My Bio

CMU

CENTRAL MICHIGAN UNIVERSITY

THE WILDLIFE SOCIETY

STATE

WILDLIFE, FISHERIES AND AQUACULTURE

Up-close and personal with bears, marten, fisher, and deer

Clay Wilton – Michigan Natural Features Inventory

Bill Parsons – Little Traverse Bay Bands of Odawa Indians

Maxwell Field – Little Traverse Bay Bands of Odawa Indians

Tyler Petroelje – SUNY ESF Global Wildlife Conservation Center

Matthew Lewis – Michigan Aerospace Corporation

27 October 2020

Michigan State University Extension
Conservation Stewards Program

Michigan Natural Features Inventory
Discover. Define. Deliver.

MICHIGAN STATE UNIVERSITY | Extension

Little Traverse Bay Bands of Odawa Indians
Odawa Natural Resources Department

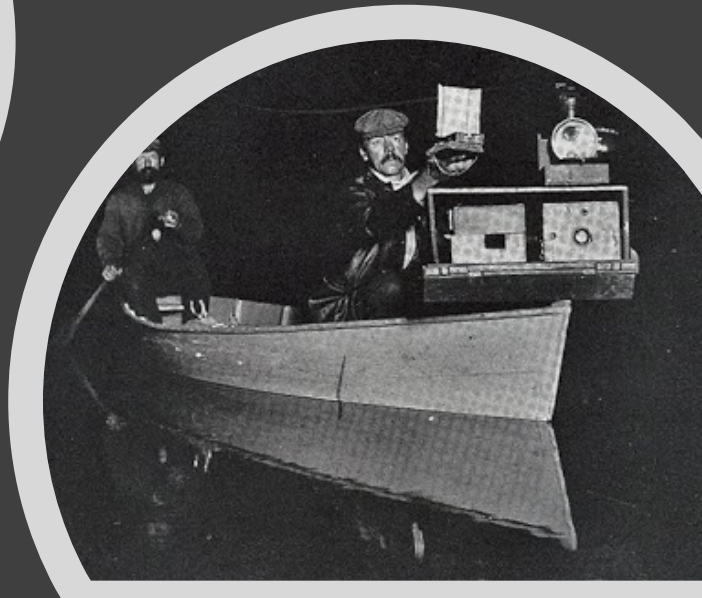
MICHIGAN AEROSPACE™

ESF Global Wildlife Conservation Center
State University of New York College of Environmental Science and Forestry

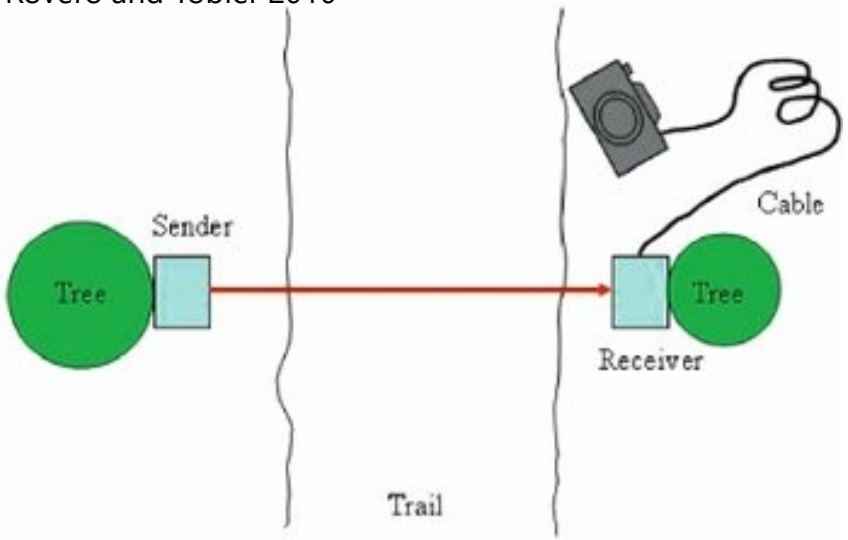
Camera trap history

- **Shiras, G., July 1906. "*Photographing Wild Game with Flashlight and Camera*", National Geographic, 17(7).**

- **Chapman, F.M., September 1927. "*Who Treads Our Trails?*", National Geographic, 52(3), 331-345.**



Rovero and Tobler 2010

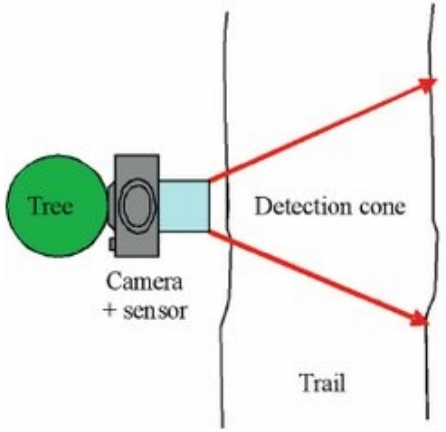


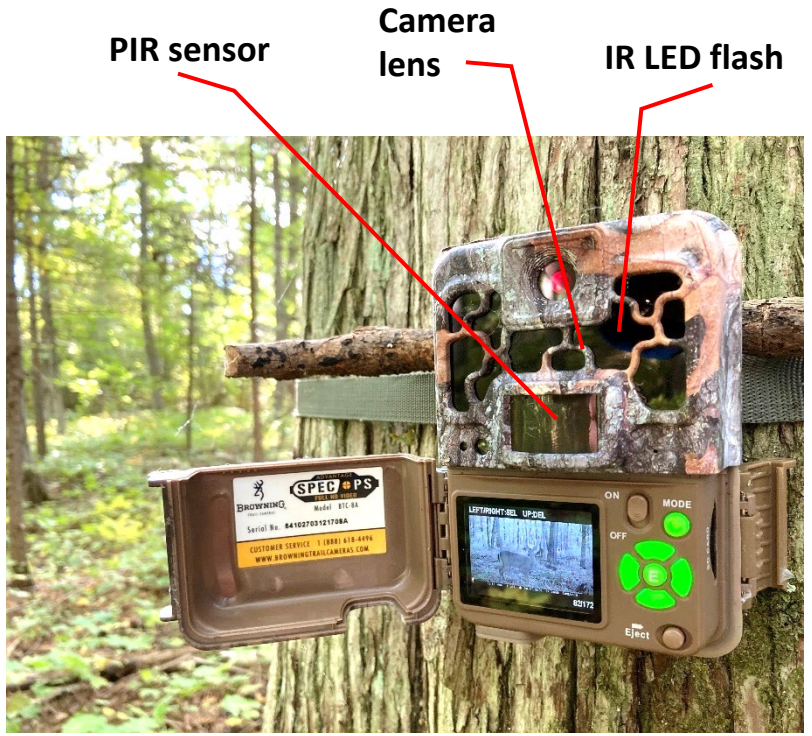
Ahmed et al. 2009

Karanth and Nichols 2011

Camera trap basics & history

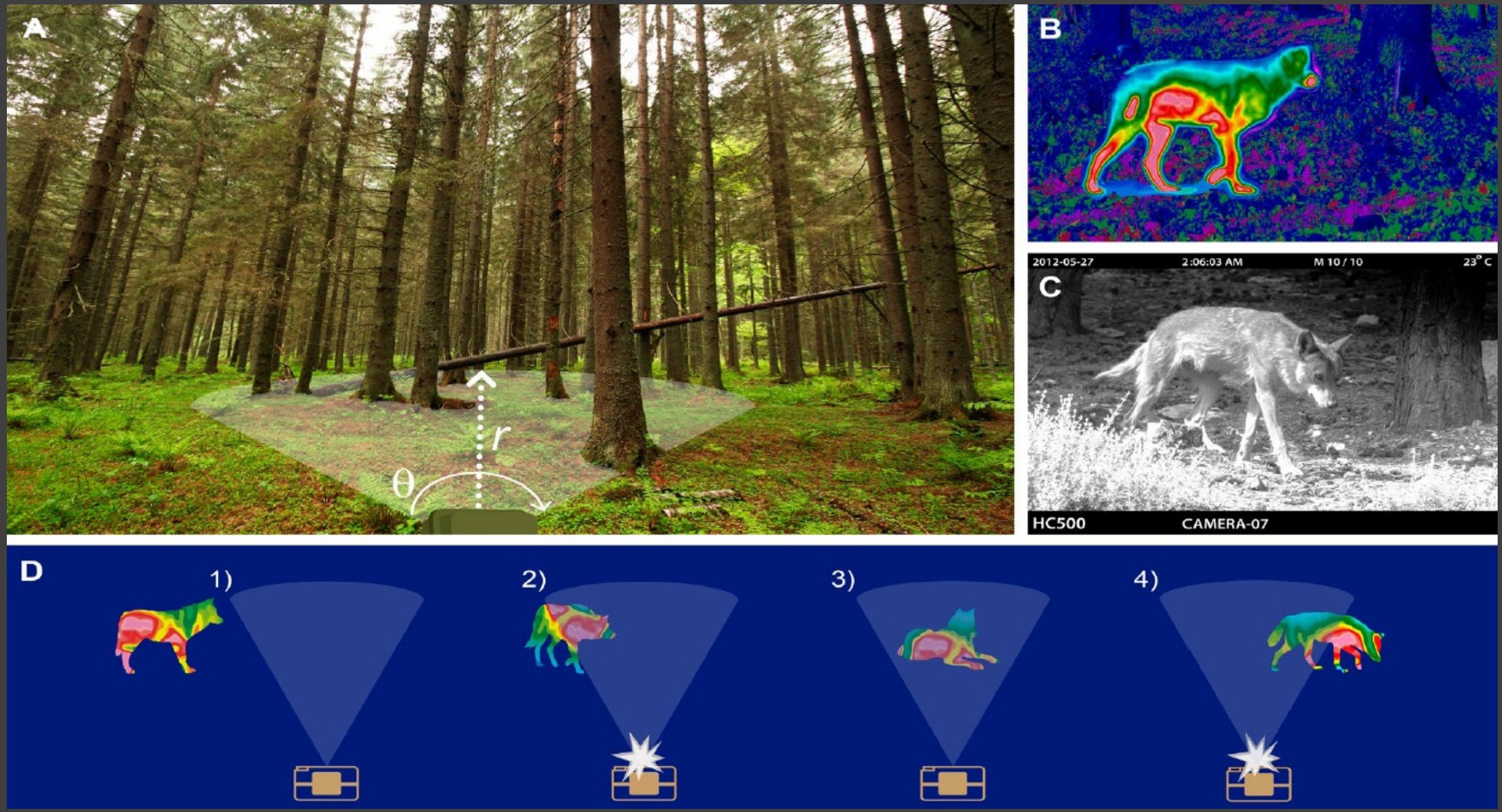
Active Infrared Sensors





Camera trap basics & history

Passive Infrared Sensors



Wearn O.R. and P. Glover-Kapfer 2017. Camera-trapping guide for conservation: a guide to best-practices

Why ecologists love camera traps

*1400 pubs as of 2017

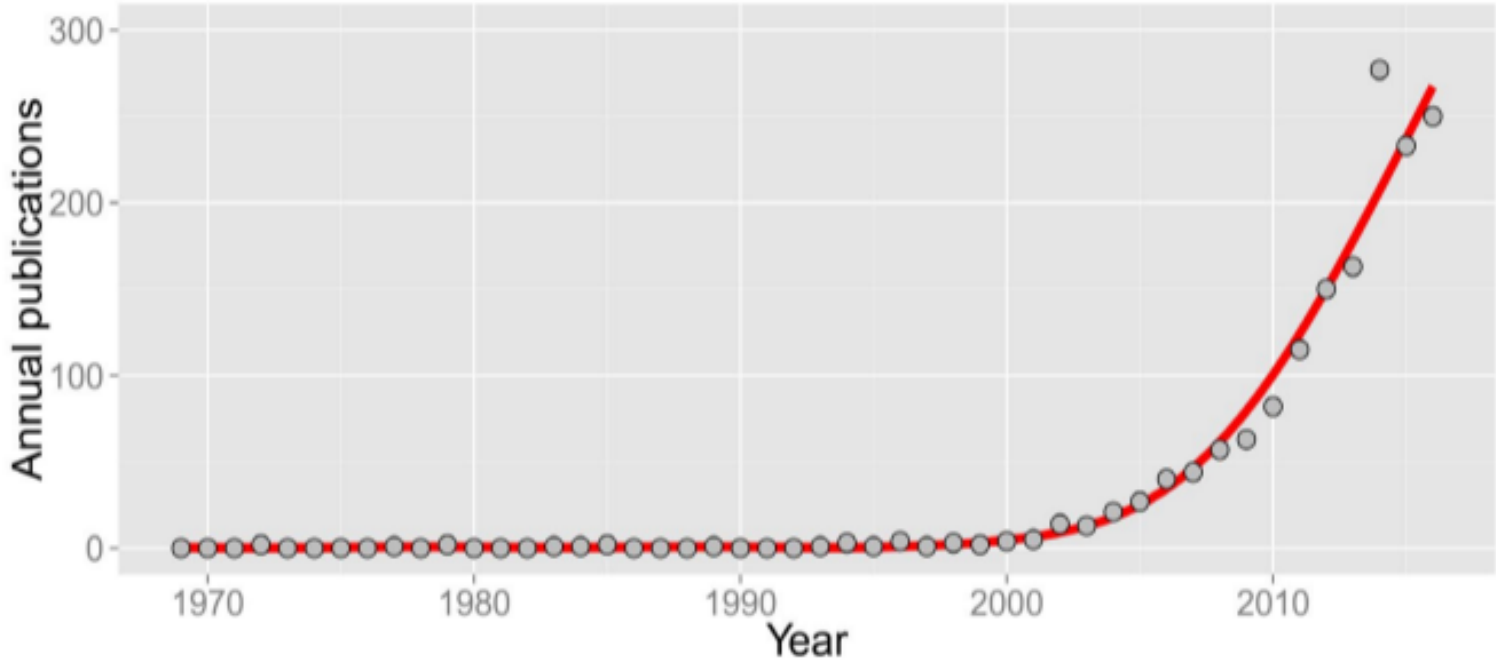


Figure 2-1. Annual number of articles listed in the Web of Science mentioning camera traps (or various other synonyms, such as automatic camera, game camera, or remote camera) between 1969 (the first year of reliable records) and 2016. For the period before 2000, a total of just 25 articles were listed, which is fewer than the annual number of publications from 2005 onwards. The figure for 2016 was extrapolated based on the results up to June of that year.

Wearn and Glover-Kapfer 2017. Camera-trapping guide for conservation: a guide to best-practices

Why ecologists love camera traps

Logistical benefits

- Non-invasive
- Passive monitoring
- Long sample period
  - Detect hyper-rare events
- Readily available & inexpensive
- Easy setup/deploy
- Verifiable data & permanence
- Highly repeatable methodology

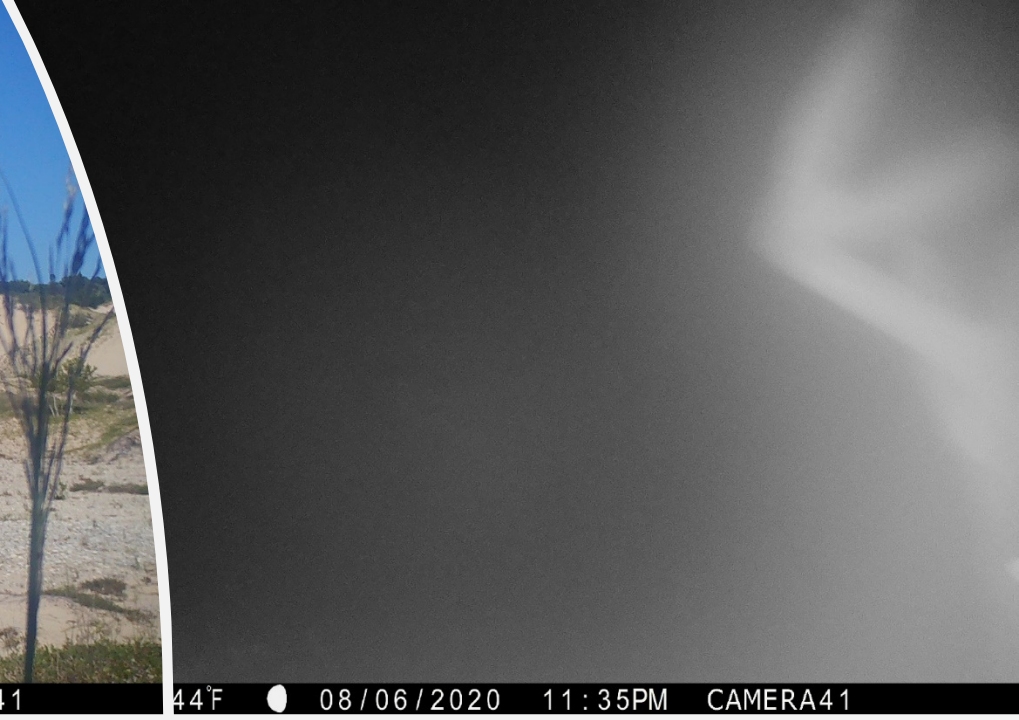
Why ecologists love camera traps

Research applications for camera traps

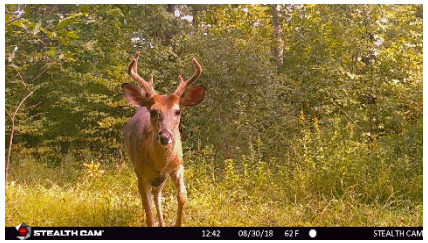
- Occupancy (habitat use and distribution)
- Abundance (relative & capture-recapture)
- Behavior (undisturbed)
- Community dynamics (e.g., cooccurrence)
- Biodiversity inventory (esp. rare species)
- And more!

So what's the catch!?

- Cost/benefit of cam traps
  - Large upfront $$
- Poor performance in extreme environments
- Limited species detection
  - Large, warm-blooded, active and terrestrial animals
- Fraction of area surveyed per camera
- False positives



So. Many. Photos.



The camera trap dilemma

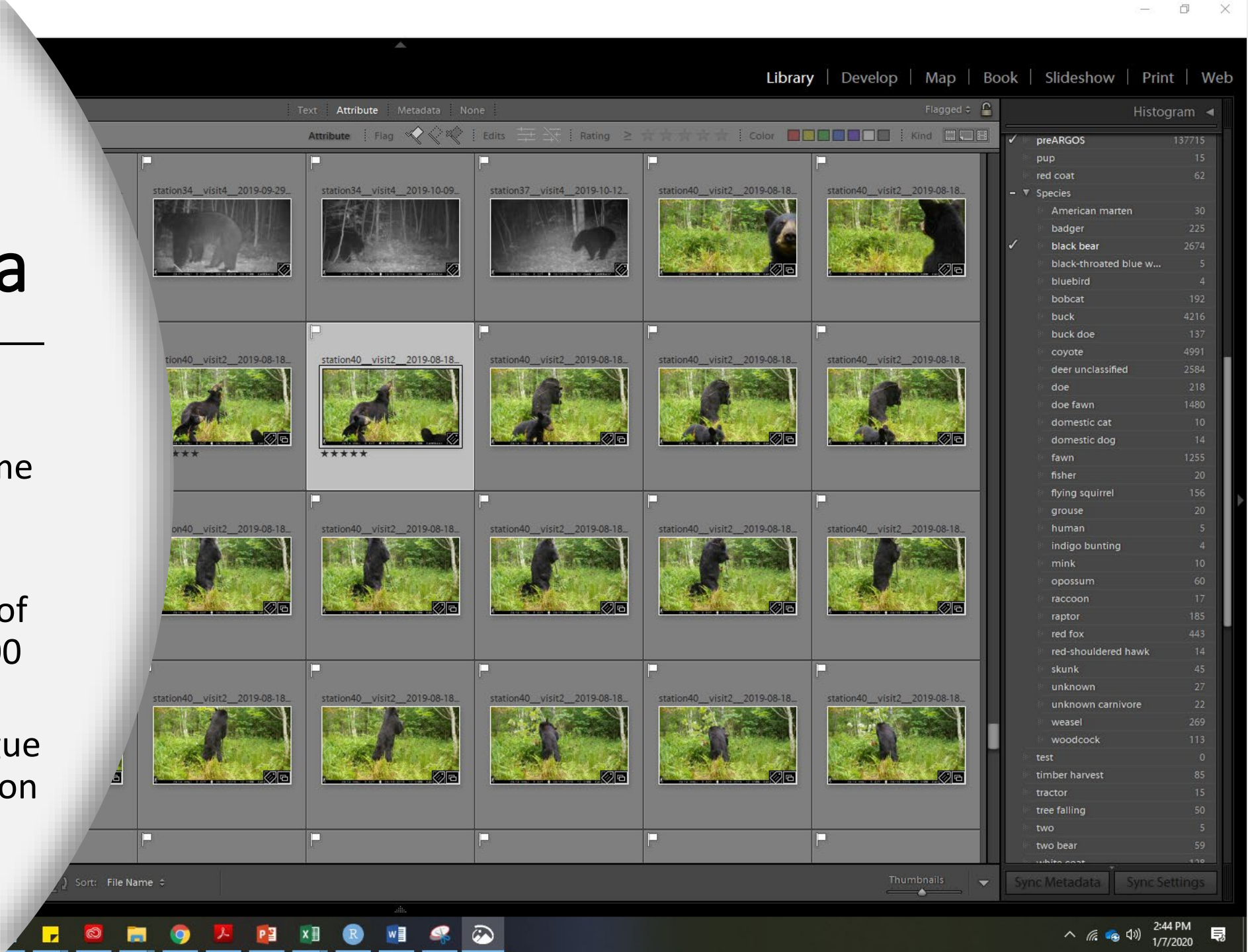
Benefit: easy to deploy cameras and collect a lot of data

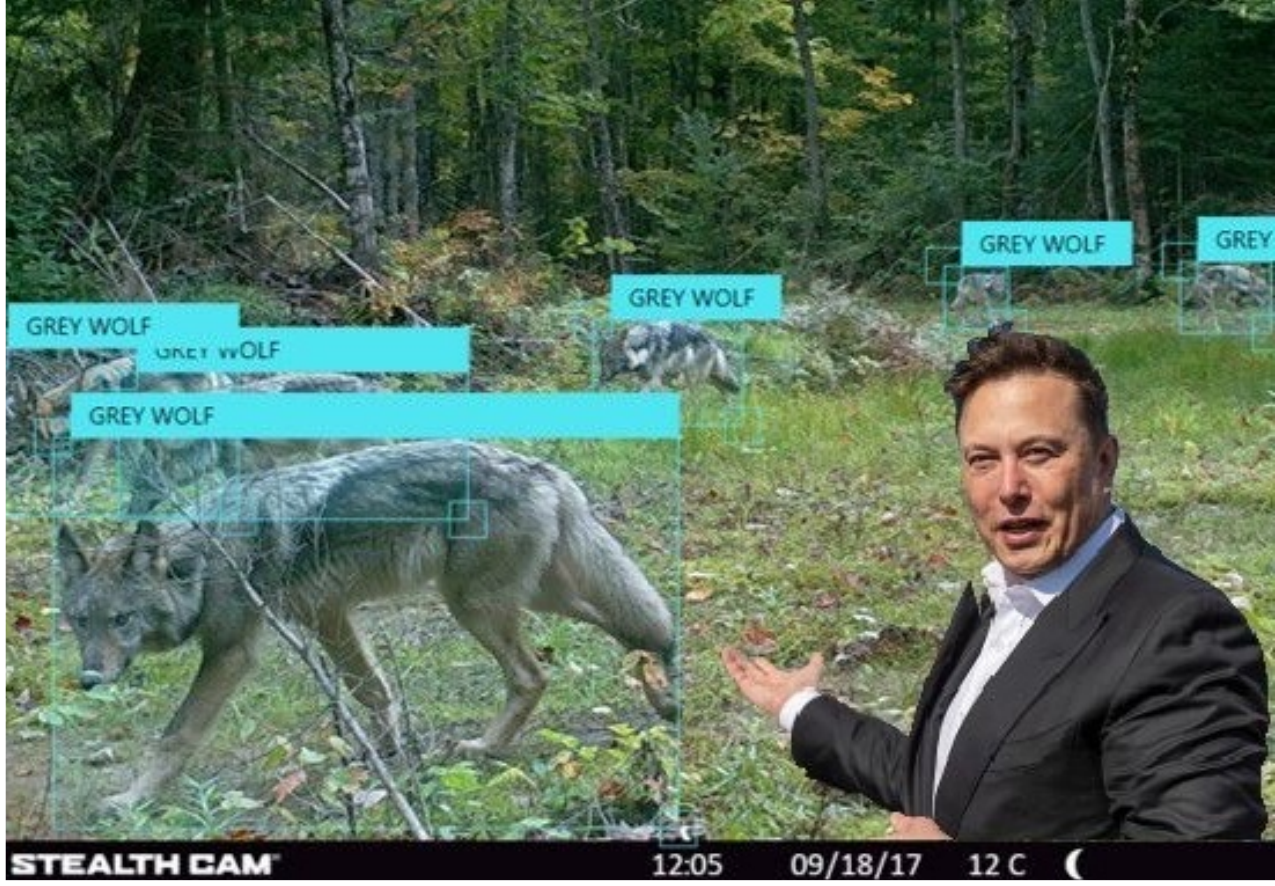
Problem: storage, organization, data extraction

The camera trap dilemma

Time investment

- Manual annotation time
  - 600 – 3,000 photos/hour
  - ~166 – 833 hours of annotating 500,000 photos
  - Identification fatigue and misclassification



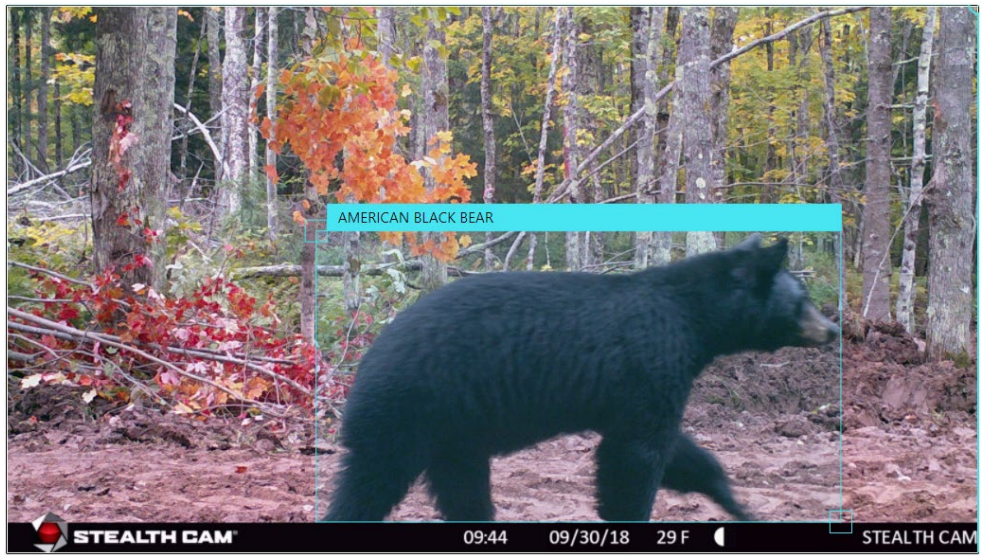


Big data solutions: Artificial Intelligence

Can we transfer this tech to camera trap data?

Interdisciplinary and Collaborative Approach

- Work directly with partners with expertise in machine learning
- Collaborative approach



MICHIGAN AEROSPACE™

Michigan Natural Features Inventory
Discover. Define. Deliver.

ESF Global Wildlife Conservation Center
State University of New York College of Environmental Science and Forestry

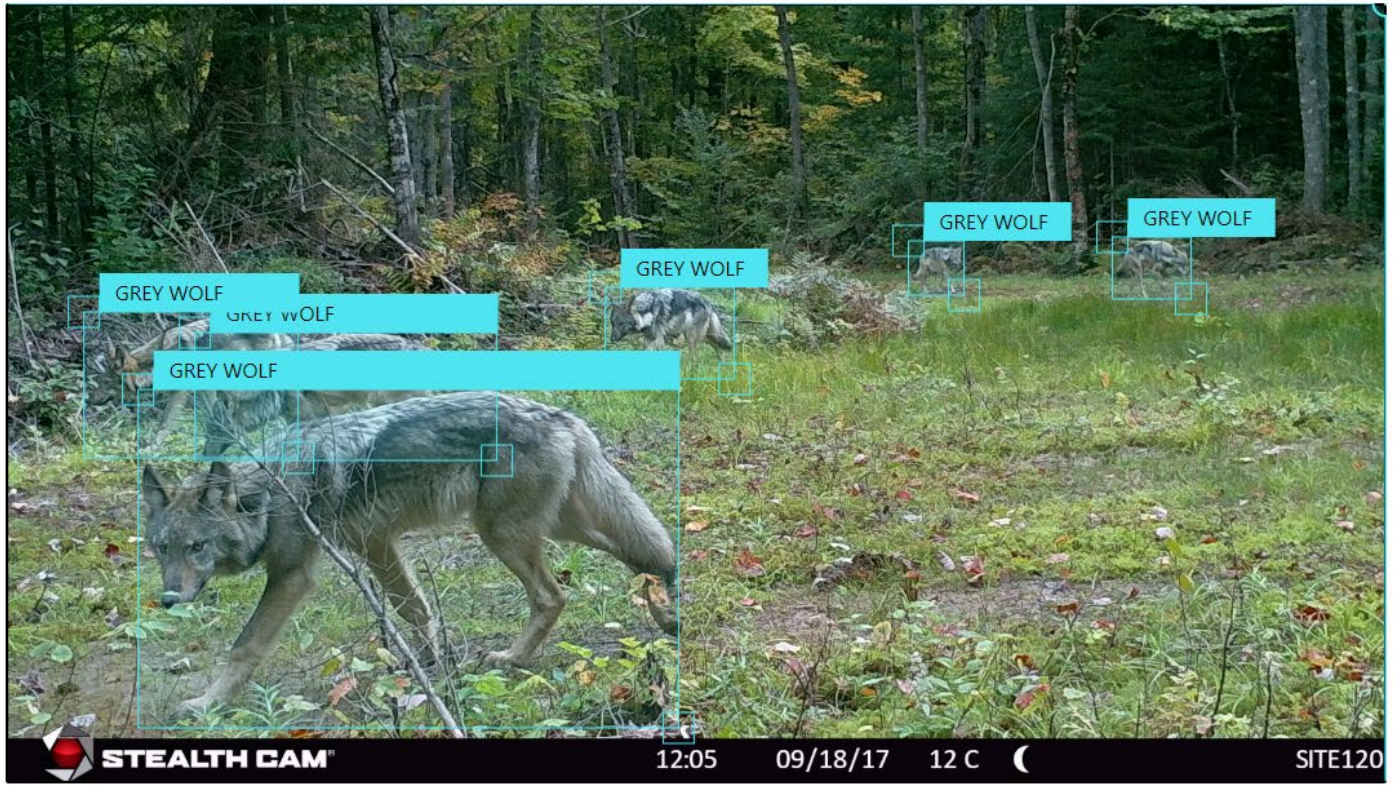
18 SEP 2017 12:05:08 (7/9)

Tips

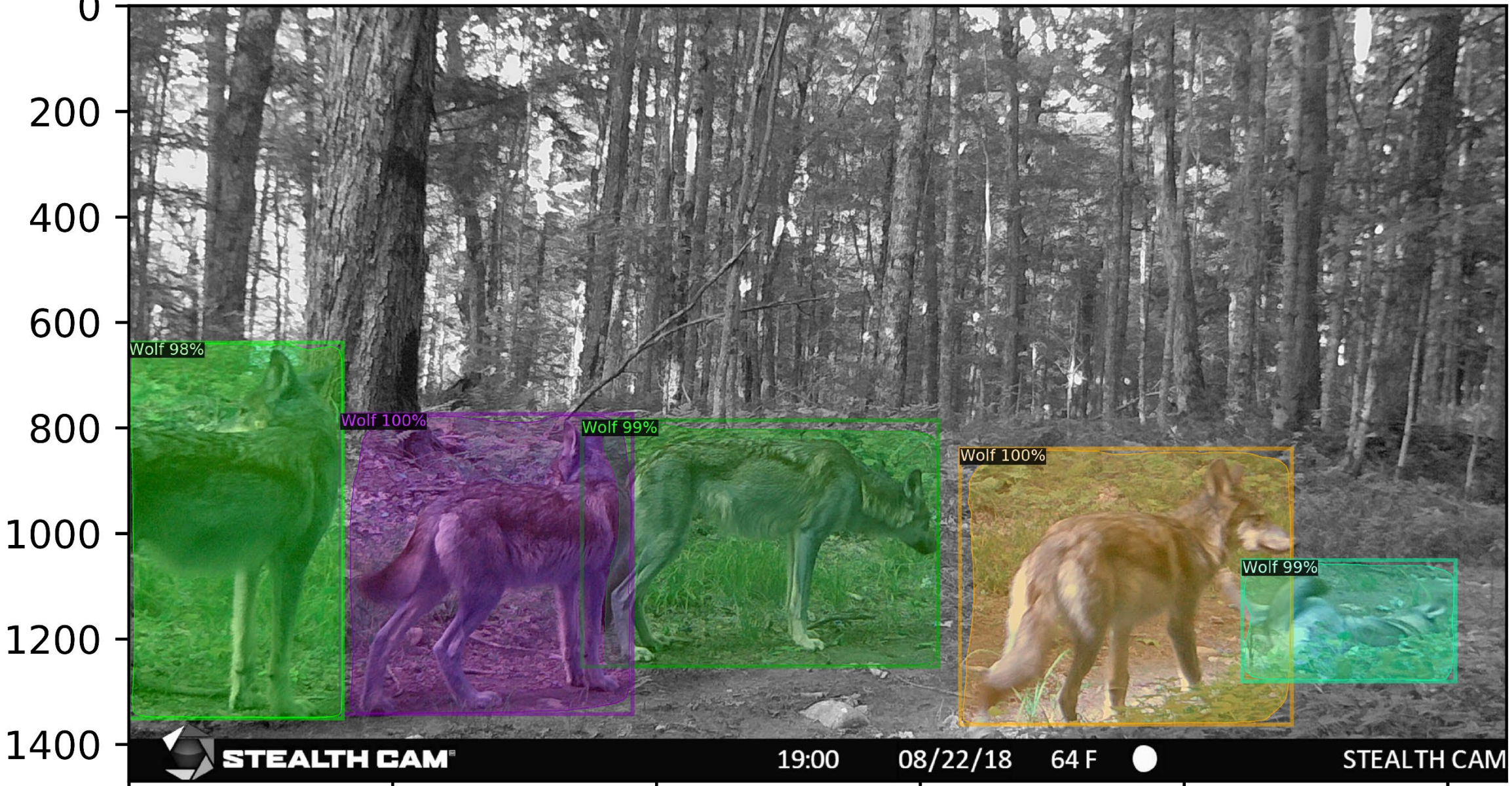
Use the arrow keys (←→) to switch between images in the current burst. Use **shift** + (←→) to navigate between camera bursts. Use the up arrow ↑ to return to the burst list.

To label image content, first select a target above and then drag on the image to label image content. To delete a label, click on the label to select it, and then press **delete**.

To change a label's target species, select the label and then select a new target above.

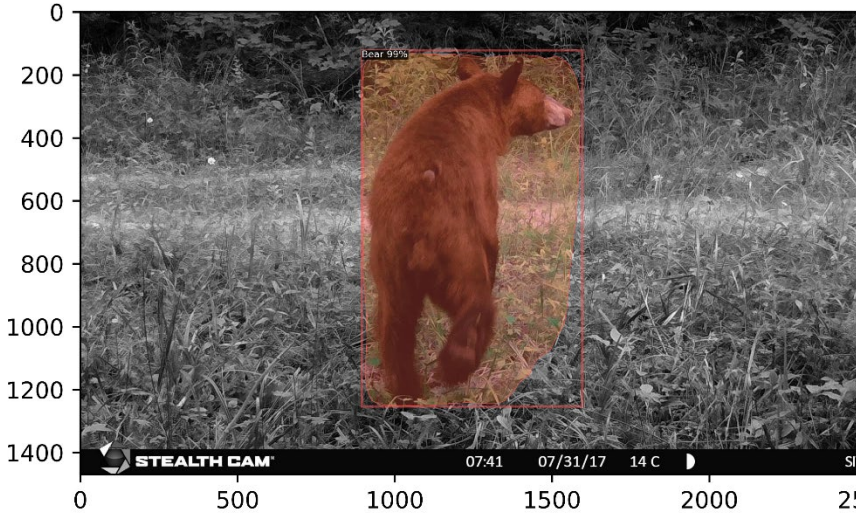


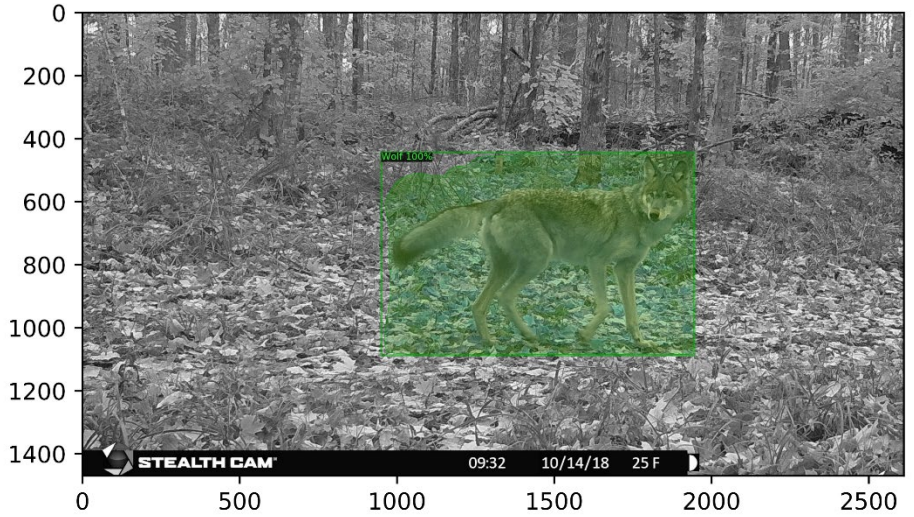
ANNOTATION

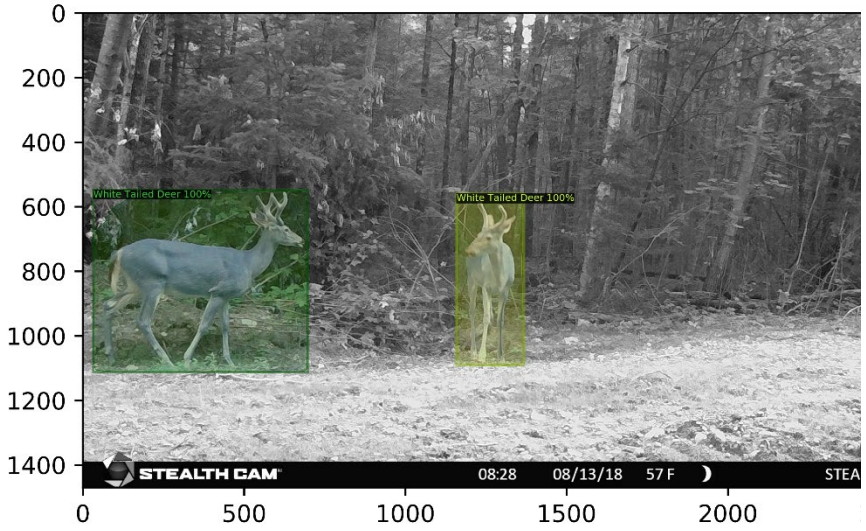

Wolf 98%
Wolf 100%
Wolf 99%
Wolf 100%
Wolf 99%
STEALTH CAM
19:00
08/22/18
64 F
STEALTH CAM
0
200
400
600
800
1000
1200
1400
0
500
1000
1500
2000
2500
PREDICTION

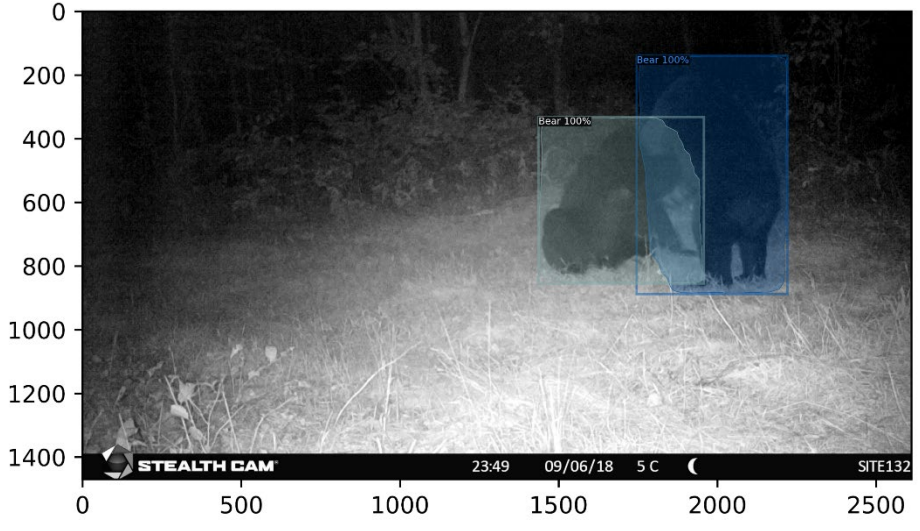
Continuing/Future Developments

- Continue growing the number of species models can identify
- Age/sex specific models (buck, doe, fawn)
- Behavioral trait models (vigilance, head up/down)



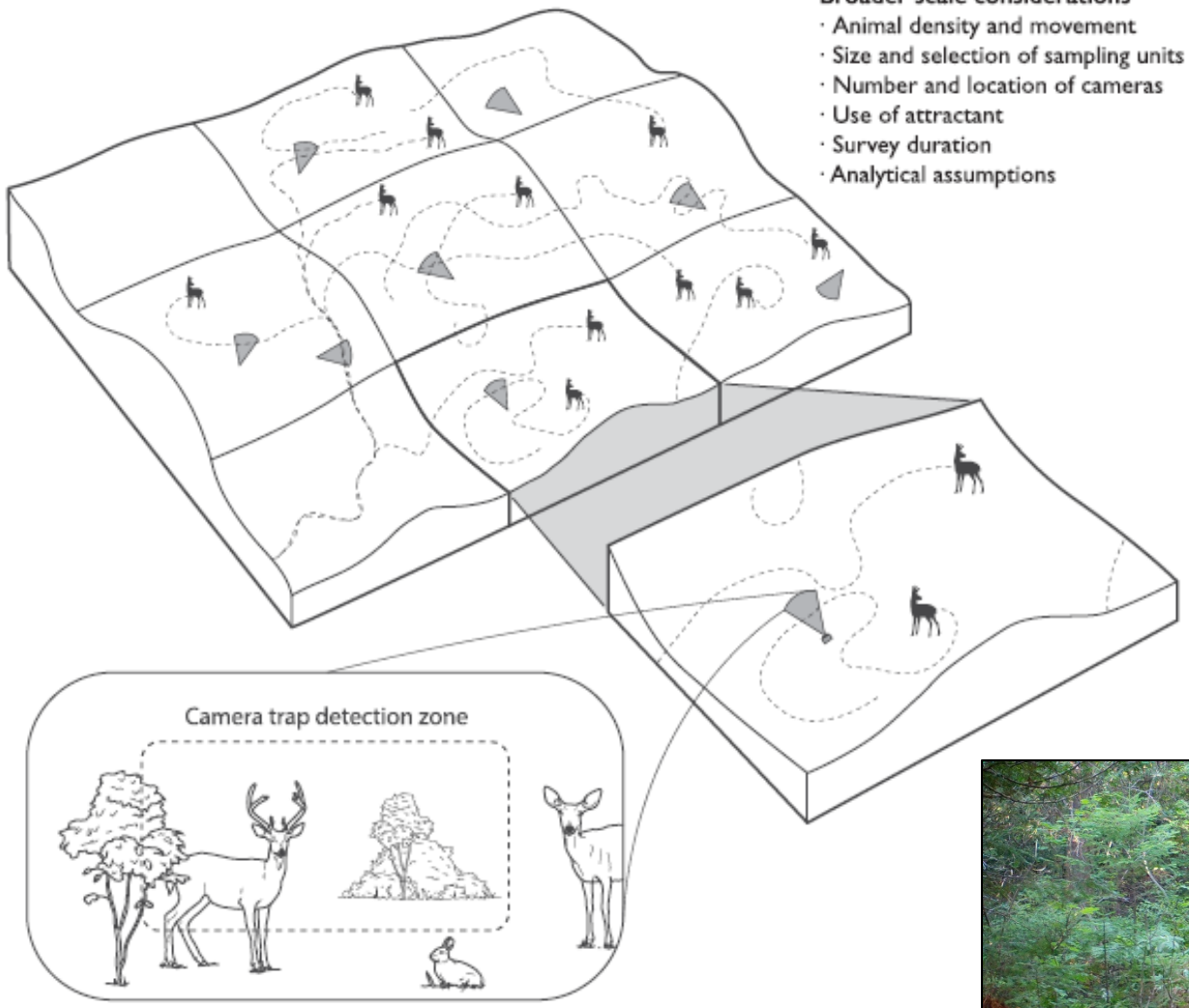




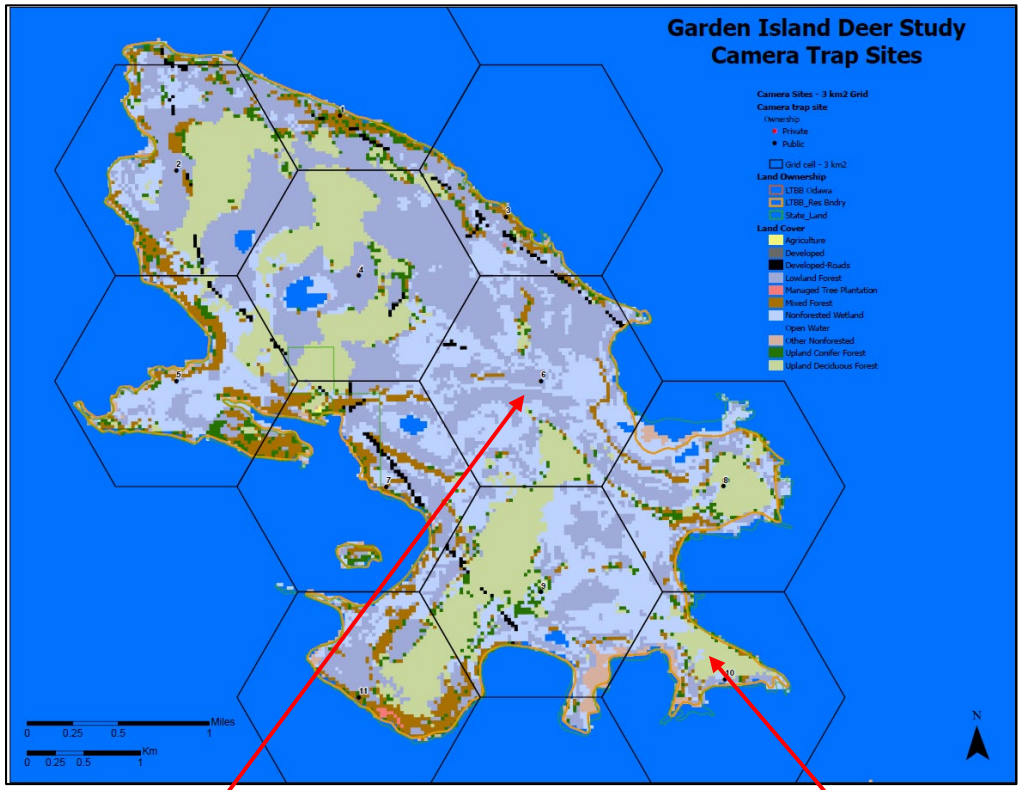


Designing a camera trap study for populations

Broader scale considerations
- Animal density and movement
- Size and selection of sampling units
- Number and location of cameras
- Use of attractant
- Survey duration
- Analytical assumptions

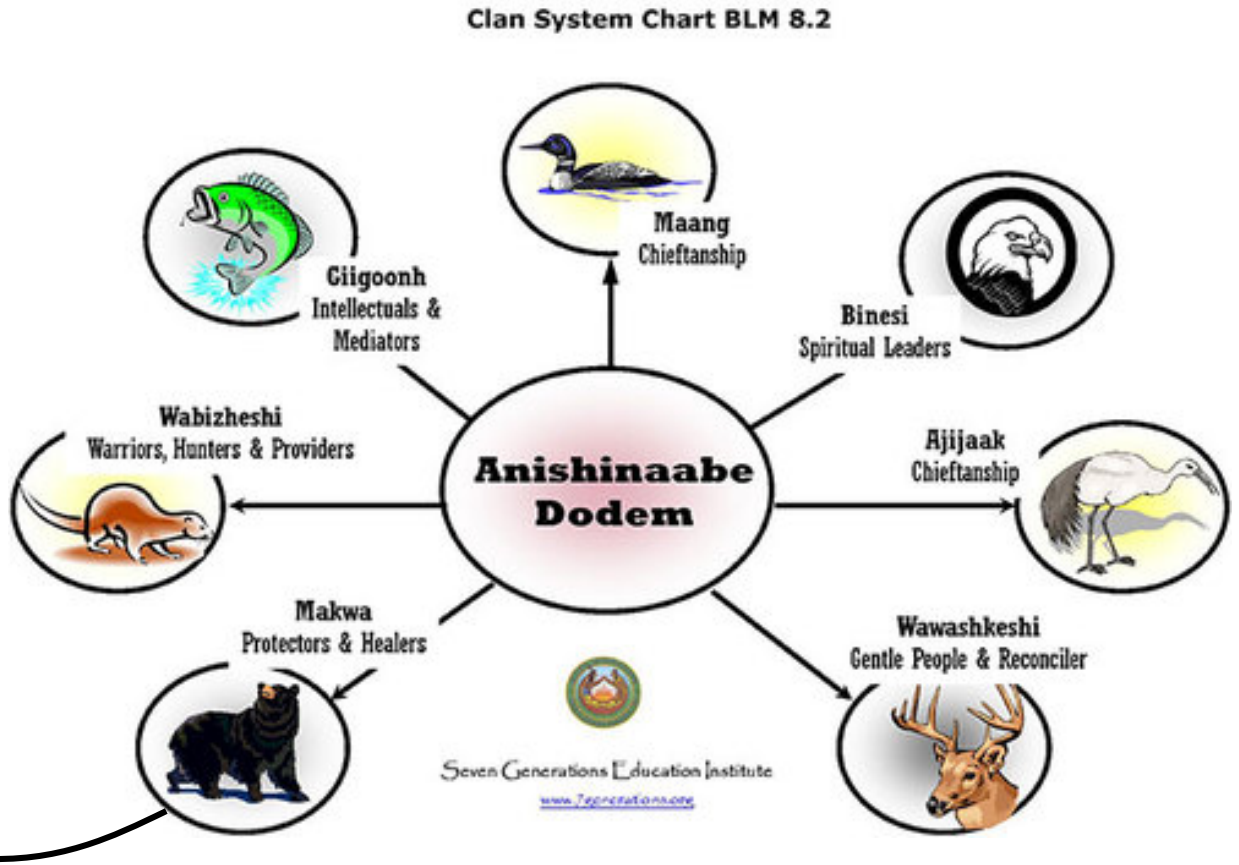


Burton et al. 2015



Up Close & Personal: American black bear

Anishinaabek clan system

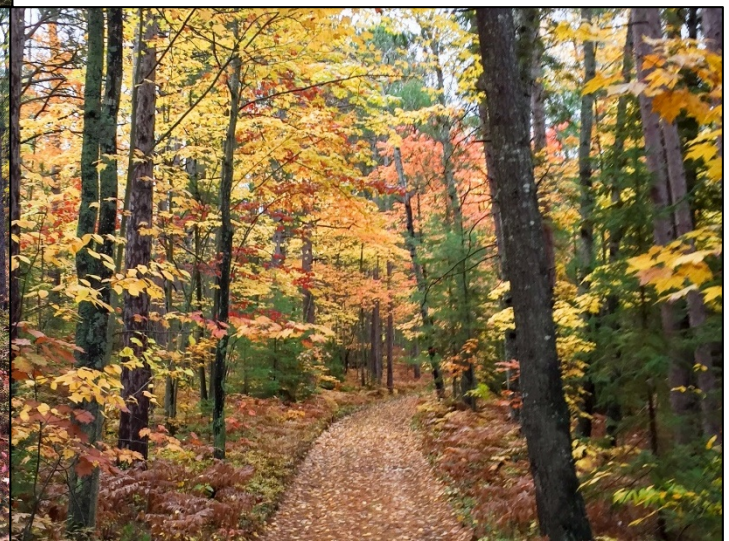


Makwa (American black bear) distribution and habitat use in the 1855 LTBB Odawa Indian Reservation

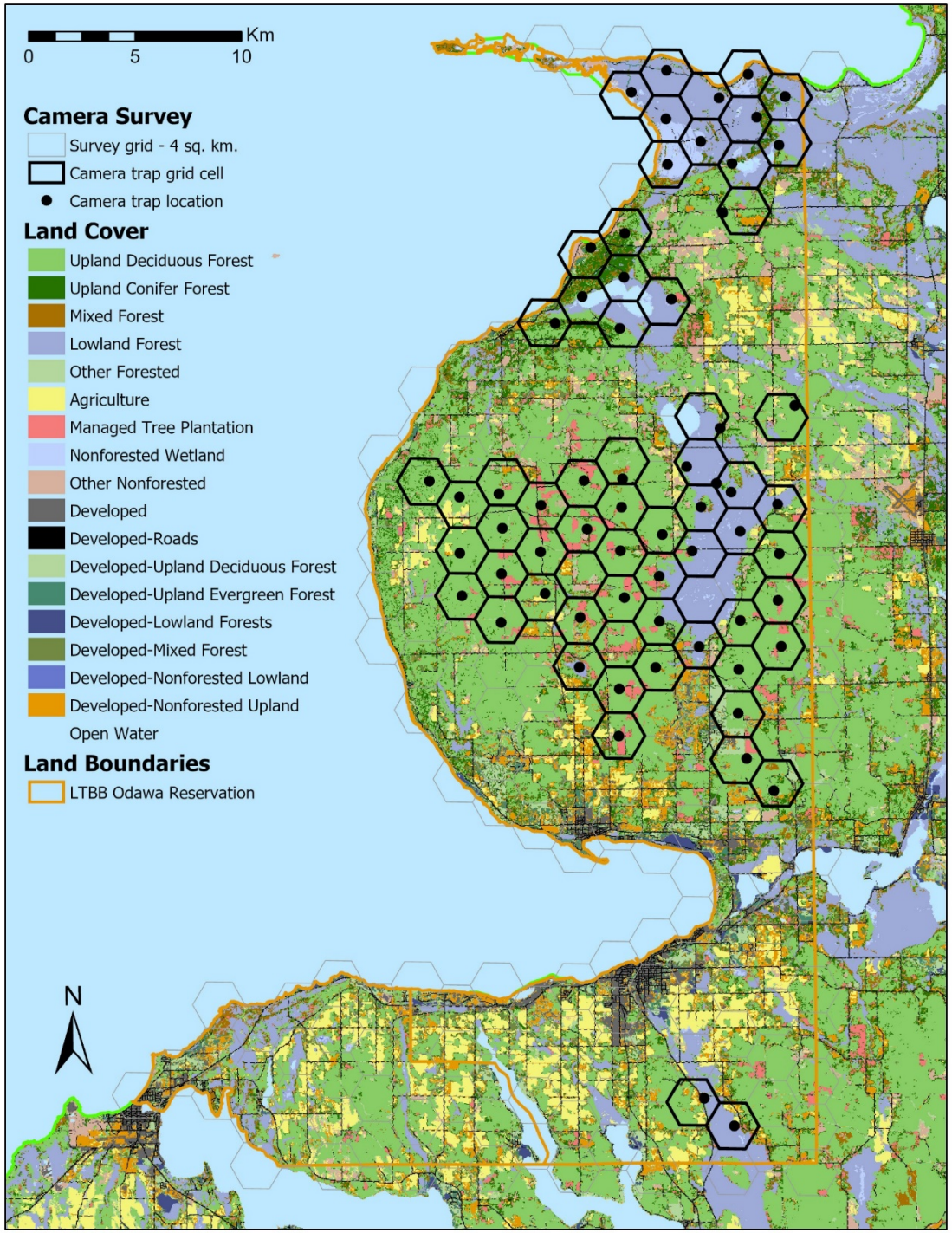
LITTLE TRAVERSE BAY BANDS OF ODAWA INDIANS
ODAWA NATURAL RESOURCES DEPARTMENT

MICHIGAN STATE UNIVERSITY | Extension

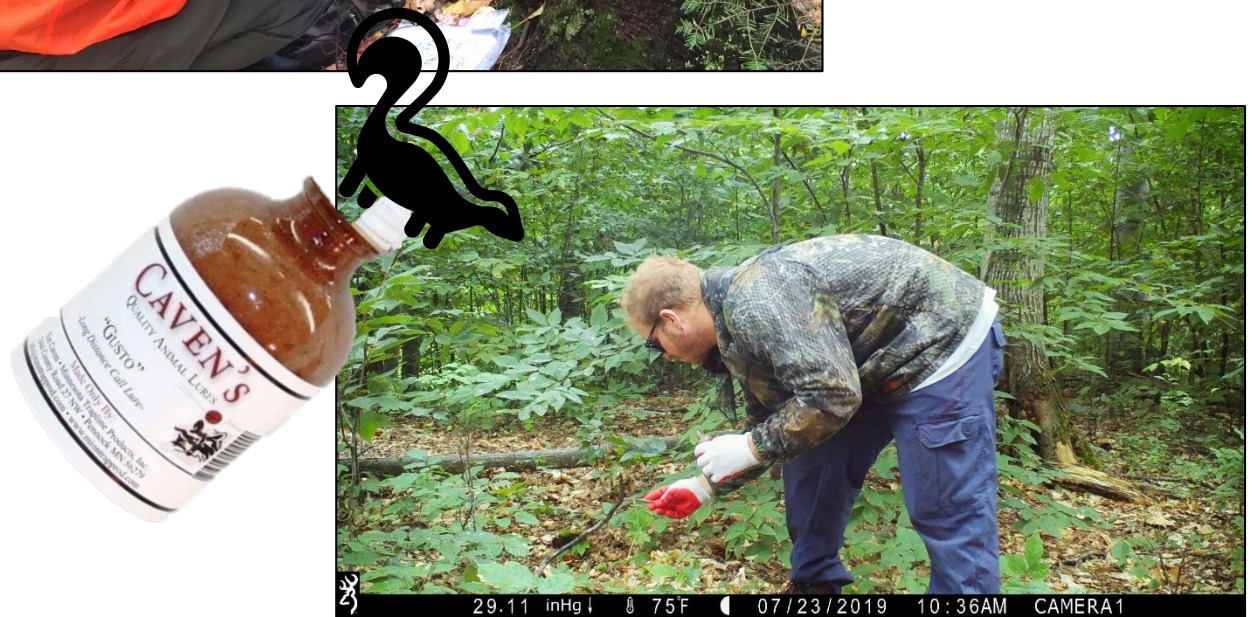
Study Area

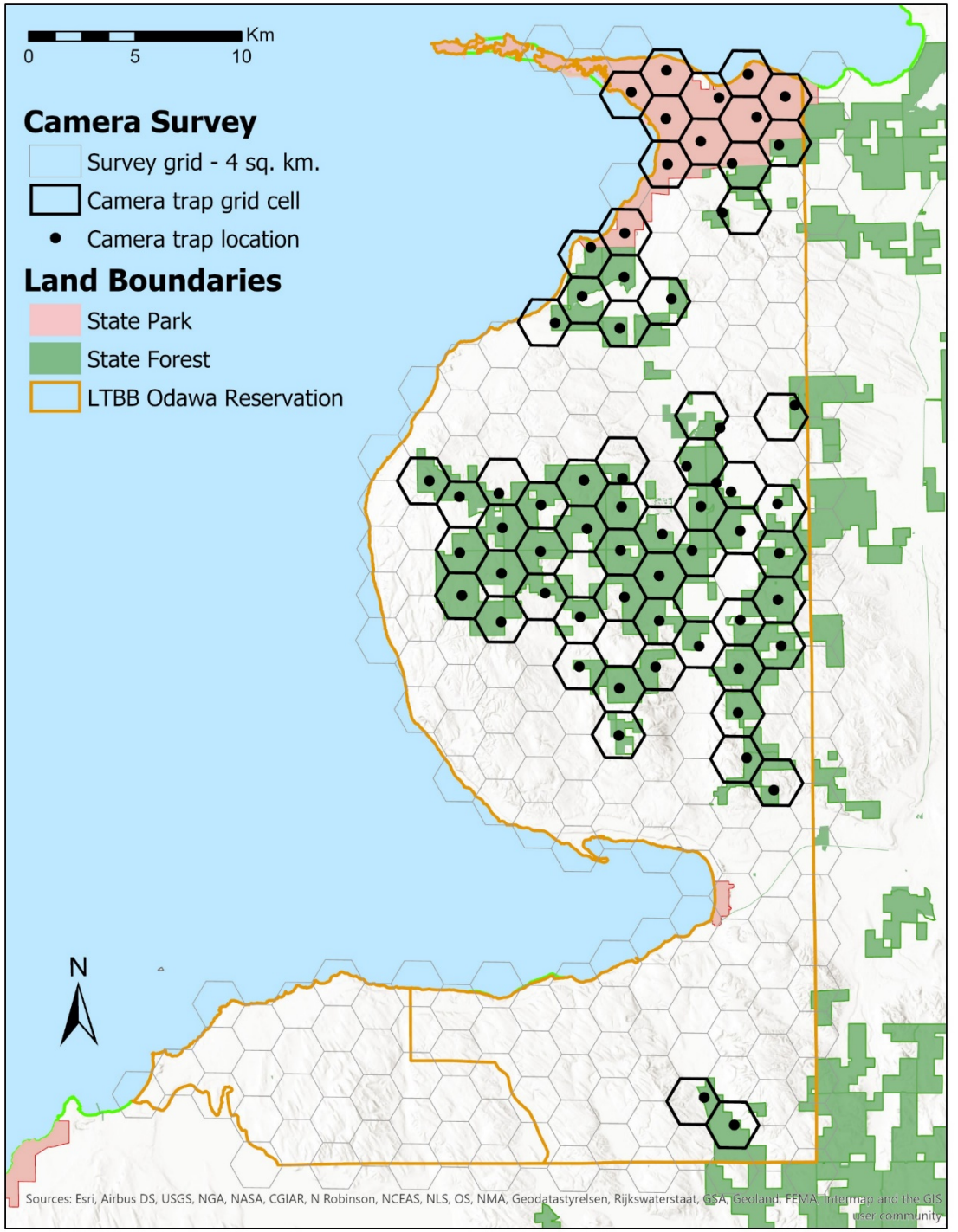


Keweenaw
Houghton
Ontonagon
Baraga
Gogebic
Iron
Marquette
Dickin-son
Meno-minee
Delta
Alger
Schoolcraft
Luce
Chippewa
Mackinac
Emmet
Cheboy-gan
Presque Isle
Charlevoix
Antrim
Otsego
Mont-morency
Alpena
Leelanau
Benzie
Grand Traverse
Kalkaska
Crawford
Oscoda
Alcona
Manistee
Wexford
Missau-kee
Roscom-mon
Ogemaw
Iosco
Arenac
Mason
Lake
Osceola
Clare
Gladwin
Huron
Bay
Oceana
Newaygo
Mecosta
Isabella
Midland
Tuscola
Sanilac
Montcalm
Gratiot
Saginaw
Muskegon
Ottawa
Kent
Ionia
Clinton
Shia-wassee
Genesee
Lapeer
St Clair
Allegan
Barry
Eaton
Ingham
Liv-ingston
Oakland
Macomb
Van Buren
Kala-mazoo
Calhoun
Jackson
Washtenaw
Wayne
Berrien
Cass
St Joseph
Branch
Hillsdale
Lenawee
Monroe


Km
0
5
10
Camera Survey
Survey grid - 4 sq. km.
Camera trap grid cell
Camera trap location
Land Cover
Upland Deciduous Forest
Upland Conifer Forest
Mixed Forest
Lowland Forest
Other Forested
Agriculture
Managed Tree Plantation
Nonforested Wetland
Other Nonforested
Developed
Developed-Roads
Developed-Upland Deciduous Forest
Developed-Upland Evergreen Forest
Developed-Lowland Forests
Developed-Mixed Forest
Developed-Nonforested Lowland
Developed-Nonforested Upland
Open Water
Land Boundaries
LTBB Odawa Reservation
N

Study Design & Methods





Summary Results

---

[1] Total number of stations: **63**

---

[1] Total trapping period: **07-22 to 10-23**

---

[1] Mean deployment: **89 days (65-91)**

---

[1] Total number of images: **137,706**

- 65% of animals, 35% empty

Summary Results Black Bear

---

[1] Mean number of observations per site: **1.03**

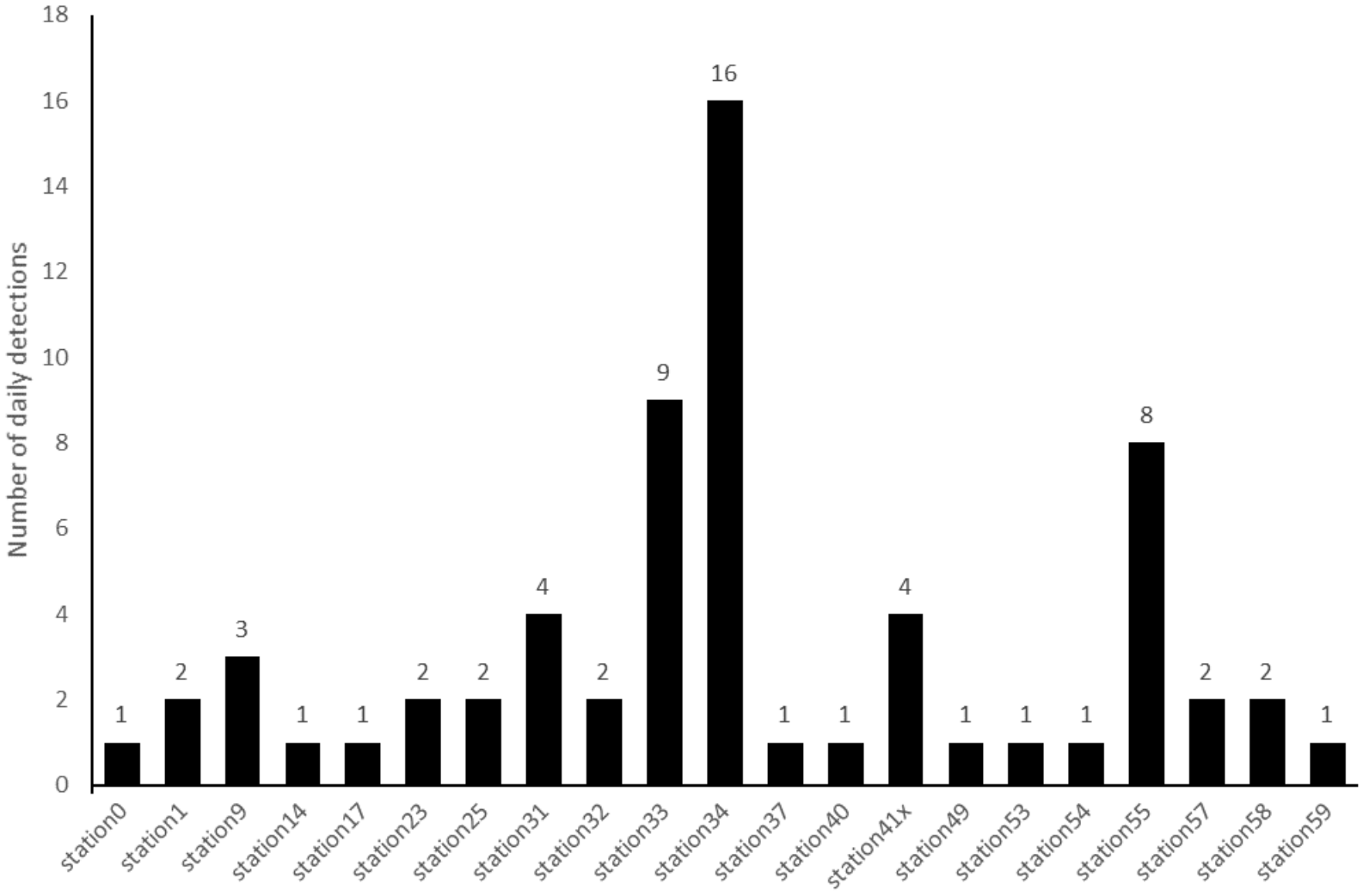
---

[1] Sites with at least one detection: **21**

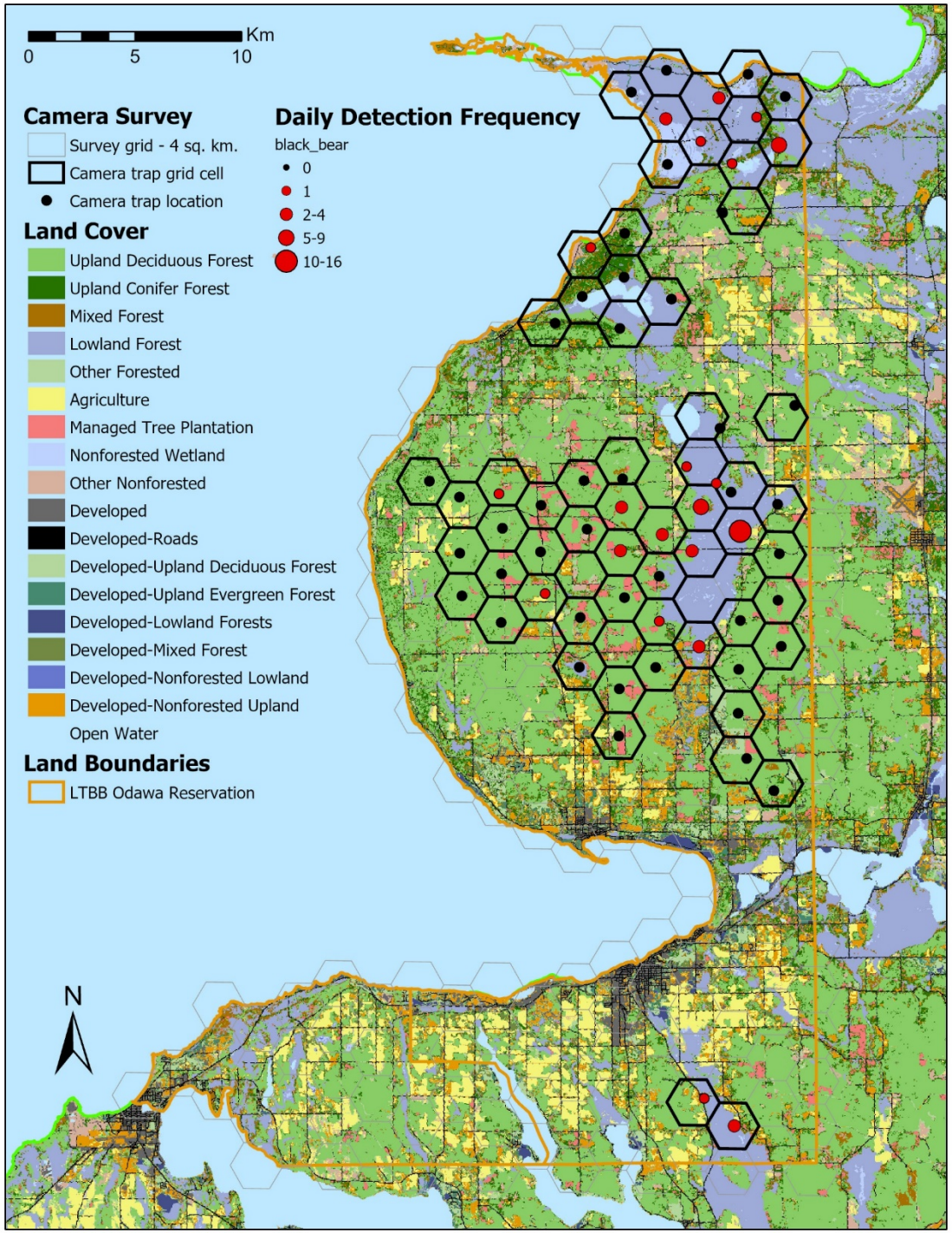
---

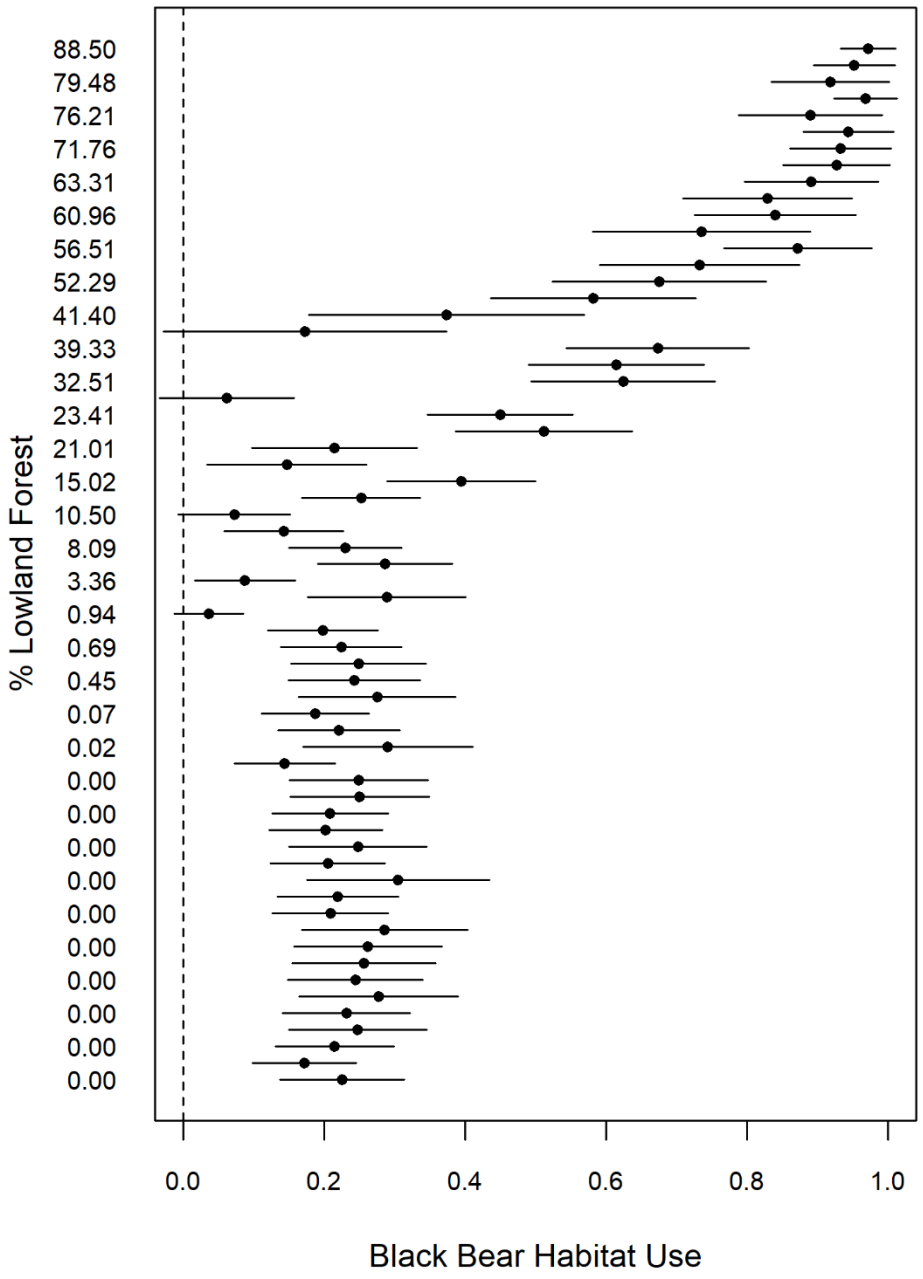
[1] Number of daily detections: **65**

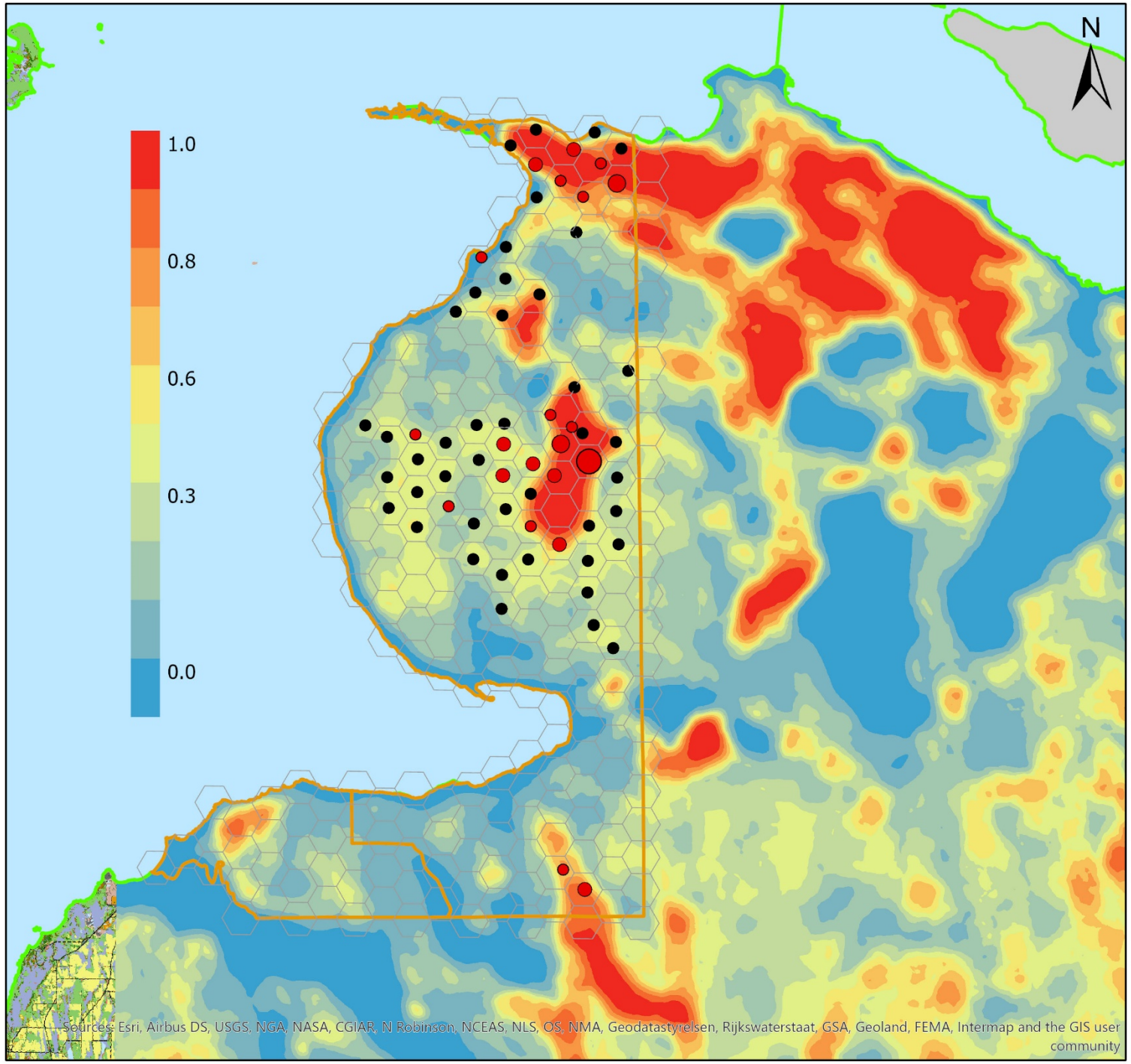
Summary Results – Black Bear



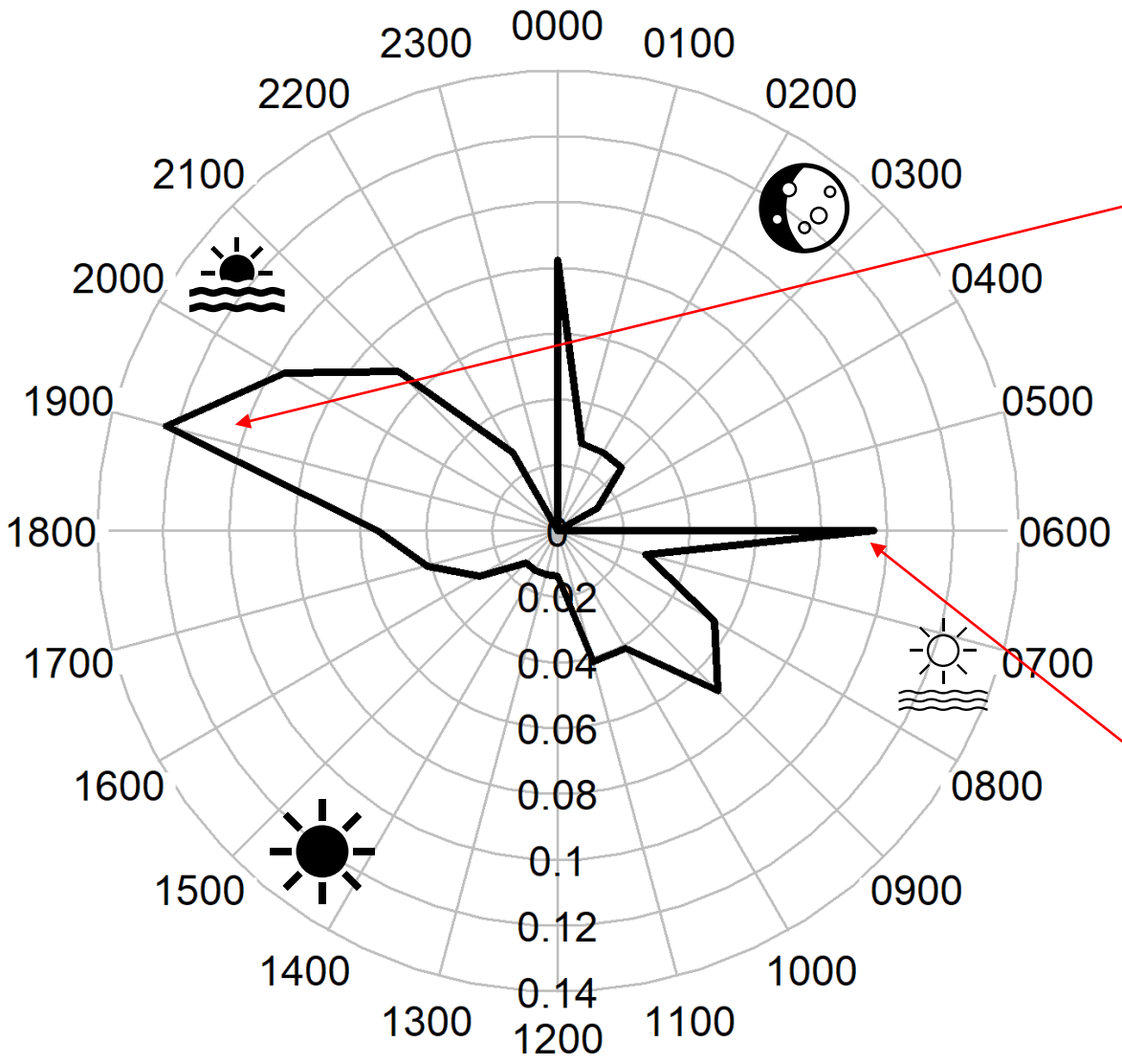
Summary Results – Black Bear




% Lowland Forest
88.50
79.48
76.21
71.76
63.31
60.96
56.51
52.29
41.40
39.33
32.51
23.41
21.01
15.02
10.50
8.09
3.36
0.94
0.69
0.45
0.07
0.02
0.00
0.00
0.00
0.00
0.00
0.00
0.00
0.00
0.00
0.00
0.00
0.0
0.2
0.4
0.6
0.8
1.0
Black Bear Habitat Use


N
1.0
0.8
0.6
0.3
0.0
Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

Activity of black bear



29.06 inHg↑ 57°F 09/04/2019 09:14AM CAMERA22

29.00 inHg↓ 48°F 08/16/2019 09:16AM CAMERA11

29.29 inHg↑ 39°F 10/15/2019 06:45AM CAMERA30

29.32 inHg↑ 57°F 09/09/2019 11:54AM CAMERA26

29.14 inHg↑ 44°F 09/16/2019 07:15PM CAMERA5

29.59 inHg- 75°F 09/19/2019 04:14PM CAMERA47

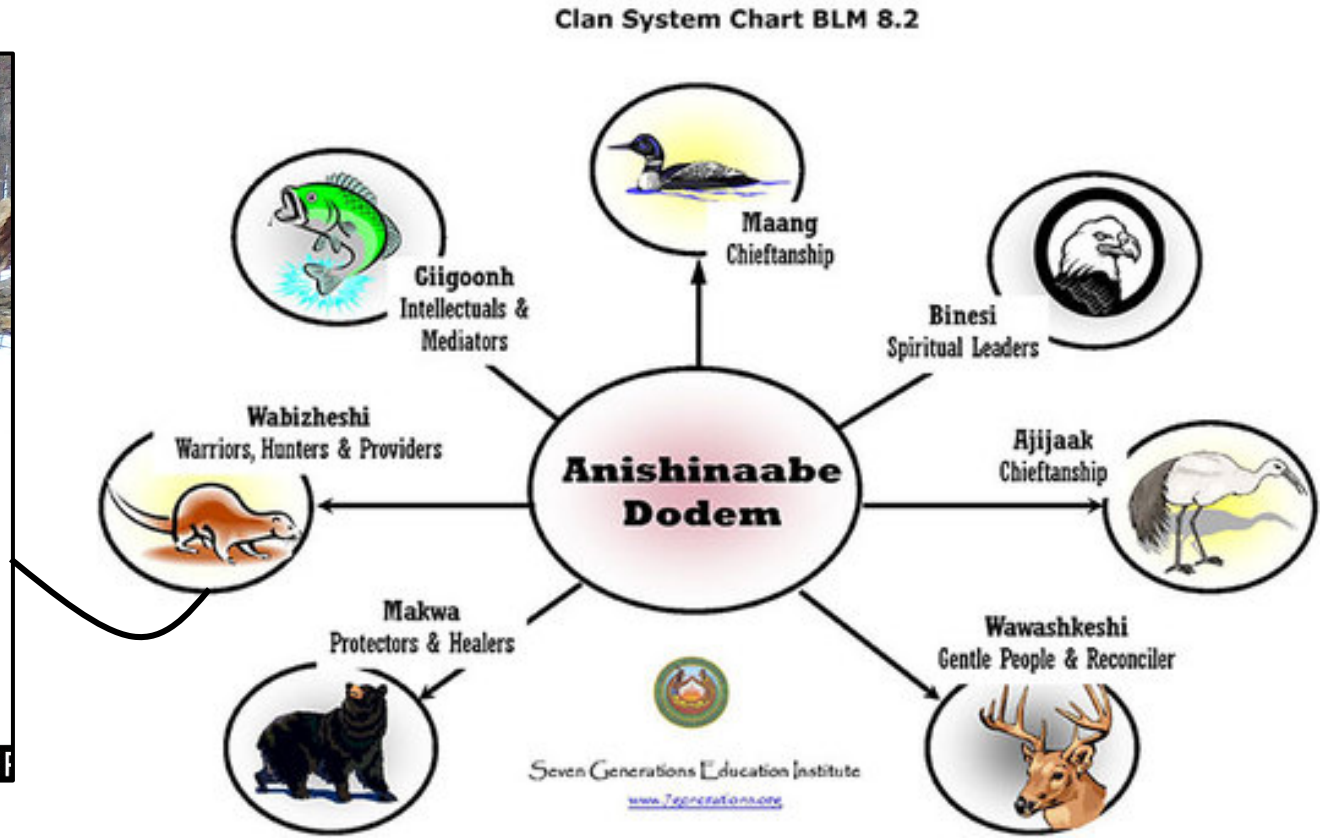
29.29 inHg- 41°F 09/11/2019 08:41AM CAMERA31

29.17 inHg↓ 71°F 08/27/2019 08:54AM CAMERA52

29.29 inHg↓ 59°F 09/23/2019 03:50AM CAMERA59

Up Close & Personal: American marten & fisher

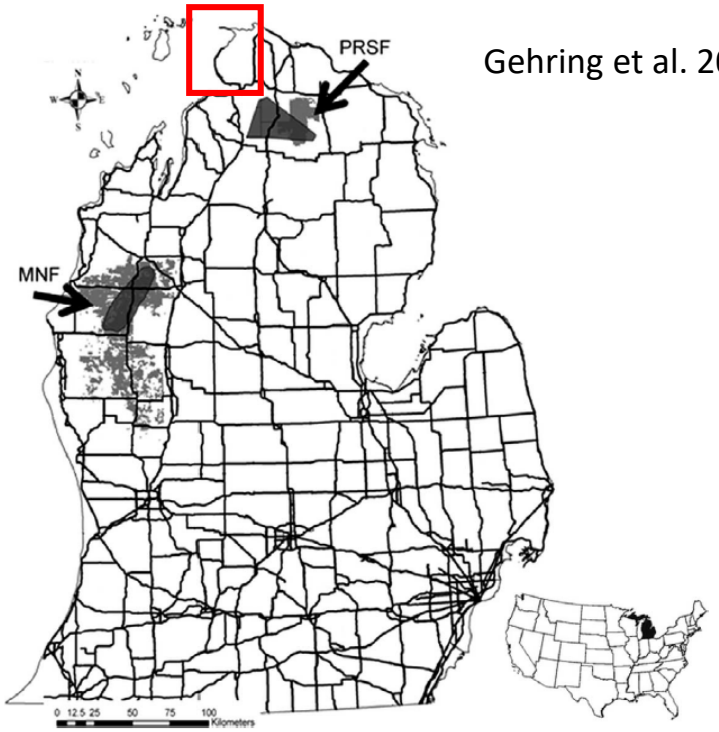
Anishinaabek clan system



American marten ecology & status

- Inhabit mix of mature hardwoods and conifers.
- Importance of large coarse woody debris and complex vertical/horizontal structure (hunting, denning)

American marten ecology & status



Gehring et al. 2019

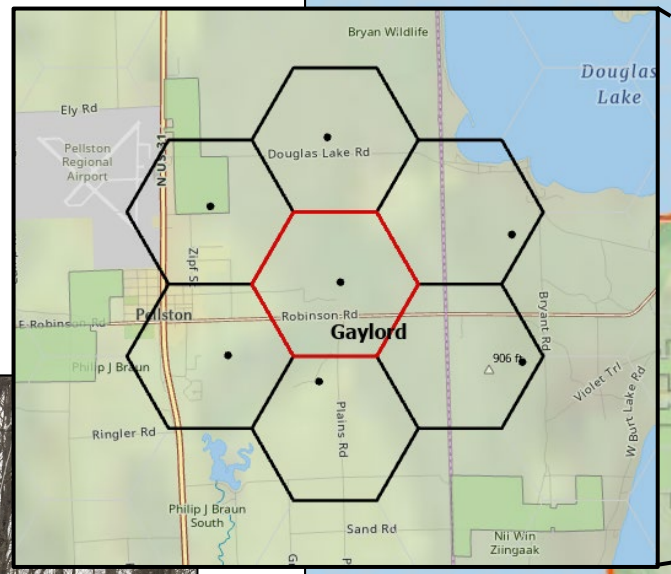
- Extirpated in NLP by 1911
- Reintroduced 1985-86, small and isolated populations.
- Managed as furbearer, but harvest only in UP.

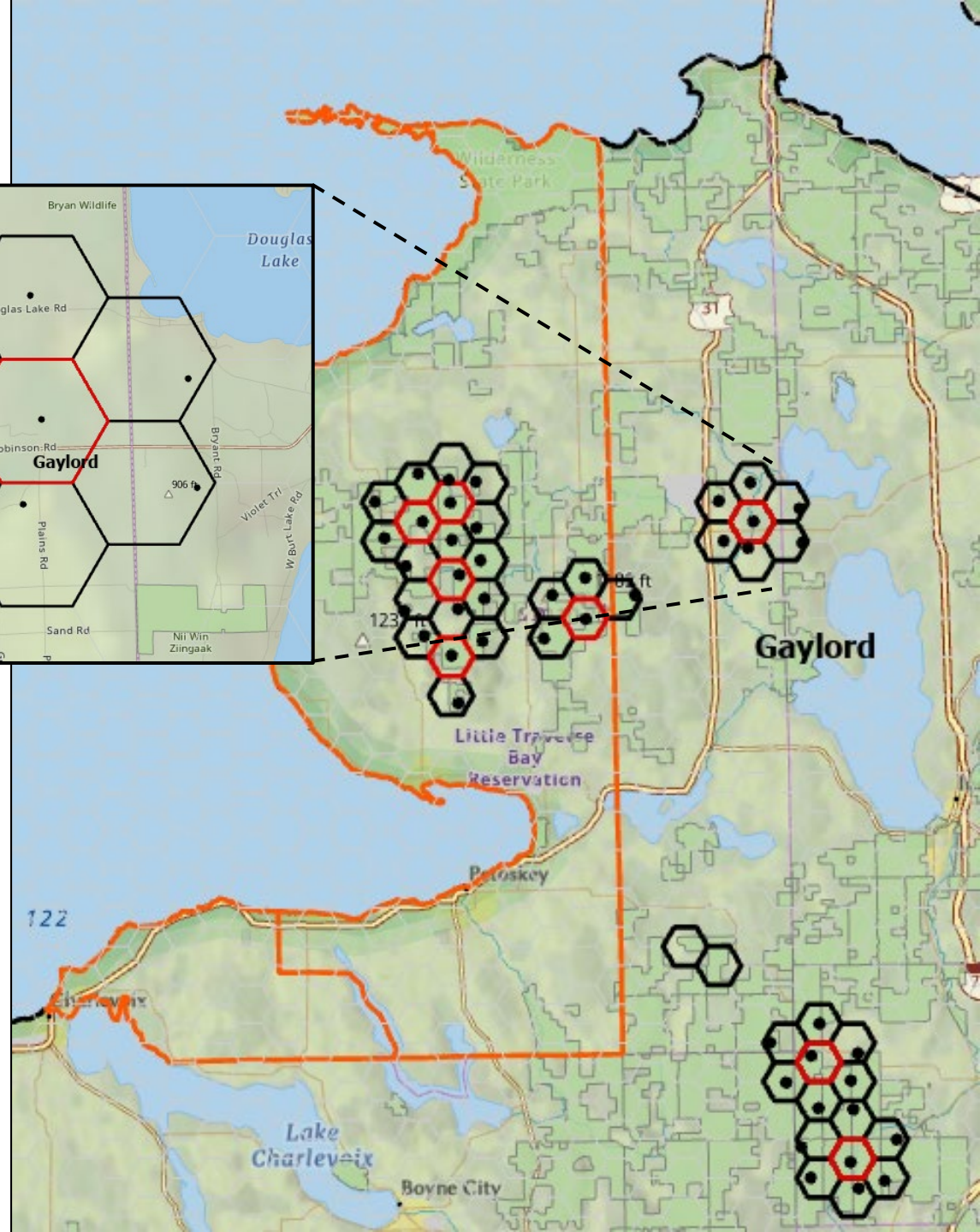
Long-tailed
weasel
29.09 inHg
29°F
04/18/2020 03:46PM CAMERA23

Fisher ecology & status

- Extirpated in NLP by early 1900s, little evidence of population in NLP.
- Managed as furbearer, but harvest only in UP.
- Inhabit mix of mature hardwoods and conifers, and lowland conifer.
- Importance of large coarse woody debris and complex vertical/horizontal structure (hunting, denning)

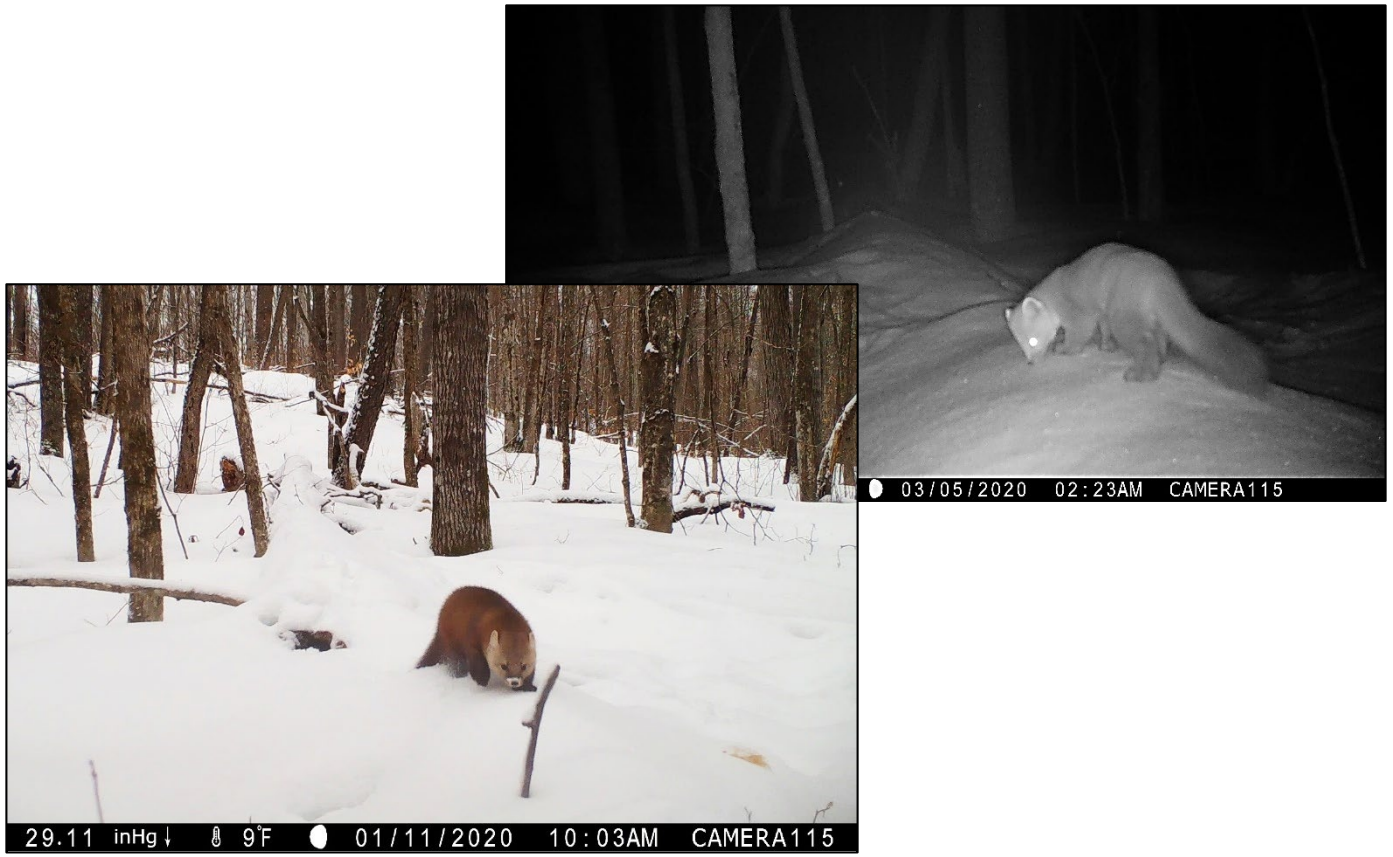
Study Design & Methods

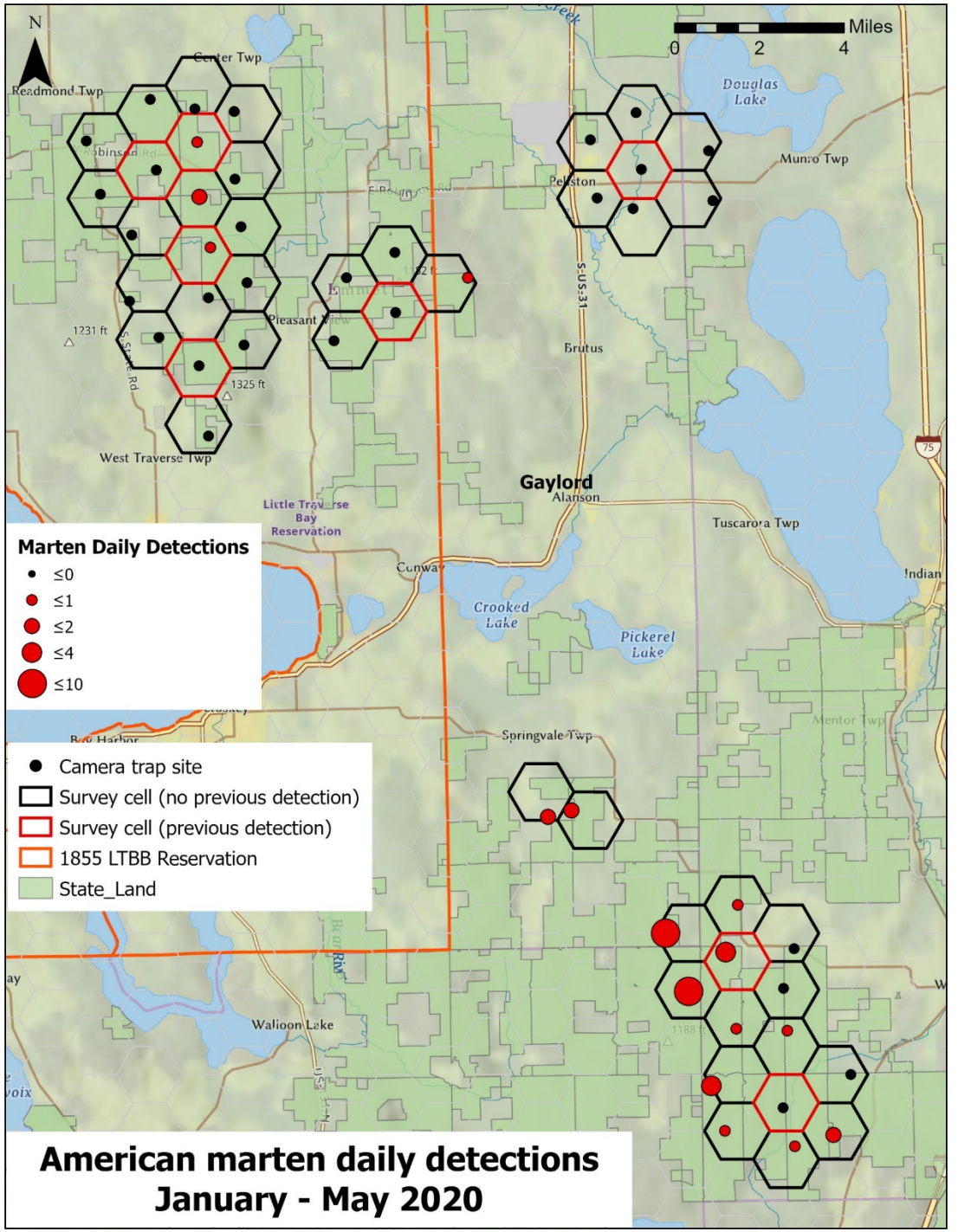




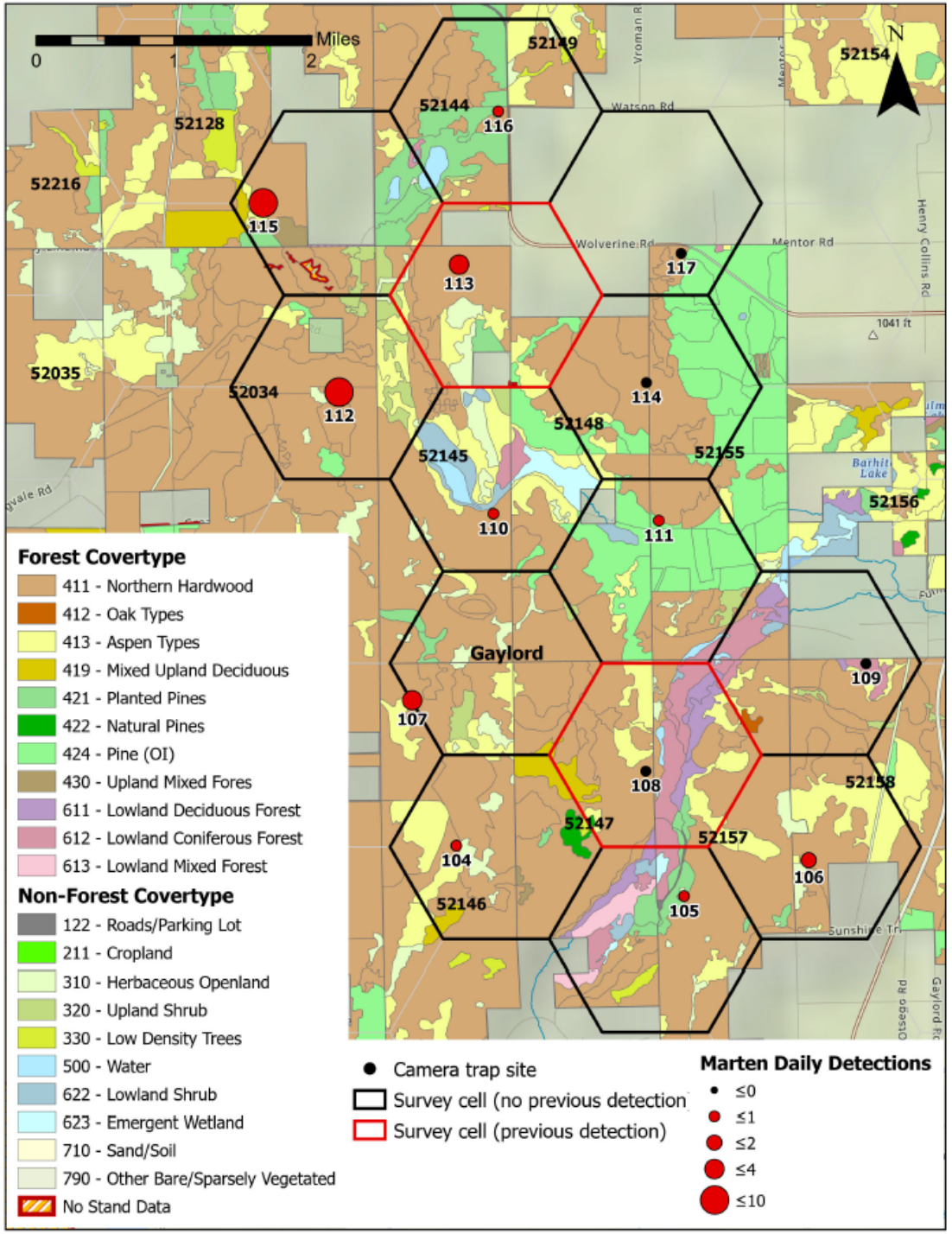
Preliminary Results

- 16 camera sites detected marten
  - 42 total unique detection events
- 0 fisher detected





Management Implications



29.26 inHg↑ 66°F 05/01/2020 11:35AM CAMERA23

29.11 inHg- 20°F 03/24/2020 03:15AM CAMERA112

29.53 inHg↑ 37°F 03/14/2020 03:24PM CAMERA22

29.03 inHg↓ 41°F 04/11/2020 11:19PM CAMERA23

28.82 inHg↓ 46°F 04/11/2020 08:55PM CAMERA22

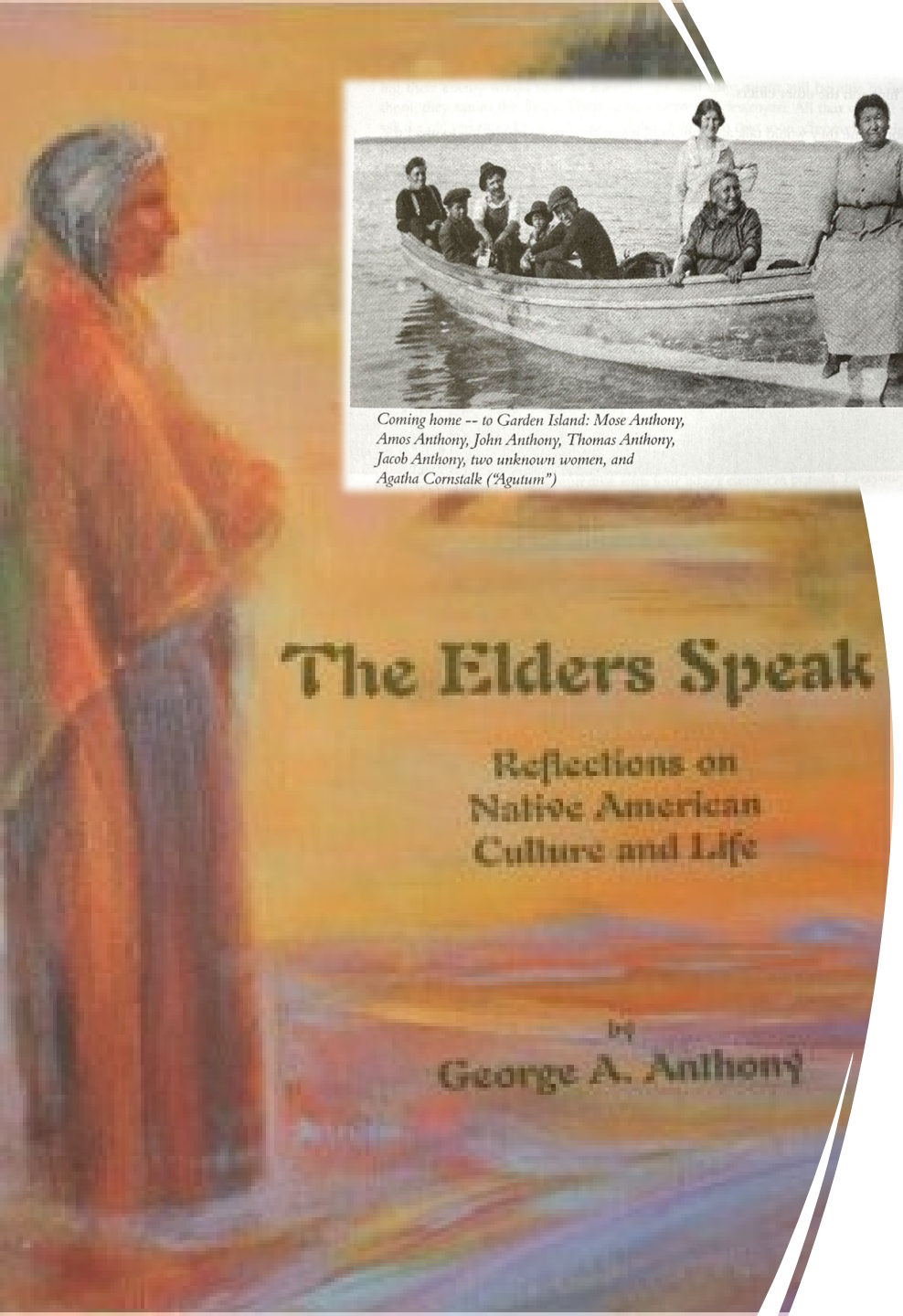
29.00 inHg↑ 32°F 04/14/2020 04:02PM CAMERA104

29.26 inHg↑ 13°F 02/17/2020 12:13PM CAMERA115

29.00 inHg- 11°F 03/30/2020 07:04PM CAMERA107

28.79 inHg↓ 14°F 04/07/2020 06:39AM CAMERA107

Up Close & Personal: White-tailed deer



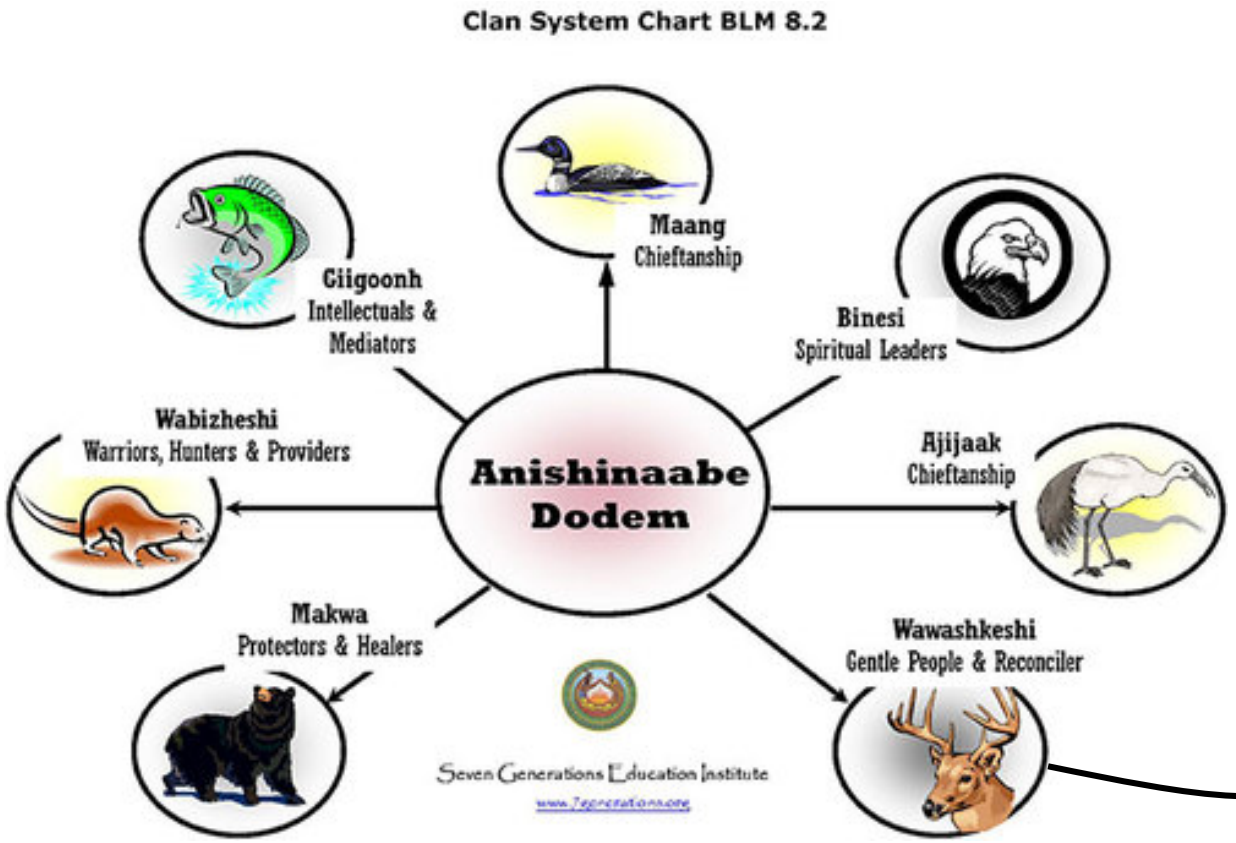
Coming home -- to Garden Island: Mose Anthony, Amos Anthony, John Anthony, Thomas Anthony, Jacob Anthony, two unknown women, and Agatha Cornstalk ("Agutum")

Anishinaabek history on the Beaver Islands

- Amikwa (Beaver) tribal group were original inhabitants .
- Deteriorating relationships with Mormons in mid-1800s pushed Native American population to Garden and High Island.
- Forced back to Beaver Island and mainland in the 1930's and 1940's.
- Garden and High Islands included within the 1855 Little Traverse Bay Bands Of Odawa Indians Reservation.

The Cultural Resources of Garden and High Islands in Northern Lake Michigan – Prepared by Wesley L. Andrews for LTBB Natural Resource Dept. - 2012

Anishinaabek clan system

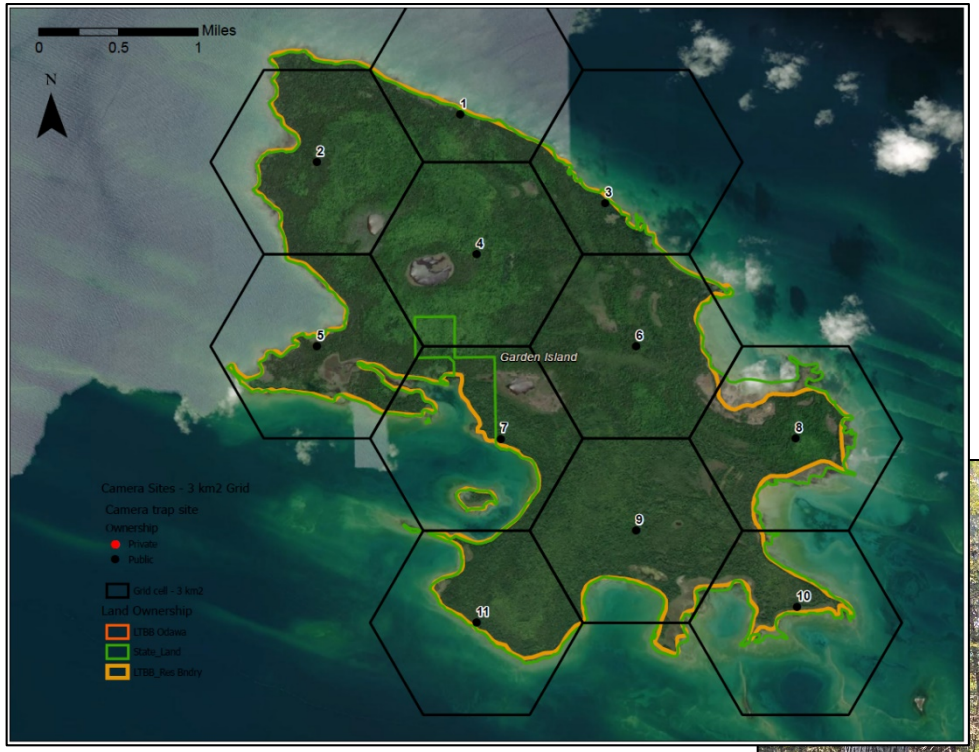


Beaver Island Archipelago

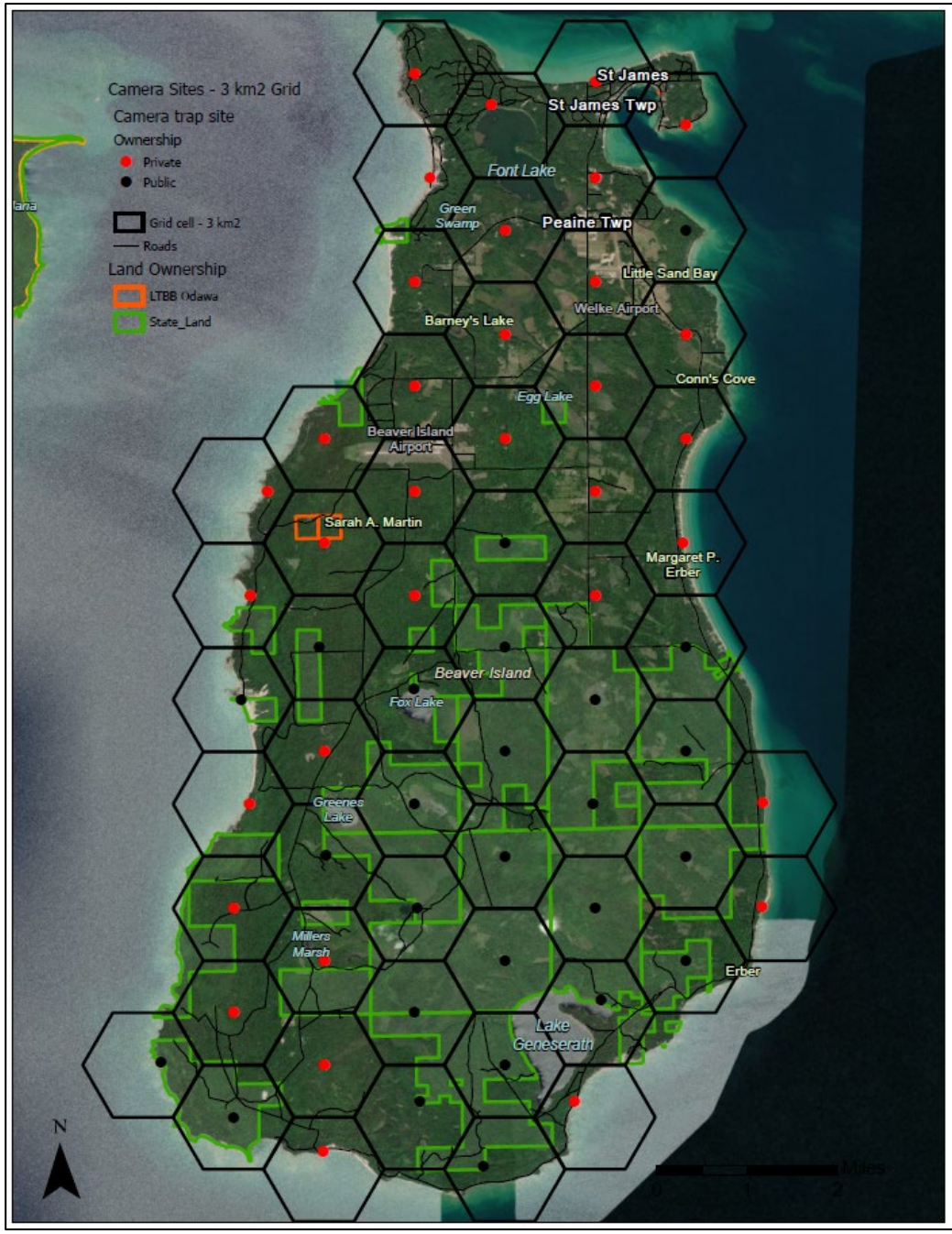
- ~ 18 miles from mainland.
- Beaver Island is 56 mi^2 (145 km^2)
  - 13 mi long, ~5 mi wide
  - ~600 residents
- Garden Island is 7 mi^2 (18 km^2)
  - ~4.5 mi long, ~2 mi wide

Deer ecology & history on Beaver Island

- Deer not endemic to Beaver Island
  - Introduced 3 bucks and 10 does in 1927.
- 1958 survey estimated ~27 deer per square mile.
- Occur throughout BI, but seasonal N-S migration to winter deer yards.
- Coyote only natural predator



Study Design & Methods



Estimating White-tailed Deer Density from Camera Trap Images

This application allows users to estimate white-tailed deer abundance and density using daily presence/absence data from remote camera s independent camera sites (i.e., at least 1.6 km apart for white-tailed deer). Occupancy and abundance estimates are calculated using model 'occu','occuRN','pcount').

Use Identified Image Data

Site 3
Buck
LGP_L03_27.jpg
9/25/2018

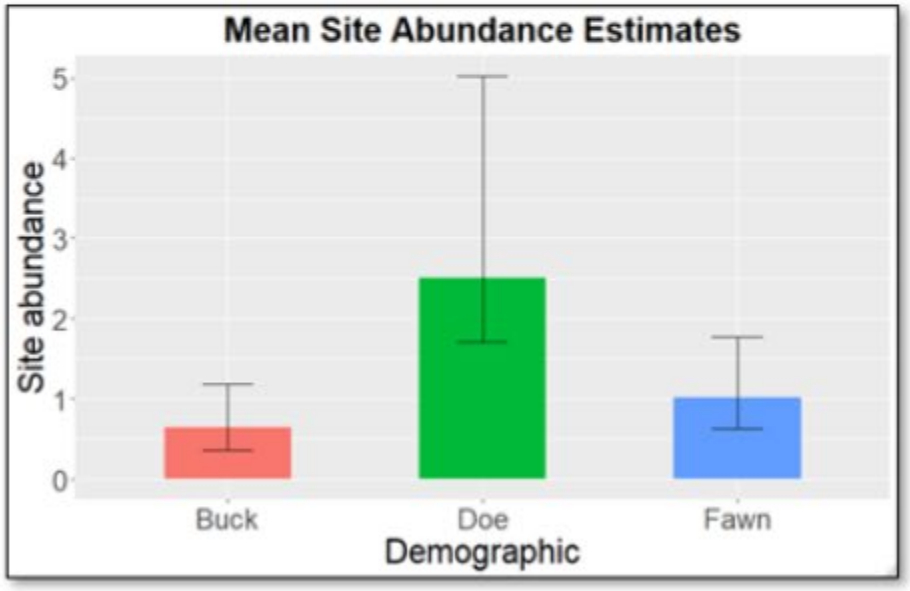
Site 5
Fawn
LGP_L05_59.jpg
8/01/2018

Site 28
Doe
LGP_L28_132.jpg
8/15/2018

App Builds Capture Histories

Site	8/1/2018	8/2/2018	8/3/2018	8/4/2018	8/5/2018	8/6/2018	8/7/2018	8/8/2018	8/9/2018
1	8	6	0	0	2	0	1	0	4
2	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	4	0	4
5	0	1	0	0	3	0	0	0	0
6	0	0	0	0	0	0	0	0	0
7	1	0	1	3	0	0	0	0	0
8	0	0	0	0	0	0	0	3	0
9	0	0	0	0	0	0	0	0	0
10	0	6	0	2	2	8	0	0	0
11	0	0	0	0	0	0	0	0	0
12	0	11	0	0	7	0	6	0	0
13	0	0	0	0	0	0	0	6	4
14	1	0	0	0	1	0	0	4	0
15	0	0	0	0	0	0	0	0	0
16	0	3	0	0	0	0	9	0	0
17	0	0	0	3	0	0	0	0	14

App Estimates Abundance with Confidence Intervals



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29.59 inHg 75°F 08/12/2020 09:34AM CAMERA30

29.17 inHg 62°F 08/31/2020 03:18PM CAMERA48

29.59 inHg 25°F 10/01/2020 06:35PM CAMERA32

29.41 inHg 46°F 07/29/2020 07:43AM CAMERA32

29.35 inHg 66°F 07/26/2020 07:03AM CAMERA48

29.88 inHg 59°F 09/19/2020 01:24PM CAMERA15

29.62 inHg 73°F 08/06/2020 09:31AM CAMERA30

29.41 inHg 64°F 09/07/2020 06:03PM CAMERA30

29.59 inHg 69°F 08/19/2020 12:06PM CAMERA30

Acknowledgments

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- Burr Mitchell (Michigan DNR)
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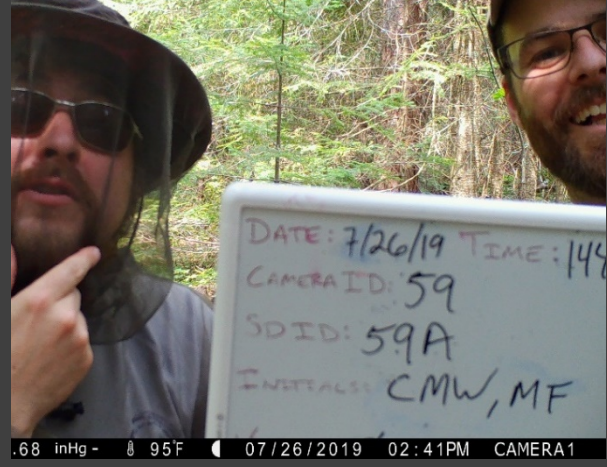
- Port St. James Association
- Township of St. James
- Township of Peaine & St. James
- CMU Biological Station
- Bill McDonough
- Ryan Fogg
- Pamela Grassmick
- Many Beaver Island landowners
- Courtney Ross



Thank you/miigwech

Clay Wilton

Michigan Natural Features Inventory

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