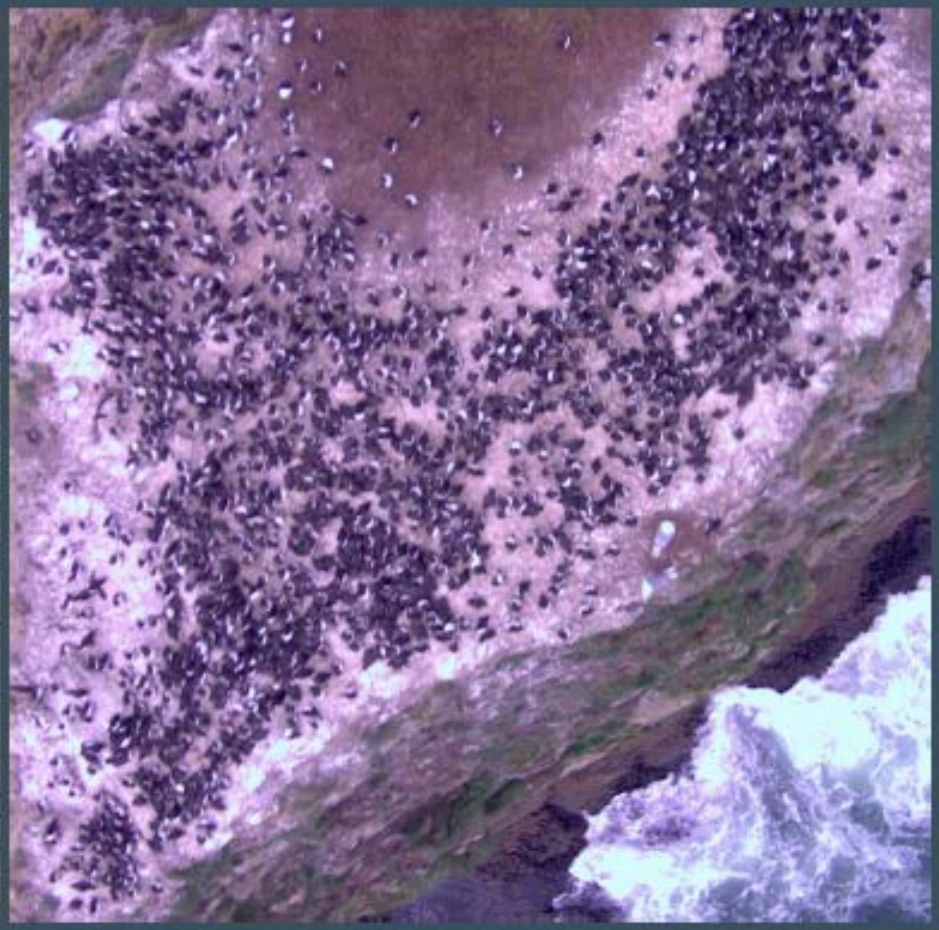
- They are suitable for localized surveys (e.g., colonial nesting waterbird counts).

Other UAS applications in the Service

- Seabird and marine mammal surveys at WA Maritime NWRC
  - Partnership with NOAA
  - Tested Puma and Quadracopter platforms
  - Overall disturbance to wildlife was low compared to current methods (helicopter)
  - However, costs were higher

Helicopter

21 MP camera; 5616 x 3744 pixels



Puma

5 MP camera; 1770 x 1701 pixels

Source: Sue Thomas, Washington Maritime NWRC

Helicopter

21 MP camera; 5616 x 3744

Quadracopter

24 MP camera *(set to 12 MP)*: 4240 x 2832 pixels

Source: Sue Thomas, Washington Maritime NWRC

Future directions

- Focus on smaller-scale surveys with current platforms (e.g., colonial nesting birds)
- Develop online crowdsourcing tools for image classification
- As longer-range platforms become available, test sampling designs for larger-scale surveys