

# Tortoise biologist to raven biologist



# Raven Biology as a Guide to Actions

- How can we use the raven's characteristics and tendencies to our advantage?
  - Curious- opportunistic
  - Cautious- easily spooked
  - Communicative- appear to talk to and learn from each other(John Marzluff's work)

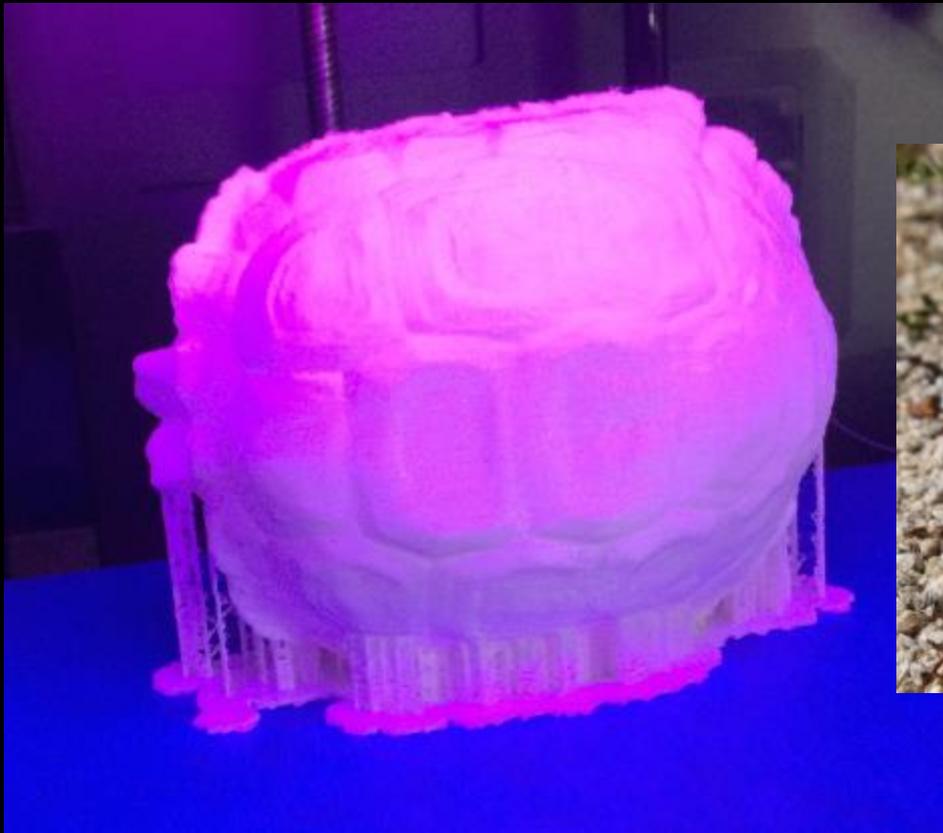


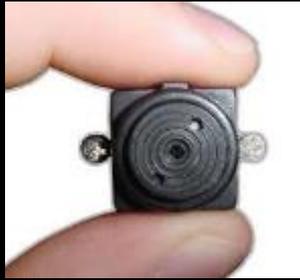
# Tool Assessment

- Rapid technological development is generating new tools and improving existing ones
- Almost all are becoming easier to use and less expensive
- These trends are likely to continue and accelerate

# Tools

- 3D printing- increasing resolution and realism, color printing





# Tools

Cameras- motion capture, 360 degree, VR, spy-cams, video. Resolution and connectivity improving across the board



# Tools

Robotics and  
control systems



# Tools



Drones- extremely rapid progress

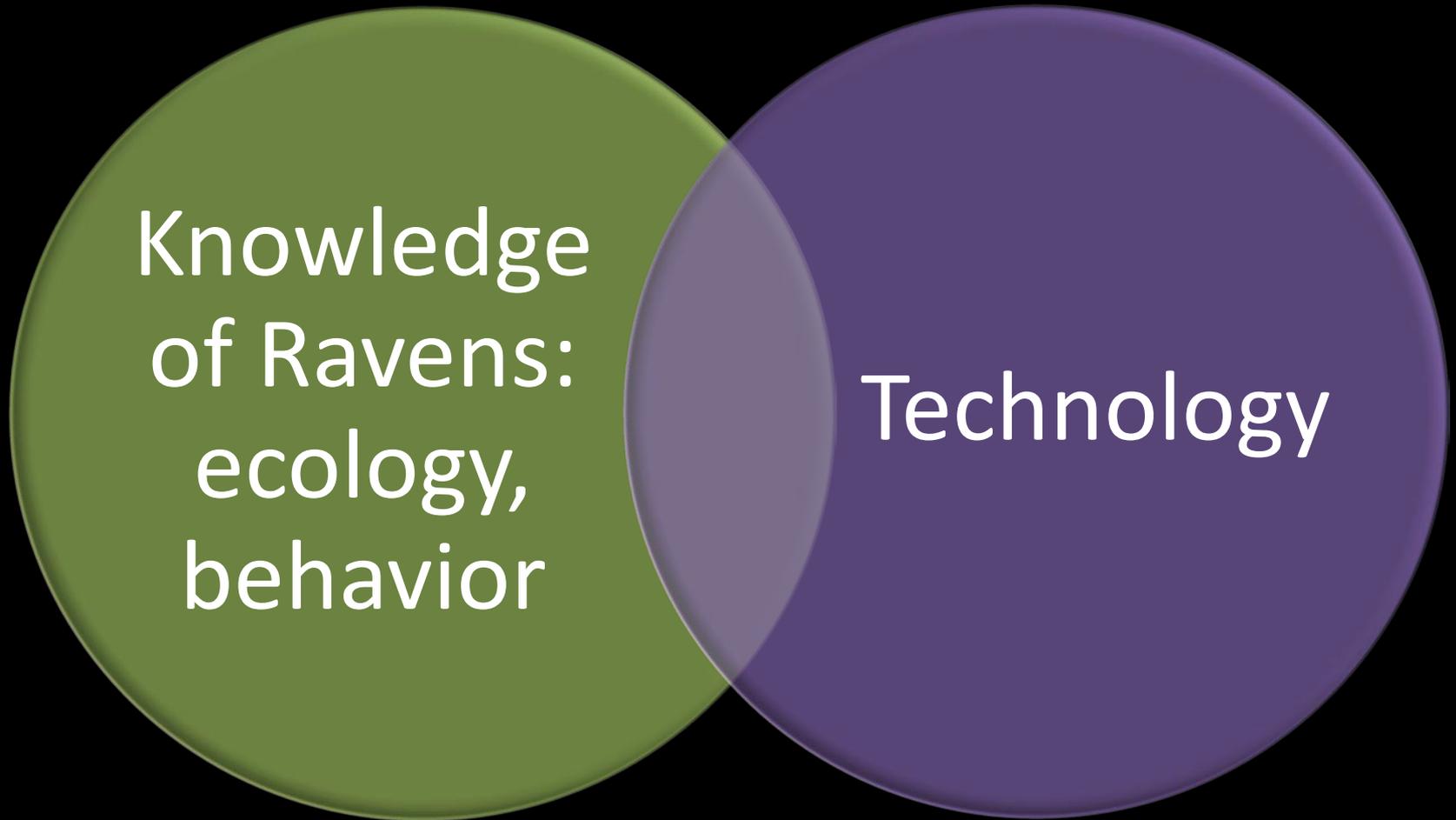
# Tools

Lasers

# Tools

- Computer Assisted Design (CAD)
- Artificial intelligence, pattern recognition, etc
- Internet- connectivity increasing steadily

# Two Expanding Spheres



# A Question

- Can an “informed” raven be more valuable than a dead one?
- The social hack: Use the communication network and information storage ability of raven groups to alter their behavior in desired ways.

# The Spreadsheet

- How do we tip a raven's cost-benefit ratio calculation so that it does what we want it to do?
- Important to consider intensity of raven motivation in relation to resource area in question: e.g. pistachio orchard vs. creosote bush scrub

# Non-lethal methods: **important tools**

- Generate less friction within the conservation/environmental community
- Applicable in circumstances that preclude lethal methods
- Have potential, given raven learning ability and communication, to persist through time

# Hardshell's Tools in Development



Techno-tortoise



Terrestrial Rover



# Aerial Drones

# Induced Egg Mortality

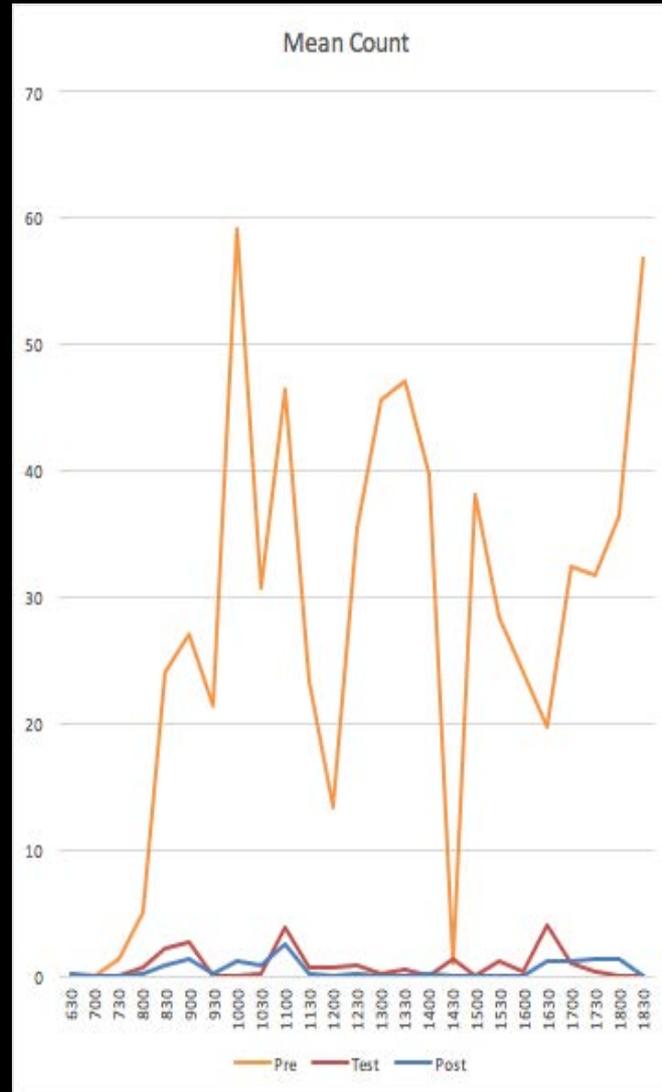
- Preliminary work on remote application of treatments to kill raven eggs in the nest without altering them visually
- Hope is that ravens will tend non-viable eggs past time of possible re-nesting
- Goal: directly reduce raven reproductive success

# Laser Repulsion

- Test at Hovaten Pistachio Orchard, Inyokern, CA, 31 August - 15 October, 2016
- 12.1 ha site
- Range of shots: 100-450m
- Reference orchard counts
- Roost counts as control
- Four phases:
  - Pre-firing
  - Initial firing
  - Main firing period
  - Post-firing

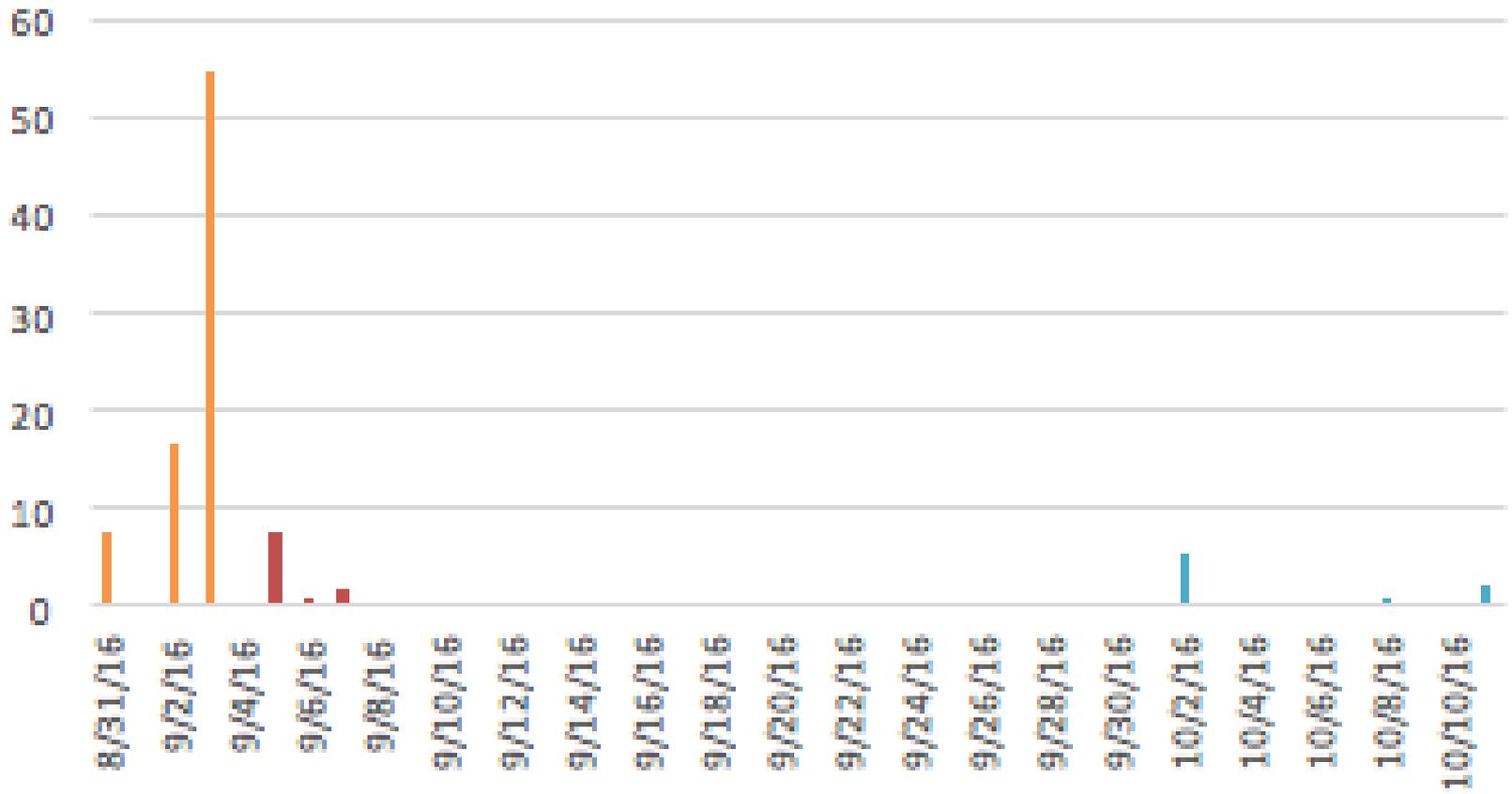


# Laser Test Results- Mean Count by Time of Day



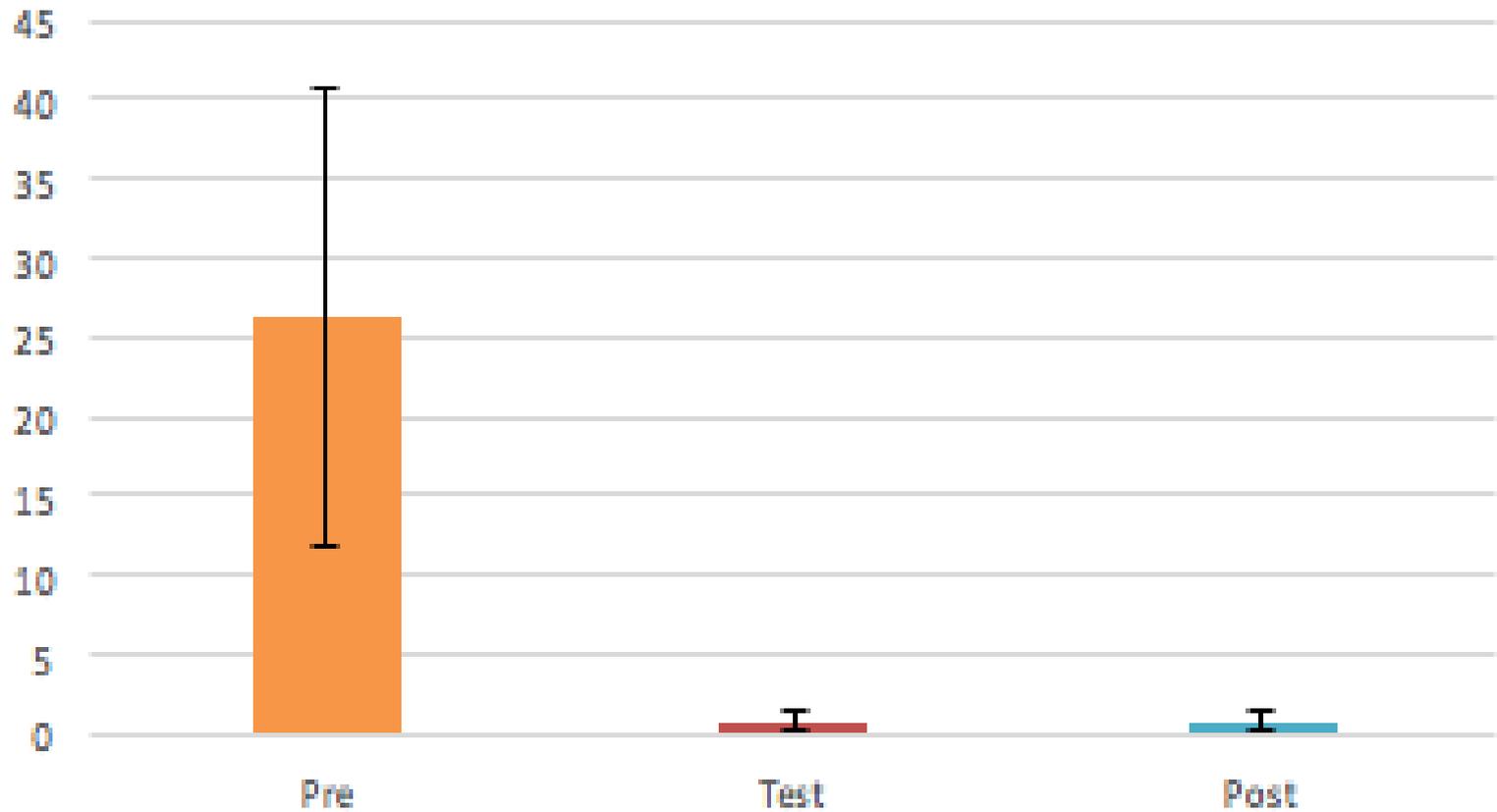
# Laser Test Results- Mean Count by Date

## Mean Count by Date



# Laser Test Results- Mean Count by Treatment Period

## Mean Count Before, During and After Laser



# Before and After



# Questions

- Scalability
  - Affordability
  - Long-term effectiveness
  - Safety for humans and wildlife
  - Social acceptability
  - Others?
- 
- Answers to such questions will depend on the applications of the tools and funding and resources devoted to the work and will apply to *any* raven control method

# Possible Goals

- **Raven-free zones** (no-fly zones)- repel ravens from high-value conservation habitat and change their habits so they avoid areas we want to devote to purposes such as rearing young tortoises
- **Denial of subsidies**, e.g. pistachios, power tower nest and perching sites, water sources
- **Aversion Training**- Techno-tortoise

# Denial of Subsidies

- Food
  - 2015 test at American Organics industrial scale composting facility, Oro Grande, CA
  - 2016 test at Inyokern, CA pistachio orchard
- Nesting substrate
  - 2017 power tower study- laser repulsion from towers in run-up to nesting
- Water sources
  - Identify crucial water sources and deny access. Use THC Mojave Desert spring inventory, e.g.

# Aversion Training

- Equip Techno-tortoise with noxious chemical (e.g. methyl anthranilate) whose explosive release is triggered by raven disturbing the model
- Fill a breakable model with meat bait treated with Carbachol or Methiocarb, inducing nausea in bird post-consumption
- Use Techno-tortoise to attract raven to a treatment external to the model

# Behavior Modification

- The raven problem is a result of human behavior- carelessness with resources
- Until such time as we can alter *that* we should find ways to alter raven behavior to buy time for species threatened by artificially large raven populations
- Fortunately, **ravens may be significantly easier to train than humans**

# What We Need to Maintain Progress

- Funding
- Agency facilitation
- Collaborators
- Connections
- Information
- Access to land
- Captive ravens

# We gratefully acknowledge:

- Autodesk, Inc.
- Think to Thing, Inc.
- USFWS
- China Lake Naval Air Weapons Station- Irregular Warfare Technology Office
- Transition Habitat Conservancy
- Lewis Center for Educational Research
- T3B, Inc.
- XADS, Inc.
- Sundance Biology, Inc.
- Open ROV
- Hyundai Motor Group
- Mojave Desert Resource Conservation District

## We gratefully acknowledge:

- Brittney Parton
- Sara Hanner
- Philip de Reimer
- Craig Sherwood
- Al De Martini
- Frank Guercio
- Dane Smith
- Eli D'Elia
- Reiner Weber
- Max Hovaten
- Alan Despreminil
- David Erlandson
- Kelly Edmond
- Tristan Sebens
- Jake and John Lopez
- Ashley Spenceley
- Eli White
- Mark Fontenot