Drone / Trail Camera Monitoring: Conservation Survey Opportunities

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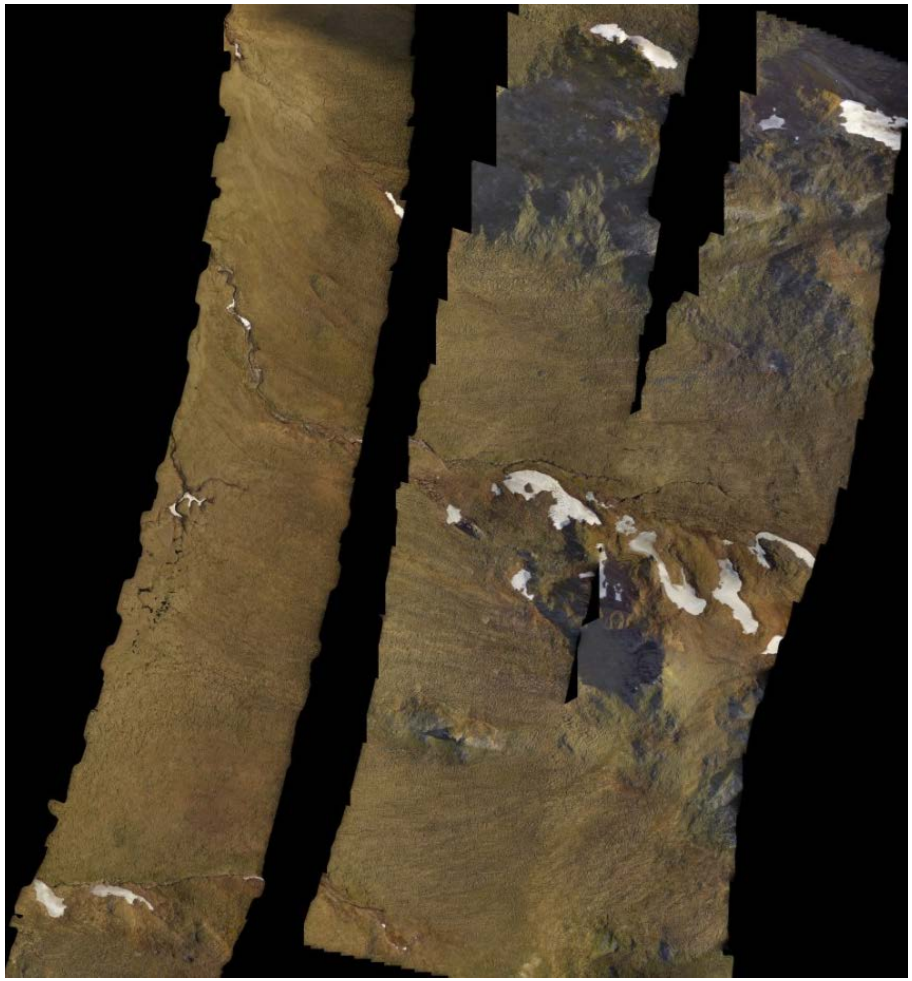
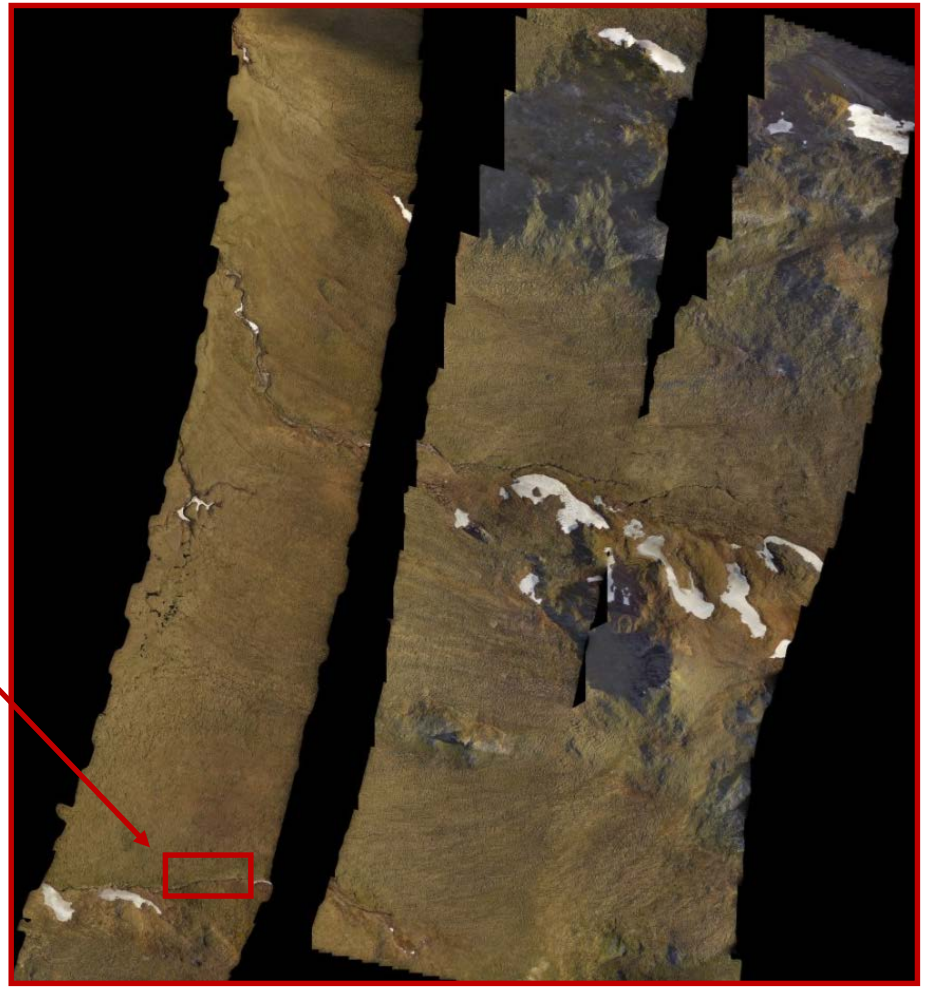
Can you find caribou in this "orthomosaic?"



Can you find them in these “chips?”

Can you identify them in these chips?

Caribou Image: detail location



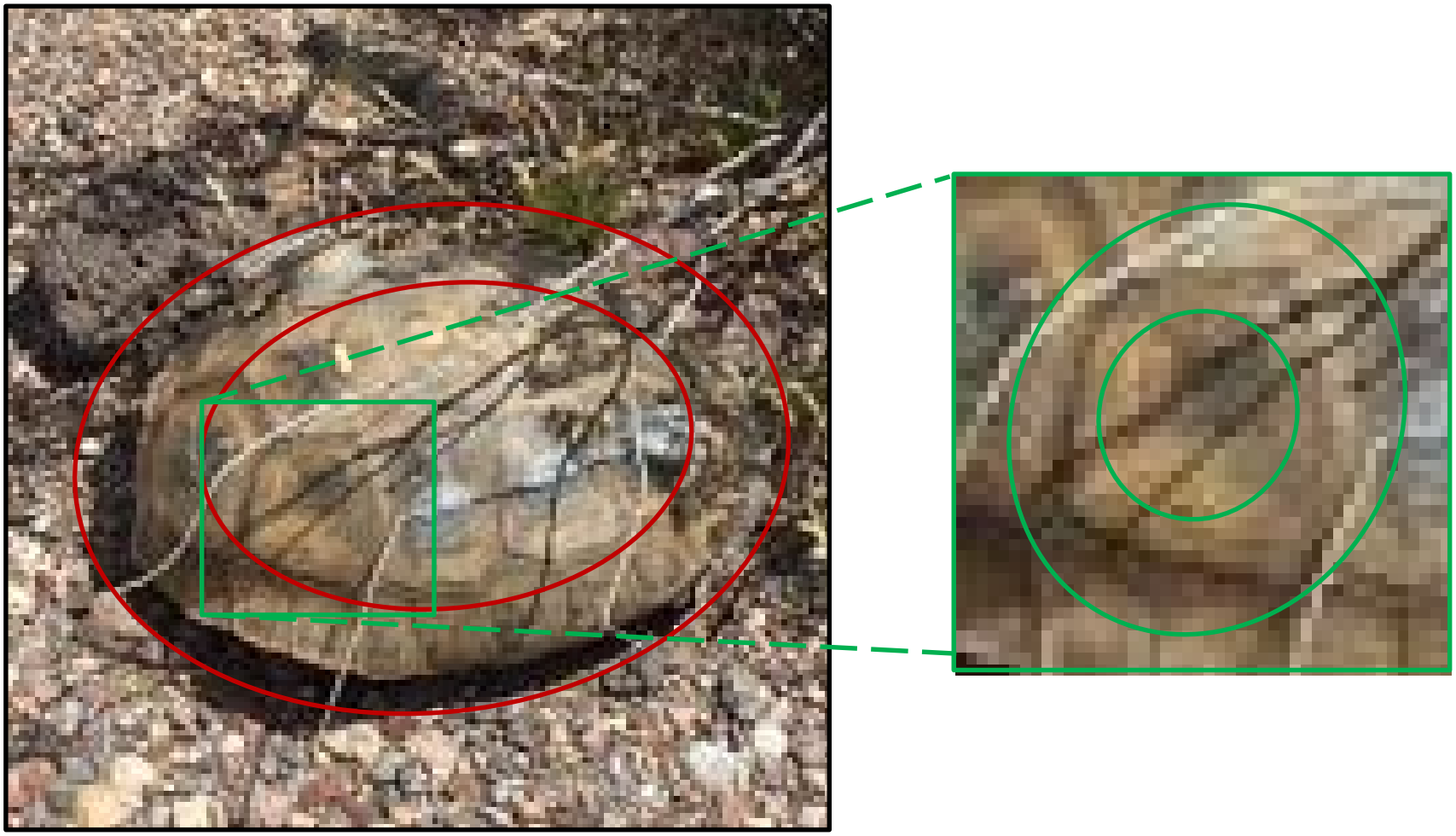
Area of Detail
(next slide)

Caribou Image: detail

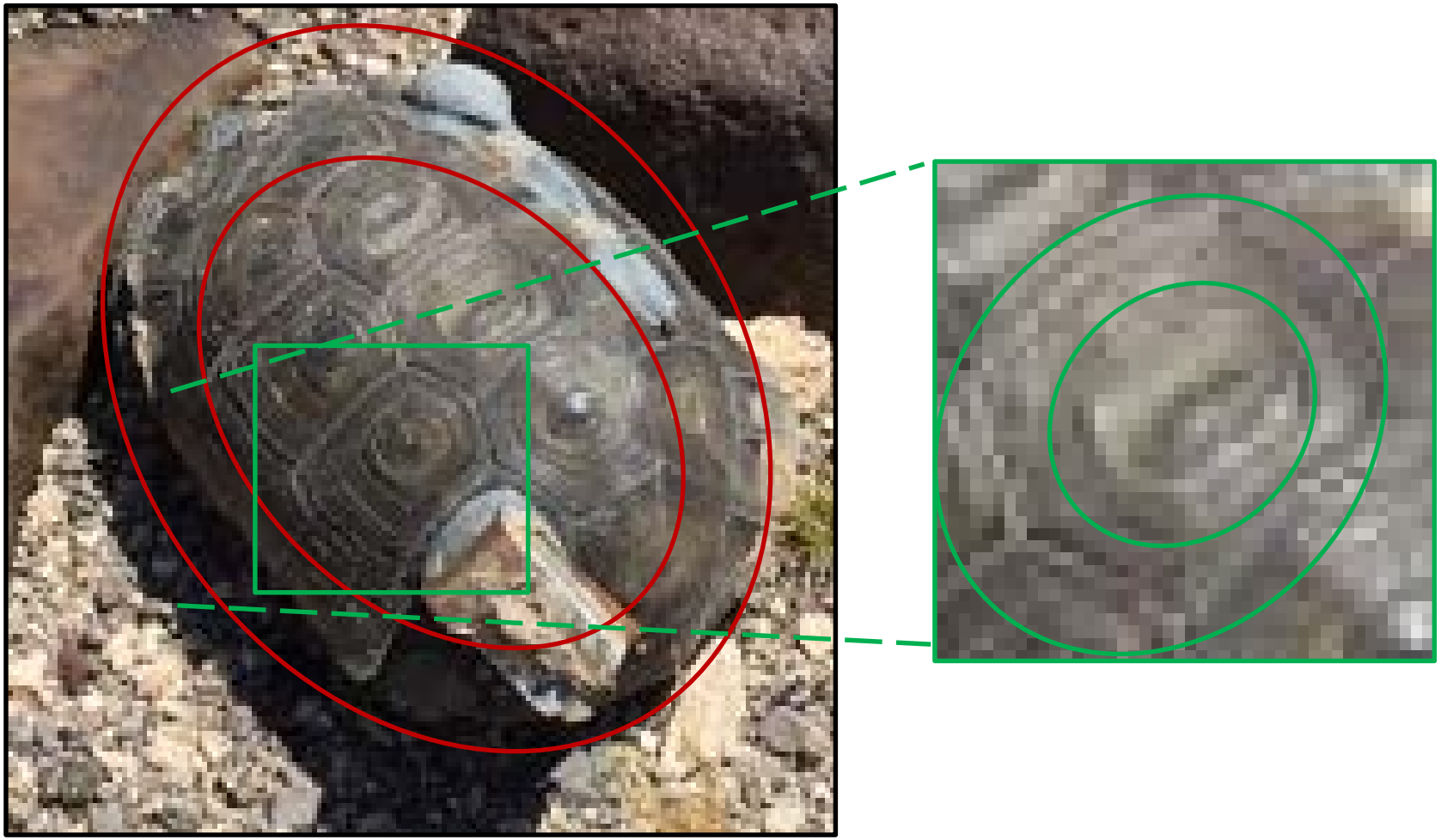
Caribou Detection: “alert map”

iPhone 6S Data Capture

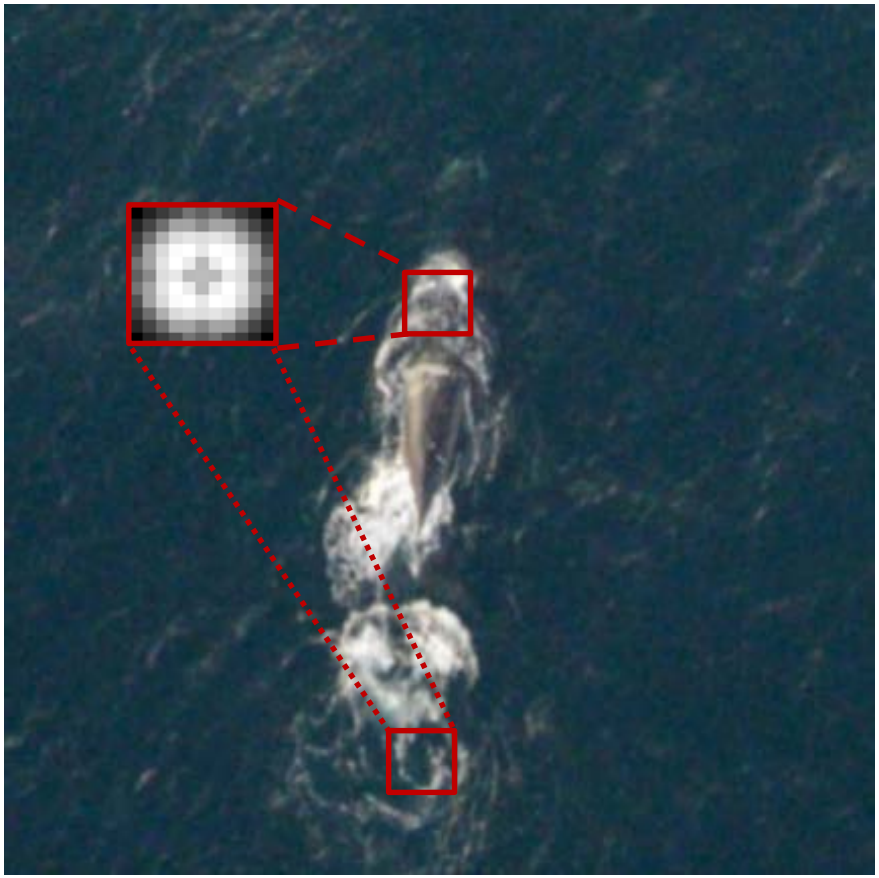
Under a Burr Sage Brush

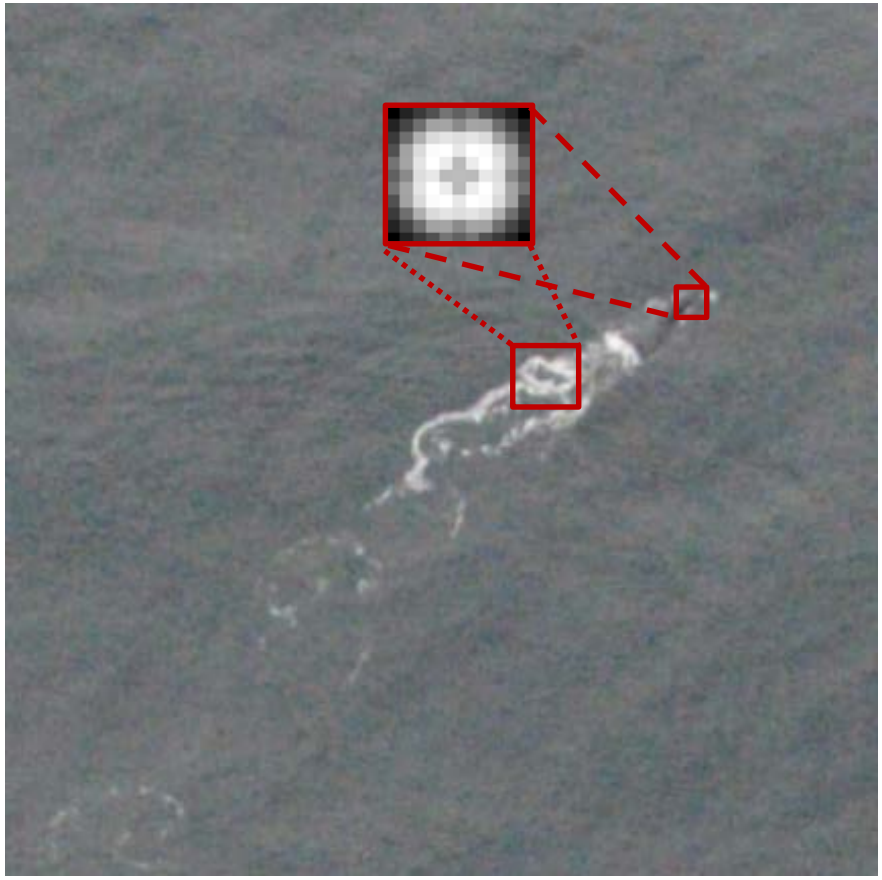


On the Rocks



Template Matching Approach





Drone / Camera Planning

Camera/lens focal length (mm)*:	55
Camera sensor row length (mm):	23.5
Camera sensor column height (mm):	15.6
Camera row resolution (pixels):	6000
Camera column resolution (pixels):	4000
Raw bits / pixel:	12
Frame rate (frames/sec):	1

Color codes

Input:

Interim (not shown):

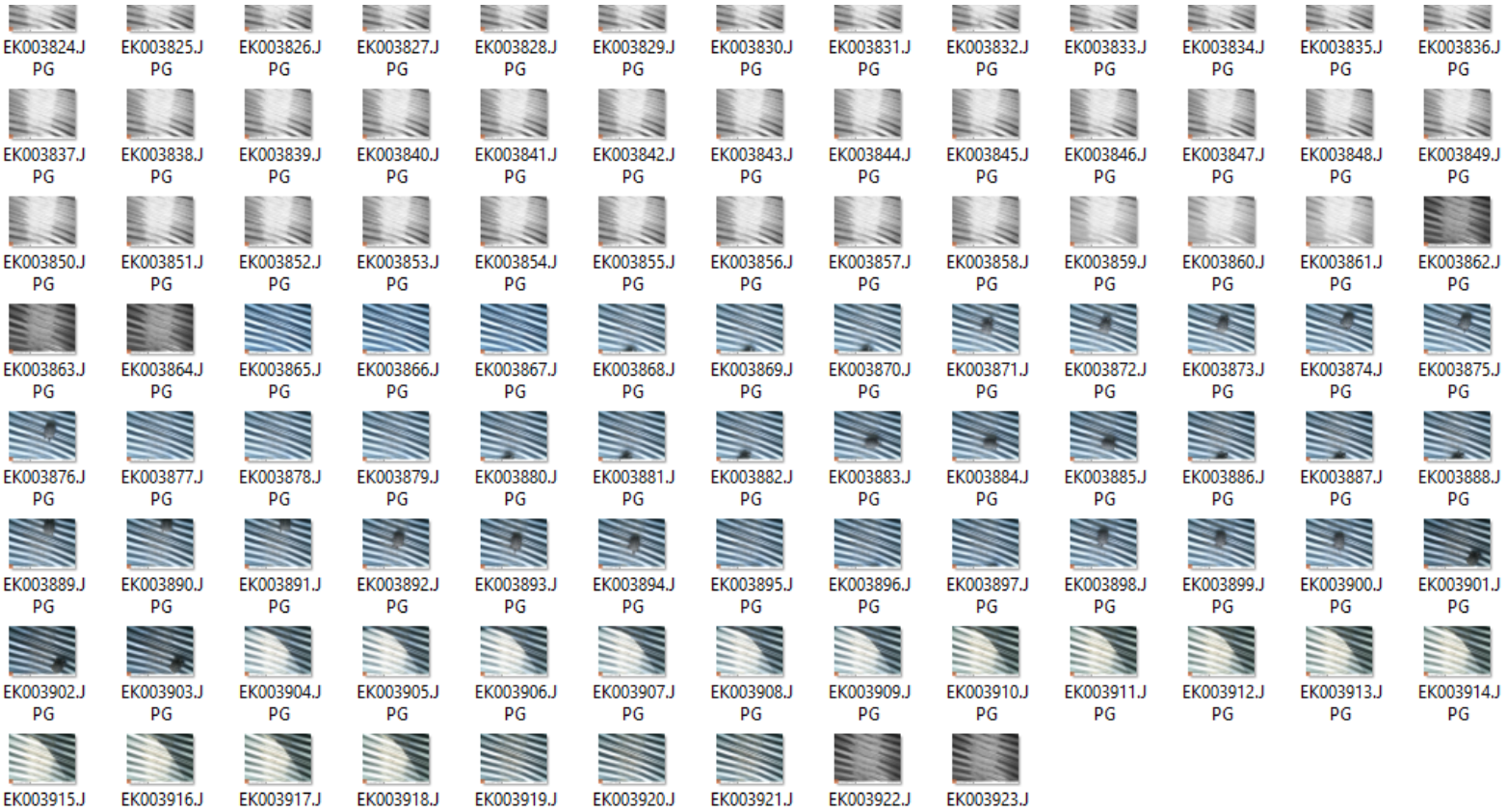
Output:

Altitude (m):	20
Ground speed (Km/hr):	20
Flight time per day (hr):	4
Transmission/upload rate (megabits/sec):	25
Triage processing rate (secs/image/processor):	16
Number of processors:	4
Triaged chip columns and rows:	600
Field observation rate (running ft/sec):	1
Chips per image (avg):	2
Triage-assisted detection rate (secs/chip):	1
Observer hourly compensation:	$20

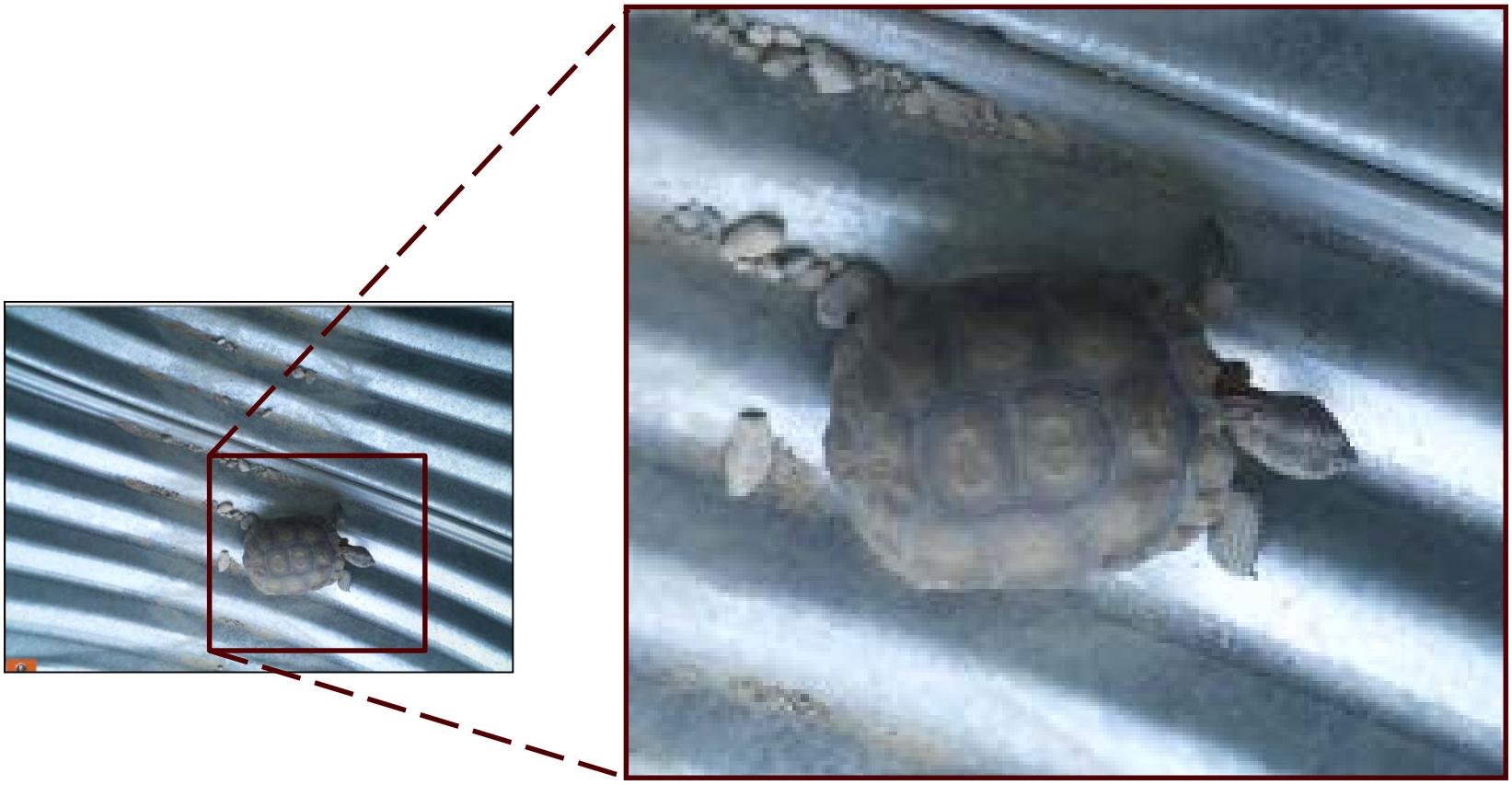
Ground resolution (inches per pixel):	0.06
Ground left-right coverage per image (ft):	28
Ground front-back coverage per image (ft):	19
Ground coverage per daily flight (acres):	169
Ground coverage per daily flight (miles^2):	0.26
Chip width (inches):	33.6
Image overlap (%):	2.5
Triaged observation time per day (hr):	8.0
Field observation time (wks):	168
Auto-triage computing rate per day (hr):	16.0
Raw data upload time per day (hr):	46.1
Chip upload time per day (hr):	1.4
Chip data rate (raw megabits/sec):	8.6
Observer labor reduction:	99.9%
Annual Return on Investment:	$134,414

* This flight/camera scenario was configured to compare field observer labor rates with observer labor rates that could be expected from drone-based image capture and automated image triage. The comparison is based on field observers walking at average rates of 1 ft/sec while scanning 10 m. wide swaths. The flight/camera scenario was set to cover the same swath with a drone, while the drone captures still images with pixel resolutions that could enable comparable detection rates. The overall coverage was set to about the same amount that current field observers cover in a season. Camera specs correspond to a Sony a6000.

"Small" Sample Dataset



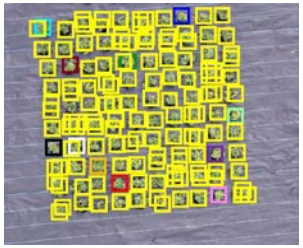
"Small" Dataset Target



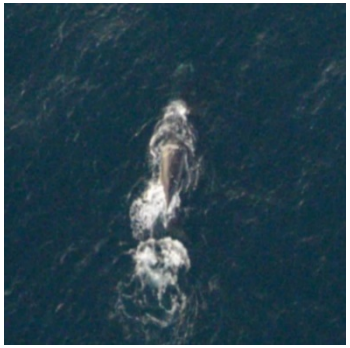
Automatic "Triage" Value

Critical Needs	Automatic Triage Solutions
Reduced detection workload	Independent validation showed that auto-adaptive triage reduced detection workload by 99%.
Faster remote turnaround	Automatic detection enables fast, actionable post-flight or in-flight decision-making.
Faster information delivery	Remote automatic event detection speeds information uploading / transmission.
Better detection precision	Automatic detection of full resolution images produces sharper pixels than real-time inspection of compressed video images.
Lower delivery cost; higher ROI	Easy-to-use analyst development kits will enable affordable analysis and integration.

Commercializing will improve precision/price.



- Equipment inspection
- Wildlife monitoring
- Other event detection
- Event measurement
- Encroachment detection



Real-time "Pull" will improve precision/price.

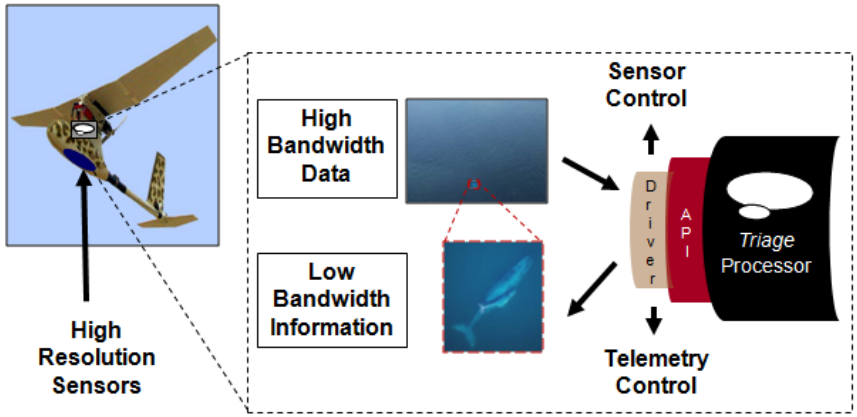
On-board vision (integration pending):

- General-purpose event detection
- Fully automated triage upstream of telemetry
- On-board, real-time processing
- Full resolution, triaged "chip" transmission
- Small packet size / Low SWaP profile
- Rapid configuration / deployment

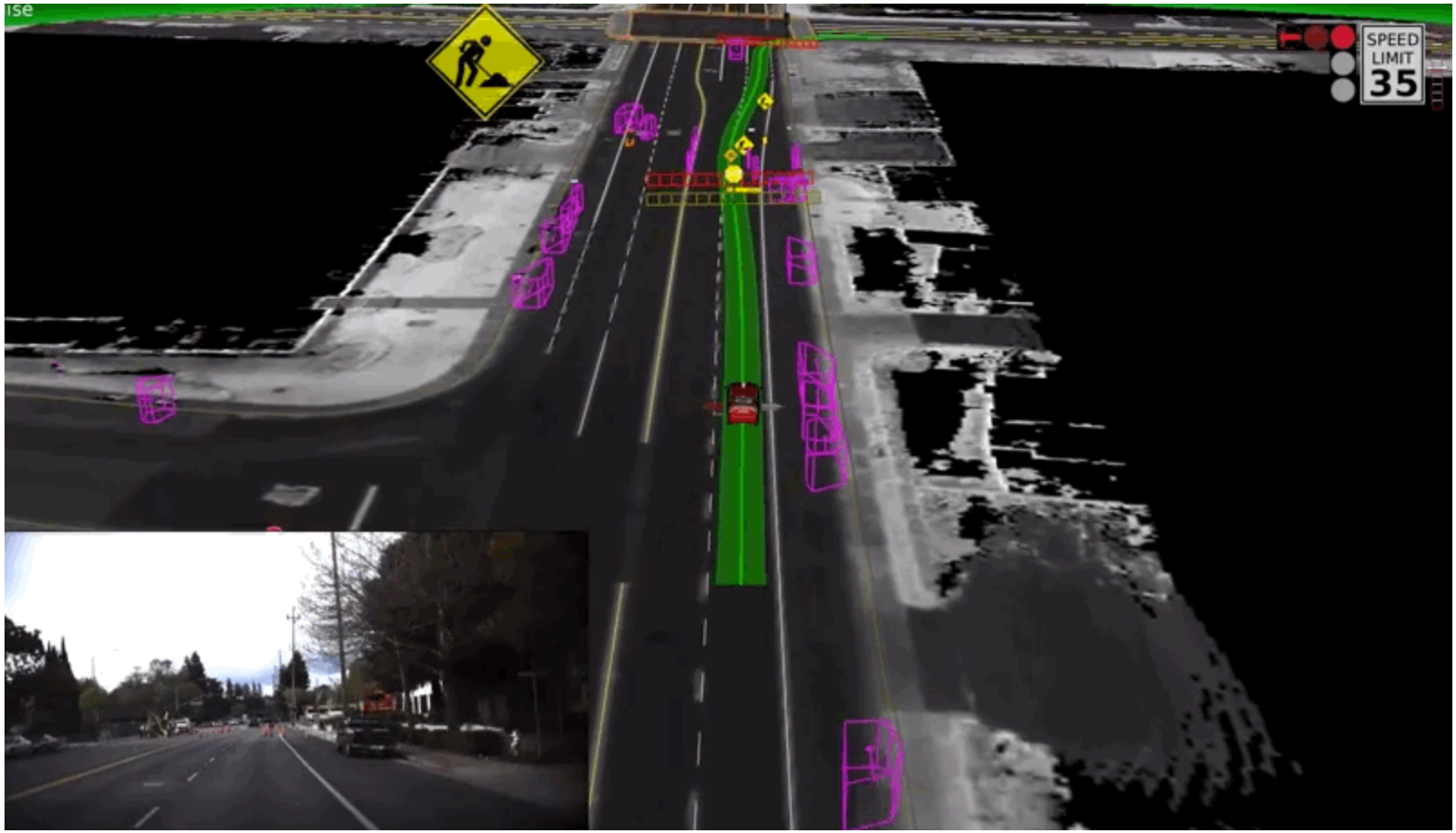
Post-flight version: Highlights event locations to simplify manual detection from airborne images within a vertical domain

Post-flight operational status:

- Locates most targets automatically
- Reduces analysis time by over 90%
- Processes 10,000 images in four hours
- Focuses on marine mammal RGB data



Driverless Car Mapping Challenge



Mapping Solution Demonstration