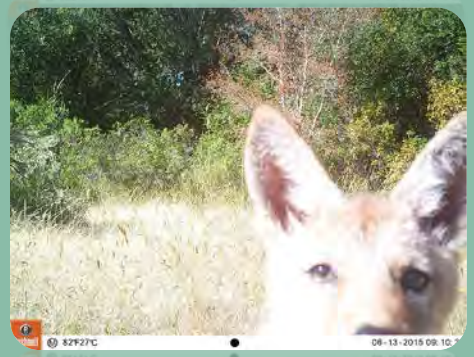
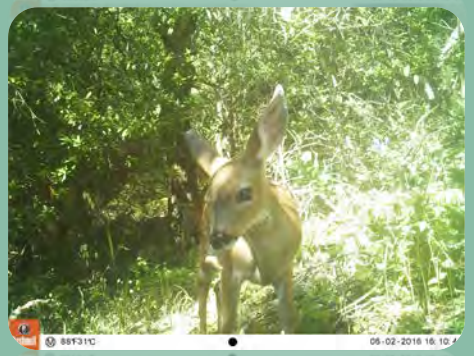
ONE TAM

TAMALPAIS LANDS COLLABORATIVE

MARIN WILDLIFE PICTURE INDEX PROJECT





Eric Fegraus
Senior Director, Technology and External Relations, Tropical Ecology, Assessment and Monitoring Network
Conservation International

Janet Klein
Natural Resources Program Manager
Marin Municipal Water District

Sue Townsend
Widlife Ecologist

Bill Merkle
Wildlife Ecologist
Golden Gate National Recreation Area

Lisa Micheli
President & CEO
Pepperwood Foundation

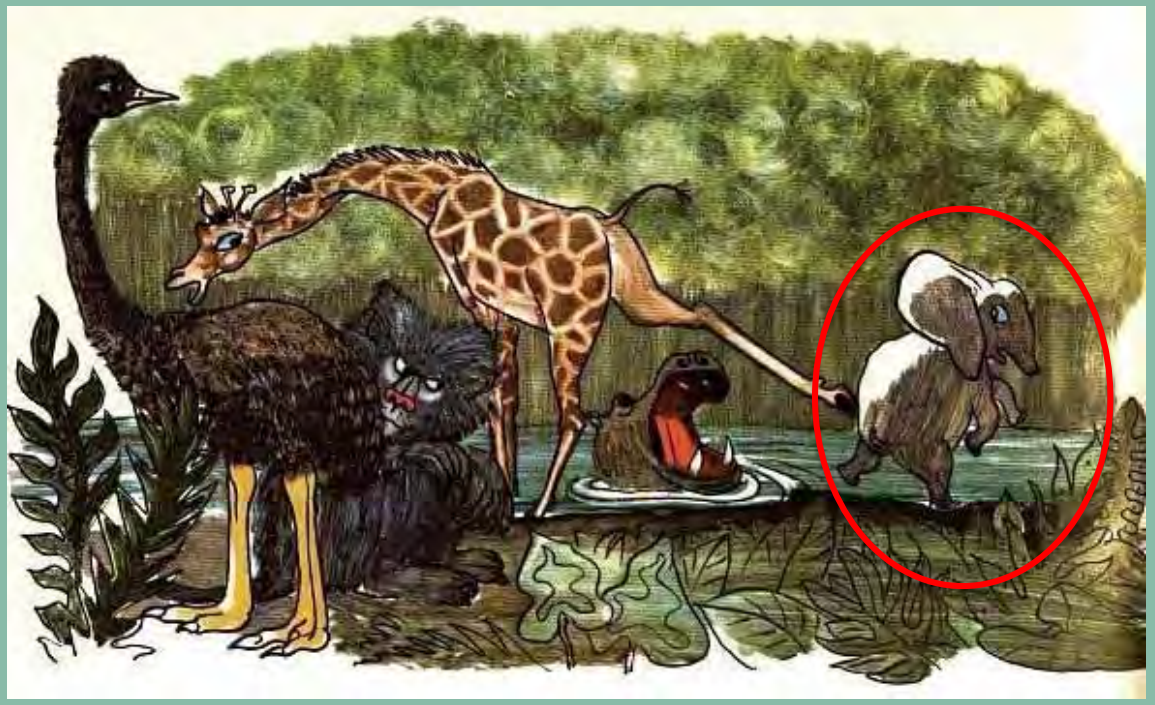
The Marin Wildlife Picture Index Project (MWPIP)

Janet Klein
Marin Municipal Water District

When I was a child, my favorite story…

…and was about an animal child…

The Elephant's Child



...who at the start of the story, has no trunk, but has "...'satiable curiosity..."

And one transformative question....

What Does the Crocodile Eat For Breakfast?

Taking some solid advise, he embarks on a journey into the wild to investigate the subject of his question first hand…

And it's a transformative experience for all elephants evermore.

And he observes the crocodile, up close, in his native habitat…

Despite the lamarckian implications of the story (and its colonial origins)…

…it highlights the transformative power of investigation.

The Marin Wildlife Picture Index
is a collaborative investigation of over 17
mammals that inhabit our wild spaces.

- Who lives here?
- How are they doing?
- Who eats who for breakfast?

MWPIP Presenters & Partners

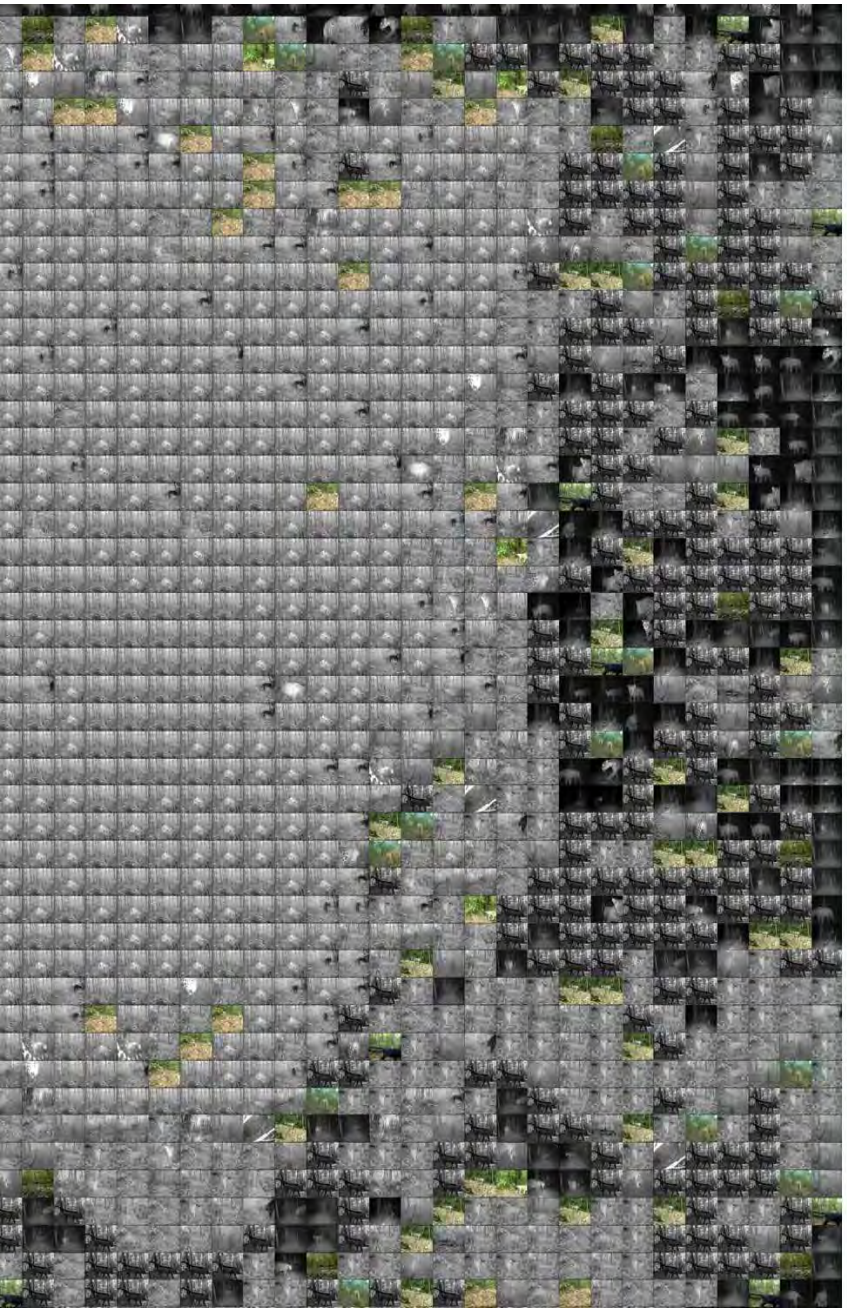
- Eric Fegraus, Conservation International: Senior Director, Technology & External Relations
- Janet Klein, Marin Municipal Water Dist. Natural Resources Program Manager
- Susan E Townsend, PhD Principal Investigator
- Bill Merkle, National Park Service Wildlife biologist
- Lisa Micheli, PhD Executive Director, Pepperwood Preserve

Conservation International

Pepperwood Preserve

Wildlife Monitoring: A global perspective

Eric Fegraus
October 26, 2017

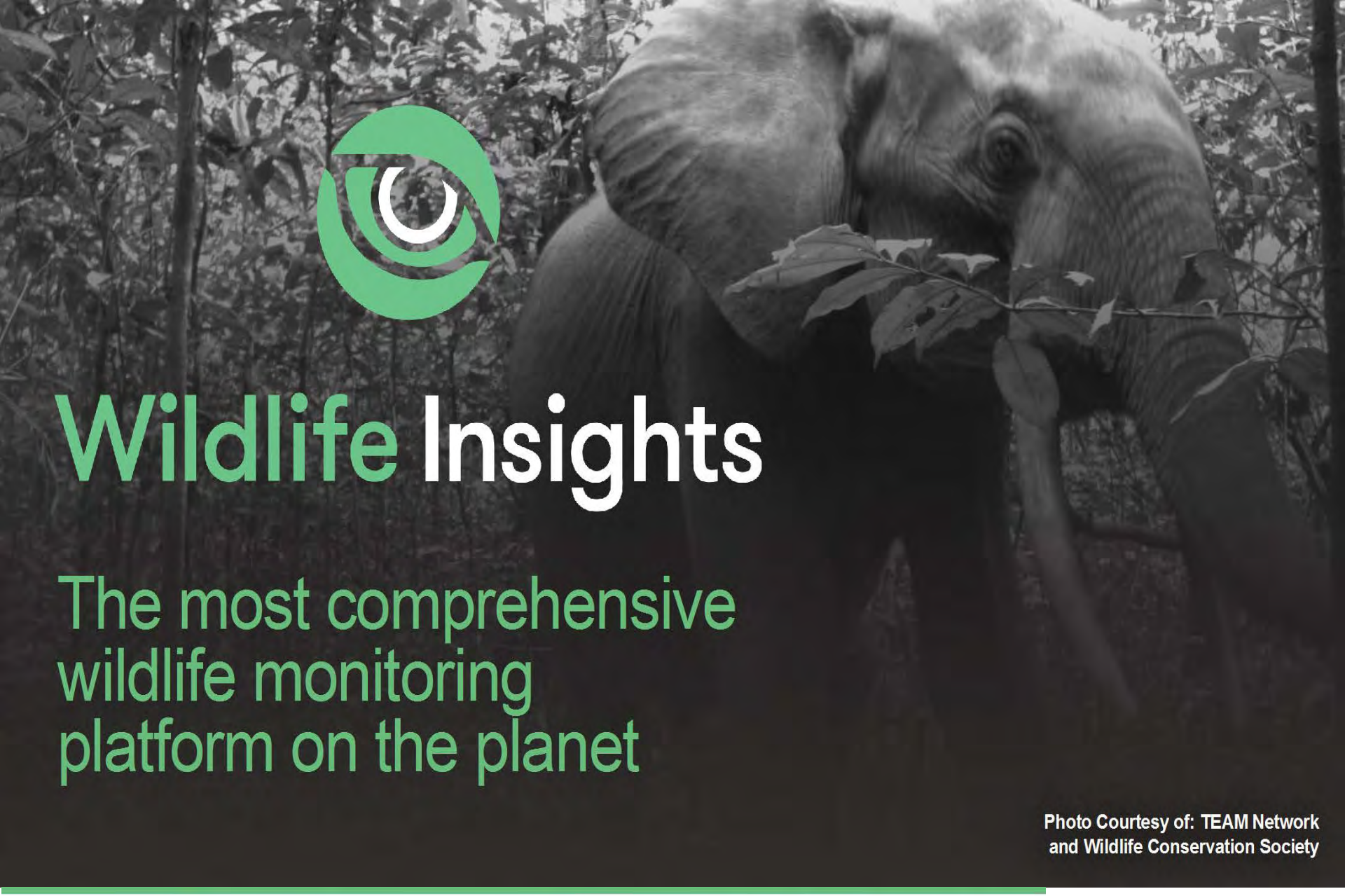


Camera traps are everywhere

- 1000s of studies
- 100,000s of camera traps
- 1,000,000s of images

Stenweg et al 2017

TEAM Network: Wildlife Picture Index



Wildlife Insights

The most comprehensive wildlife monitoring platform on the planet

Photo Courtesy of: TEAM Network and Wildlife Conservation Society

CONSERVATION INTERNATIONAL

North Carolina Museum of Natural Sciences

Smithsonian Institution

WCS

Google

THANK YOU

ERIC FEGRAUS

SENIOR DIRECTOR OF CONSERVATION TECHNOLOGY

CONSERVATION INTERNATIONAL

EFEGRAUS@CONSERVATION.ORG

CONSERVATION INTERNATIONAL

Scalable Conservation Solutions

- **Governance**: The model of ONE TAM, a multi-organizational effort is a great model to replicate regionally and in other places around the world.
- **Tools and technology**: There is a large role technology can play in scaling conservation solutions and we are really just getting started doing this - Underlying common infrastructure with customizable local results.
- *Don't underestimate the value a single or local project can have on influencing regional, state, national and even global projects.*

Our vision

We envision a world where wildlife populations are stable or recovering.

Wildlife Insights

Our mission

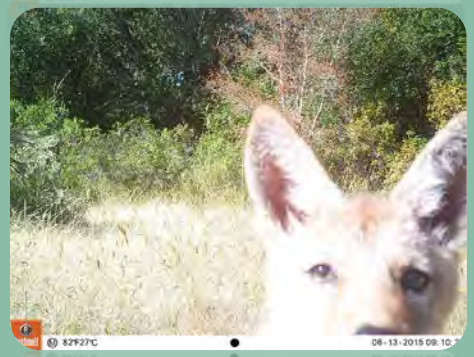
To provide an open access platform where global wildlife data can be aggregated, analyzed and shared to enable evidence-based conservation

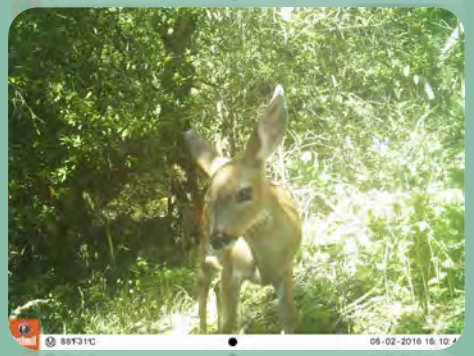
Wildlife Insights

ONE TAM

TAMALPAIS LANDS COLLABORATIVE

MARIN WILDLIFE PICTURE INDEX PROJECT





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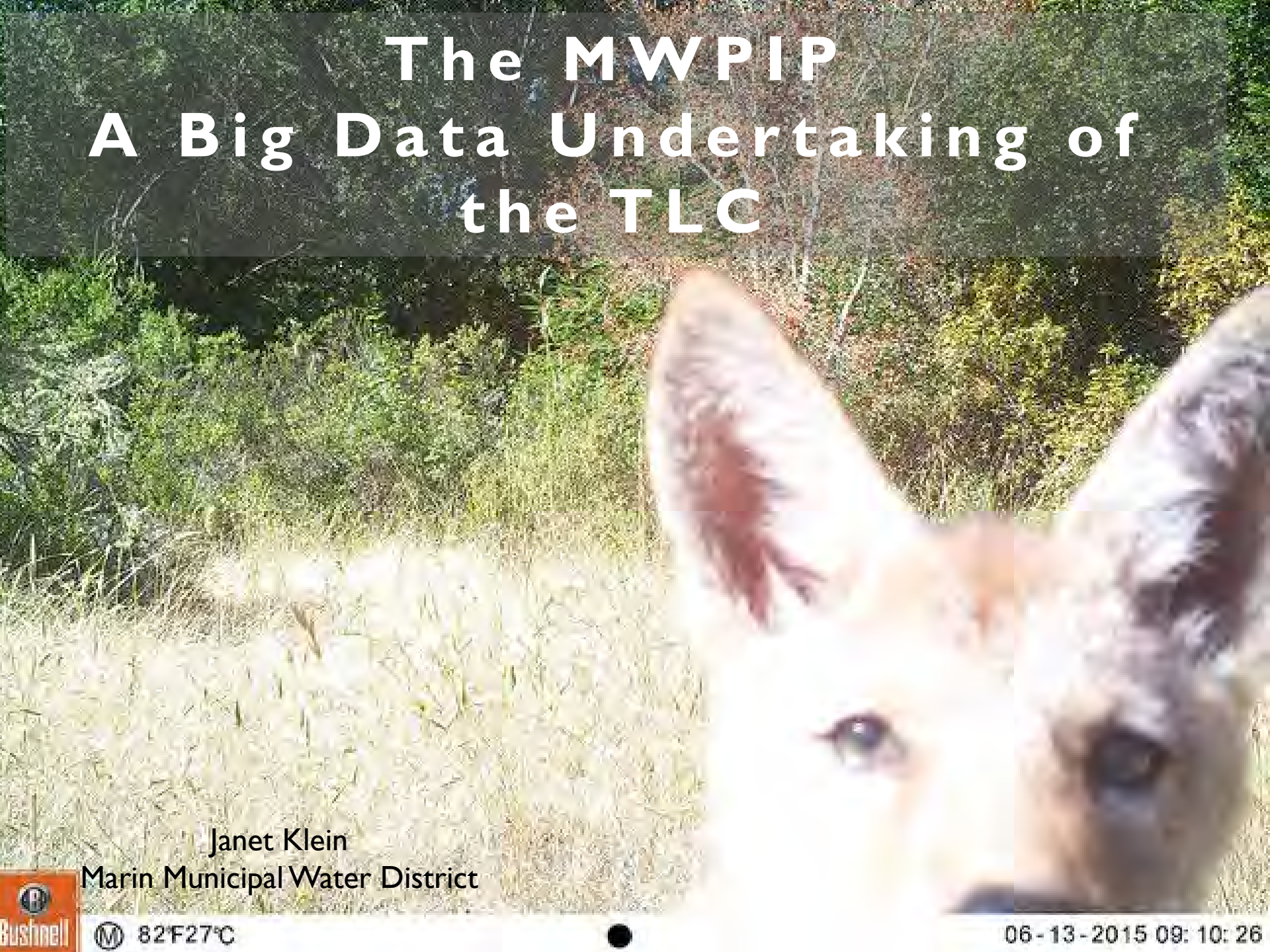
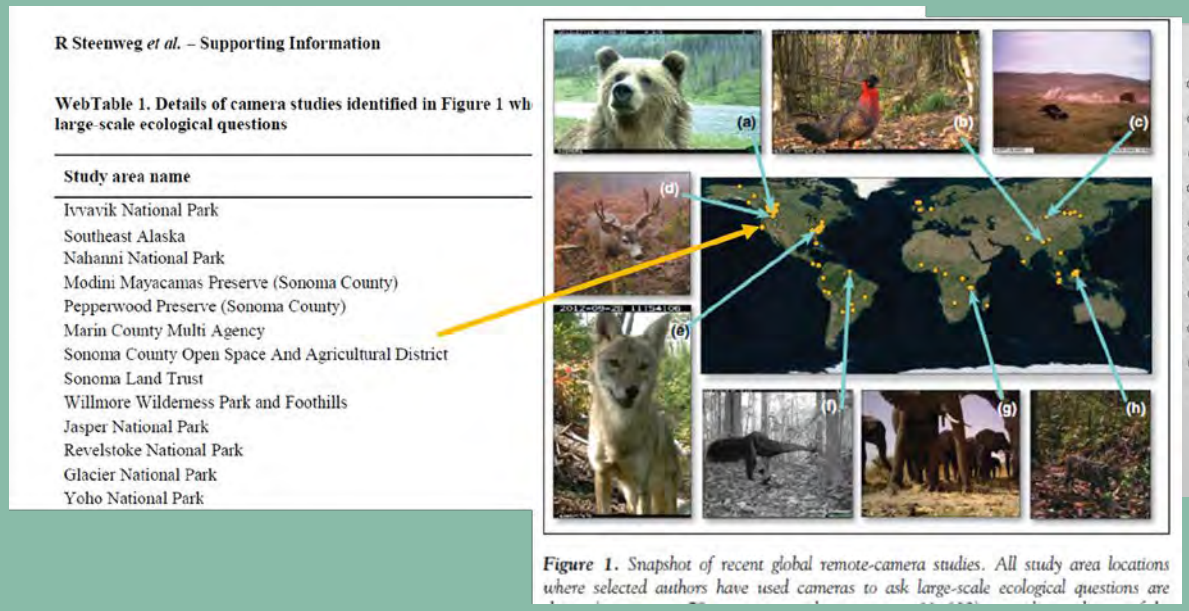
The MWPIP
A Big Data Undertaking of the TLC



Janet Klein
Marin Municipal Water District

The Wildlife Picture Index (WPI) is part of a global adoption of Big Data tools that is revolutionizing our understanding of our planet.



R Steenweg *et al.* – Supporting Information

WebTable 1. Details of camera studies identified in Figure 1 wh large-scale ecological questions

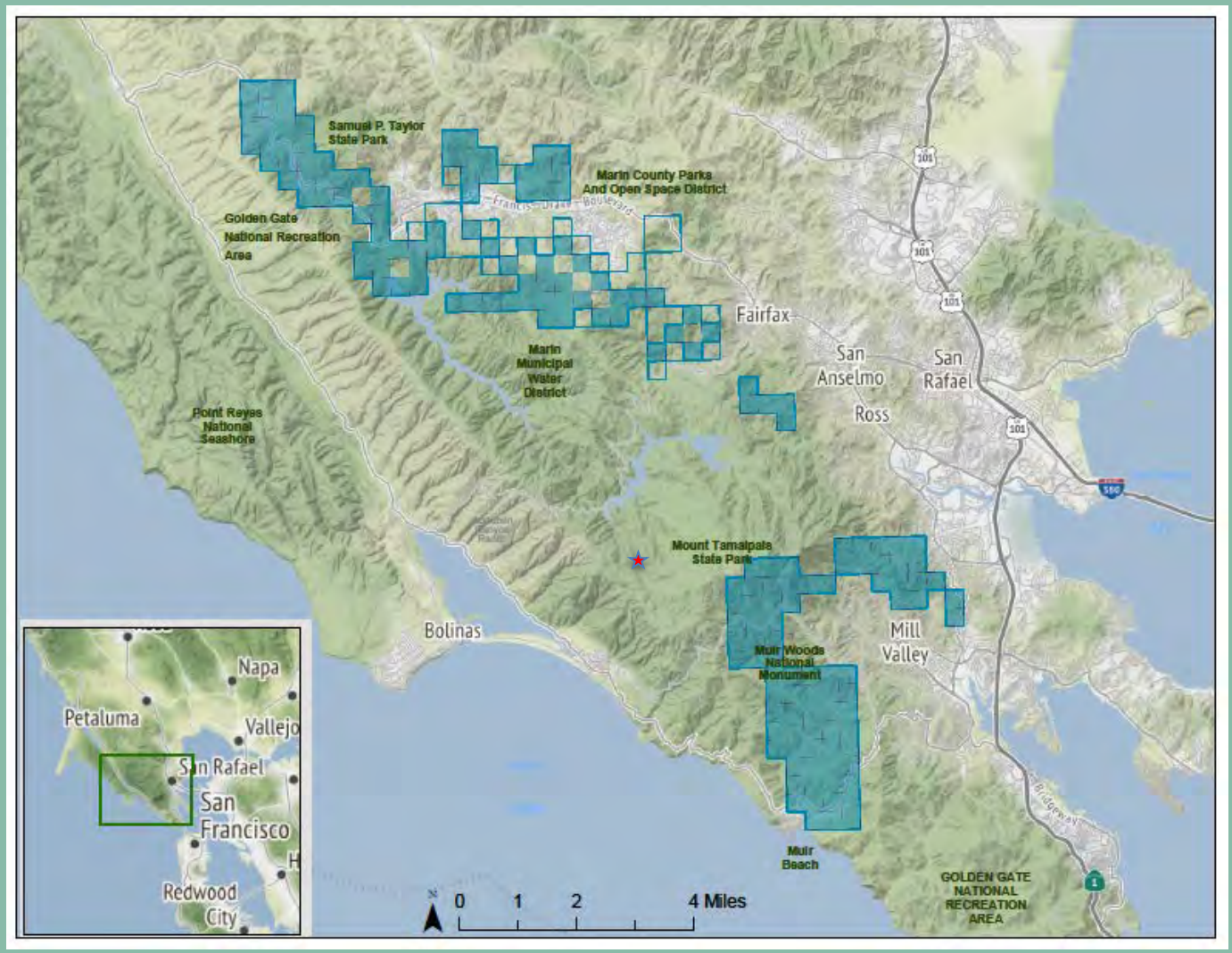
Study area name
Ivvavik National Park
Southeast Alaska
Nahanni National Park
Modini Mayacamas Preserve (Sonoma County)
Pepperwood Preserve (Sonoma County)
Marin County Multi Agency
Sonoma County Open Space And Agricultural District
Sonoma Land Trust
Willmore Wilderness Park and Foothills
Jasper National Park
Revelstoke National Park
Glacier National Park
Yoho National Park

Figure 1. *Snapshot of recent global remote-camera studies. All study area locations where selected authors have used cameras to ask large-scale ecological questions are*

The Marin Project is the largest WPI deployment in North America.

MWPIP: The Basics

- 5 Jurisdictions
- 128 cameras at the start
- Presently 174 cameras deployed
- About 43.5 square km in the study area.
- Northern array has been running since Sept. 2014
- Southern array launch in June 2017.



ONE TAM

DATA ABOUT DATA

(northern array only)

TAMALPAIS LANDS COLLABORATIVE

- Trap Nights: **110,000**
- Images captured: **3 million** in motion triggered, 3-shot bursts
- Images processed to date: **2.7 million (90%)**
- Processed Images with wildlife: **500,00 (20%)**
- Time spent processing images: **1.3 million minutes (2.5 years)**

- Volunteers: **993**
- Volunteer cataloguing parties: **90**
- Images processed by volunteers: **966,000**
- Images processed by one dynamic duo of volunteers: **300,000**




THE EASY WORK

Using a single protocol and uniform cameras in a standard grid:

Camera Installation

Trouble shooting Field Check

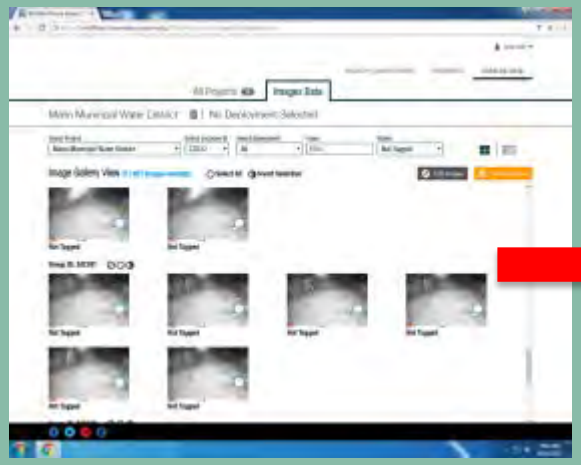
Log photos for 6 weeks

Did I say repeat?

Repeat quarterly

Field check: change photo card and batteries, resume logging

THE HARD WORK

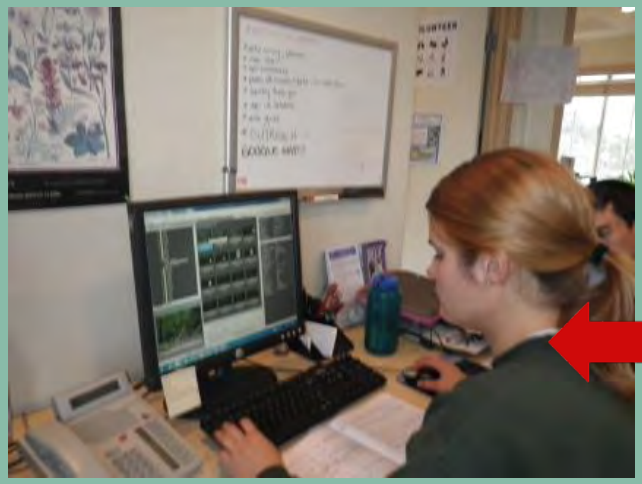


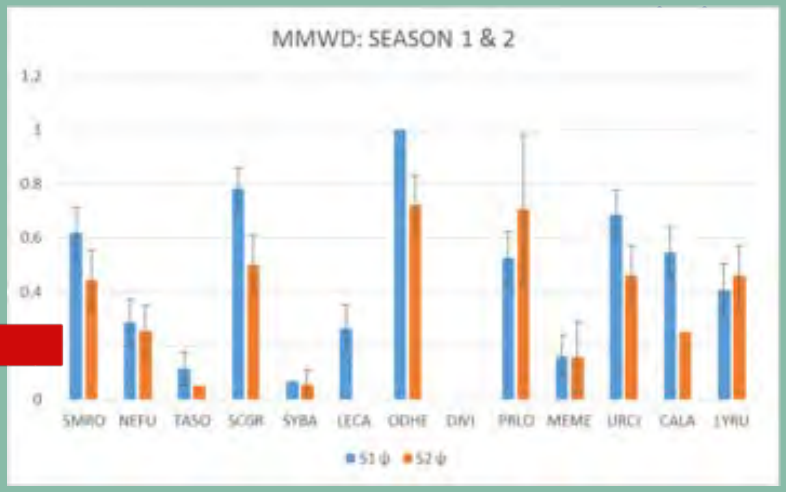
Transfer files into Cloud-based, OneTam/CI data management system

Train volunteers and catalogue images

Real time

Quality control, analysis, interpretation





ONE TAM

Tamalpais Lands Collaborative


Bushnell
71°F21°C
05-26-2015 15:11:24


Bushnell
46°F7°C
11-15-2014 07:13:59


Bushnell
59°F15°C
06-12-2015 23:34:47


Bushnell
48°F8°C
08-09-2015 06:17:39

SQUIRREL!!!

3 million pictures?

400 volunteers?

We got this!

FUN!

Owl!

I like a challenge.

A little extra training helps.

3 million pictures?

We got this.

Rock!

No.

Bird!

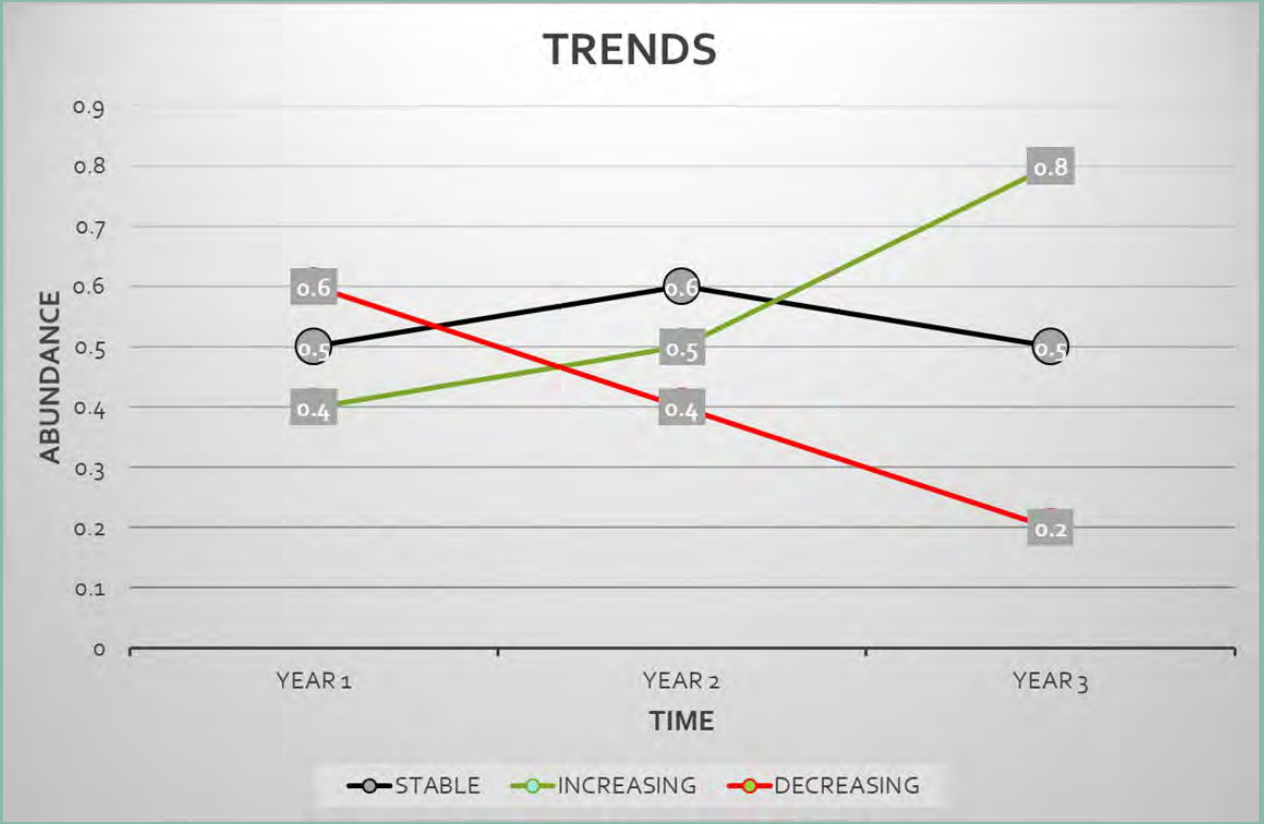
No.

Yes.

No.

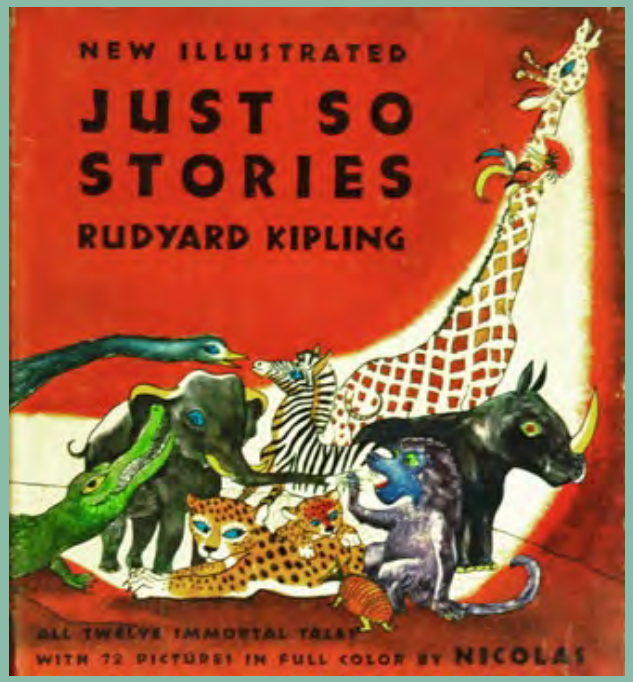
Maybe.

MWPIP cameras finished logging 3 consecutive years of images from the northern array in September 2017.



Cataloging is still underway;
the MWPIP trend graph is still forthcoming.

Our original intent for today was a deep dive into what we have learned.

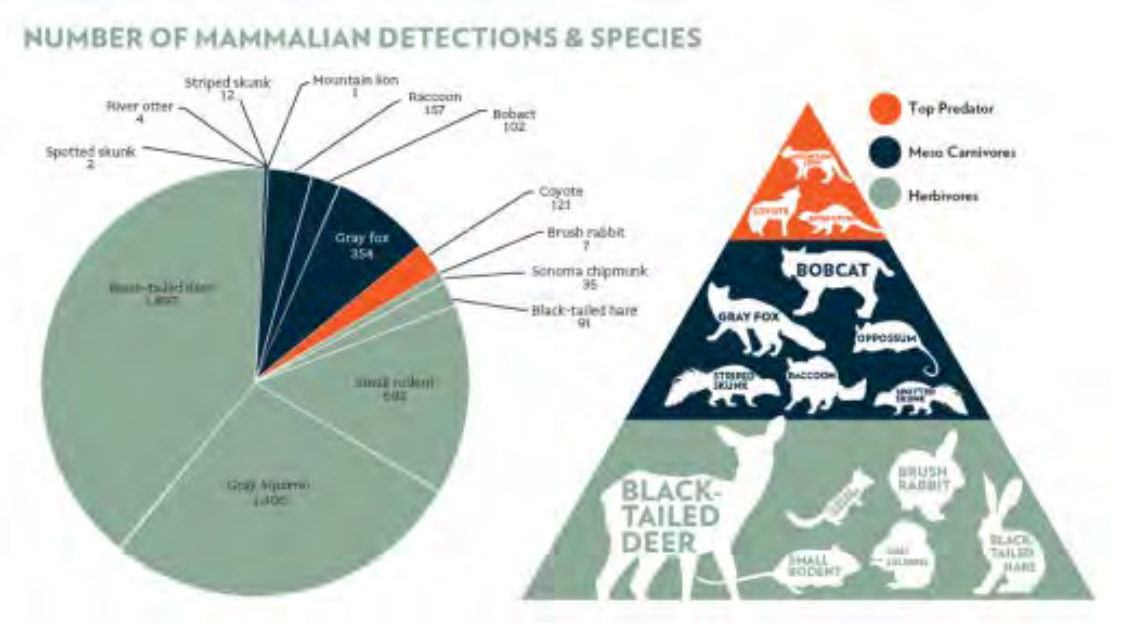


But we have not unpacked all the data yet. And we don't want to tell *Just So Stories*.

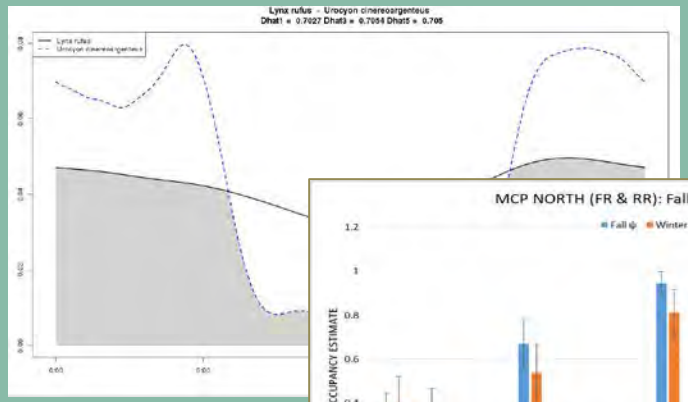
Today, we'll be sharing the questions asked at the outset, the tools we have developed for that deep data dive, and the most preliminary of results.

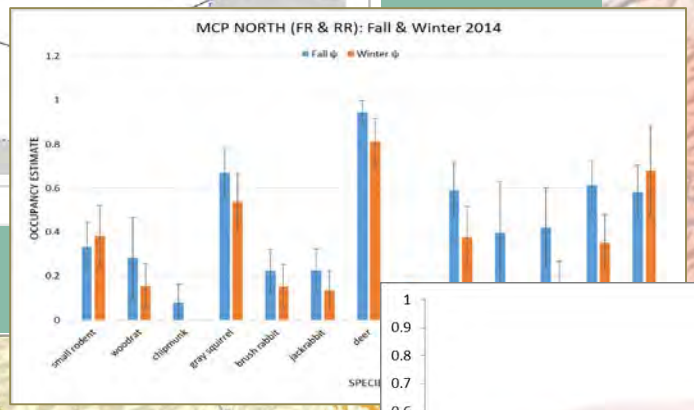
Questions at the outset:

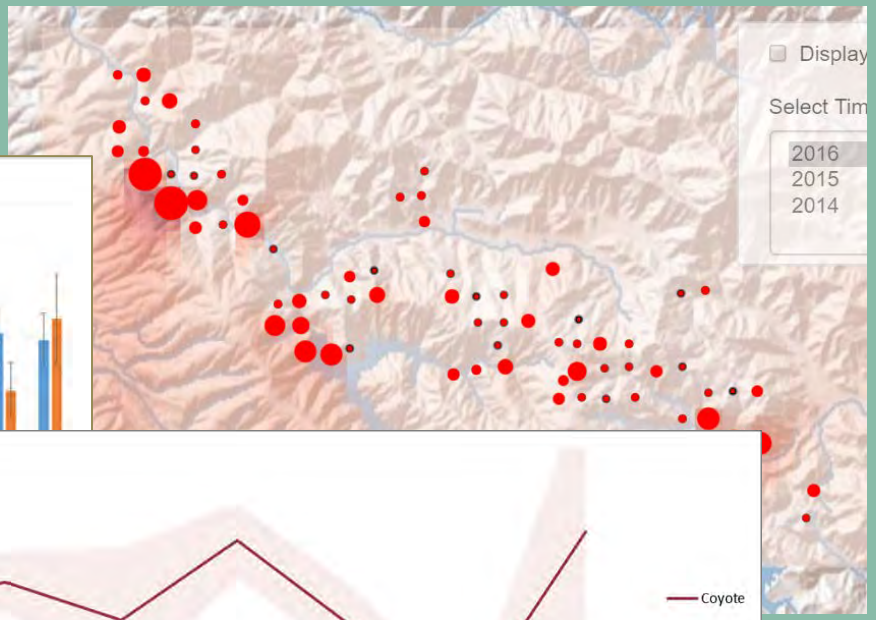
- Species Richness
- Presence and distribution of rare species
- Trophic-level structure
- Overall ecosystem health

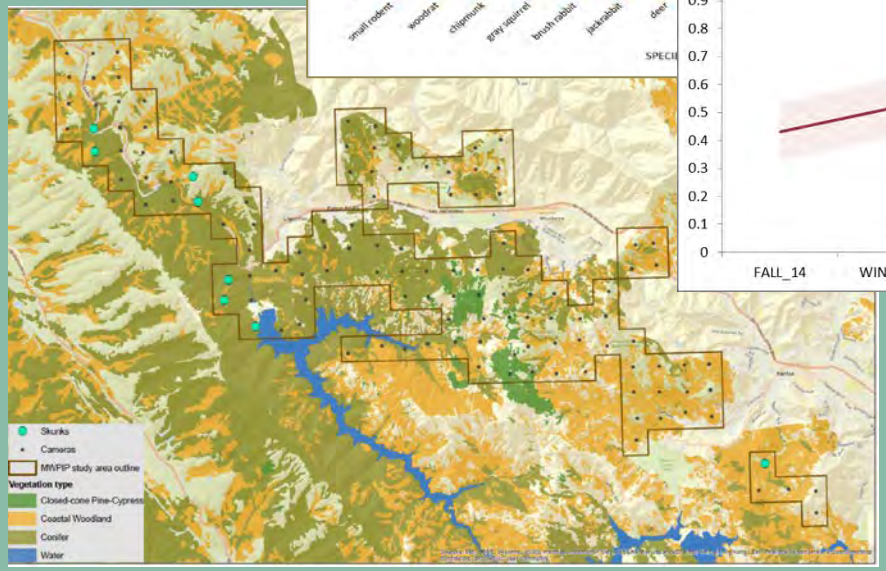


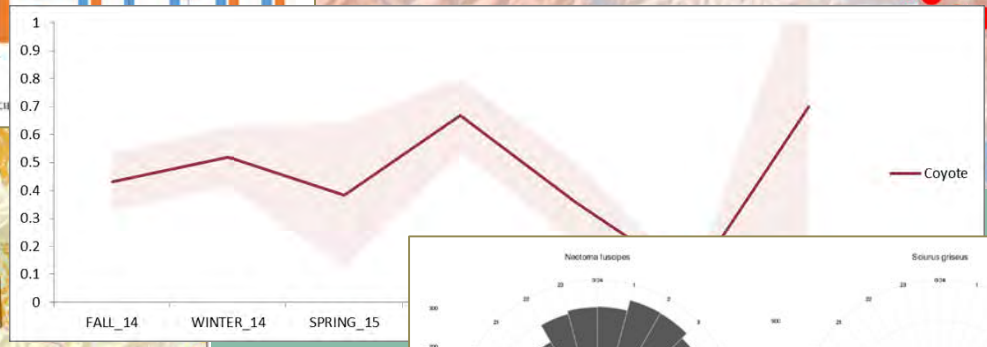
New Analytic Ability

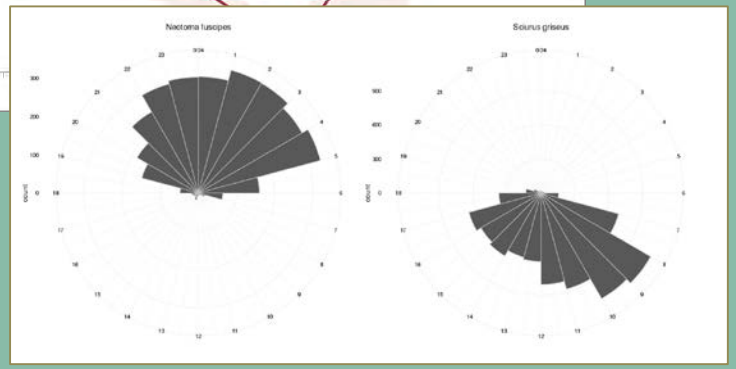




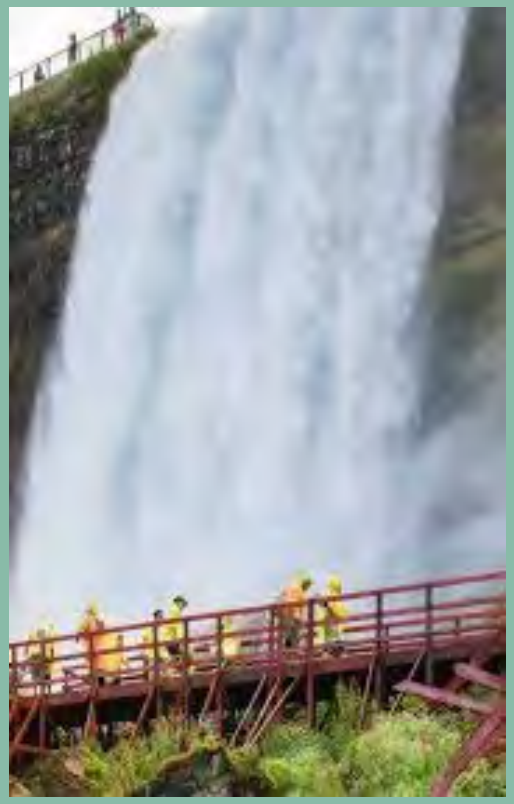








MWPIP is inundating us with new information…



We need your help gathering it, cataloguing it, analyzing it and interpreting it.

New Challenge:

What do we do with this flood of wildlife information available to us?

What implications does it have for us as land stewards, Marin residents, and park users?

Summer 2018: Launch of a regional conversation about these issues.

I. Wildlife biologists, land managers and planners convening

II. Broader conversation with all our public lands stakeholders.

BAY AREA OPEN SPACE COUNCIL

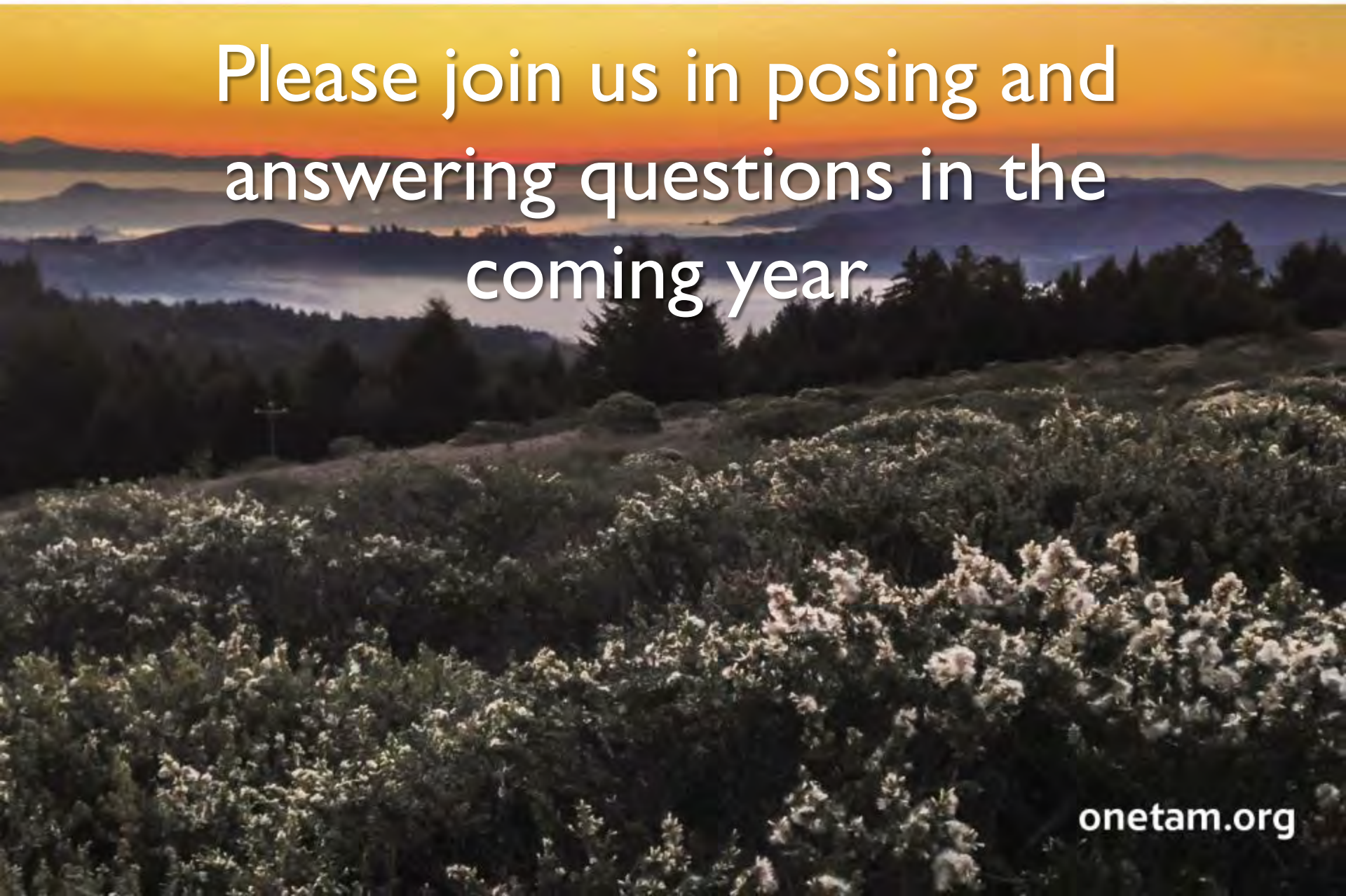
CALIFORNIA STATE PARKS
MARIN MUNICIPAL WATER DISTRICT
MARIN COUNTY PARKS
NATIONAL PARK SERVICE
GOLDEN GATE NATIONAL PARKS CONSERVANCY

Once upon a time there was a fox who picked up a woodrat for breakfast….

ONE TAM

Tamalpais Lands Collaborative

Please join us in posing and answering questions in the coming year

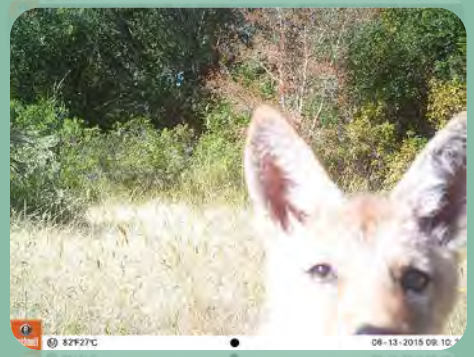


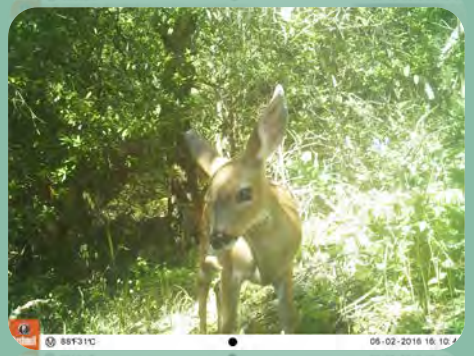
onetam.org

ONE TAM

TAMALPAIS LANDS COLLABORATIVE

MARIN WILDLIFE PICTURE INDEX PROJECT





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The Marin Wildlife Picture Index Project

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In collaboration with
Lizzy Edson, NPS and ONE TAM
Eric Fegraus, Conservation International

ONE TAM

GOLDEN GATE NATIONAL PARKS CONSERVANCY

MARIN MUNICIPAL WATER DISTRICT

CALIFORNIA STATE PARKS
SINCE 1864
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PRESERVATION • RECREATION

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PARKS
NATIONAL
PARK
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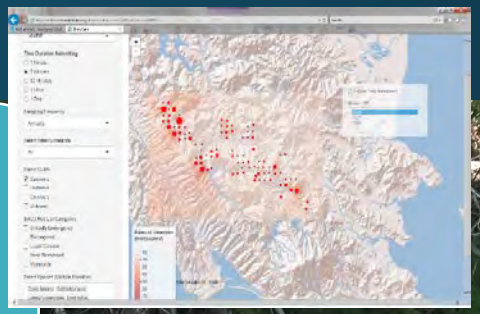
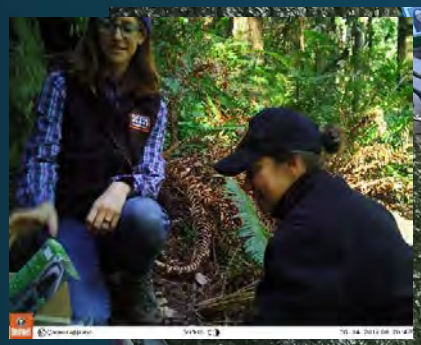
CONSERVANCY

The Wildlife Picture Index

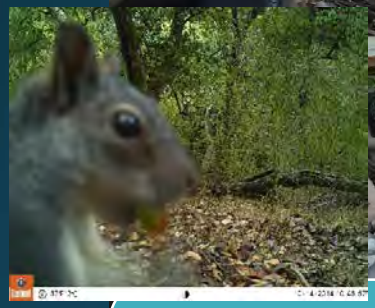
- How do we assess the health of an ecosystem?
- How do we understand an ecosystem's resilience to external perturbations both anthropogenic (people caused) and natural (mother nature)?
- How we do we assess if the wildlife populations within our ecosystems are stable, thriving or collapsing?

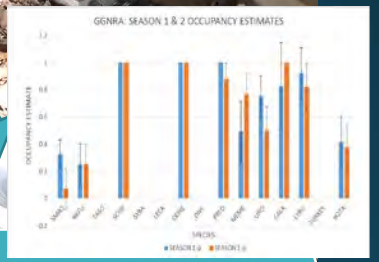
Resource managers





WPI





General Public

Academic researchers

Answers questions like…

- How did the drought affect wildlife populations?
- How will the wildfire affect regional wildlife abundance and health?
- How are restoration projects on the Mountain affecting wildlife populations?
- How does the Mountain and surrounding open space contribute the overall health of our wildlife populations in the Bay Region?
- How is that bobcat population doing?

Collateral Information

- Richness
- Community Structure
- **Trends and Abundance**
- Temporal Analysis
- Rare species detections
- Inventory

Why terrestrial mammals?

Reliably detect with camera traps (big! warm!)

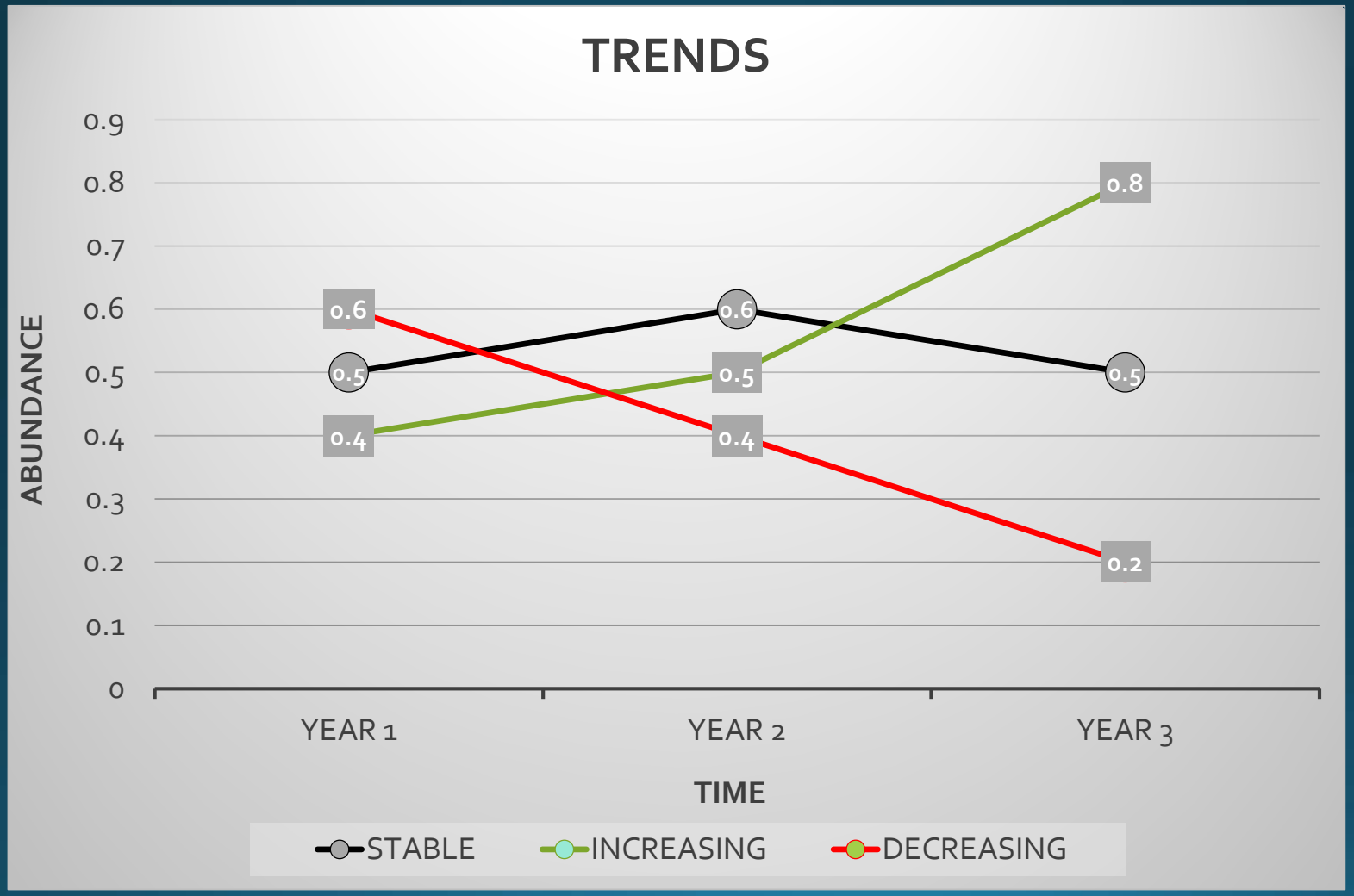
Hard to detect otherwise (shy! nocturnal!)

Indicators of ecosystem productivity (plants, insects, prey…)

Birds and bats are great (Small! Quick!) but not as reliably detected by camera traps.

You can’t monitor what you don’t measure

The WPI is a tool to measure trends in wildlife abundance



What if we didn't have close to 200 years of standardized weather data?

Would we really know what "normal weather" is?

What would our discussions around climate change be like?

Terms: What is a healthy ecosystem?

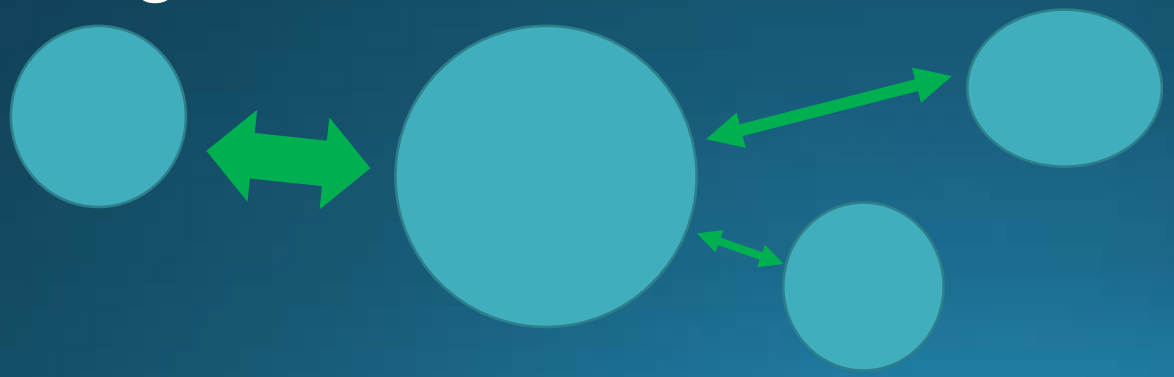
- All or most of the expected species ("richness")
- Able to find food, mates, shelter
- Able to have and raise young into adulthood
- Able to disperse to other suitable habitat

Terms: What is resilience?

The ability for wildlife to rebound from perturbations (that is, disturbances both natural and human caused)

Both ***health*** and ***connectivity*** build resilience:

- Able to disperse to other suitable habitat
- Can serve as a source of wildlife populations for region



Seasonal Analysis

Year 'round data collection: what does it tell us?

Spring

Finding mates, mating and giving birth

(smaller home ranges and resources like shelter and rich food)

Summer

Young growing

(food and safety)

Fall

Dispersal

Fattening up for winter

Winter

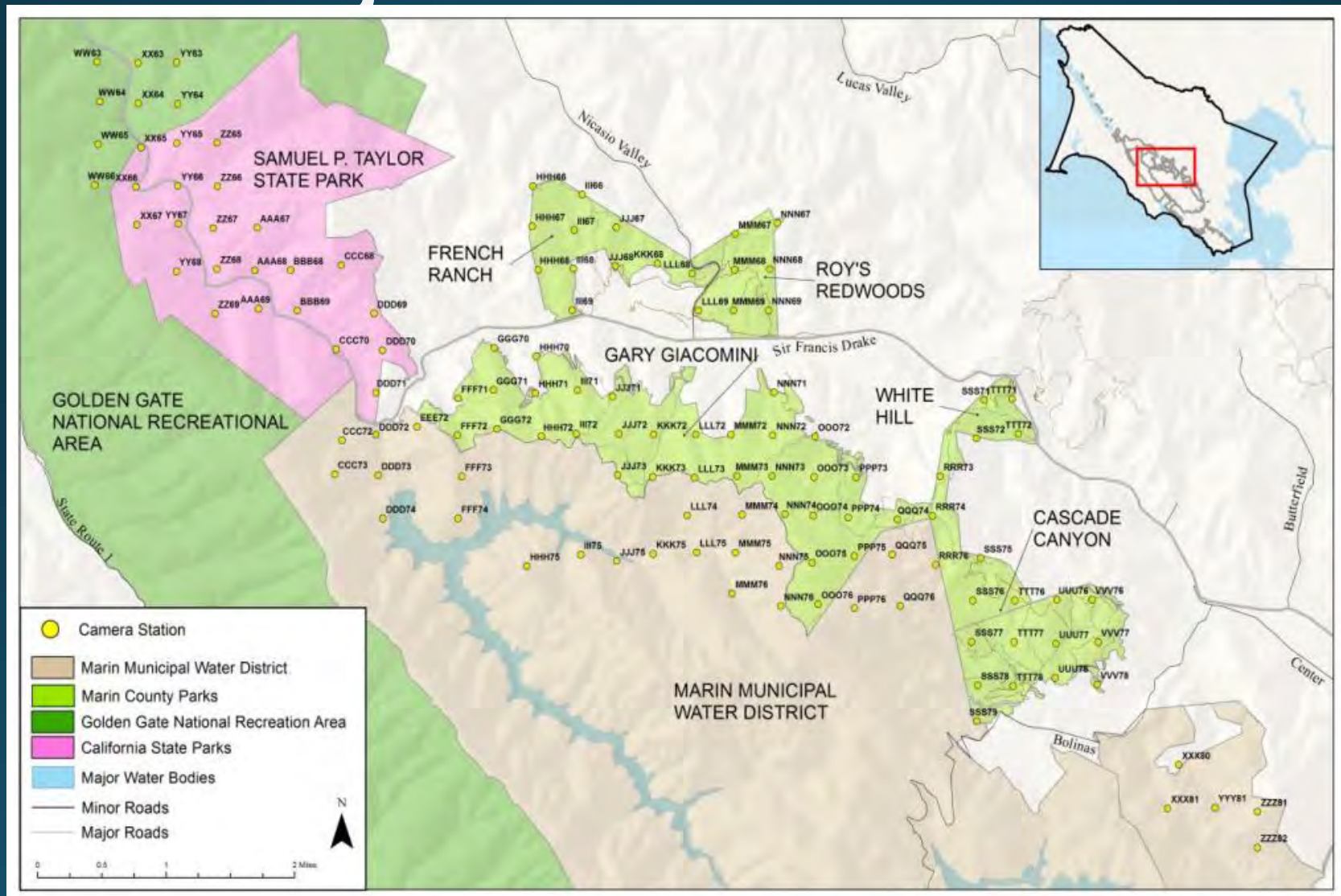
Adequate food and shelter

(may range more widely or hunker down)

Comparing seasonal abundance

Multiple species

Study Area: Multiple Jurisdictions

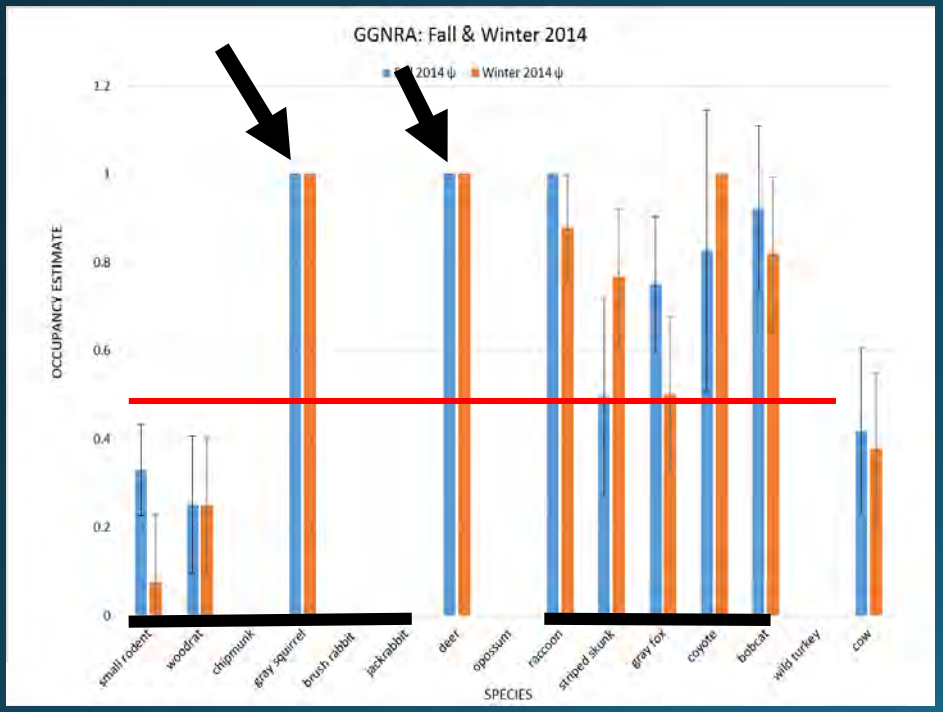


Occupancy: A useful surrogate for abundance

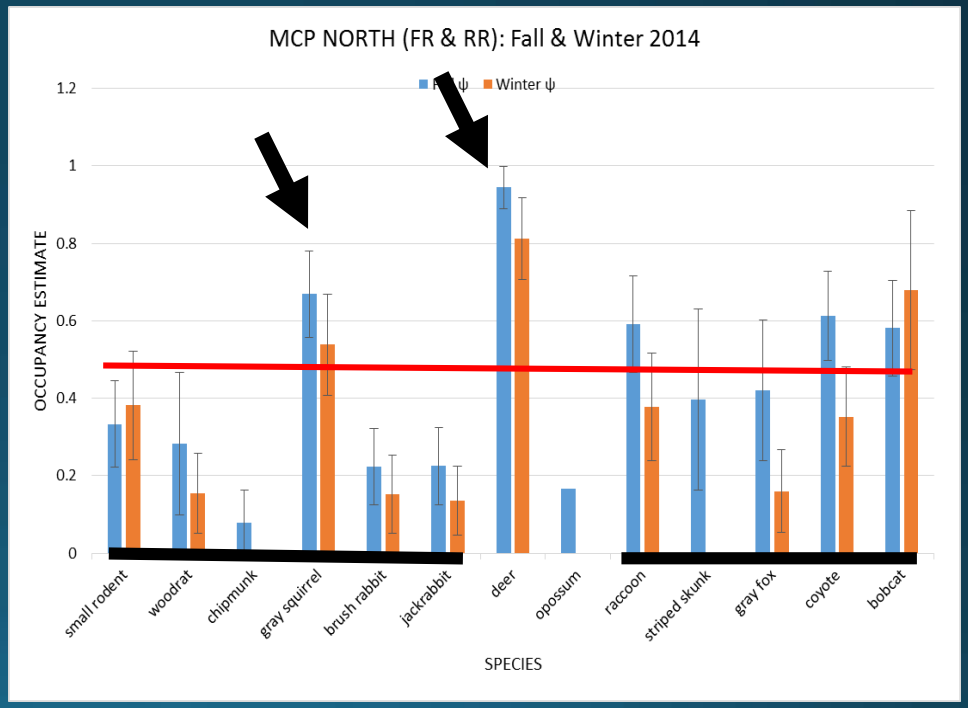
- Relatively **NEW** metric (even for scientists!)
- **RELIABLE** in detecting trends and comparing sites with **LESS EFFORT**
- ***SITE WIDE ABUNDANCE METRIC which does not rely on detection rates but rather detection (1's) and non-detections (0's) within a 24-hr period.***
- Probability of detection corrects for "undetected presences" and does not require individual recognition or marking of animals

DIVERSITY AND ABUNDANCE: SITE TO SITE SEASONAL COMPARISON

Golden Gate National Recreation Area and Marin County Parks



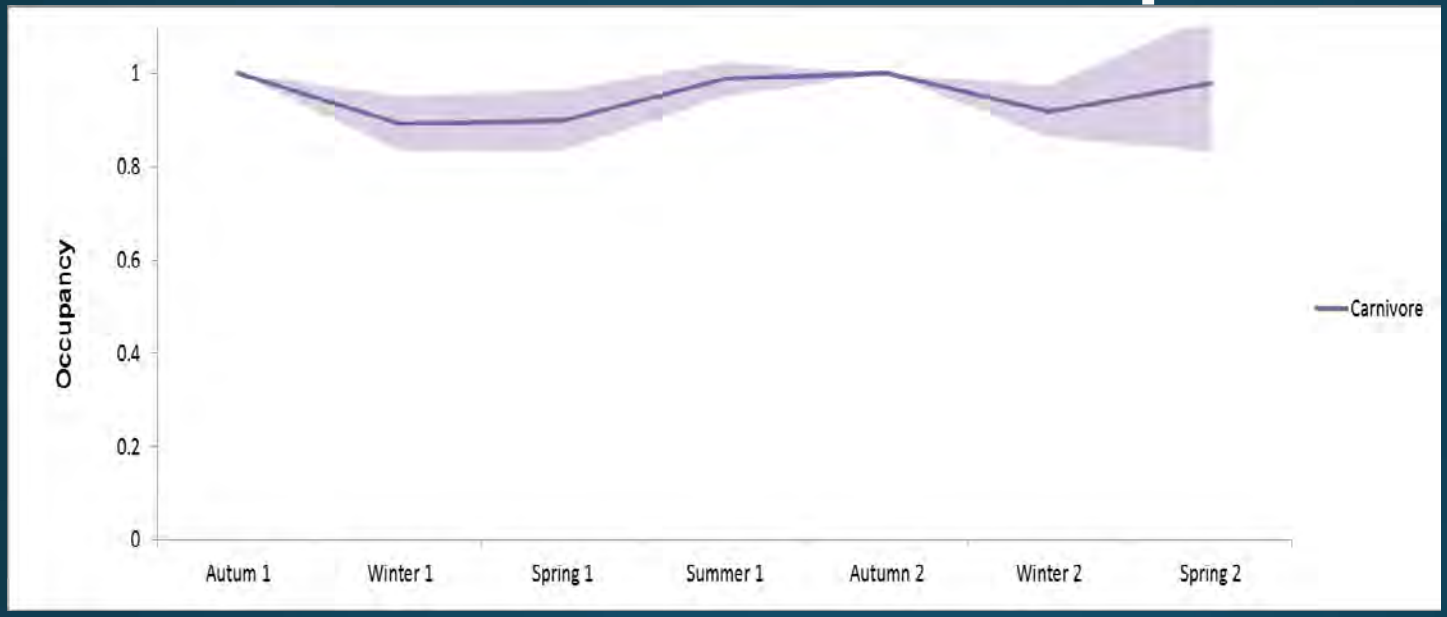
Small mammals **Carnivores**

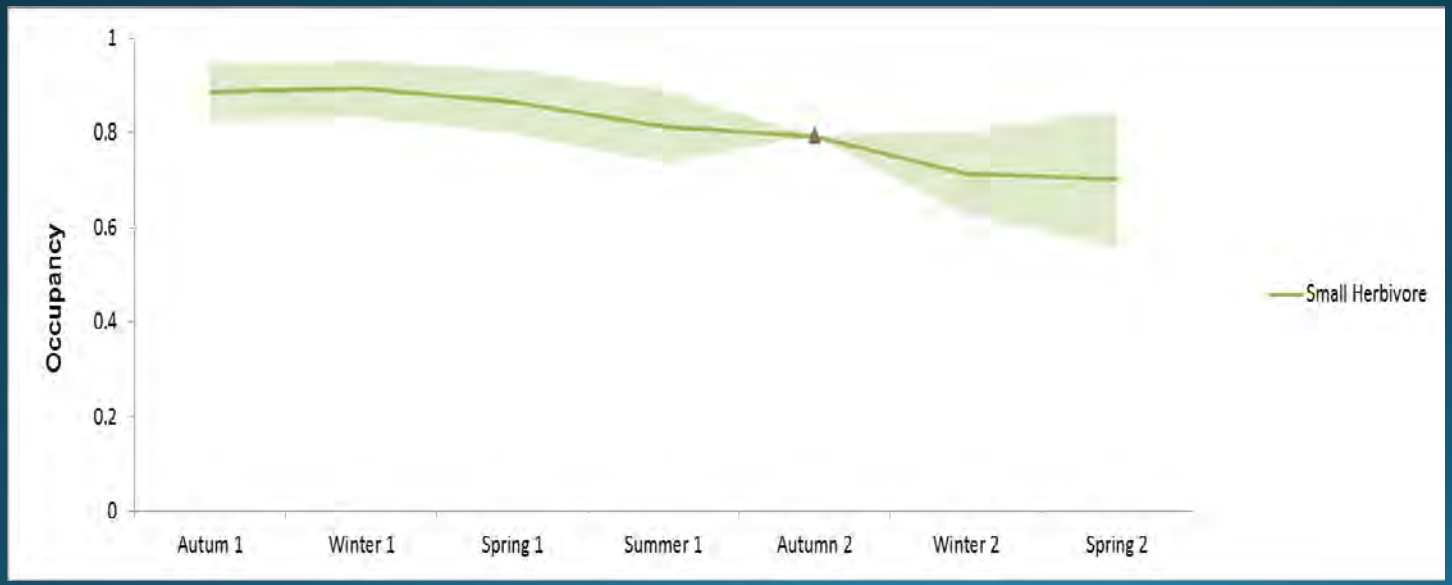


Small mammals **Carnivores**

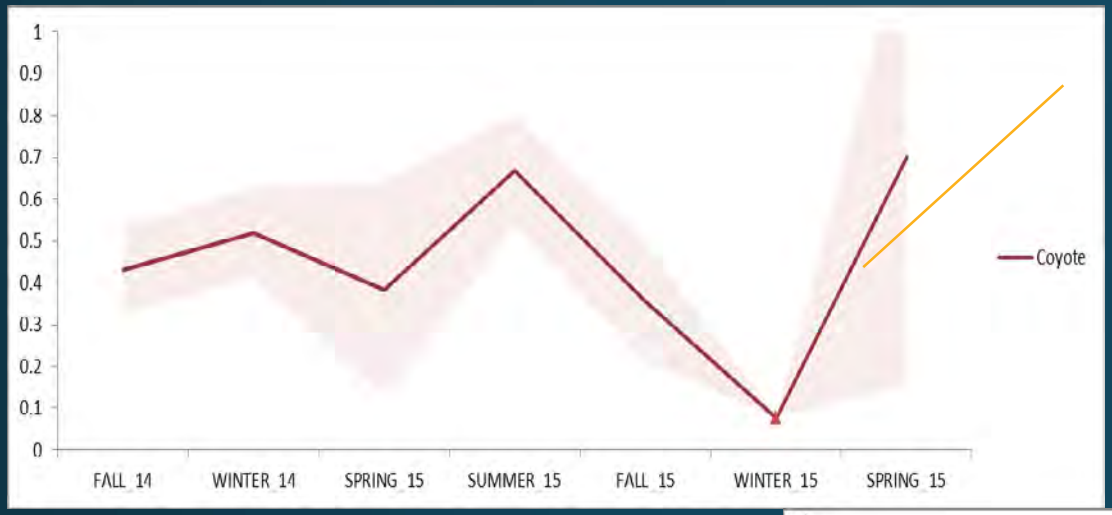
S.E. Townsend

Seasonal abundance: Trophic level





Field Site: MCP
Source: Lizzy Edson, NPS/OT

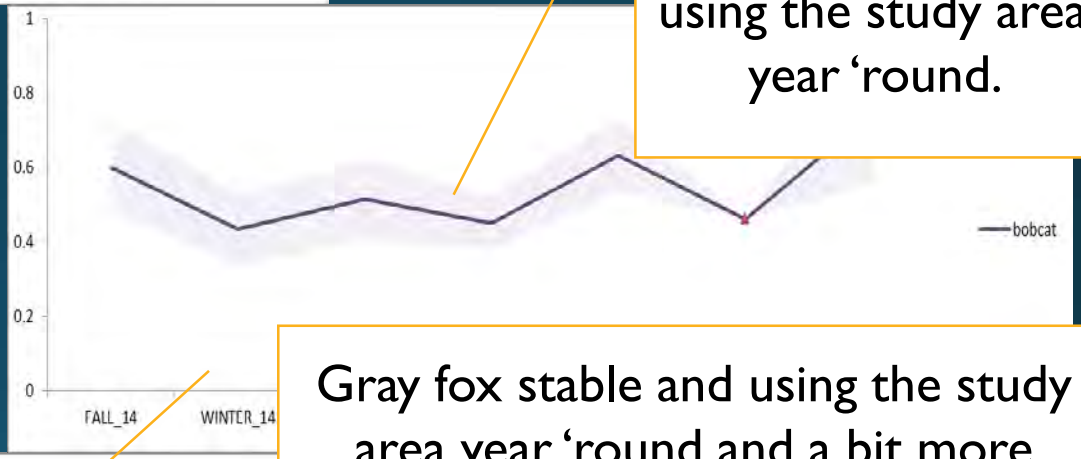


Coyote showing seasonal variation.

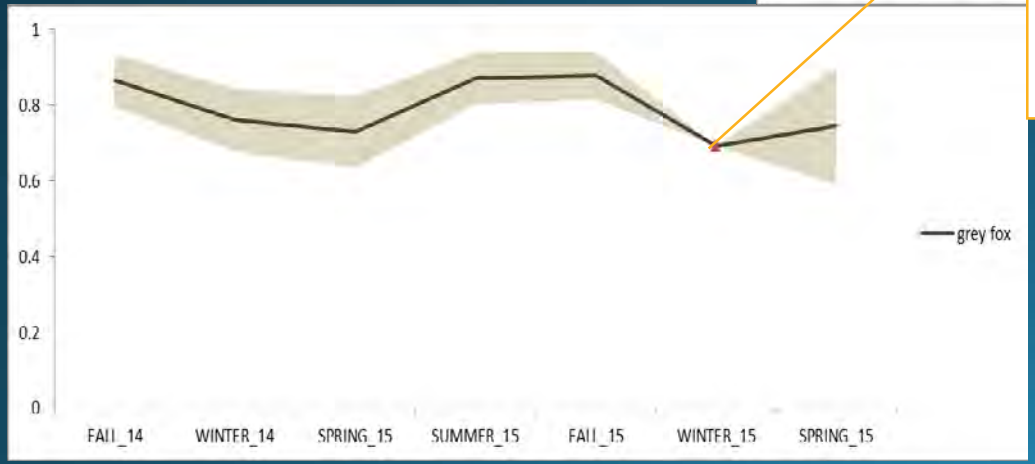
COYOTE

Bobcat stable and using the study area year 'round.

BOBCAT



Gray fox stable and using the study area year 'round and a bit more abundant than bobcat

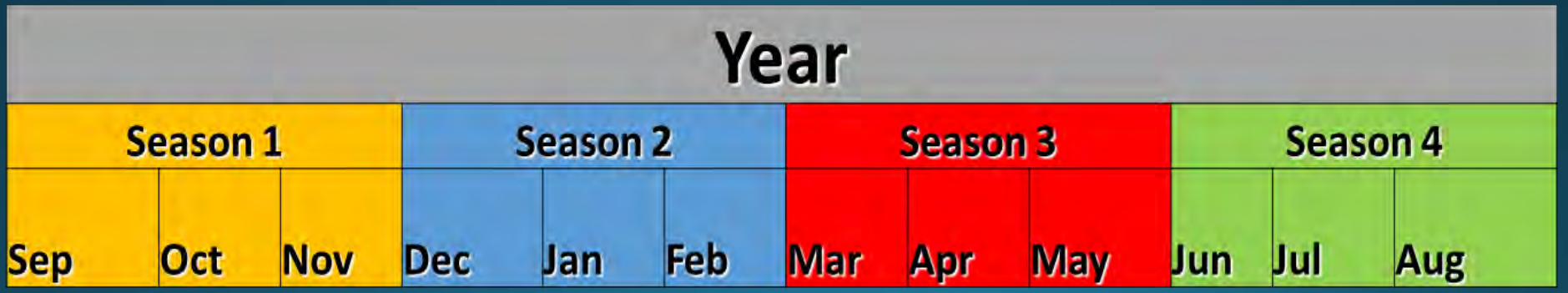


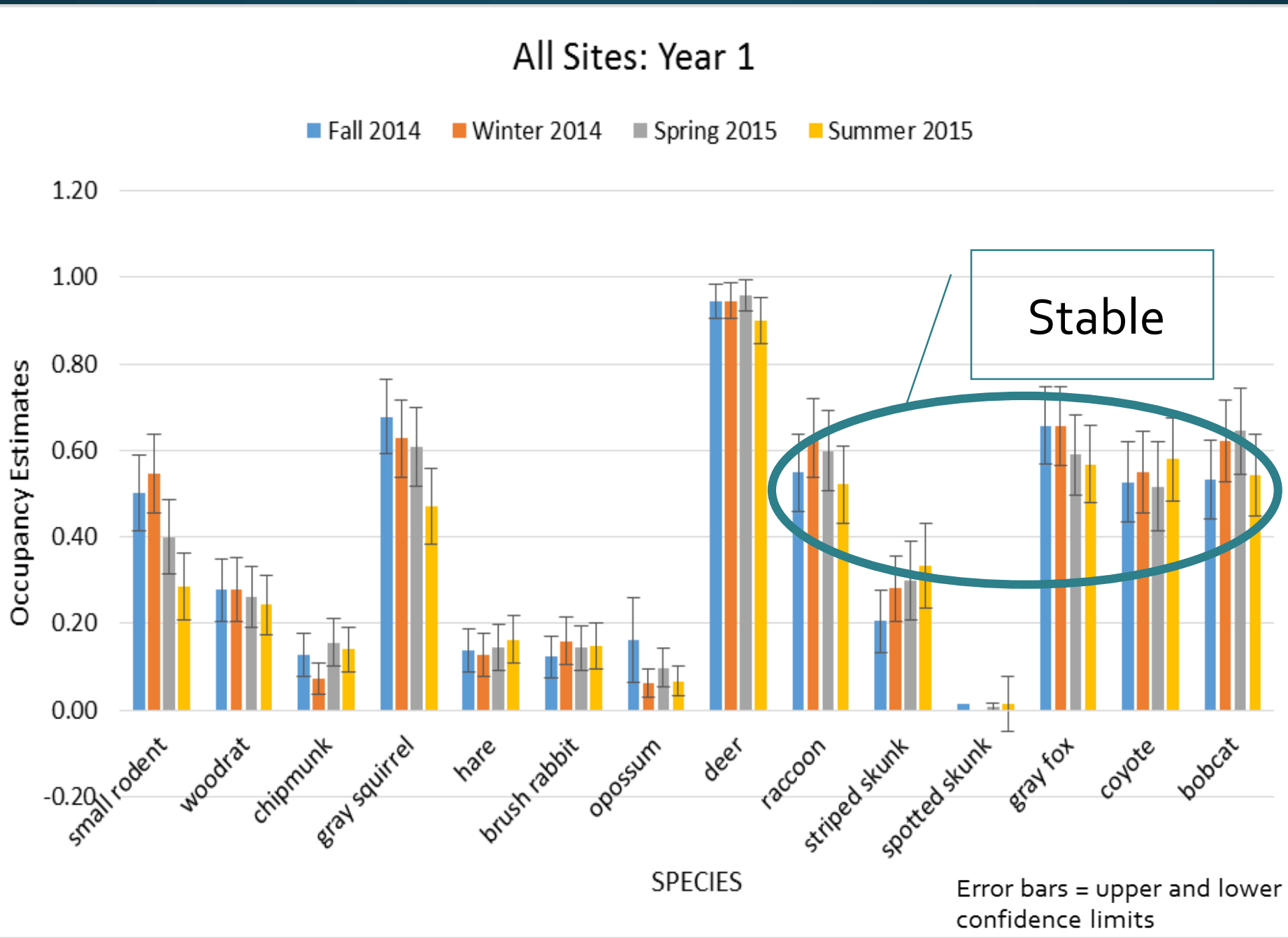
GREY FOX

Field Site: MCP
Source: Lizzy Edson, NPS/OT

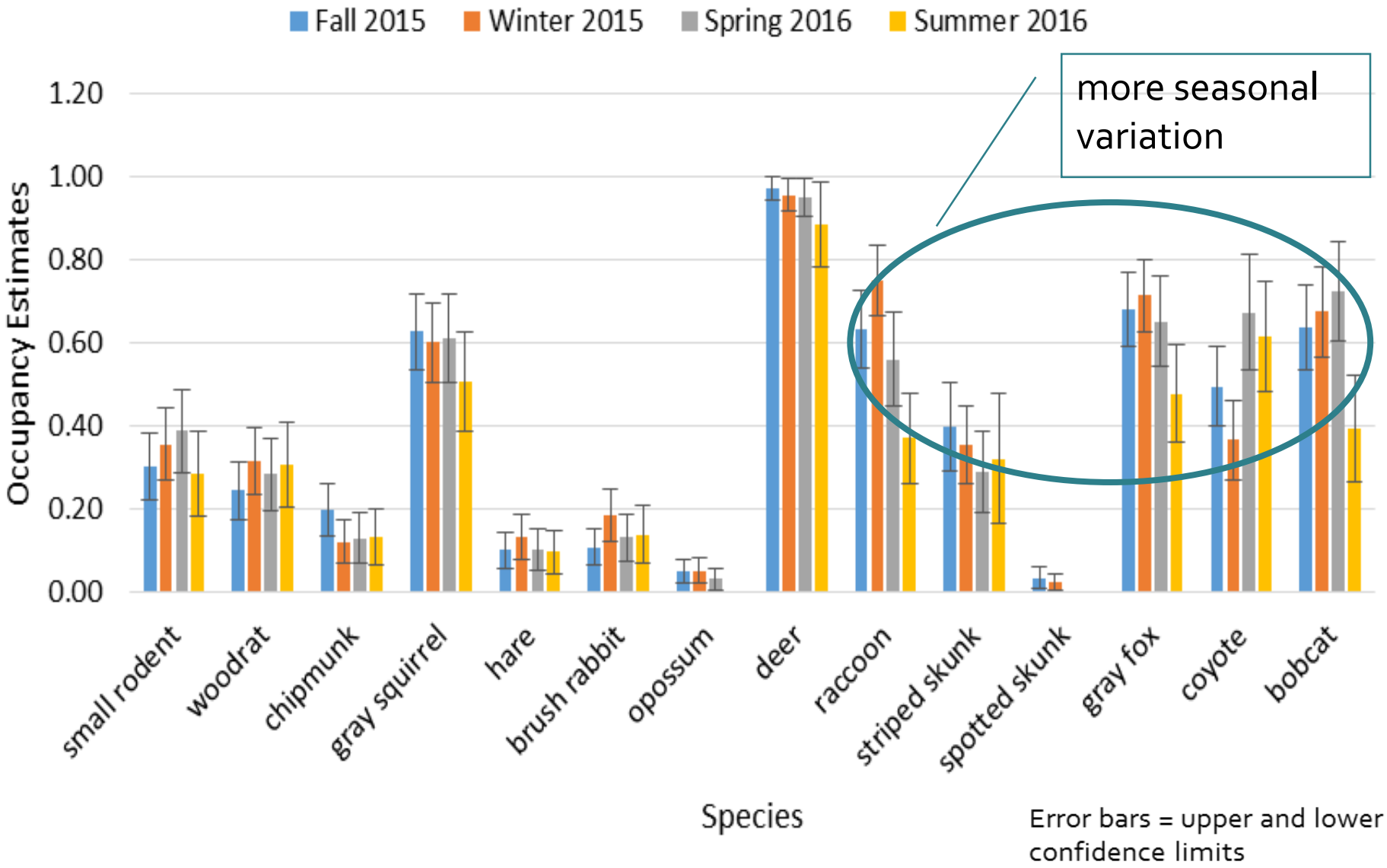
Seasonal Analysis for All Sites

Year 1	**Fall 2014**	**Winter 2014**	**Spring 2015**	**Summer 2015**
Year 2	**Fall 2015**	**Winter 2015**	**Spring 2016**	**Summer 2016**
Year 3	**Fall 2016**	*Winter 2016*	*Spring 2017*	*Summer 2017*

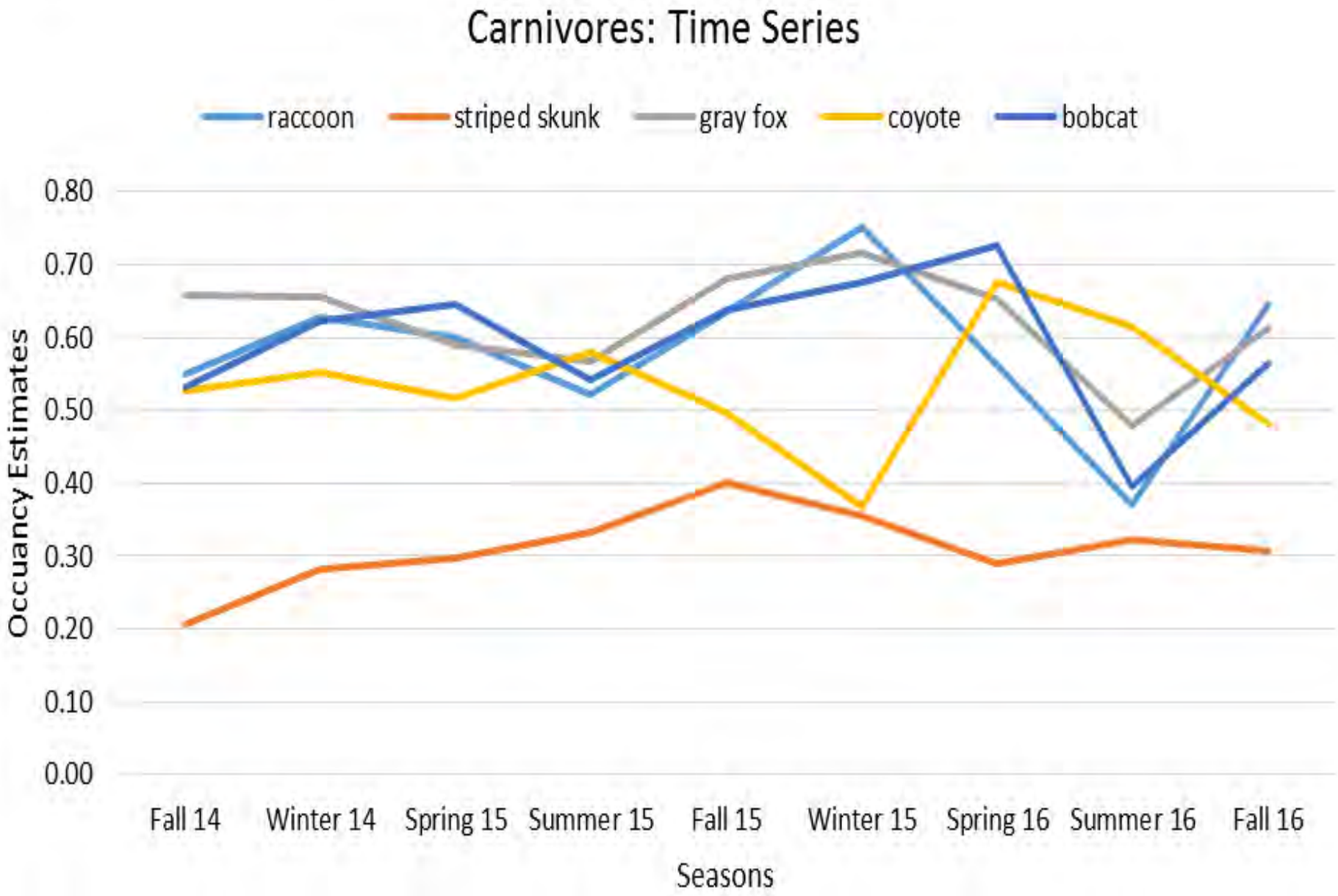



All Sites: Year 1
Fall 2014
Winter 2014
Spring 2015
Summer 2015
Occupancy Estimates
1.20
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
small rodent
woodrat
chipmunk
gray squirrel
hare
brush rabbit
opossum
deer
raccoon
striped skunk
spotted skunk
gray fox
coyote
bobcat
SPECIES
Stable
Error bars = upper and lower confidence limits

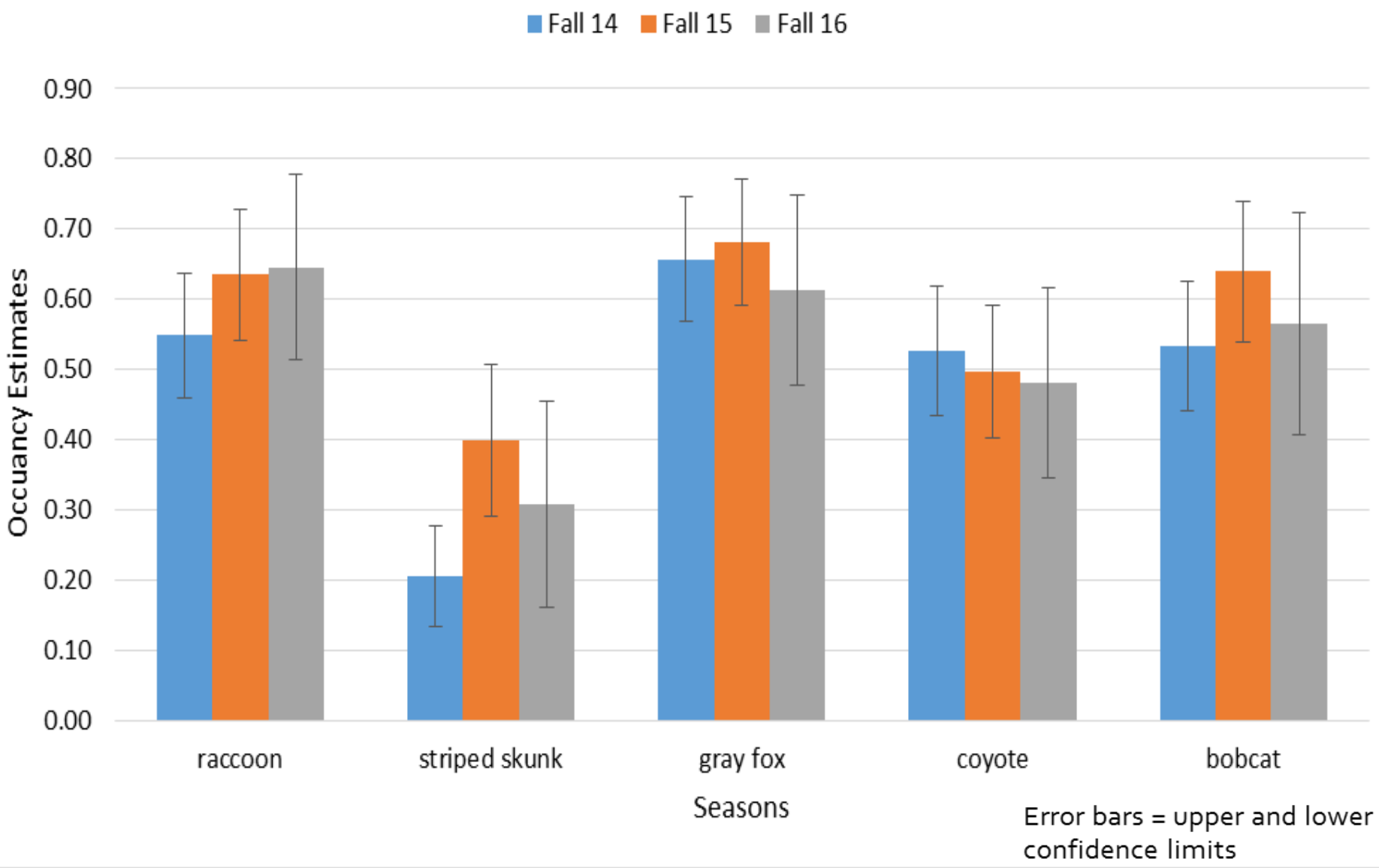
All Sites: Year 2



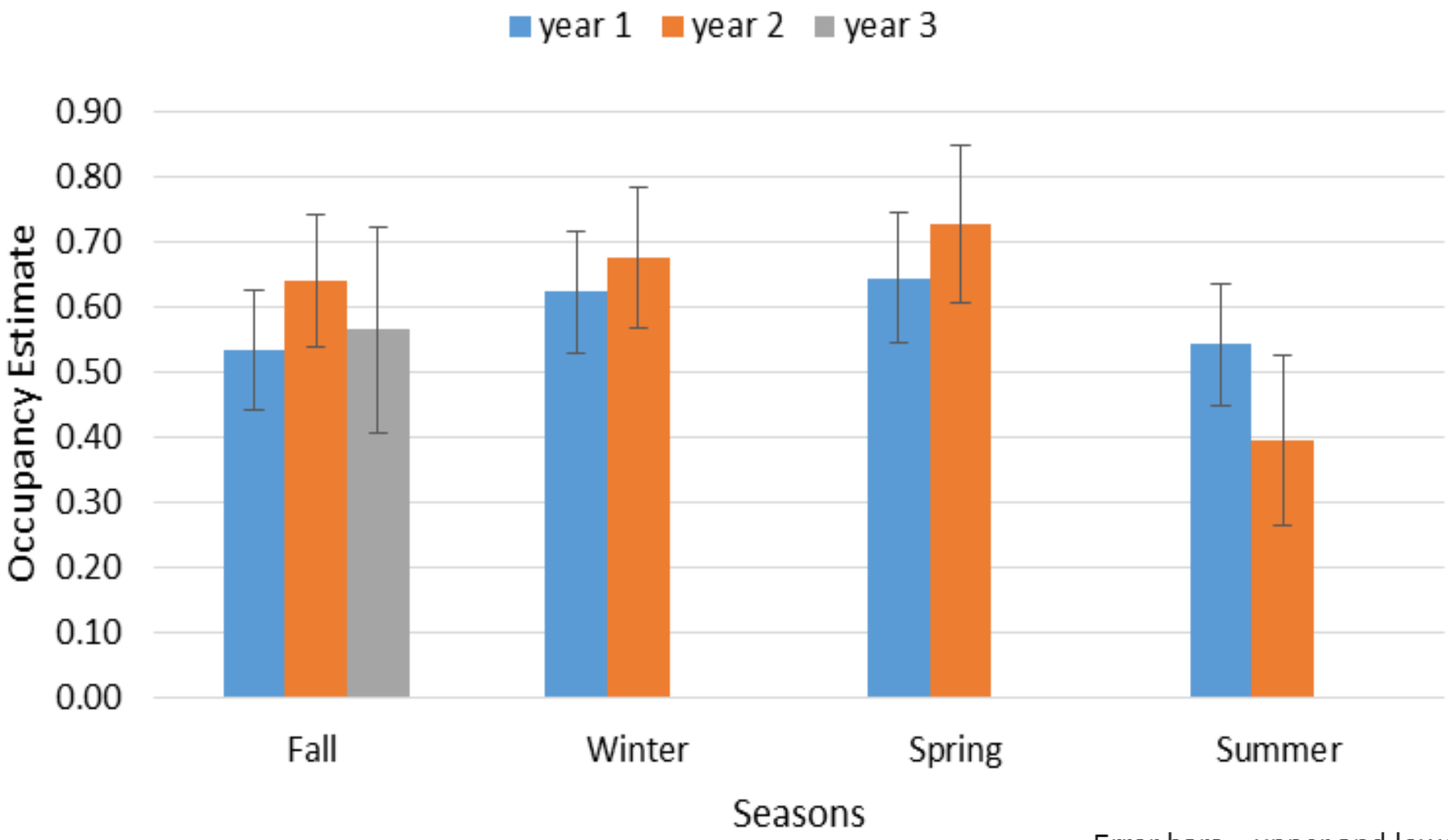
Error bars = upper and lower confidence limits


Carnivores: Time Series
raccoon
striped skunk
gray fox
coyote
bobcat
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Occuancy Estimates
Fall 14
Winter 14
Spring 15
Summer 15
Fall 15
Winter 15
Spring 16
Summer 16
Fall 16
Seasons

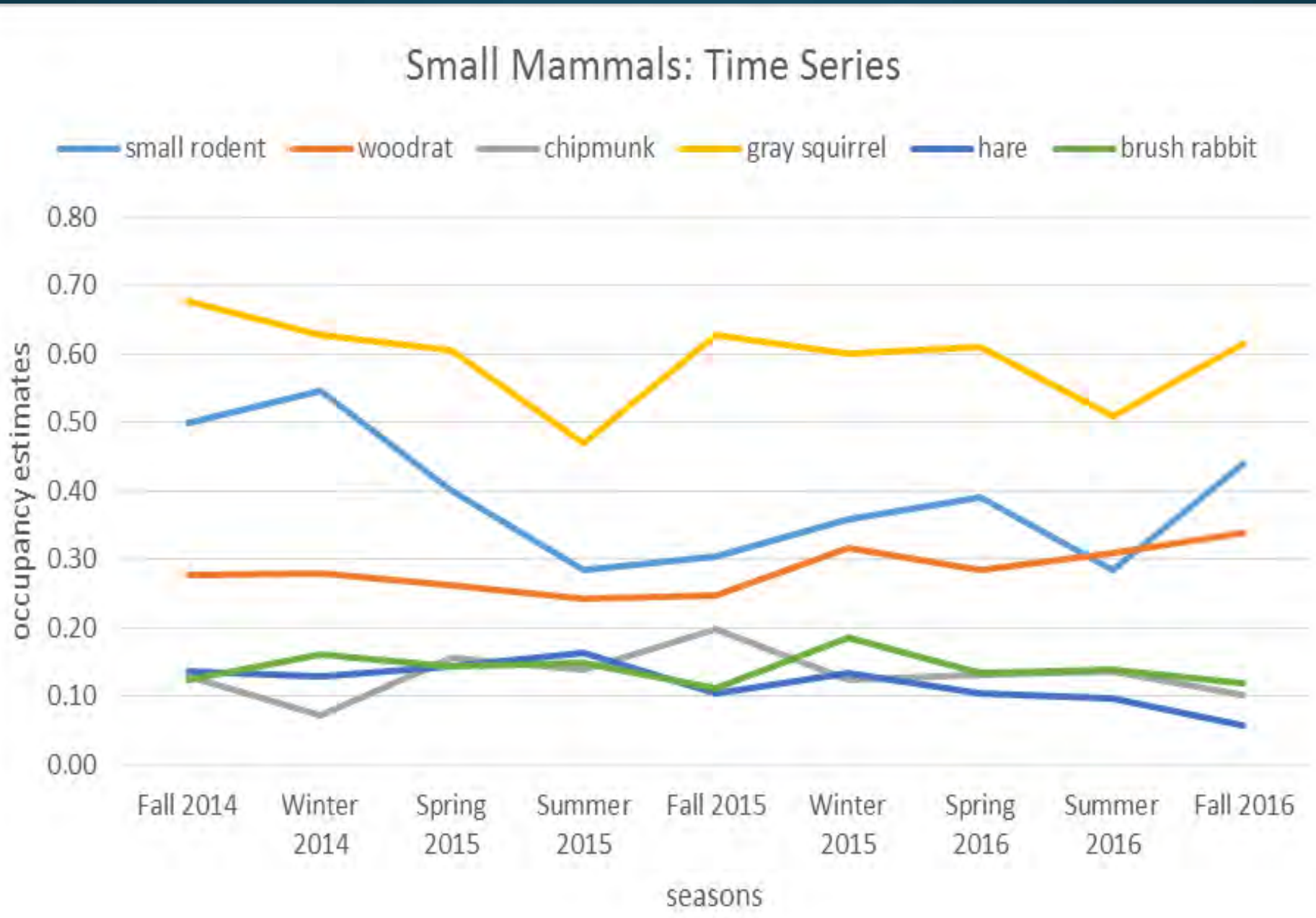
Carnivores: Fall 2014 - 2016



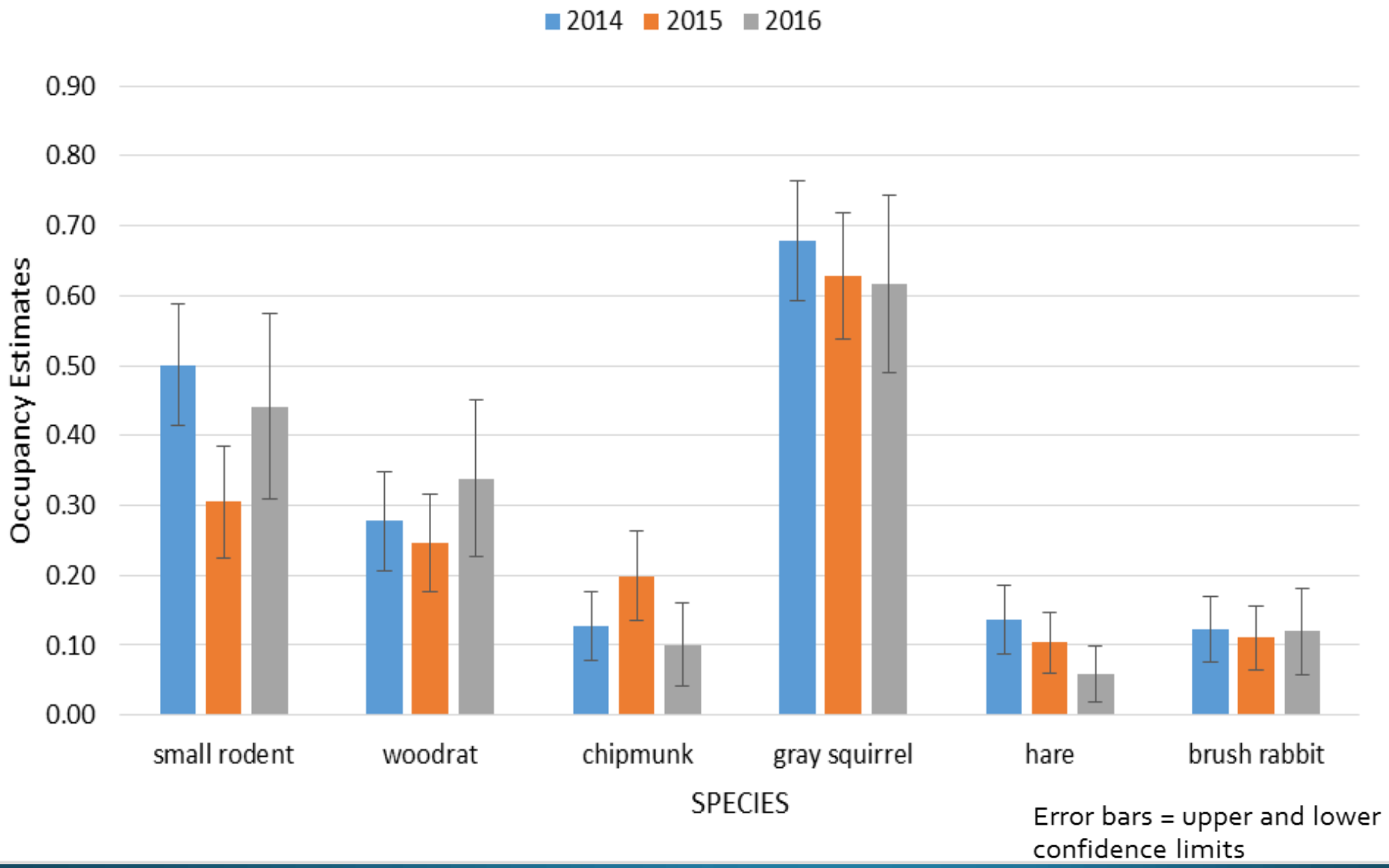
Bobcat: Seasonal Occupancy 2014 - 2016



Error bars = upper and lower confidence limits


Small Mammals: Time Series
small rodent
woodrat
chipmunk
gray squirrel
hare
brush rabbit
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
occupancy estimates
Fall 2014
Winter 2014
Spring 2015
Summer 2015
Fall 2015
Winter 2015
Spring 2016
Summer 2016
Fall 2016
seasons

Small Mammals: Fall 2014-2016

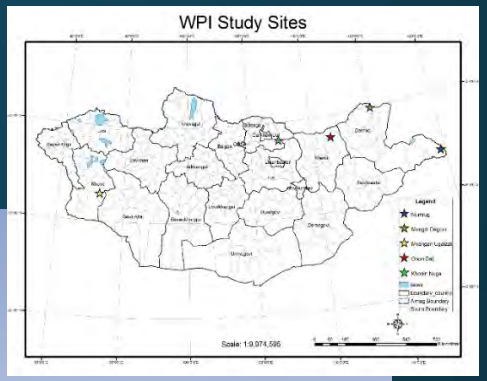


Error bars = upper and lower confidence limits

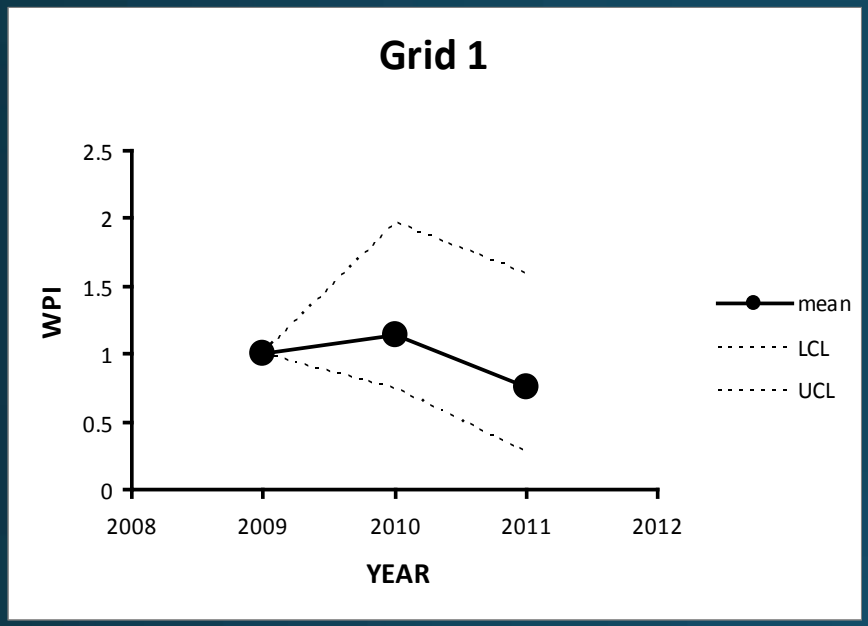
Trends in biodiversity

The WPI

Mongolia: Myangan Ugalzat Protected Area



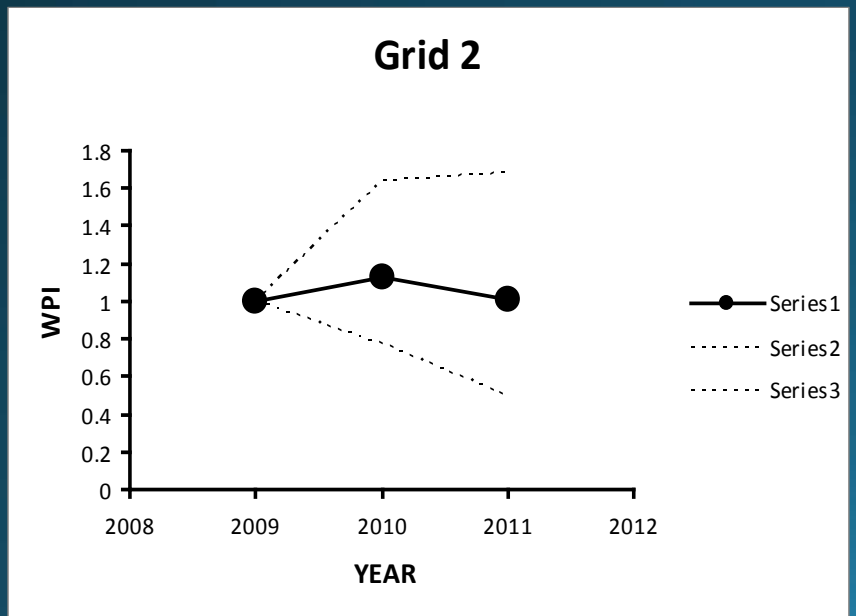
The WPI for Myangan Ugalzat, Altai Sayan, Mongolia



GRID 1: Less Protected

From 2009 to 2010, the WPI rose 14.5%

In 2011, the WPI had declined by 38%



GRID 2: More Protected

Between 2009 and 2010, the WPI rose 12.6%

Between 2010 and 2011, the WPI declined to 2009 levels

Conclusions: Preliminary insights

- From Fall 2014 to Fall 2016, a preliminary assessment shows **no marked declines** in the species for which we have reliable estimates.
- **Abundance** within small mammals and carnivores seems **balanced.**
- **Diversity is well represented** overall for small mammals and carnivores.

Carnivores, large ungulate, and small mammals appear to have some differences in seasonal abundance and diversity between study areas within the overall study area.

Coming soon…

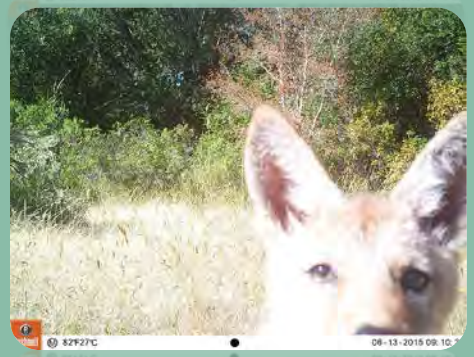
- Four seasons of the WPI for the MWPIP
- Results from the wet winter and end of the drought
- More seasonal analyses…
- Any predictions?

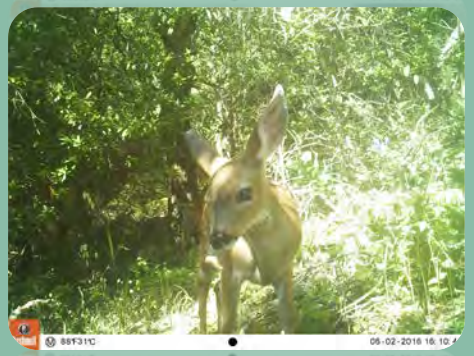

Thank you for
your attention!
Bushnell
51°F10°C
09-30-2014 07: 14: 05

ONE TAM

TAMALPAIS LANDS COLLABORATIVE

MARIN WILDLIFE PICTURE INDEX PROJECT





Eric Fegraus
Senior Director, Technology and External Relations, Tropical Ecology, Assessment and Monitoring Network
Conservation International

Janet Klein
Natural Resources Program Manager
Marin Municipal Water District

Sue Townsend
Widlife Ecologist

Bill Merkle
Wildlife Ecologist
Golden Gate National Recreation Area

Lisa Micheli
President & CEO
Pepperwood Foundation

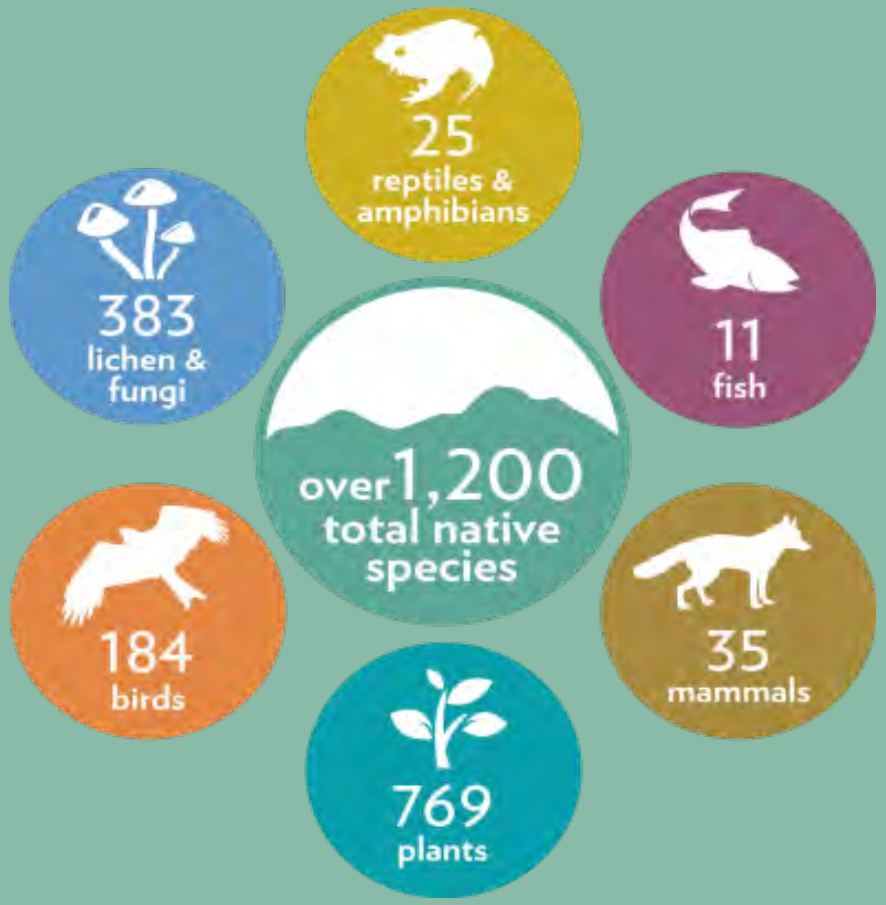
Marin Wildlife Picture Index Project: A Resource Manager's Perspective

Bill Merkle
Wildlife Ecologist
Golden Gate National Recreation Area

ONE TAM

INVENTORY

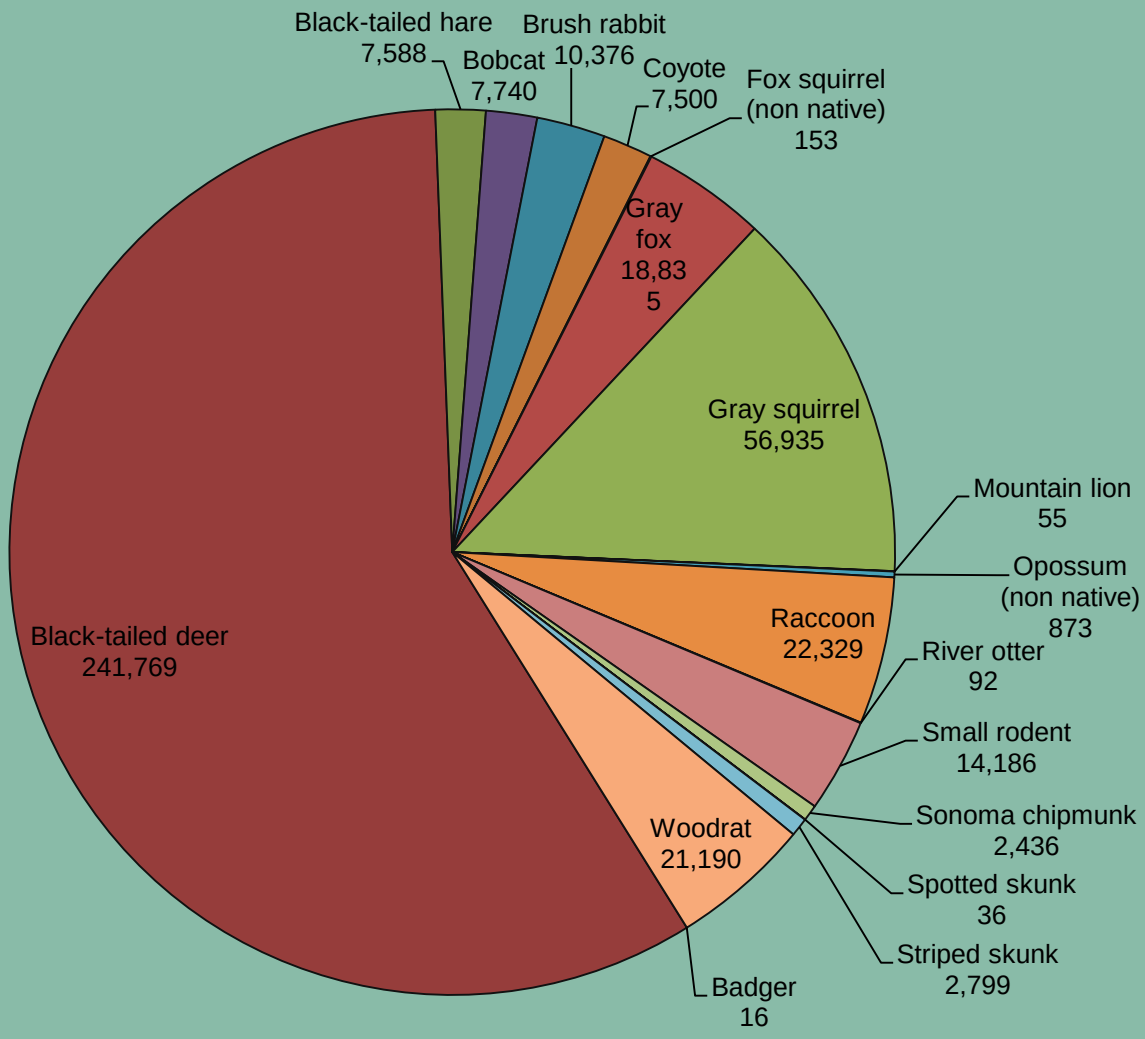
TAMALPAIS LANDS COLLABORATIVE



- Native Biodiversity
- Rare Species
- Planning/Compliance
- Restoration or further research

NATIVE SPECIES RICHNESS

GOOD ?



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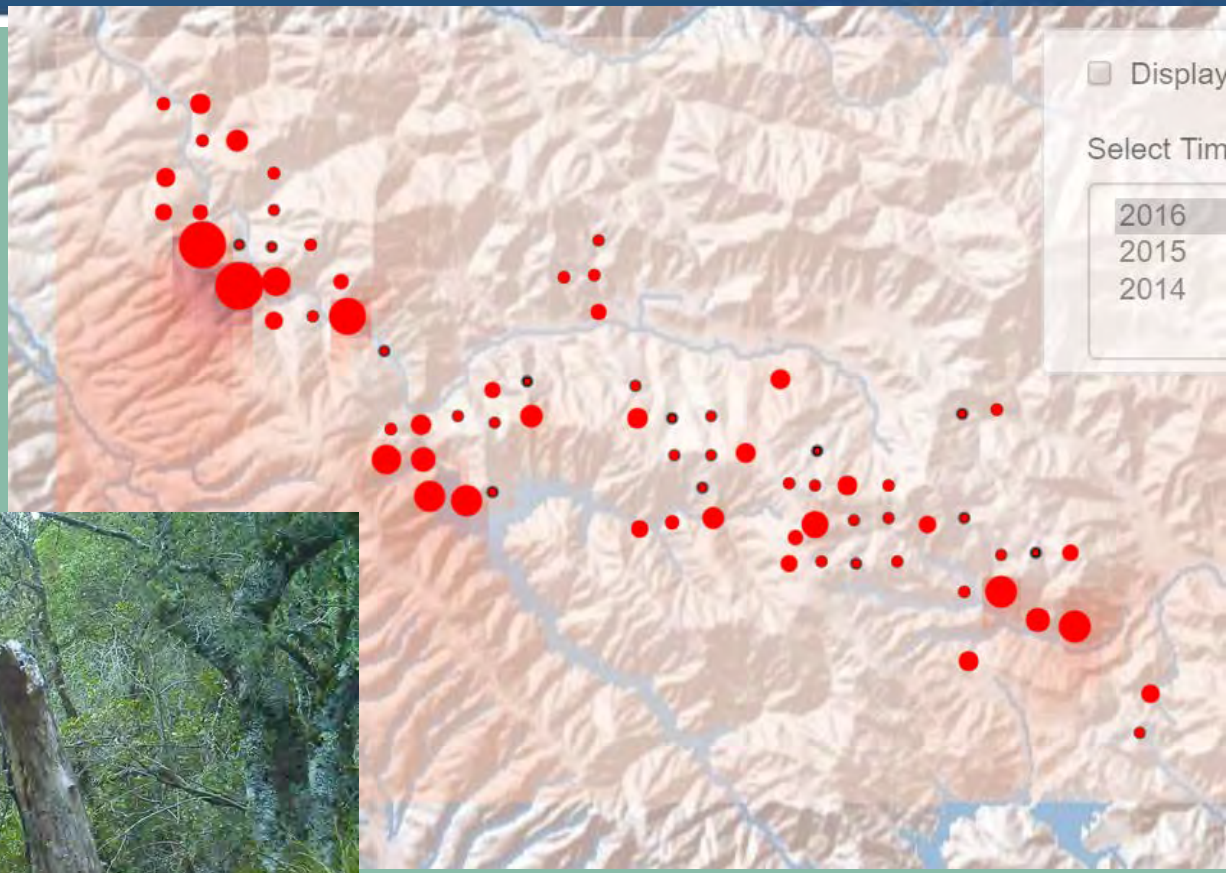
SPATIAL INFORMATION

TAMALPAIS LANDS COLLABORATIVE



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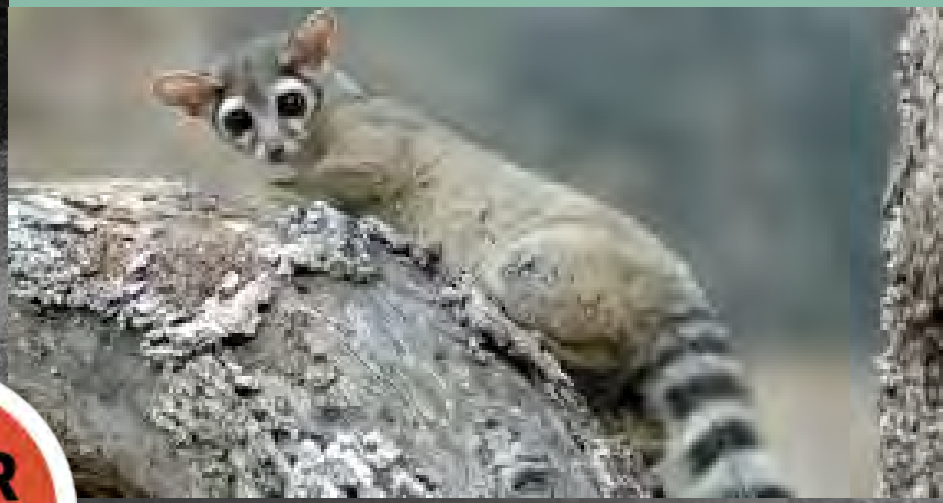
RARE SPECIES

TAMALPAIS LANDS COLLABORATIVE

POOR ?



SPATIAL INFORMATION

ONE TAM

TAMALPAIS LANDS COLLABORATIVE

Badger
Cameras
MWPIP study area outline
Vegetation type
Coastal Scrub
Grassland
Water

Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), Mapmyindia, © OpenStreetMap contributors, and the GIS User Community

SPATIAL INFORMATION

ONE TAM

TAMALPAIS LANDS COLLABORATIVE

Skunks
Cameras
MWPIP study area outline

Vegetation type
Closed-cone Pine-Cypress
Coastal Woodland
Conifer
Water

ONE TAM

MOUNTAIN LIONS

TAMALPAIS LANDS COLLABORATIVE

Documentation of mountain lions in Marin County, California, 2010–2013

VIRGINIA L. FIFIELD, AVIVA J. ROSSI, AND ERIN E. BOYDSTON*

P.O. Box 2230, Mill Valley, CA 94942, USA (VLF)

Department of Wildlife, Fish, and Conservation Biology, University of California, Davis, CA 95616 USA (AJR)

U.S. Geological Survey, Western Ecological Research Center, Thousand Oaks, CA 91360 USA (EEB)

**Correspondent: eboydston@usgs.gov*

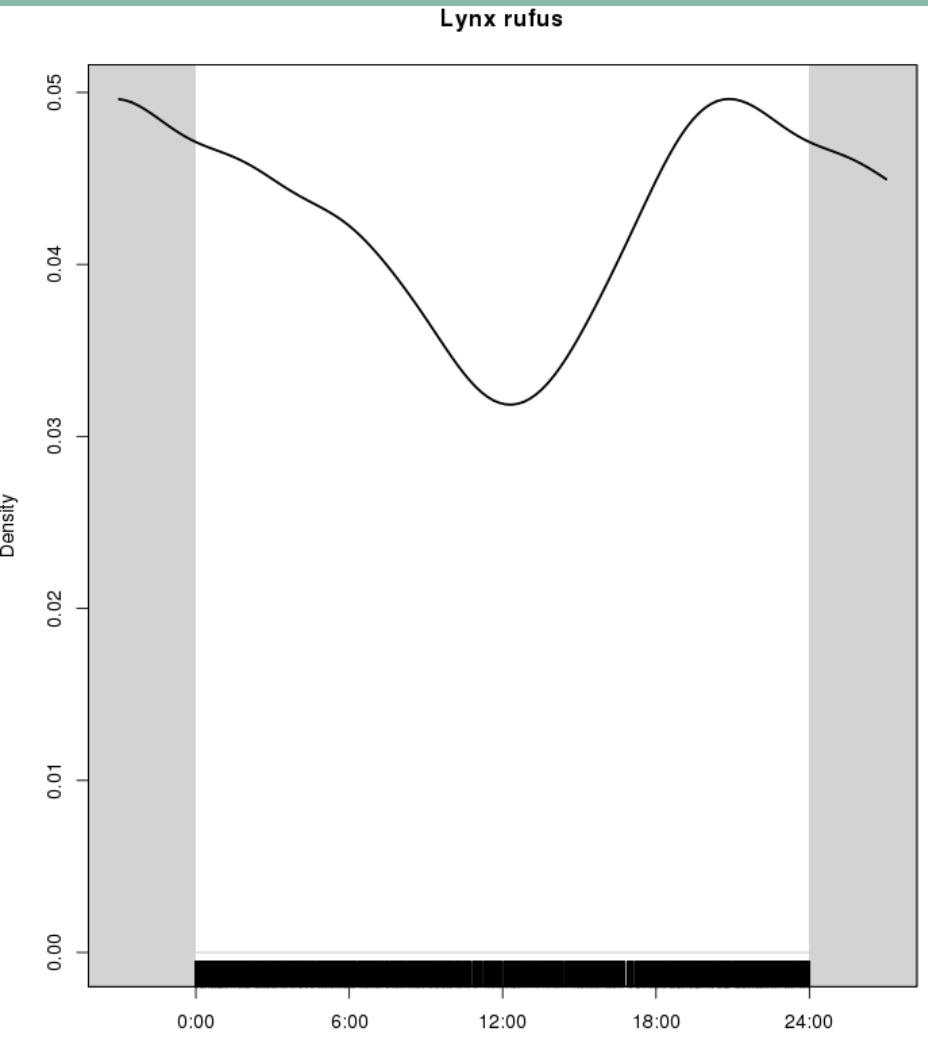
Keywords: mountain lion, cougar, panther, puma, *Puma concolor*, ocular defect, eyeshine, Marin County, camera trap, San Francisco Bay Area

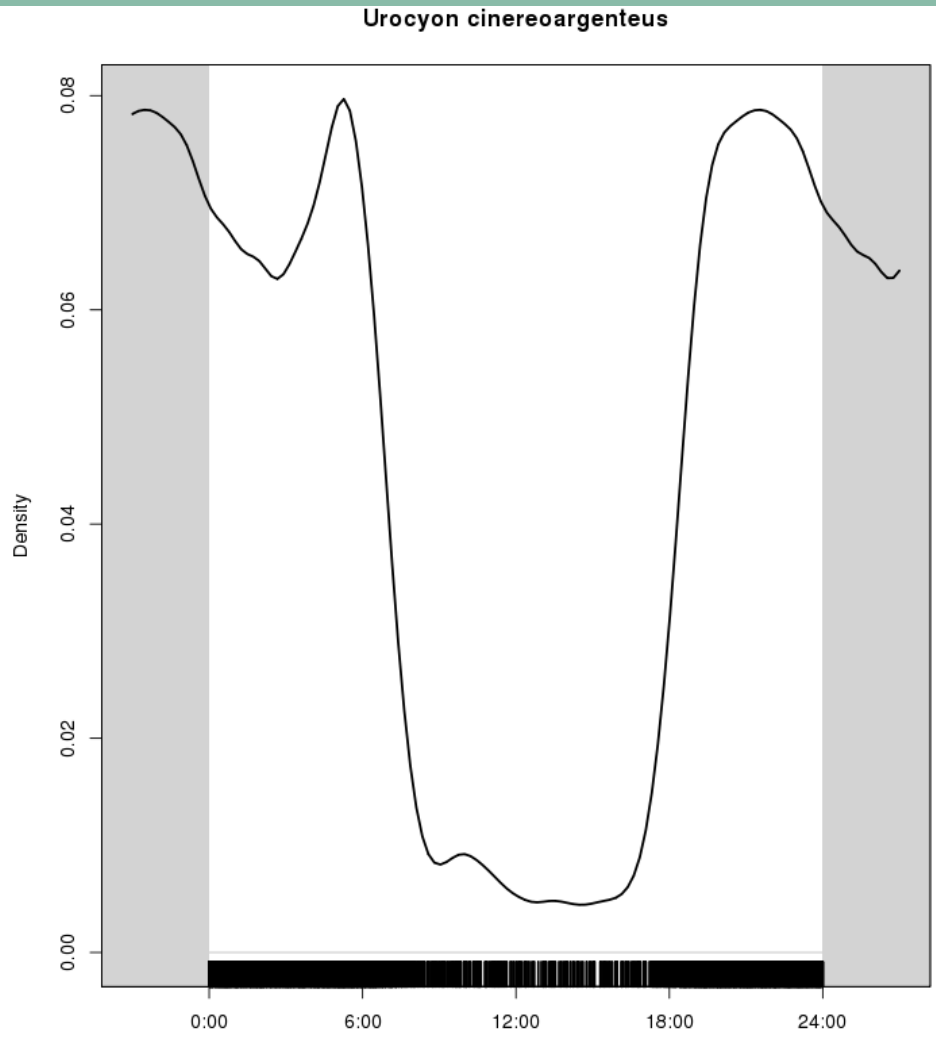
ONE TAM

TEMPORAL DATA

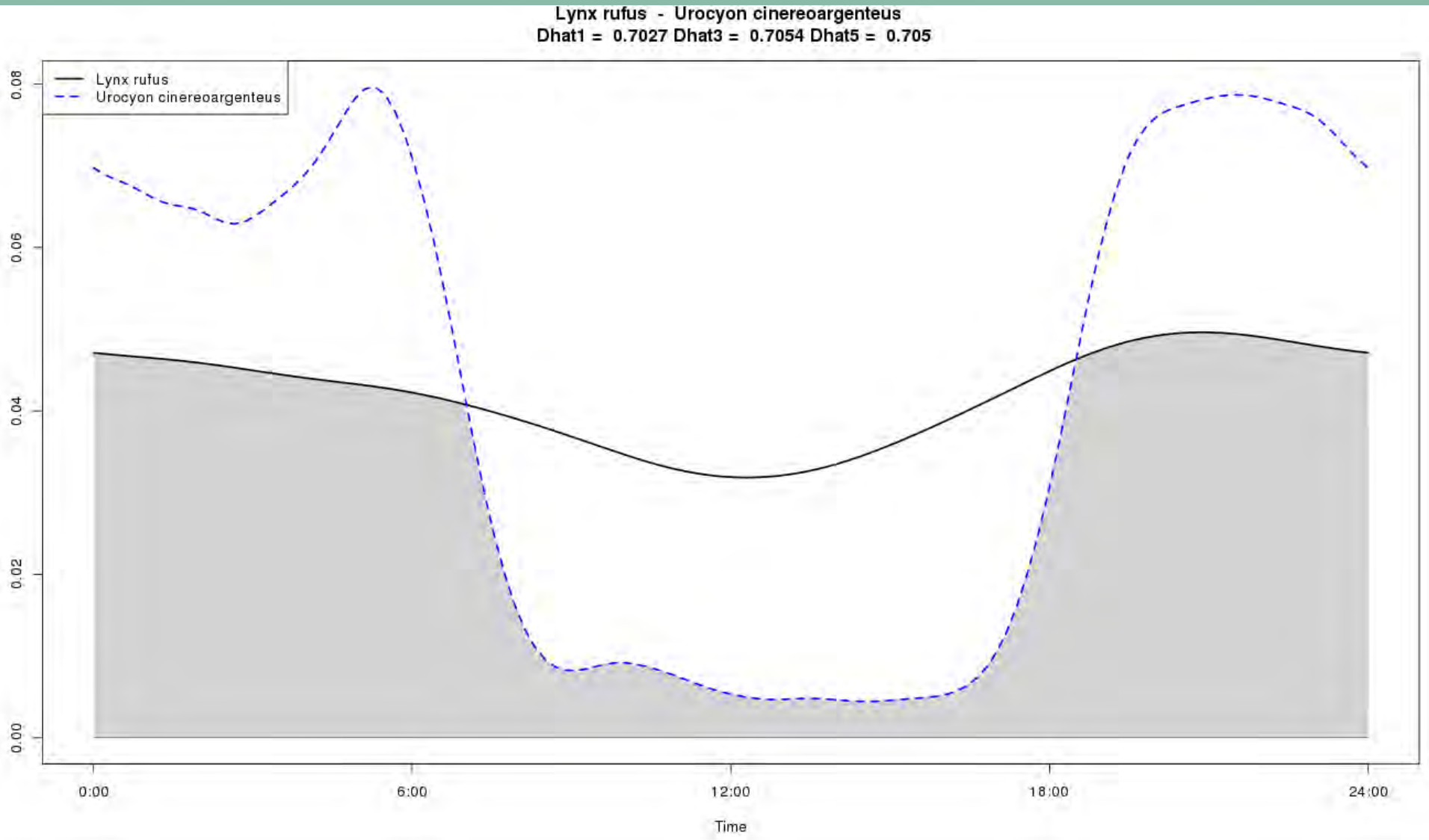
TAMALPAIS LANDS COLLABORATIVE

TEMPORAL DATA





TEMPORAL DATA

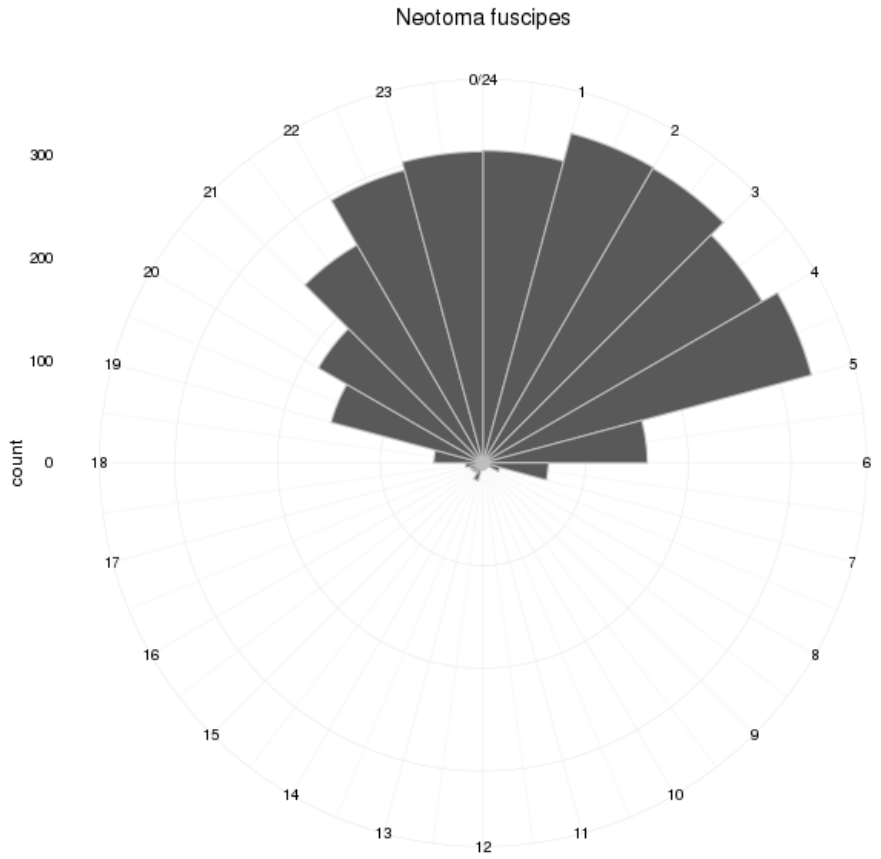


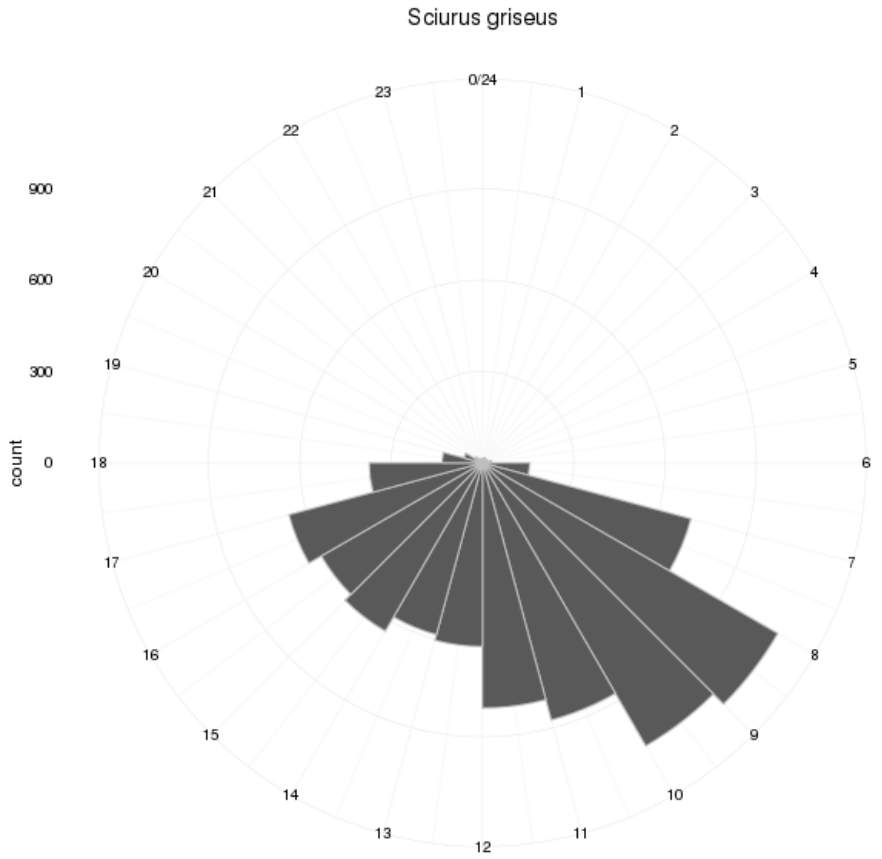
ONE TAM

TEMPORAL DATA

TAMALPAIS LANDS COLLABORATIVE

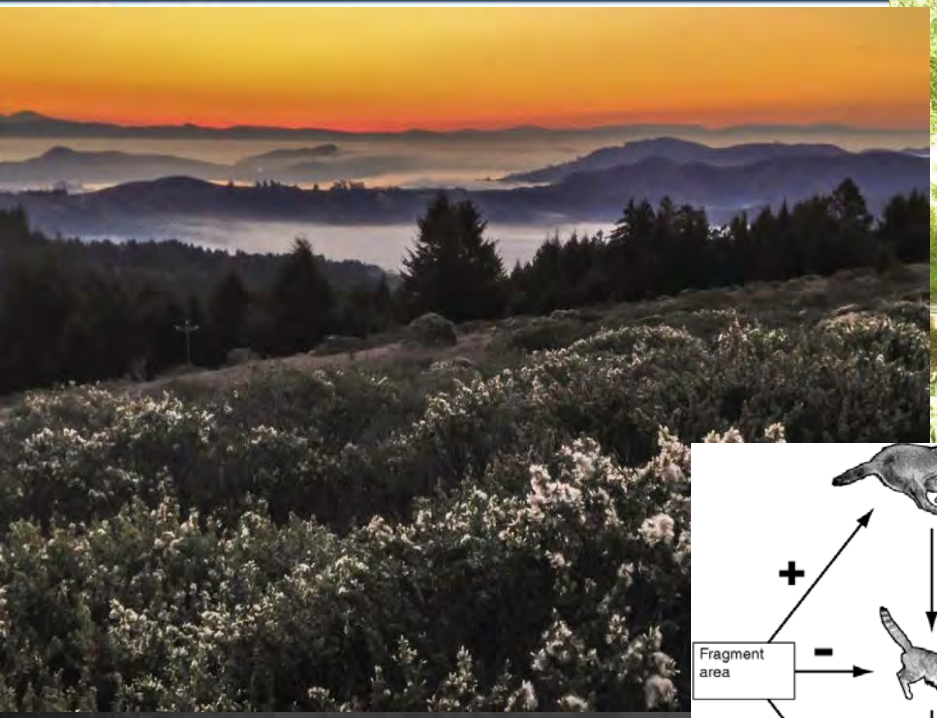
TEMPORAL DATA

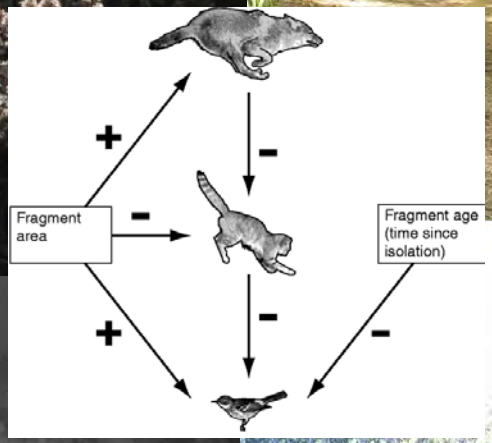




ONE TAM

TAMALPAIS LANDS COLLABORATIVE





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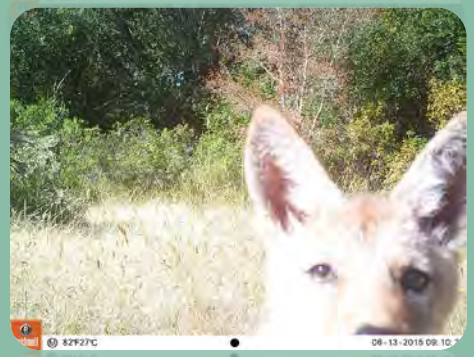
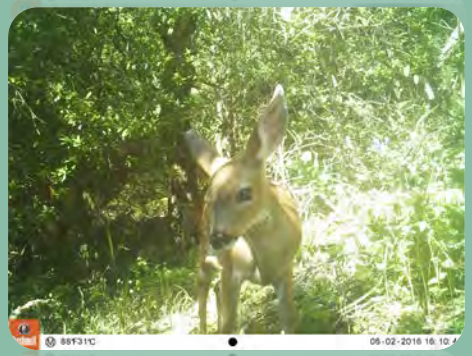
TAMALPAIS LANDS COLLABORATIVE

MARIN WILDLIFE PICTURE INDEX PROJECT





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Golden Gate National Recreation Area

Lisa Micheli
President & CEO
Pepperwood Foundation

Tracking wildlife across the Bay Area?

social and data platforms to support a regional Wildlife Picture Network

Lisa Micheli, Pepperwood

October 26, 2017

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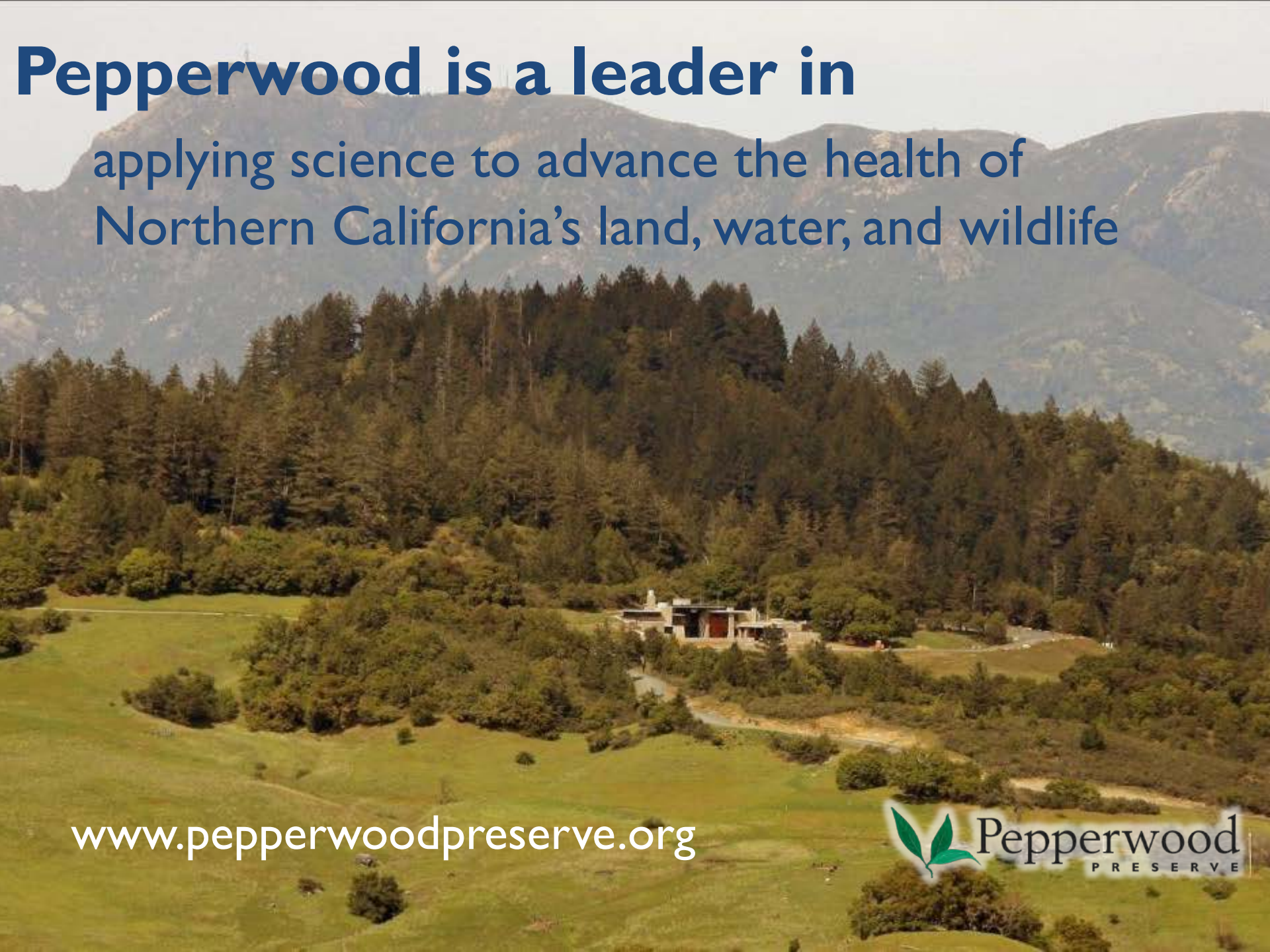
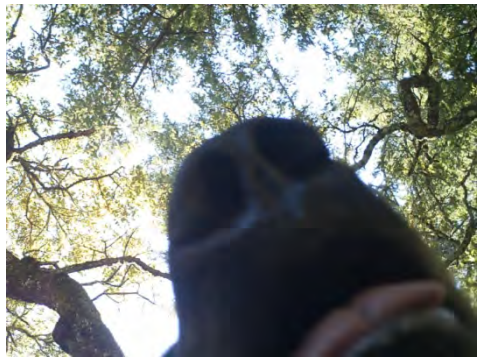
onetam.org

Pepperwood
PRESERVE
Inspiring conservation through science

CONSERVATION INTERNATIONAL


Pepperwood is a leader in
applying science to advance the health of
Northern California's land, water, and wildlife
www.pepperwoodpreserve.org
Pepperwood
PRESERVE

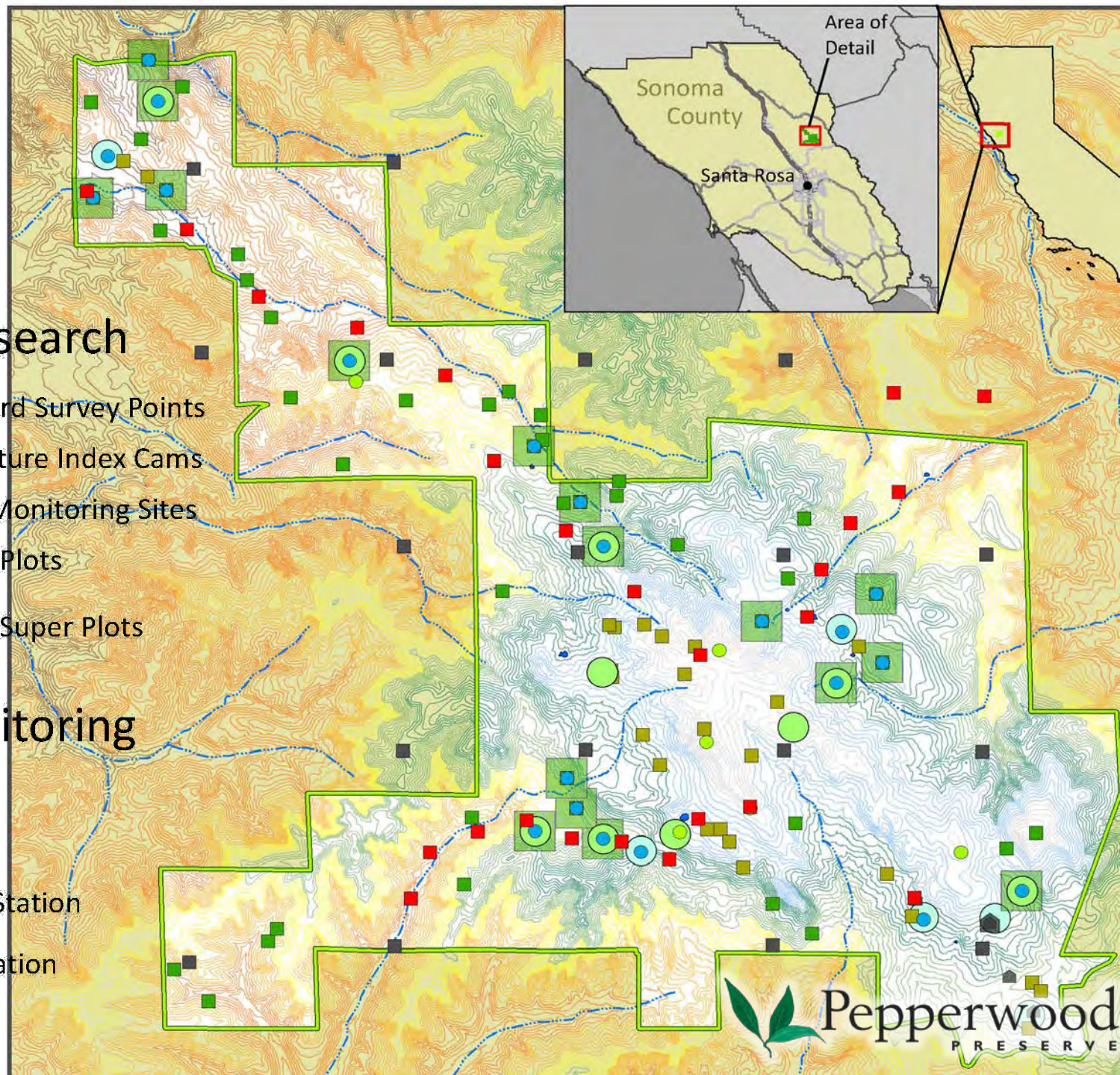
Imagine a world where our living landscapes got check ups *and* preventative care….

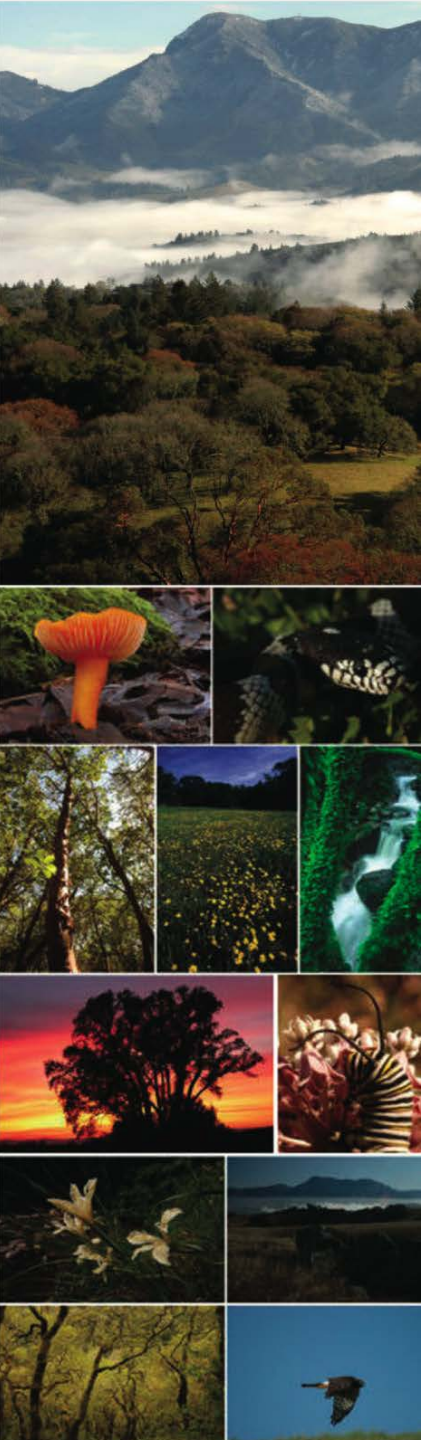


=

…..with wildlife biodiversity routinely evaluated as a critical "vital sign"

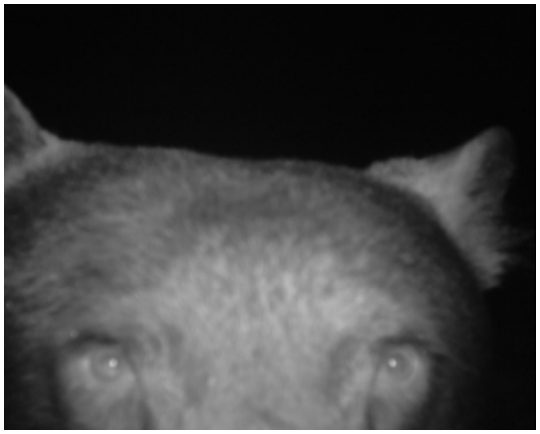
Sentinel Site





Why monitor landscape health?

- to develop scientifically-sound information on the current status and long term trends in the composition, structure, and function of ecosystems in the face of local and global change
- to identify drivers of observed ecosystem change
- to determine how well current management practices collectively are sustaining those ecosystems
- to evaluate site-specific adaptive management strategies



Pepperwood PRESERVE

Wildlife Picture Network origins

- Pepperwood's WONBA (Wildlife Observer Network Bay Area) sprouted in 2011 to support emerging camera user community
- Quarterly to biannual WONBA practitioners' roundtables-compare work in progress, lessons learned, applications
- Wildlife Picture Index methods trainings
- Co-creation of data platform capable of housing diverse project data
- Technical support for targeted long-term arrays
- User community support

email me to sign up for our Wildlife Observer Network base camp!
lmicheli@pepperwoodpreserve.org

Pepperwood
PRESERVE

So why a regional Wildlife Picture Network?

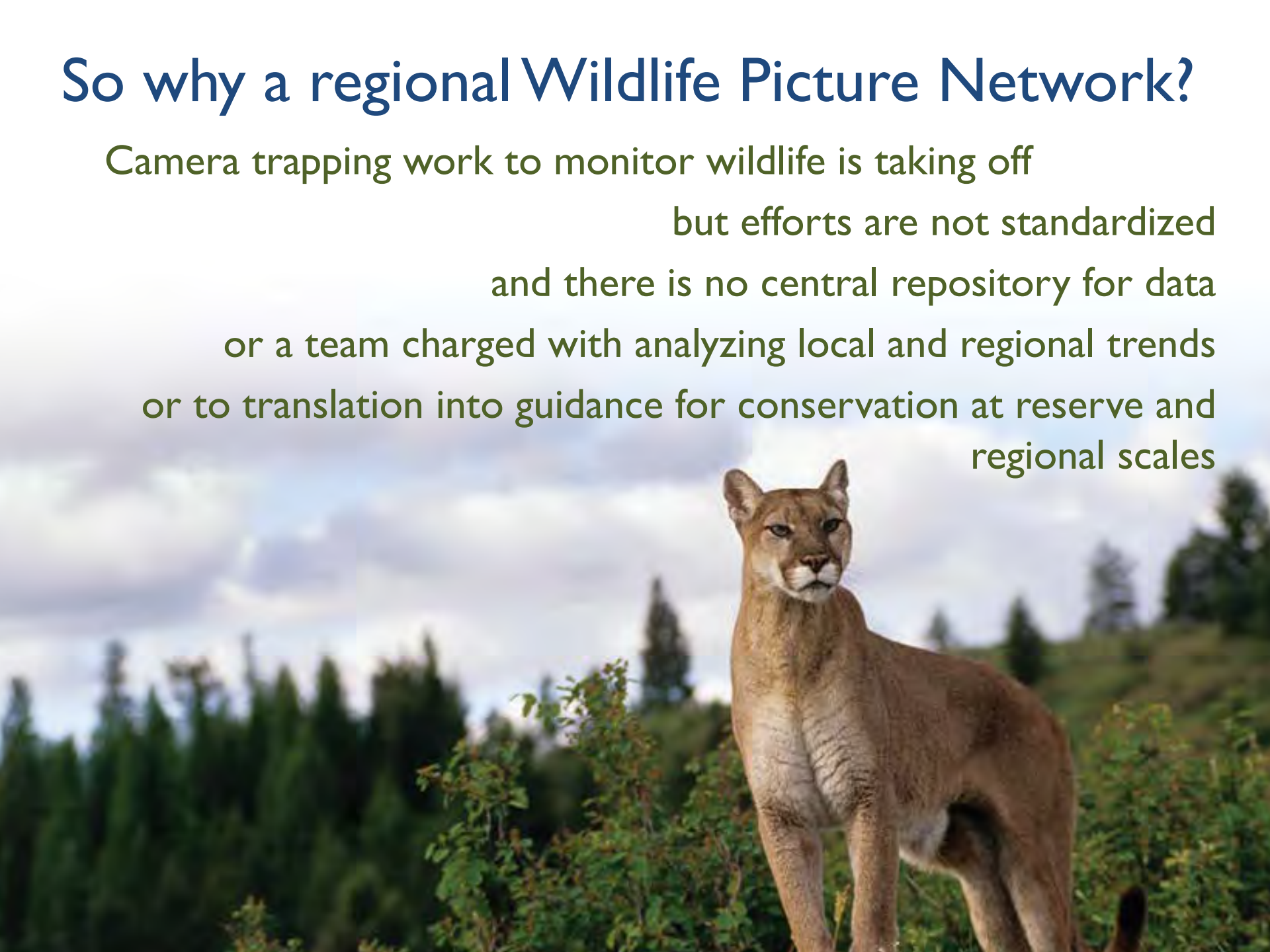
Camera trapping work to monitor wildlife is taking off

but efforts are not standardized

and there is no central repository for data

or a team charged with analyzing local and regional trends

or to translation into guidance for conservation at reserve and regional scales



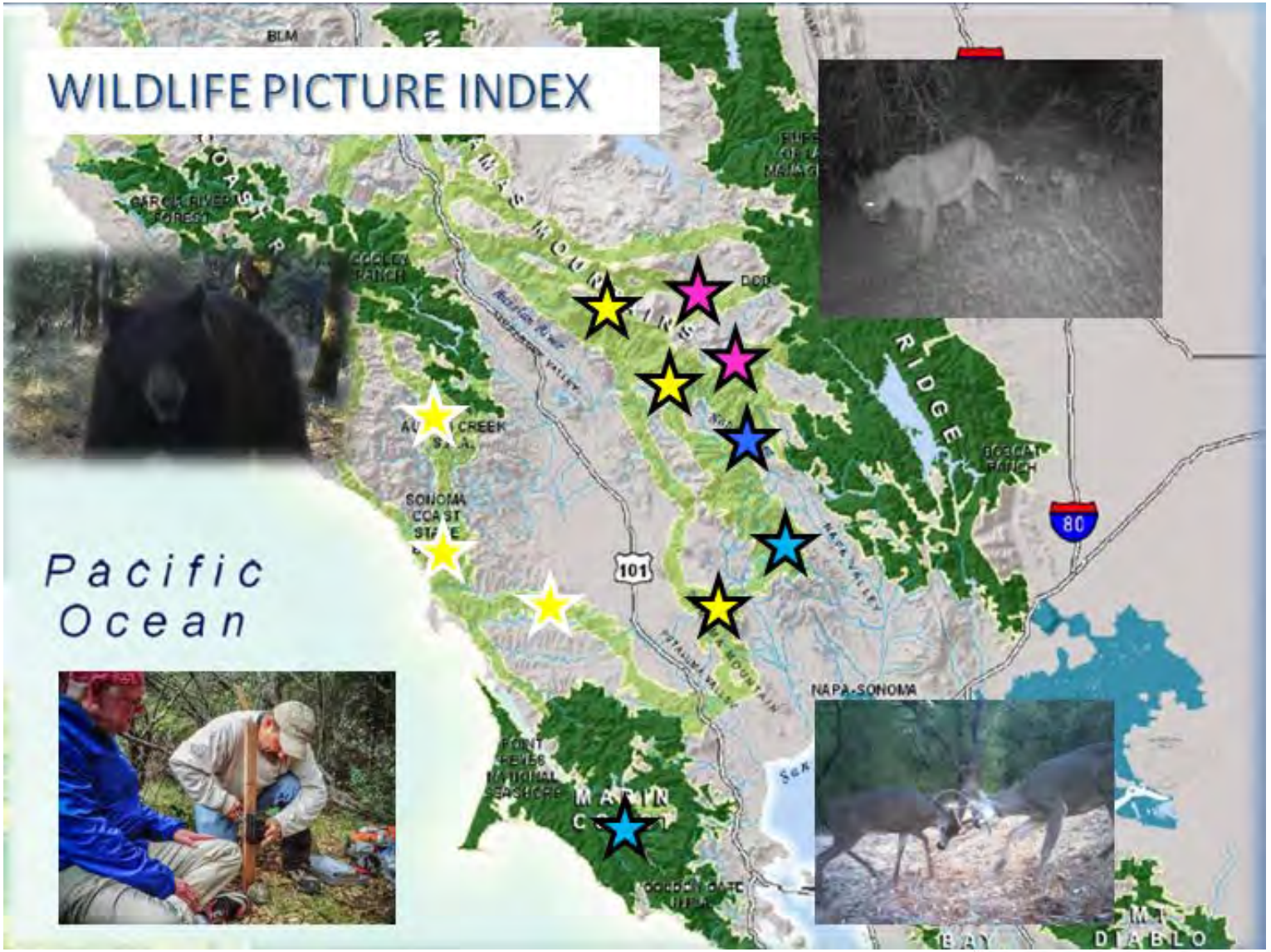
What kind of questions

can a regional network answer?

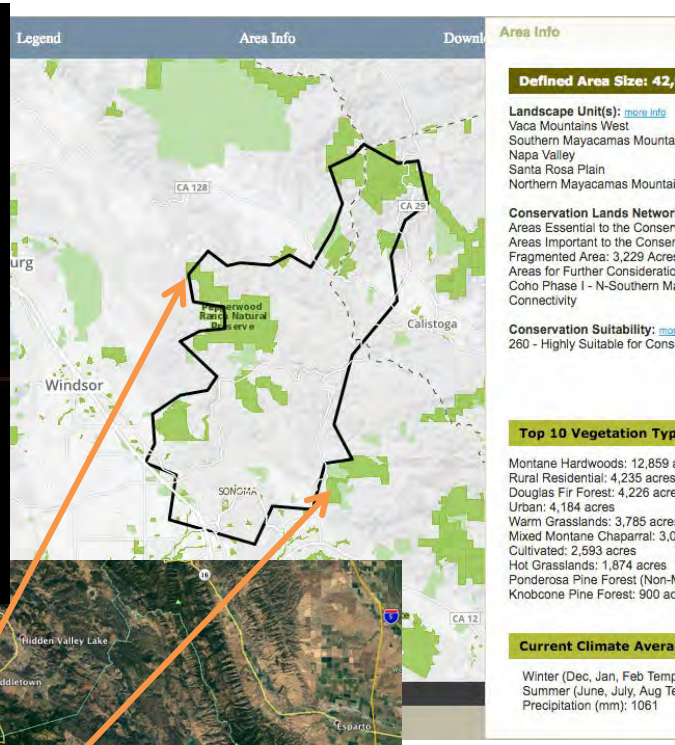
What are the impacts of drought on wildlife?

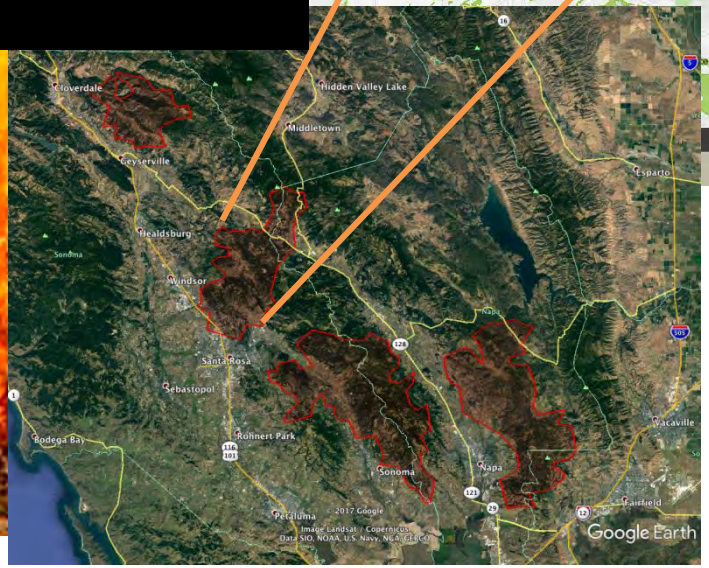
How effective are our habitat protection efforts?

How do habitat corridors function?



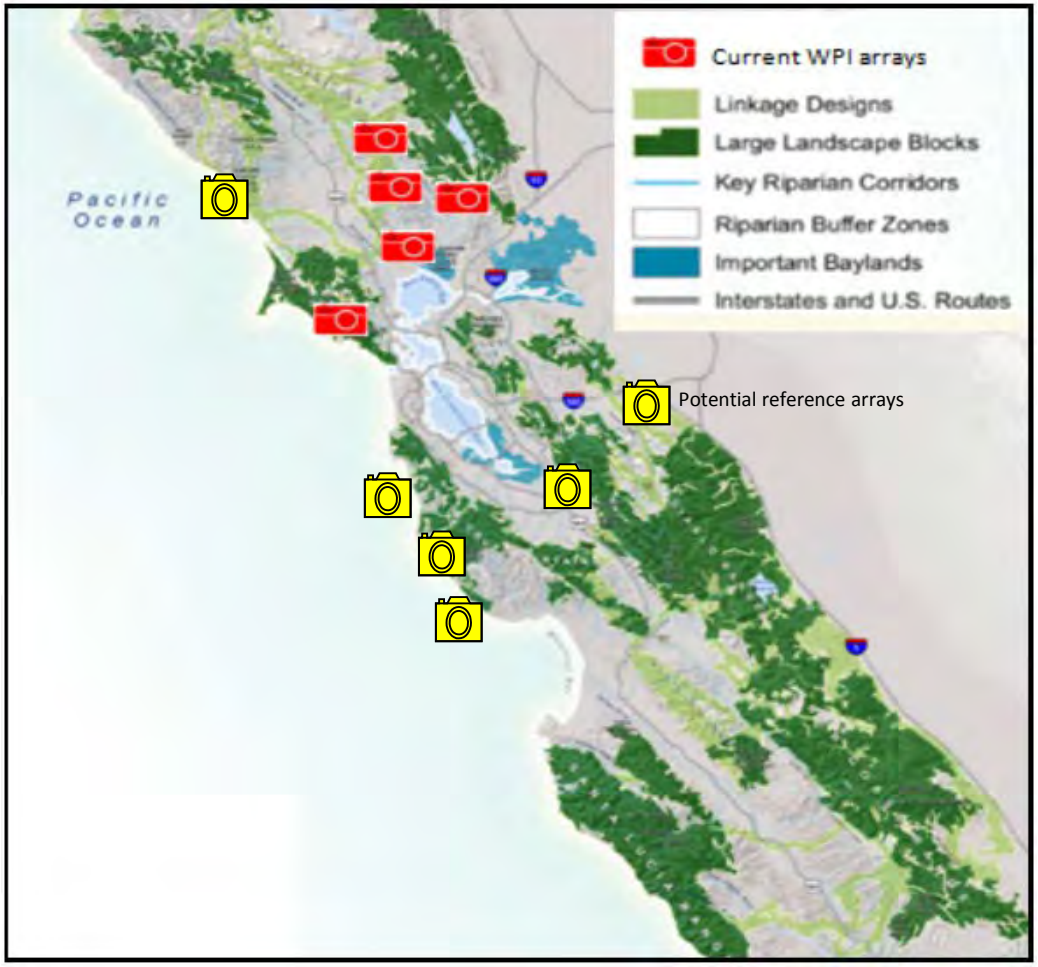
Pepperwood
PRESERVE
Inspiring conservation through science





How do wildlife respond to episodes of fire?

Expanding coverage of long-term WPI arrays…



….and creating support for individual camera users and individual projects

Landscape conservation collectives provide critical capacity for realizing a Wildlife Picture Network!

ONE TAM

Mayacamas to Berryessa (M2B)

Redwoods Rising

Santa Cruz Mtns Stewardship

Bay Area Biosphere Reserve

Pepperwood PRESERVE
Inspiring conservation through science

CONSERVATION WHICH POSITION SHOULD I PLAY?

LET'S TAKE A LOOK AT THE AVERAGE STATS FOR EACH POSITION IN THE EPL

STRIKER

Height: **184 cm** Weight: **80 kg**

Speed: Strength:

Forwards need to be goal. They need to b both feet. They need ball, turn with the ba

researchers

LEFT/RI

Height: 175 cm

Speed:

Midfield players have to be incredibly fit and possess amazing stamina. They need to understand how to manage space. Helps to be all round competent and a flexible player.

FULLBACK

Height: **177 cm** Weight: **74 kg**

Speed: Strength:

Often smaller than the central defenders, quicker and more attack minded. They have to be quick at closing down players and quick to recover and compress space.

GOALKEEPER

Height: **194 cm** Weight: **85 kg**

Typically very tall (190cm+) with a long reach. Have very good reflexes and must be able to position themselves correctly. A good keeper can easily stay focused. Must be brave enough to take some hits.

landscape-stewardship - networks

Info: http://www.soccer-universe.com/soccer-positions.html

Data: https://www.easports.com/uk/fifa/ultimate-team/fut/database

WINGER

Height: **174 cm** Weight: **70 kg**

Speed: Strength:

land managers

Main link between midfield and the attack-ers. has to be quick, possess a good shot, be able to dribble past players and to play short quick passes with his attackers.

DEFENSIVE MID

Height: **183 cm** Weight: **75 kg**

Speed: Strength:

Often the one who collects the ball from the defenders and then can set up the attack playing long balls to team mates. Requires huge amounts of skill and vision.

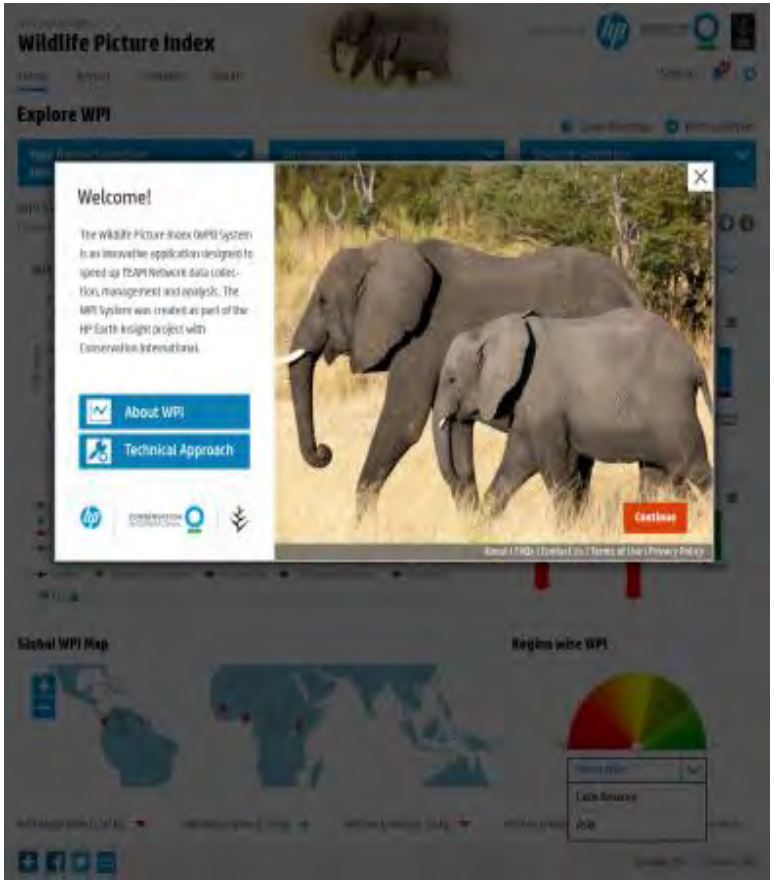
CENTREBACK

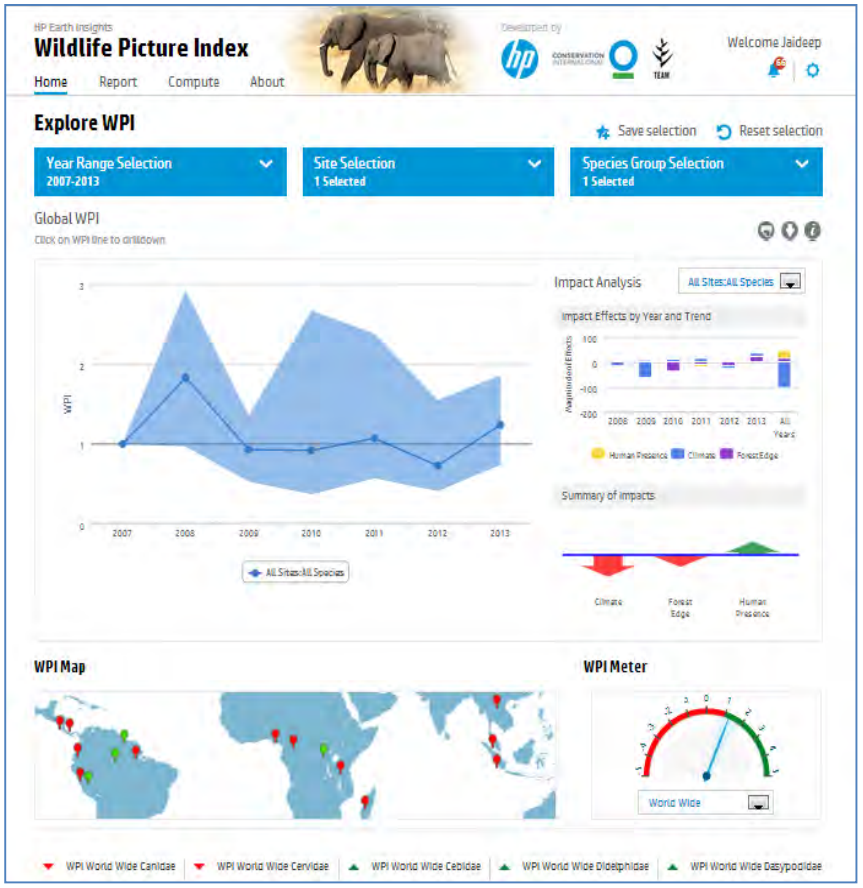
Height: **190 cm** Weight: **85 kg**

Speed: Strength:

Typically at least 182cm tall and are often "big and strong". Have to be good in the air, winning and challenging for headers. Centrebacks must be brave and determined.

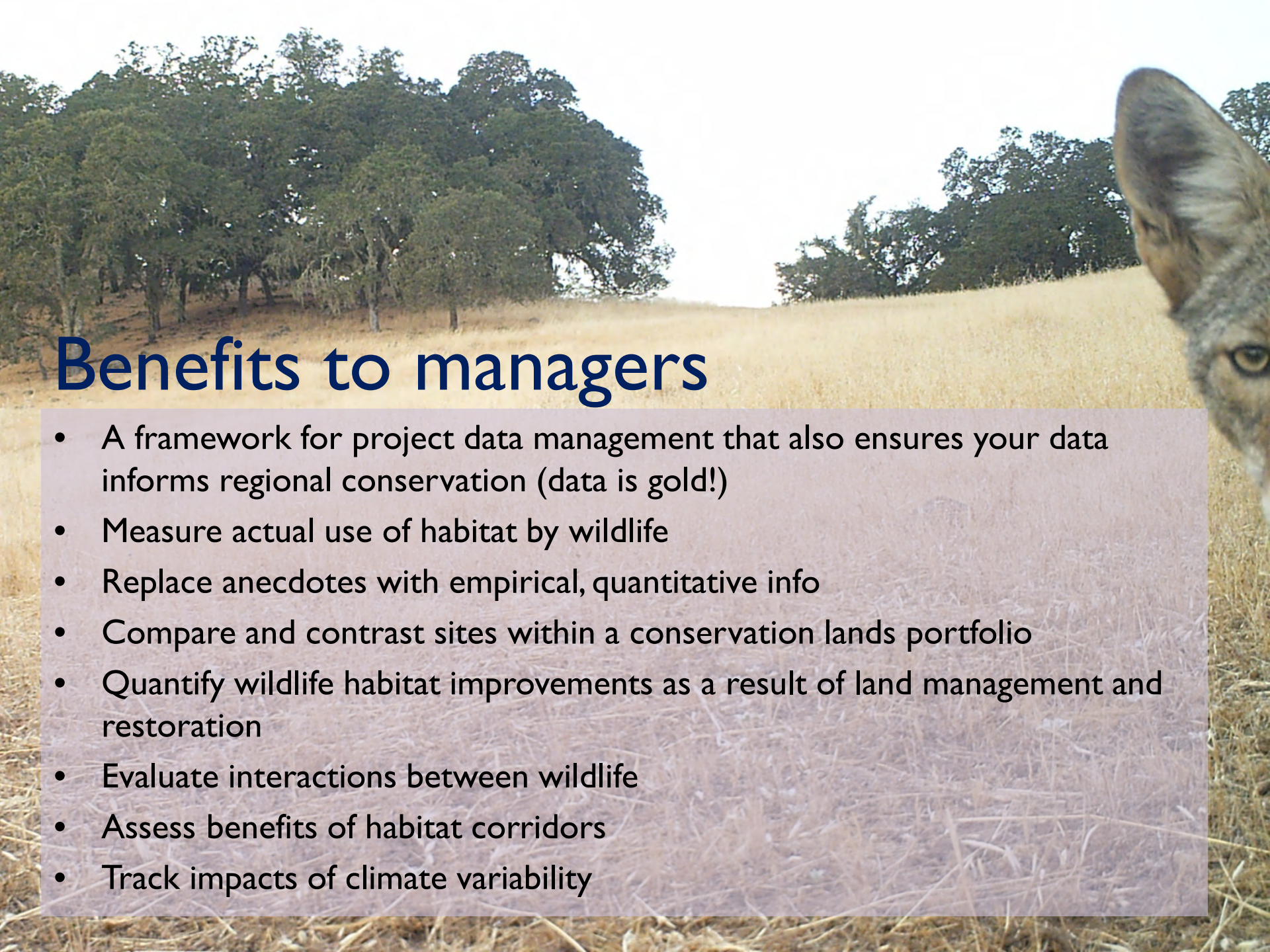
Wildlife Insights platform facilitates cataloging, database creation, analytics, and archiving





Users can contribute WPI array data or individual camera data for regional analysis using a regional WPI approach!

https://www.wildlifeinsights.org



Benefits to managers

- A framework for project data management that also ensures your data informs regional conservation (data is gold!)
- Measure actual use of habitat by wildlife
- Replace anecdotes with empirical, quantitative info
- Compare and contrast sites within a conservation lands portfolio
- Quantify wildlife habitat improvements as a result of land management and restoration
- Evaluate interactions between wildlife
- Assess benefits of habitat corridors
- Track impacts of climate variability

So please help us build a Wildlife Picture Network!

One parameter, multiple sites, multiple applications, accessible, clear landscape-level conservation applications, and people get it!

email me to sign up for our Wildlife Observer Network base camp!
lmicheli@pepperwoodpreserve.org

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Thank you!
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