

What stresses out California ground squirrels?



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How do animals respond to changing environments?





My academic journey...





Oakland, California

Rocky Mountain Biological Laboratory, Colorado



Behavioral Ecology Project of California Ground Squirrels (2013-present)



Team Squirrel



In this lab,
WE BELIEVE



SCIENCE
is real



LOVE
is love



BLACK LIVES
matter



FEMINISM
is for everyone



SQUIRRELS
are cool



IMMIGRANTS
are welcome



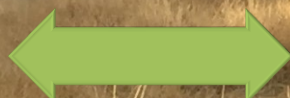


[Smith Lab: www.jenniferlainsmith.com/team.html](http://www.jenniferlainsmith.com/team.html)

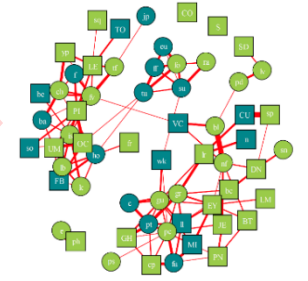
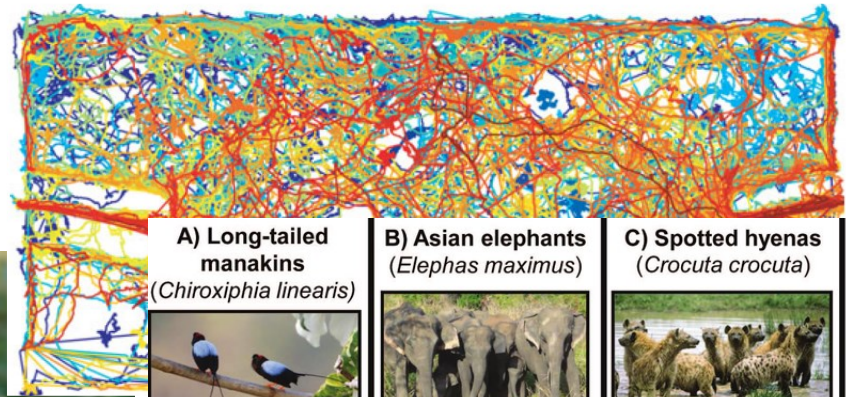
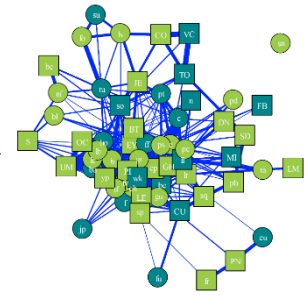
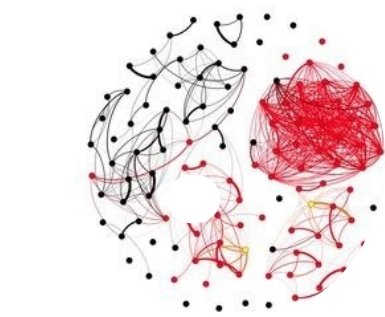
Physiology

Behavior

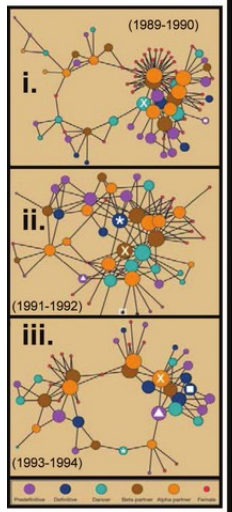
Ecology



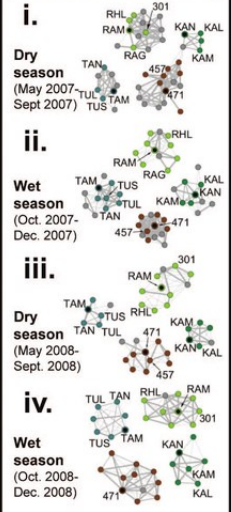
Using "Big Data" to track changes in social behavior over time!



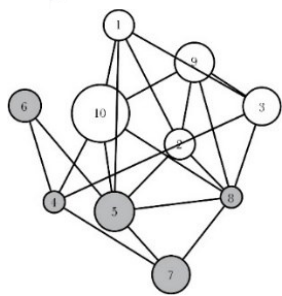
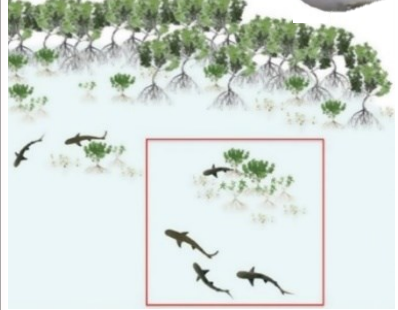
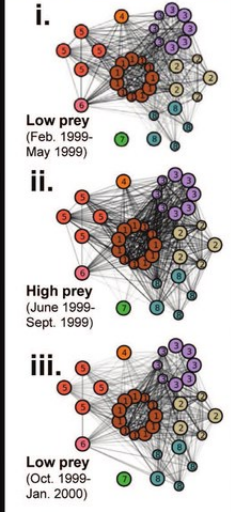
A) Long-tailed manakins
(*Chiroxiphia linearis*)



B) Asian elephants
(*Elephas maximus*)



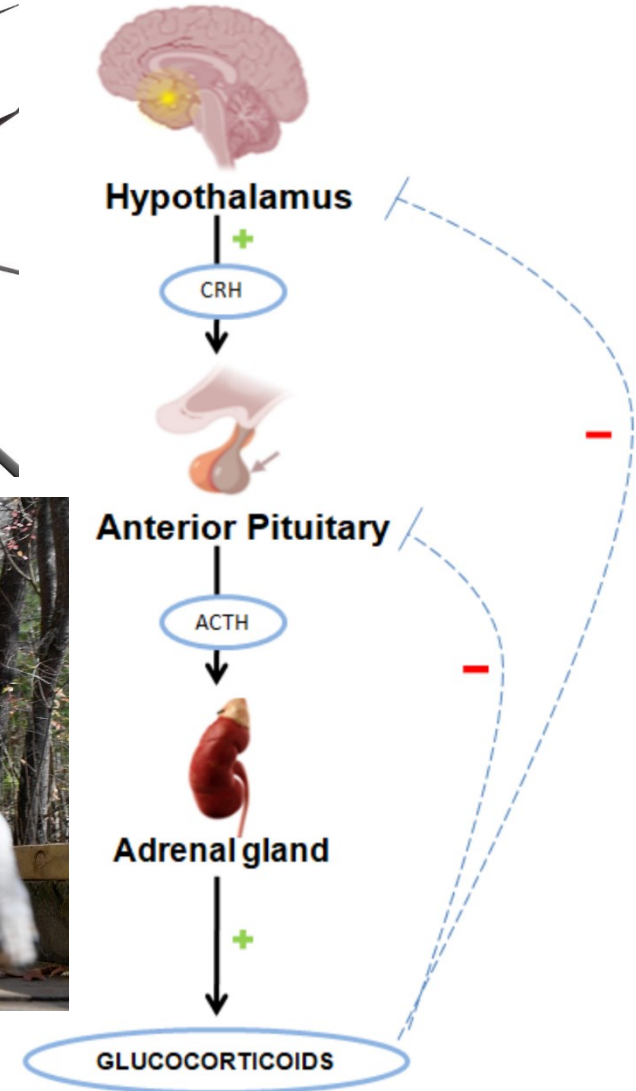
C) Spotted hyenas
(*Crocuta crocuta*)



TODAY: What stresses out wildlife in semi-urban parks?



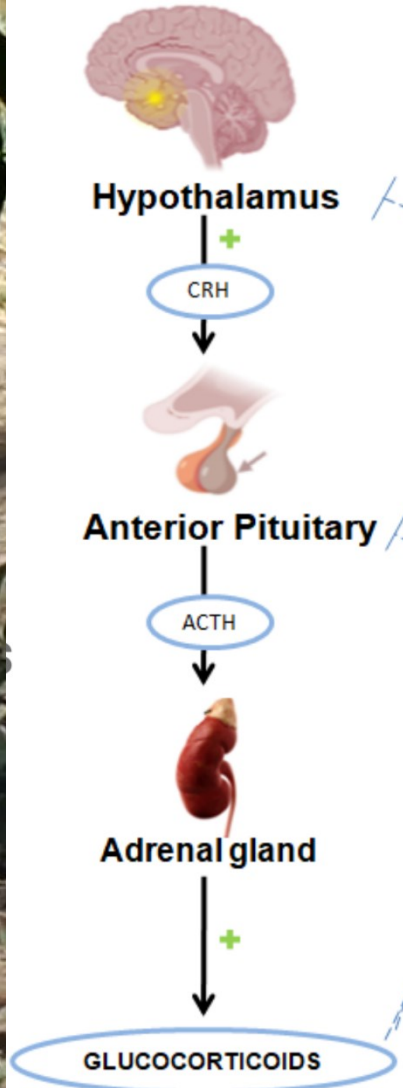
STRESS



Predator sightings! – rattlesnakes & tail flagging



STRESS



Predator sightings! – alarm calls towards coyotes!



STRESS



Hypothalamus

+

CRH



Anterior Pituitary

ACTH



Adrenal gland

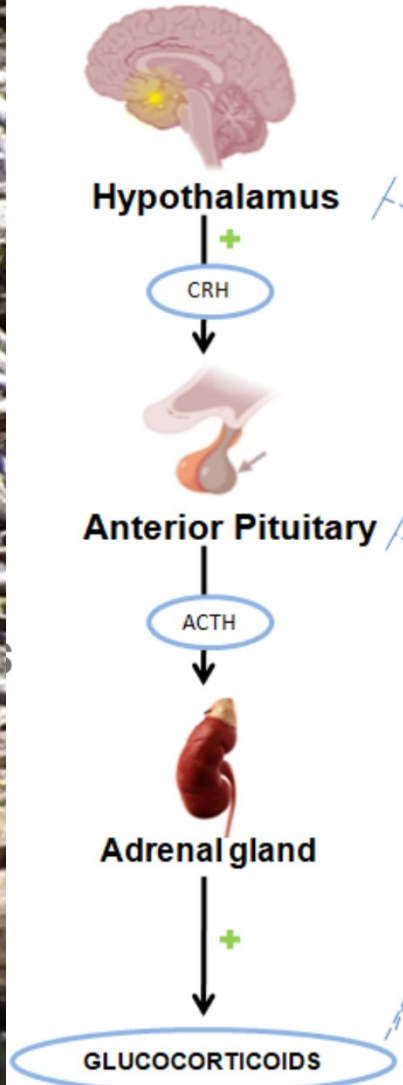
+

GLUCOCORTICIDS

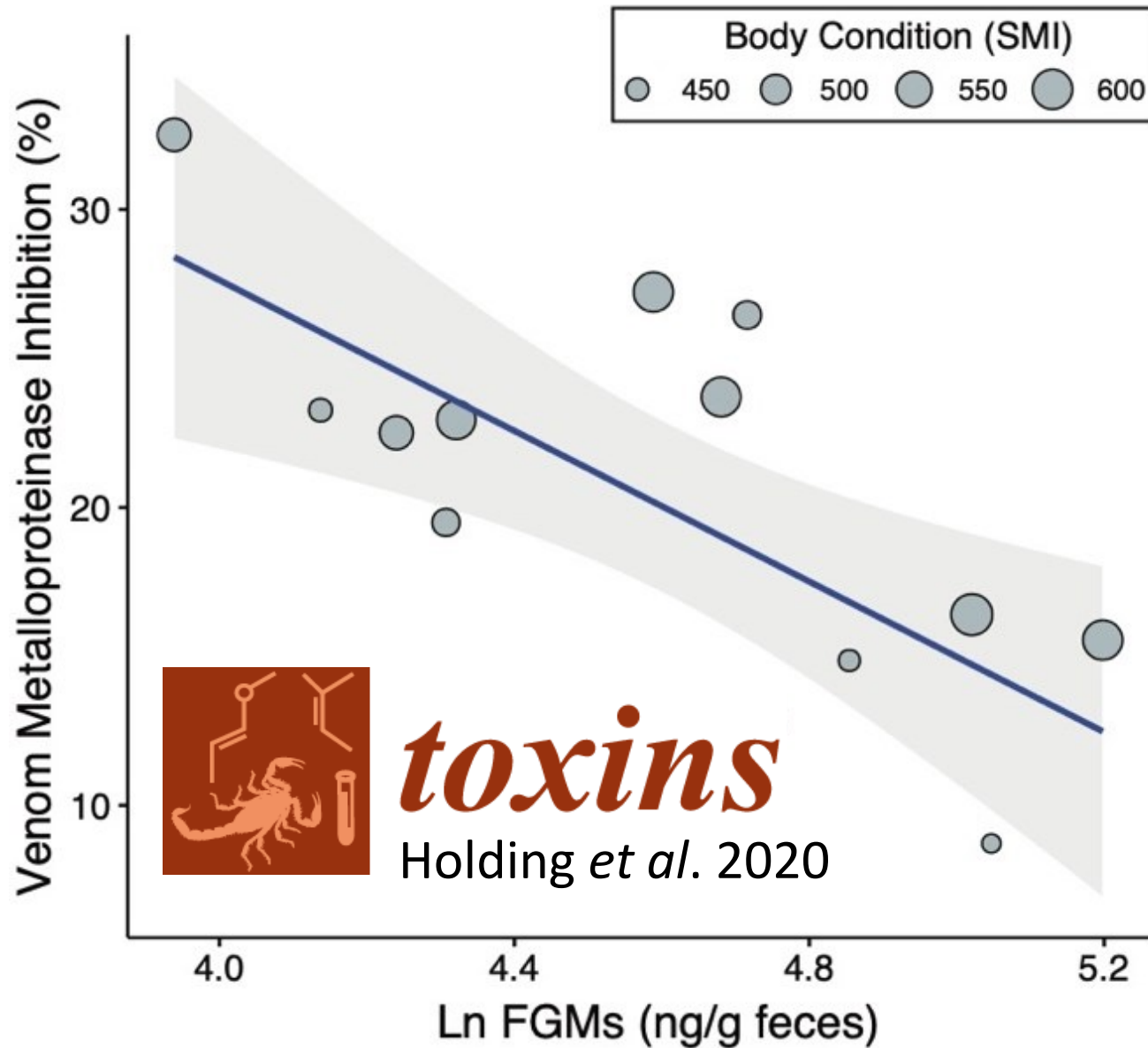
Natural predators are stressors – rattlesnakes!



STRESS



“Stressed” squirrels less resistant to rattlesnake venom



How do we measure “stress” from feces?

Hypo-
thalamus

Pituitary
gland

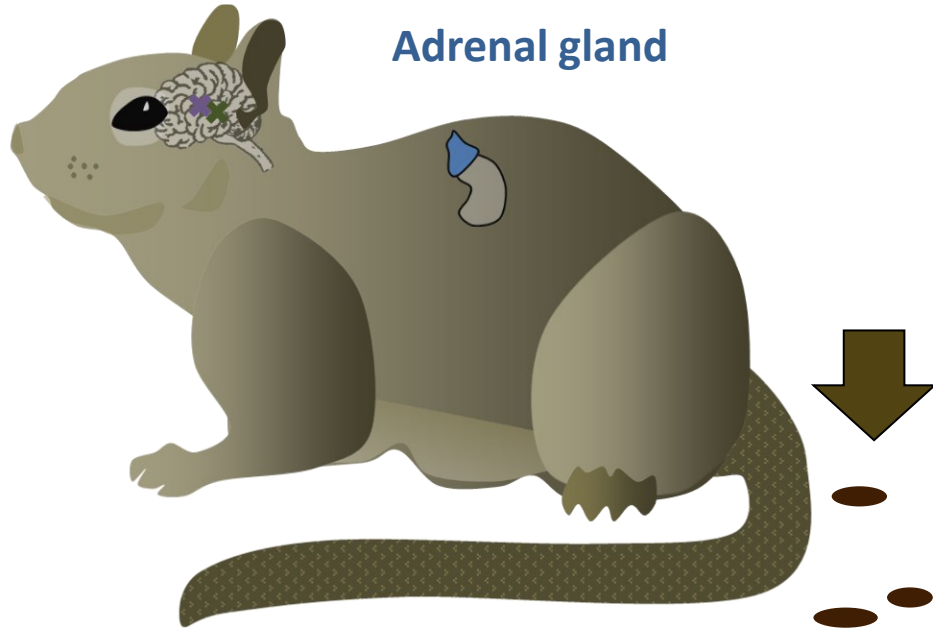
Adrenal
glands

Glucocorticoids in:
blood feces

Hypothalamus

Pituitary gland

Adrenal gland



Fecal sample



How do we measure “stress” from feces?

Hypo-
thalamus

Pituitary
gland

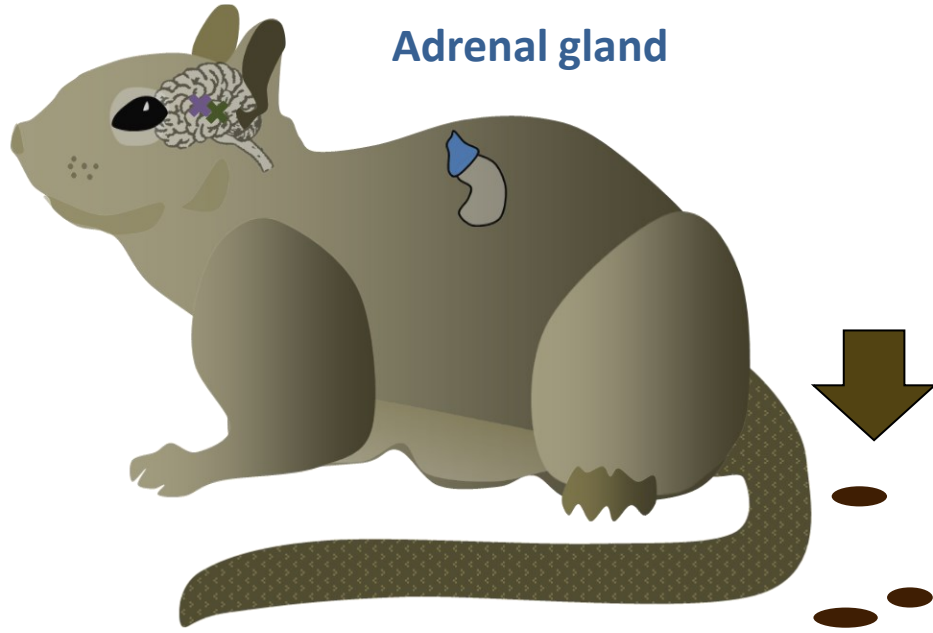
Adrenal
glands

Glucocorticoids in:
blood feces

Hypothalamus

Pituitary gland

Adrenal gland



Fecal sample



Mark individuals & release

How do we measure “stress” from feces?

Hypo-
thalamus

Pituitary
gland

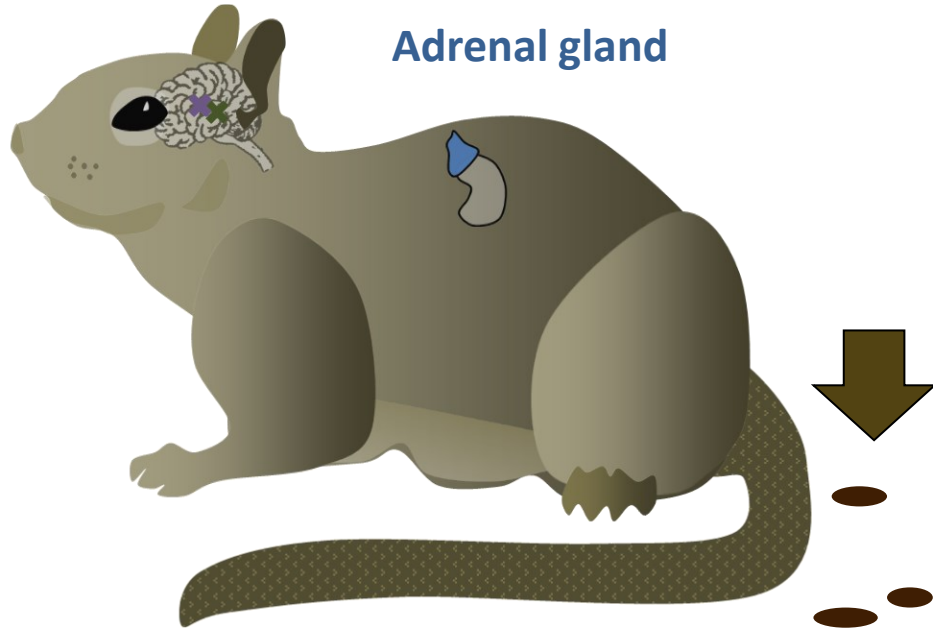
Adrenal
glands

Glucocorticoids in:
blood feces

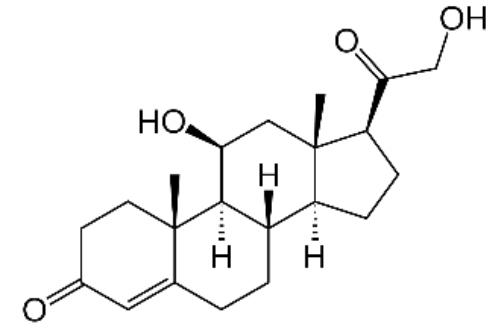
Hypothalamus

Pituitary gland

Adrenal gland



Fecal sample



Fecal glucocorticoid metabolites (FGMs) assayed for “CORT” in lab

TODAY: Is "stress" explained by human & dog presence?



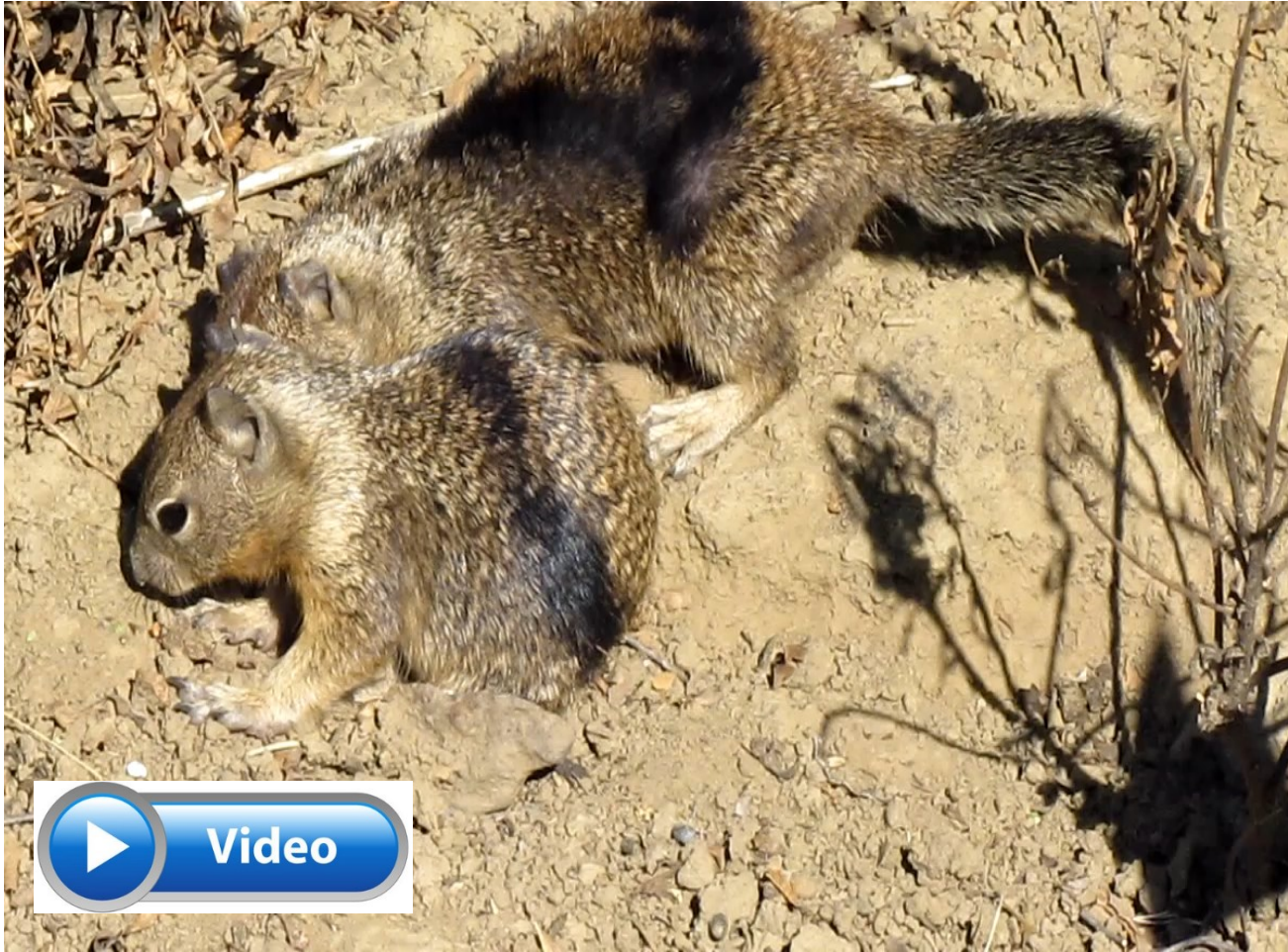
Low disturbance



Moderate disturbance



TODAY: Is "stress" explained by age, sex, & condition?
(mass divided by foot length)



TODAY: Are an individual's "stress" levels repeatable?



TODAY: Does trapping area repeatably predict "stress"?

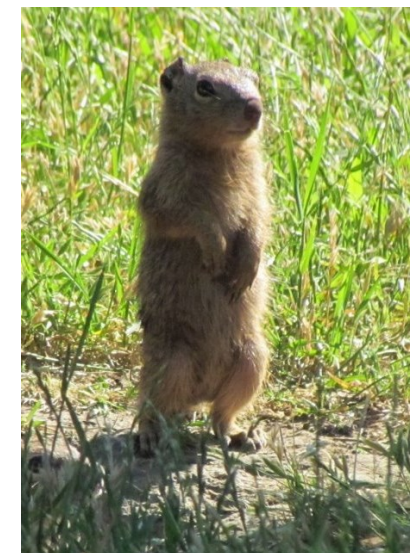
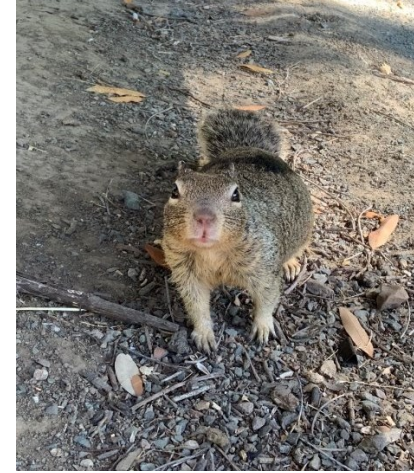


How do we test hypotheses?

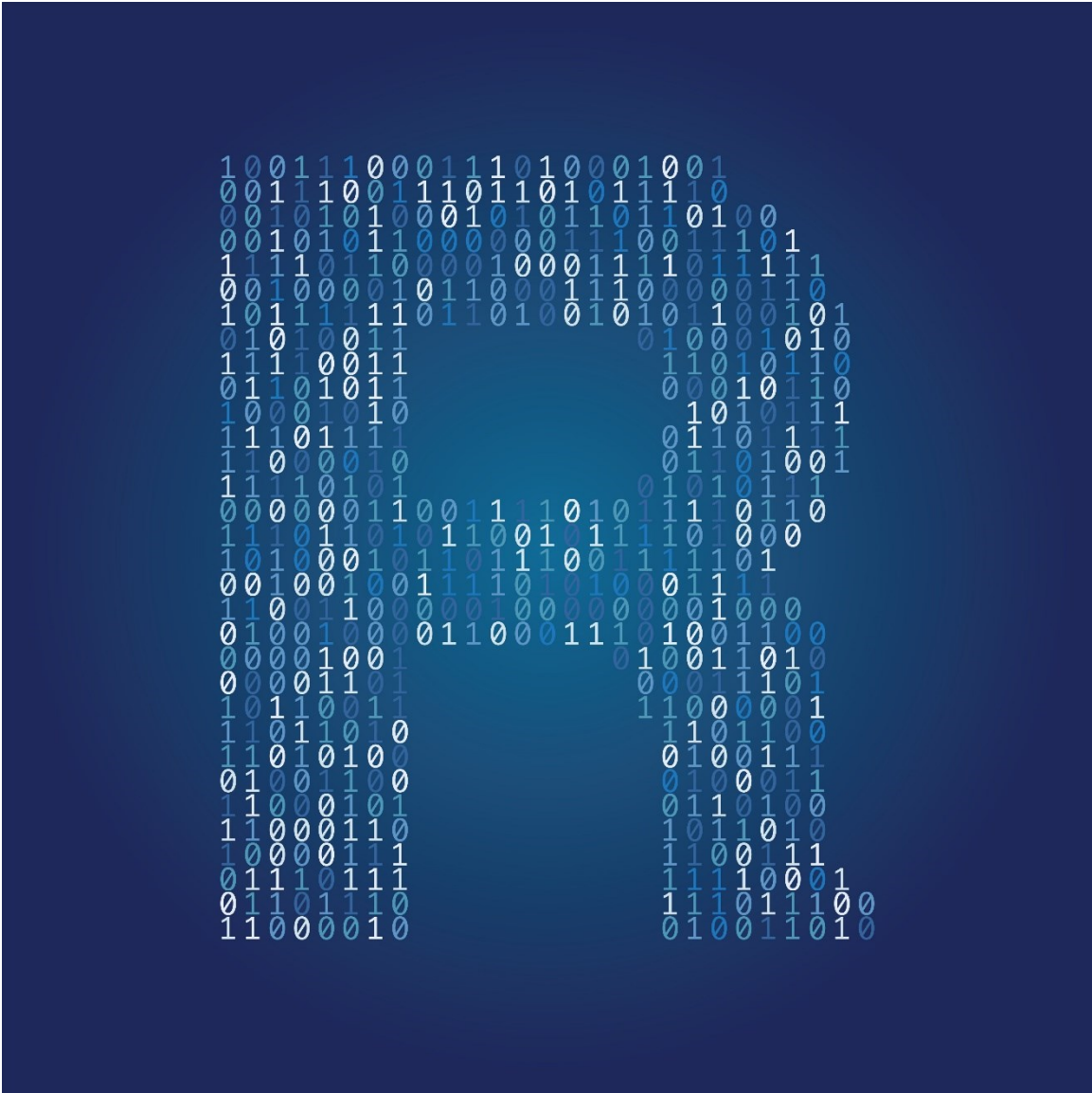


We have a LOT of data!!!

> 4,300 measures of “stress” from >1100 squirrels over 11 years captured at ~150 locations from 2 sites



What does it mean? -> Statistical computing & data visualization



```
R Console

R version 4.0.0 (2020-04-24) -- "Arbor Day"
Copyright (C) 2020 The R Foundation for Statistical Computing
Platform: x86_64-w64-mingw32/x64 (64-bit)

R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditions.
Type 'license()' or 'licence()' for distribution details.

R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

> |
```



R software is open-source and free software – very popular in Biology!



Run 3 “R scripts” in Jupyter



1. Model & graph long-term data: *what explains “CORT” levels?*
2. Calculate repeatability: *how consistent is “CORT”?*
3. Cross-sectional data: *does human & dog activity predict “CORT”?*



OPEN

nDemand



University of Wisconsin-Eau Claire

Enter your UW-Eau Claire username and password below, then select the **Log In** button to continue.

[Forgot your password?](#)

Username

Password

Log In

LOGIN SERVICE

For security reasons, **completely close your web browser when you are done** accessing services that require you to log in.

Note: Be wary of any program or web page that asks you for your username and password. Secure UW-Eau Claire web pages that ask you for your username and password will generally have URLs that begin with "https://...uwec.edu". In addition, your browser should visually indicate that you are accessing a secure page.

Open Ondemand: <https://ondemand.hpc.uwec.edu>



OPEN


OnDemand

OnDemand provides an integrated, single access point for all of your HPC resources.


Pinned Apps A featured subset of [all available apps](#)




Jupyter Notebook
System Installed App




BOSE Cluster Shell Access
System Installed App




Home Directory
System Installed App



Active Jobs
System Installed App



Desktop
System Installed App



Visual Studio Code (Preview)
System Installed App



Interactive Apps
Desktop Programs
Flair Desktop (Preview)
QGIS Desktop (Preview)
Desktops
Desktop
Servers
Jupyter Notebook
RStudio Server (Preview)
Visual Studio Code

Jupyter Notebook

This app will launch a Jupyter Notebook server.

Accounting Group

smitjenn_ethology - Default **Group: Default** ▾

Which research/class account is this tied to?

Slurm Partition

Week (7 Days) - Default **Partition: Default** ▾

Which partition are you running the job on?

CPU Cores

8 **CPU Cores = 8**

How many cores do you want to request? (Max of 64)

Memory

15G **Memory = 15 G**

How much memory do you want to request? M = Megabytes, G = Gigabytes

GPU Cards

No GPUs - Default **No GPUs - Default** ▾

(GPU Partition Only) How many GPUs would you like to reserve? 0 = No GPU needed, max of 3. Please do not use multiple GPUs if you do not need them.

Next: Launch Notebook

Number of hours

2 **Number of hours: 2**

How long do you intend to keep Jupyter Notebook running? Note that the server automatically will shut down and this form will have to be resubmitted when the time is up. Your work will typically be saving automatically throughout the duration of your notebook being opened.

Custom working dir

Select Path

Select your project directory that Jupyter starts at; defaults to your home directory (/data/users/<username>). This is needed if you want to use a group project folder.

Email Notifications

None - No Email ▾

Do you want to receive emails when the job officially starts, ends, or fails?

Launch

* The Jupyter Notebook session data for this session can be accessed under the [data root directory](#).

Session was successfully created.

Home / My Interactive Sessions

Interactive Apps

Desktop Programs

Flair Desktop (Preview)

QGIS Desktop (Preview)

Desktops

Desktop

Servers

Jupyter Notebook

RStudio Server (Preview)

Jupyter Notebook (81865)

1 node | 8 cores | Running

Host: >_ cn52

Cancel

Created at: 2024-06-21 09:32:58 CDT

Time Remaining: 1 hour and 53 minutes

Session ID: 3501a24a-71e6-4112-867f-97dd569a6188

Problems with this session? [Submit support ticket](#)

Connect to Jupyter

Next: Connect to Jupyter

Next: Open “New” Notebook – R [conda env:UB-Squirrel]



Upload

New ▾



Files

Running

Clusters

Nbexte

Select items to perform actions on them.



0



/



ondemand



Untitled Folder



Untitled.ipynb

Notebook:

Magma [conda env:magmakernel]

Python 3

Python [conda env:UB-Squirrel]

Python [conda env:cplex-test]

Python [conda env:download-changes]

R [conda env:UB-Squirrel]



1. Locate "Presentation Code" on workshop's page

hpc.uwec.edu/explore-opportunities/summer-workshops/ub-workshop-2024/

UWEC links Faculty Page UWEC forms Smith Lab Marine Biolnquiry Emojipedia Google Sch

Blugold Center for HPC

About Explore Opportunities Resources

Phillips Hall 265 - All Participants

Friday, June 21st

Time	Session
9:00 - 10:15	Pushing science to its limits with "High Performance Computing" Blugold Center for HPC Staff Links: OnDemand Linux Quick Guide
10:30 - 11:45	Building "trees" of South African shrubs Dr. Nora Mitchell Biology Links: My Website
11:45 - 12:45	Lunch Break
12:45 - 2:00	What stresses out California ground squirrels? Dr. Jennifer Smith Biology Links: Presentation Code My Website

What stresses out California ground squirrels?

Dr. Jennifer Smith

Biology

Links: [Presentation Code](#) [My Website](#)

<https://hpc.uwec.edu/explore-opportunities/summer-workshops/ub-workshop-2024/>

2. Copy/Paste: Code Block 1 text into Jupyter notebook

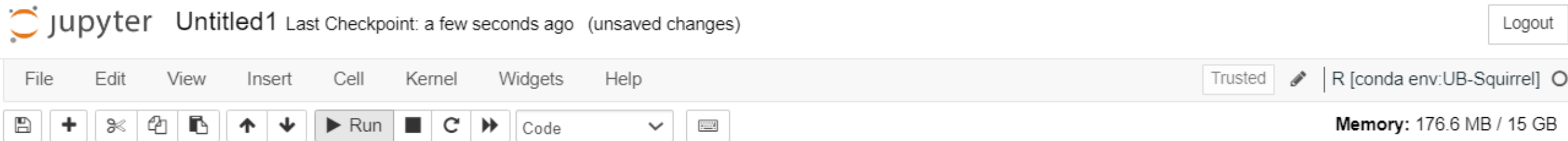


The screenshot shows a web browser at the URL docs.hpc.uwec.edu/classes/ub-squirrel/. The page is titled "Blugold Center for HPC Documentation". A sidebar on the left contains navigation links: Home, Introduction, Infrastructure, and Get Started. A "Table of contents" on the right lists "Code Block 1", "Code Block 2", and "Code Block 3". The main content area shows "Code Block 1" with a red rectangular highlight around the following text:

```
#LINEAR MIXED EFFECTS MODEL: CORT DISTURBANCE DATA
#install packages for running statistical models, assessing repeatability, and mak:
#install.packages('glmmTMB')
```



3. "Run" Script from "Block 1" in Jupyter notebook



The screenshot shows the Jupyter notebook interface. The top bar displays the Jupyter logo, the notebook name "Untitled1", and the status "Last Checkpoint: a few seconds ago (unsaved changes)". A "Logout" button is visible in the top right. Below the top bar is a menu bar with options: File, Edit, View, Insert, Cell, Kernel, Widgets, and Help. The right side of the menu bar shows "Trusted" and "R [conda env:UB-Squirrel]". Below the menu bar is a toolbar with icons for file operations (save, new, copy, paste, undo, redo) and a "Run" button. The right side of the toolbar shows "Code" and a memory usage indicator: "Memory: 176.6 MB / 15 GB".

```
In [ ]: ▶ #LINEAR MIXED EFFECTS MODEL: CORT DISTURBANCE DATA
#install packages for running statistical models, assessing repeatability, and making graphs
#install.packages('glmmTMB')
```

```
#load libraries running statistical models, assessing repeatability, and making graphs
```

Run 3 “R scripts”



1. Model & graph long-term data: *what explains “CORT” levels?*
2. Calculate repeatability: *how consistent is “CORT”?*
3. Cross-sectional data: *does human & dog activity predict “CORT”?*



Does human presence reduce fear of natural predators?





Wrap-up & Discussion

Data are complex & computers help to inform conservation – *what else might be important?*

