REMOTE EGG OILING (REO)

THE USE OF EMERGING TECHNOLOGY FOR MANAGEMENT OF THE COMMON RAVEN FOR CONSERVATION OF THE MOJAVE DESERT TORTOISE

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PARTNERS/COLLABORATORS

Avian Power Line Interaction Committee

HYUNDAI KIA MOTORS

HARDSHELL LABS

SOUTHERN CALIFORNIA EDISON

TURTLE CONSERVANCY T.C.

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NVEnergy

U.S. DEPARTMENT OF THE INTERIOR BUREAU OF LAND MANAGEMENT

LA DWP Los Angeles Department of Water & Power

REAT

SPECIAL THANKS TO

ANDREA CURRYLOW
JENNIFER BROWN
LARRY LaPRE

BRENDA HANLEY
STEPHEN FETTIG
PHIL DeREIMER

TARA CALLAWAY
CRAIG SHERWOOD
ASHLEY SPENCELEY

INTRODUCTION

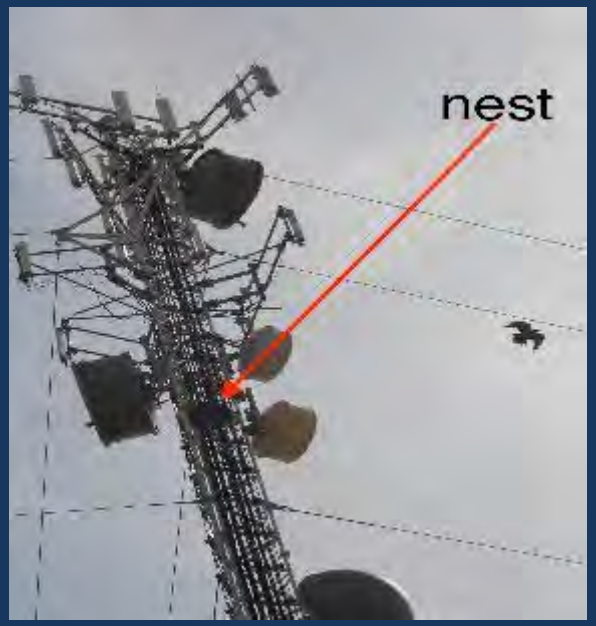
- Egg Oiling- for 70 years oiling the eggs of ground nesting birds (Canada geese, cormorants) has been used to control their reproduction
- Remote Egg Oiling (REO) – Since 2016 Hardshell, Sundance and their partners have developed methods of remotely oiling raven eggs on natural substrates (cliff faces, Joshua trees, tamarisks, etc)
- We anticipate oiling raven nests on utility towers in 2019 as well as expanded natural substrate nest treatment in CA

THE PROBLEM: TOO MANY RAVENS!

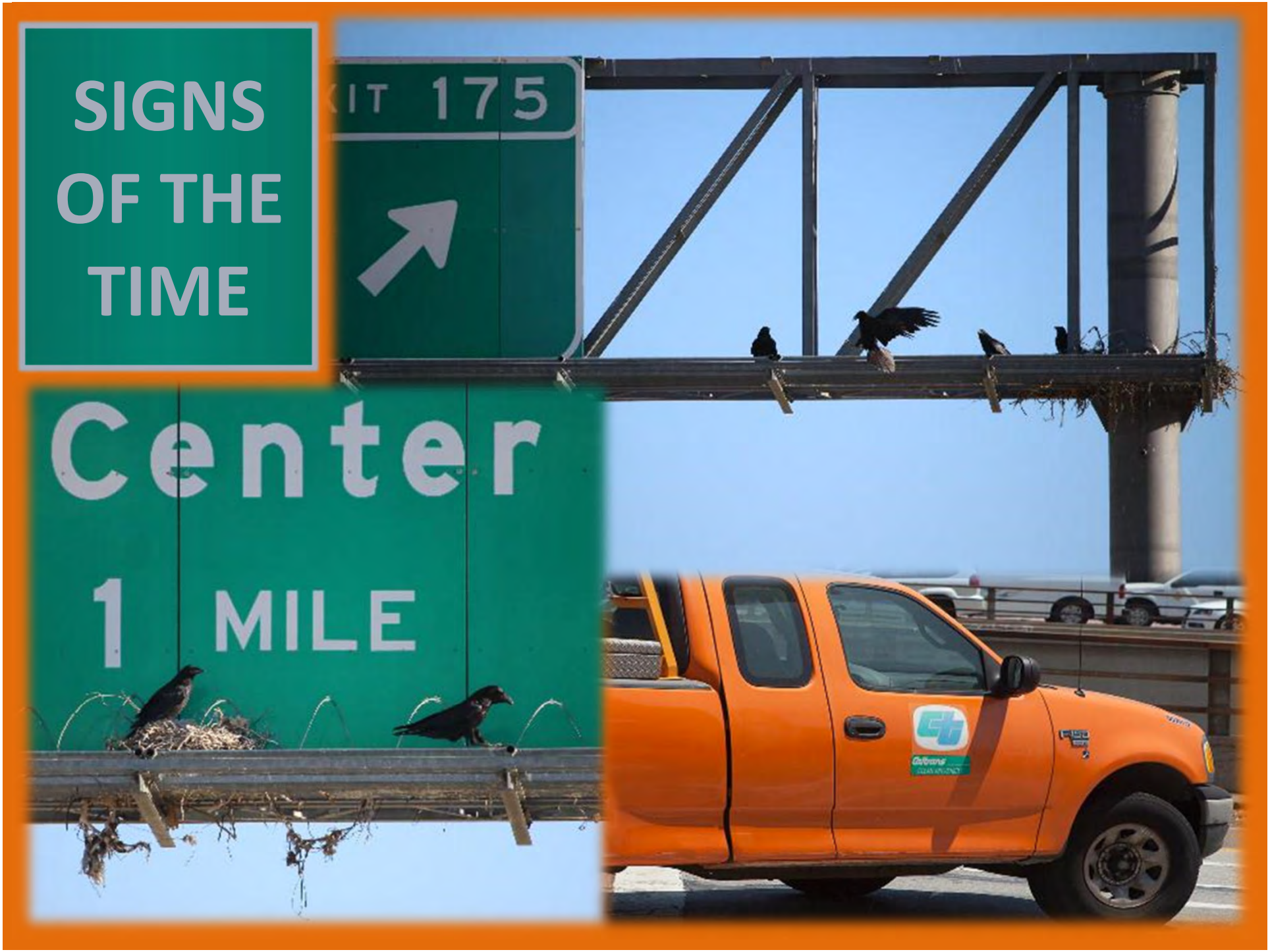
WHY SO MANY RAVENS?

NATURAL SUBSTRATE NESTS

NESTING SUBSTRATES HUMANS PROVIDE



SIGNS OF THE TIME

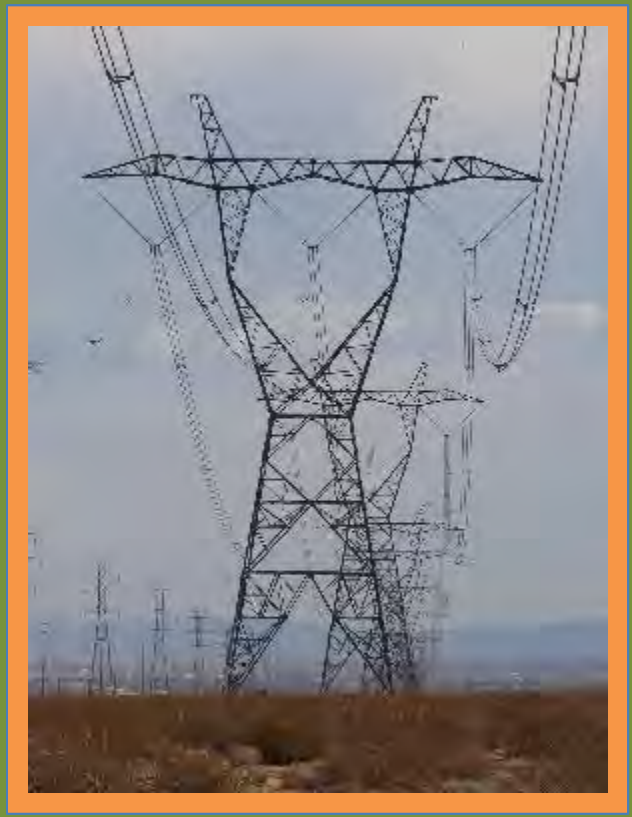


TOWERS OF POWER

LOCATION, LOCATION, LOCATION

RAVENREALTY.COM

- A raven's view of transmission towers
  - Complete protection from terrestrial predators
  - Nearly complete protection from aerial predators
  - Solid structure
  - Great view of surrounding landscape
    - Approach of rivals and enemies obvious
    - Movement of prey obvious



A BROAD ECOLOGICAL CRISIS

TORTOISES IN PERIL

Kramer Hills Permanent Study Plot, 1988

NATURAL BORN KILLER

WHAT HAS BEEN DONE?

- Public education: limited but valuable efforts
- Subsidy reduction: inherently limited
  - Capping of landfills
  - Use of raven-proof dumpsters
  - Enforcement of municipal codes
  - Anti-perching devices
- Nest removal: labor intensive and ultimately futile
- Shooting: difficult, expensive, unpopular with public in portions of the tortoise range; for tortoise conservation limited to “offending ravens” in CA
- Poisoning: controversial in portions of the tortoise range; not allowed in CA; difficult to document effectiveness

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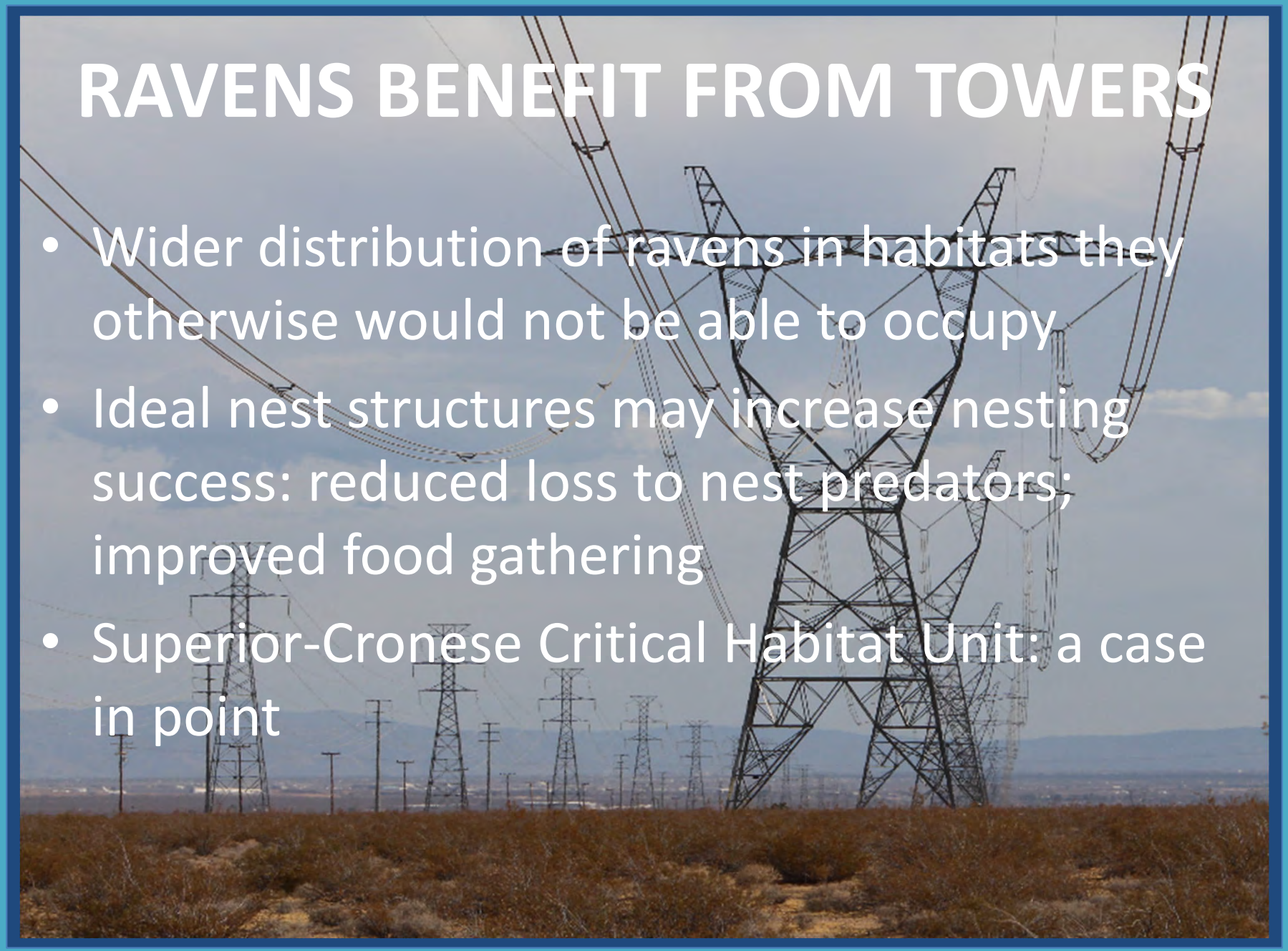
NET RESULT: MINIMAL EFFECT ON RISING RAVEN NUMBERS

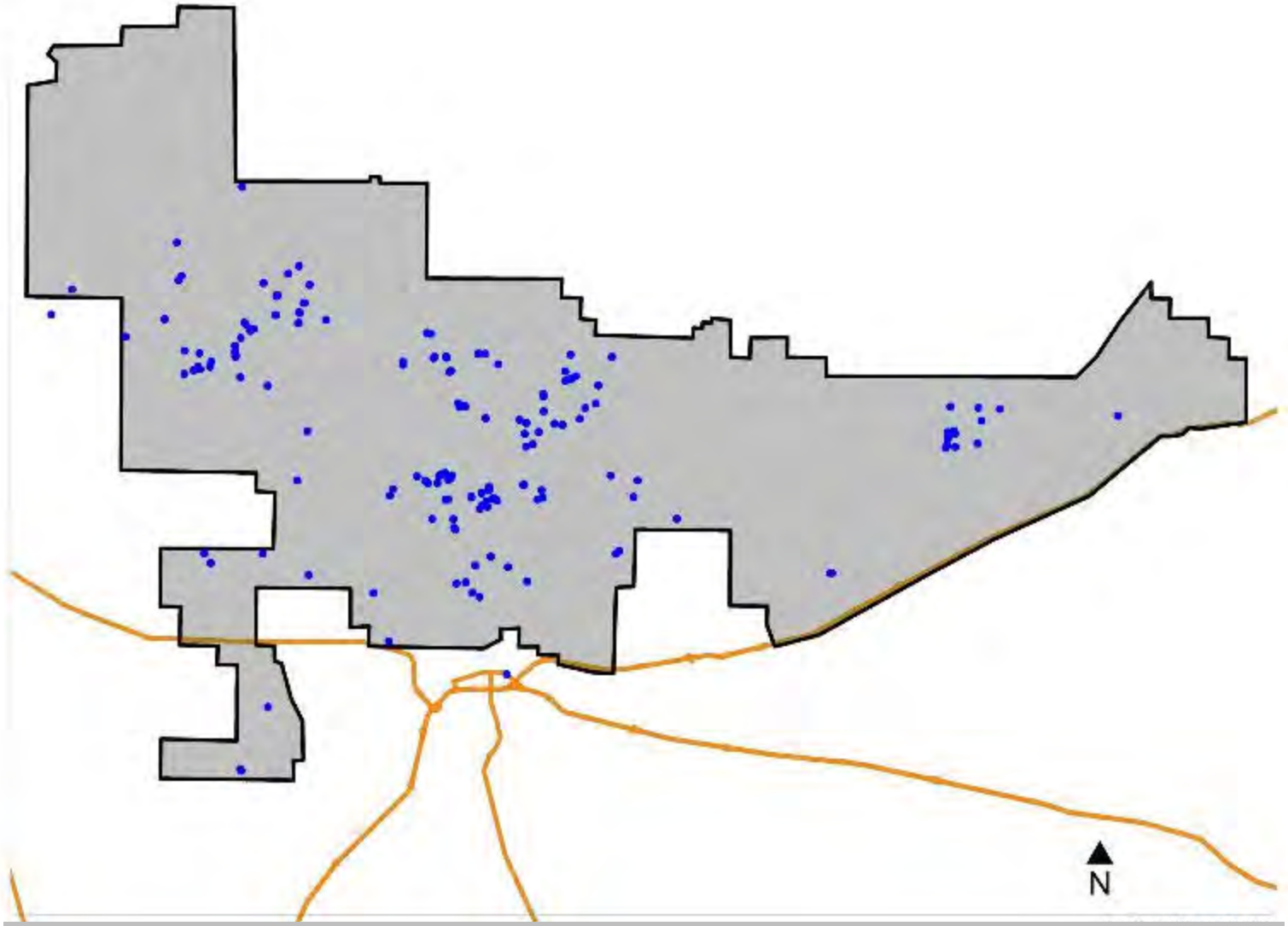
The ”Offending Ravens” Question

- History of the current approach in CA.
- Are there ravens specializing on killing juvenile tortoises?
- Is that predation limited to the nesting season?
- Finding raven predated juveniles in open desert calls the assertion into question.
- How can we answer the question?
- What can we do about the problem?

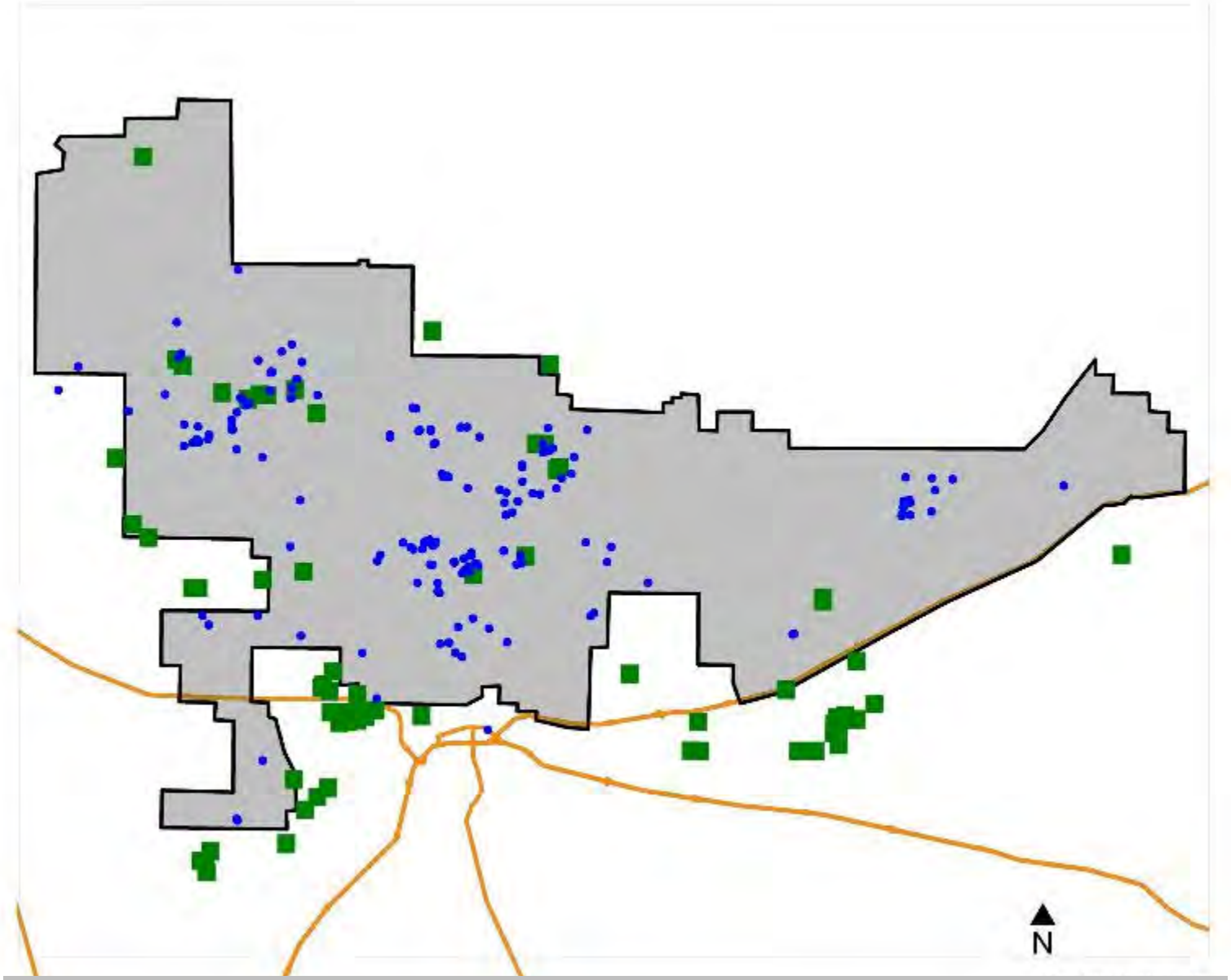


RAVENS BENEFIT FROM TOWERS

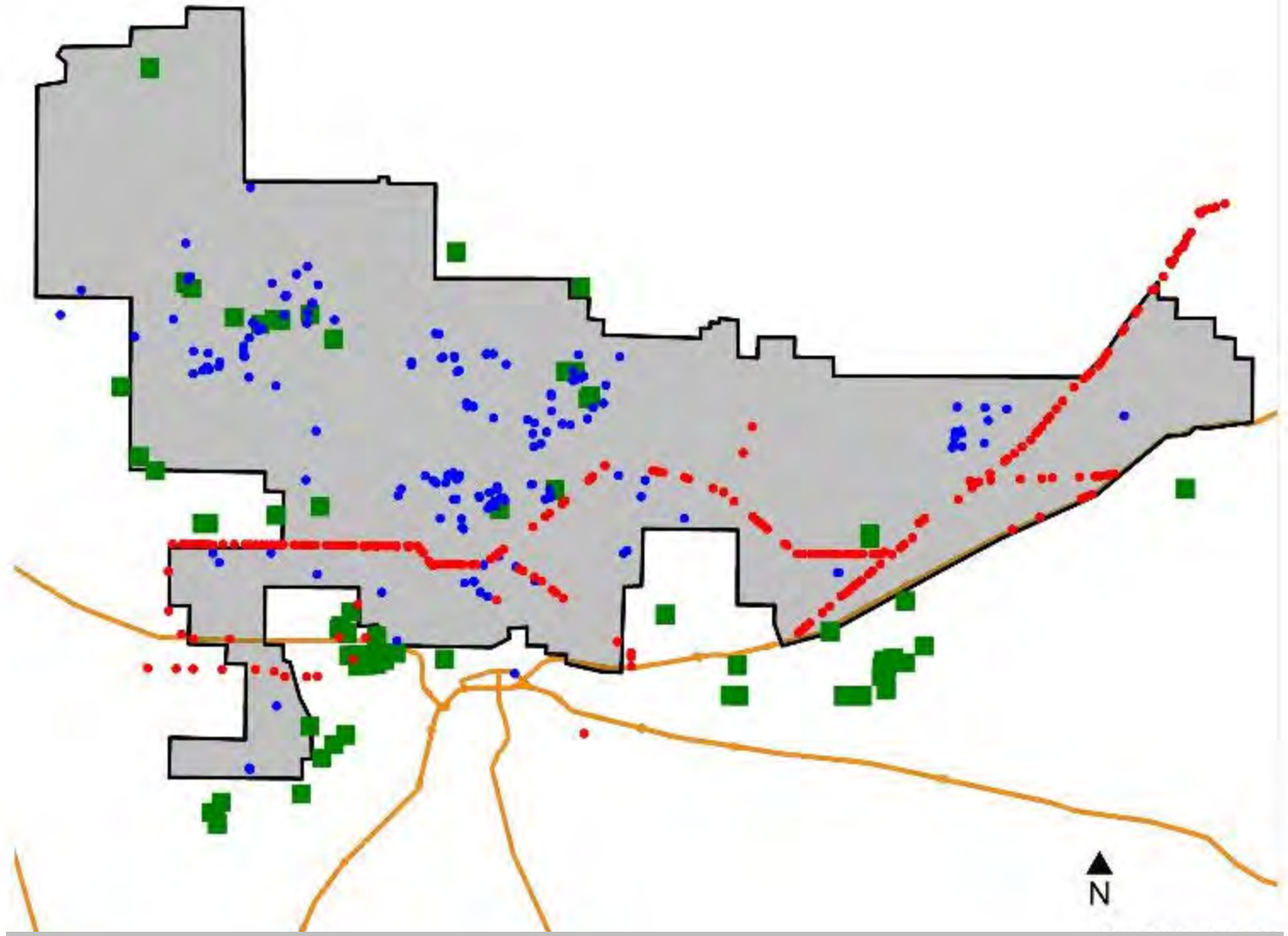
- Wider distribution of ravens in habitats they otherwise would not be able to occupy
- Ideal nest structures may increase nesting success: reduced loss to nest predators; improved food gathering
- Superior-Cronese Critical Habitat Unit: a case in point



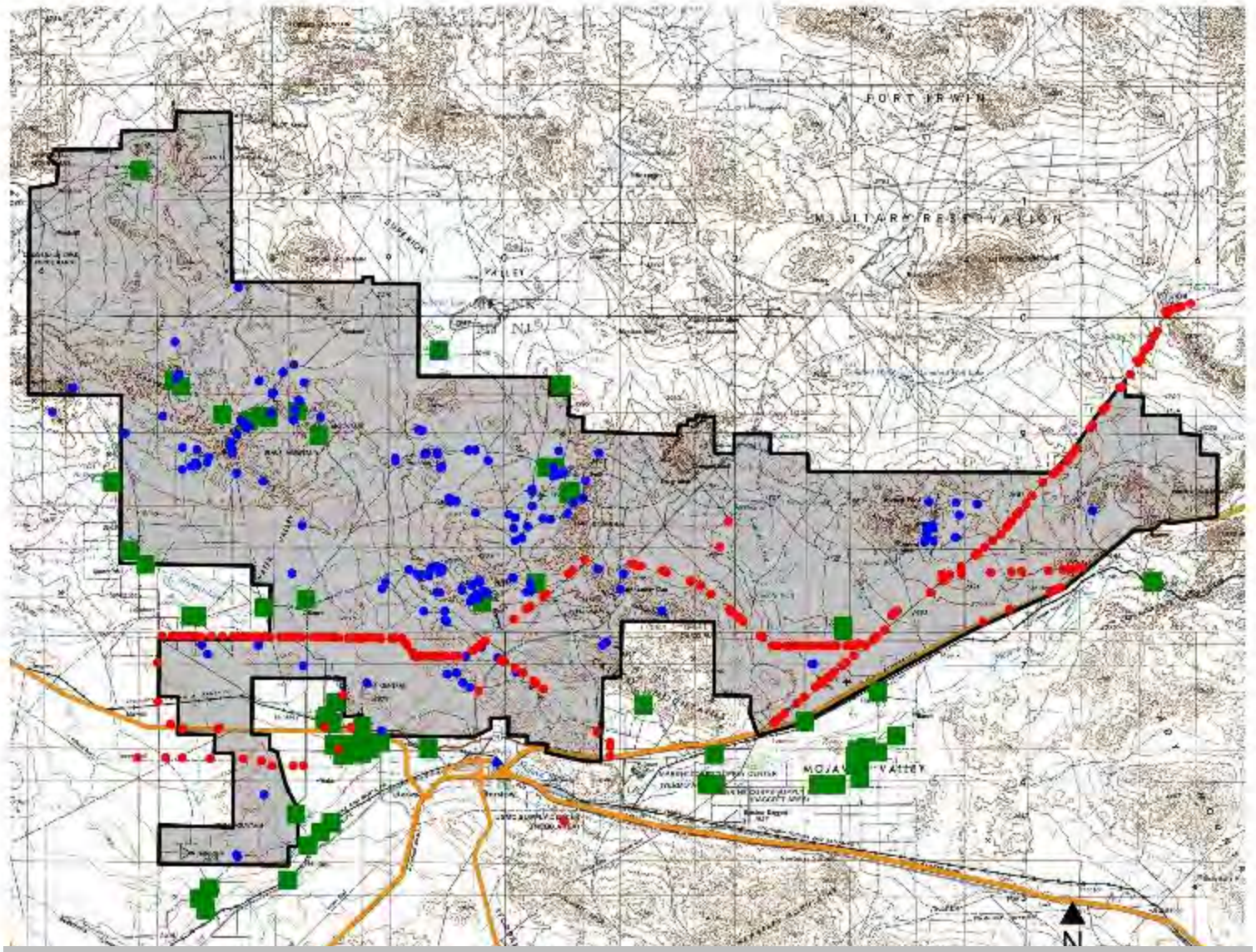
NATURAL SUBSTRATE NESTS



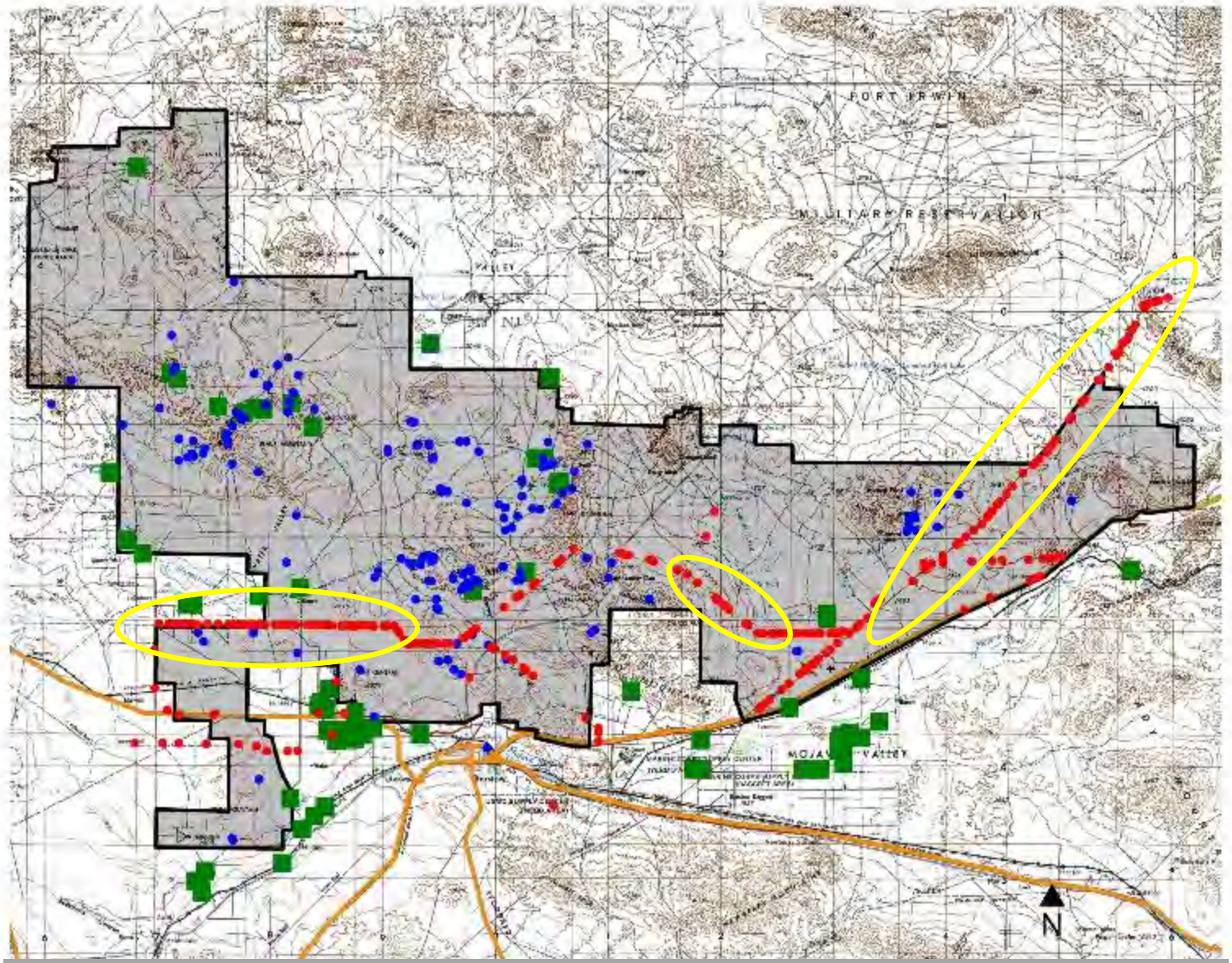
NATURAL SUBSTRATE NESTS AND SUBSIDY SITES



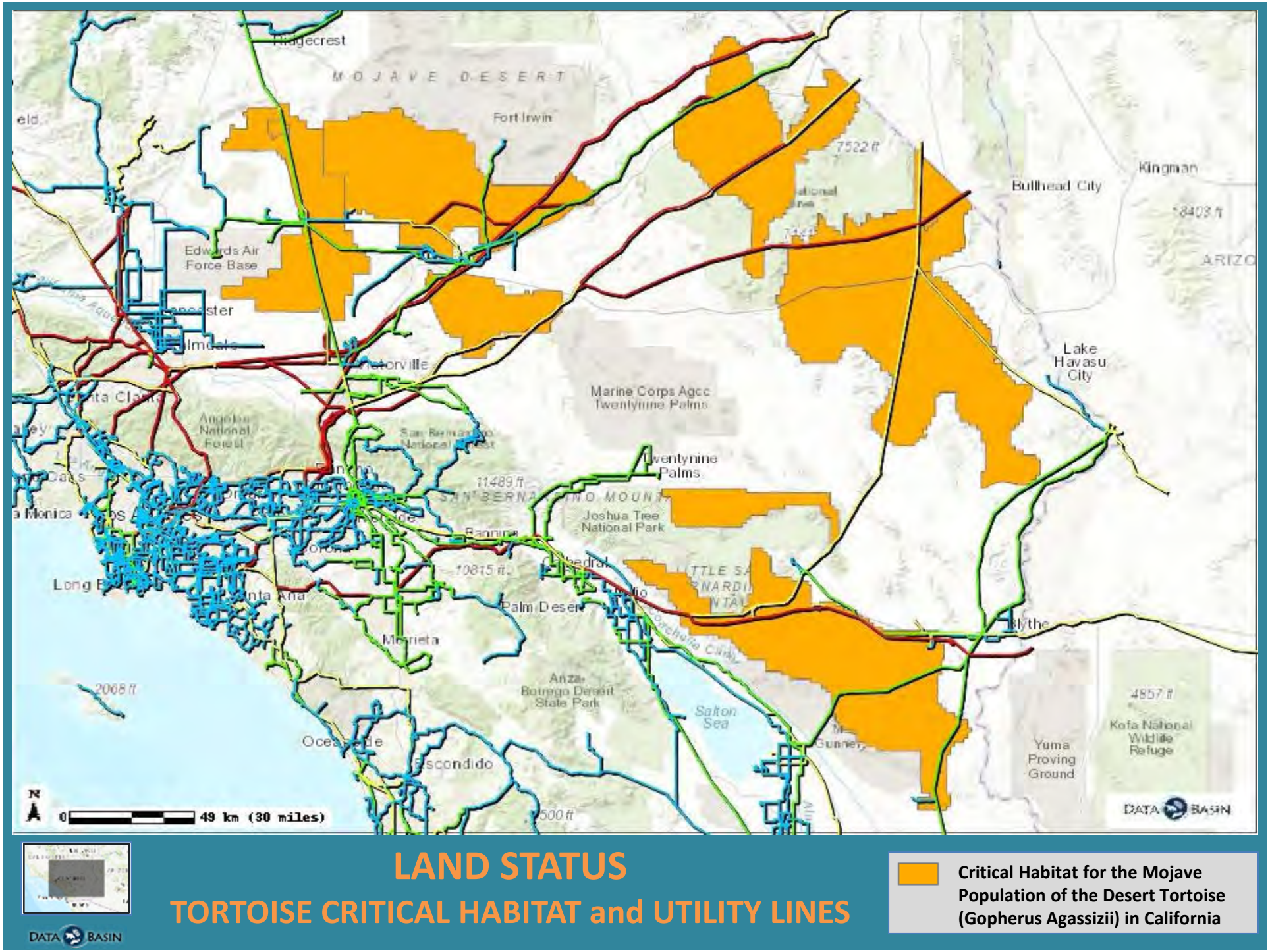
NATURAL SUBSTRATE NESTS, SUBSIDY SITES, AND TOWER NESTS



NATURAL SUBSTRATE NESTS, SUBSIDY SITES, AND TOWER NESTS WITH TOPOGRAPHY



TOWER NESTS WHERE NATURAL SUBSTRATE IS LIMITED OR UNAVAILABLE



LAND STATUS

TORTOISE CRITICAL HABITAT and UTILITY LINES

Critical Habitat for the Mojave Population of the Desert Tortoise (Gopherus Agassizii) in California

DATA BASIN

REO: A NEW APPROACH

- 2016
  - Obtained permits
  - Experimentation with three methods at Hyundai-Kia California Proving Grounds
- 2017
  - Focus on egg oiling on natural substrates at Hyundai and Superior-Cronese CHU
  - Initial Remote Fluid Application System (RFAS) development
- 2018
  - Engineered tools (patent pending, RFAS) and methods for treating natural substrate nests at Hyundai, Superior-Cronese and Chemehuevi CHUs
  - Engineered drone based oiling RFAS for transmission tower application

REO: A NEW APPROACH

- 2018 (continued)
  - Initial publication on egg oiling results in review
  - Intellectual property protection in place
  - Numerous demonstrations, workshops and presentations over last year
  - Best Management Practices document now complete
  - Pending agreements with SCE and LADWP for tower nest oiling
  - Expanded use of REO on natural substrate nests

Best Management Practices for Remote Egg Oiling (REO) of Raven Nests on Electrical Transmission Towers and "Out-of-Reach" Substrates

Remote Fluid Application System (RFAS), (*patent pending*)

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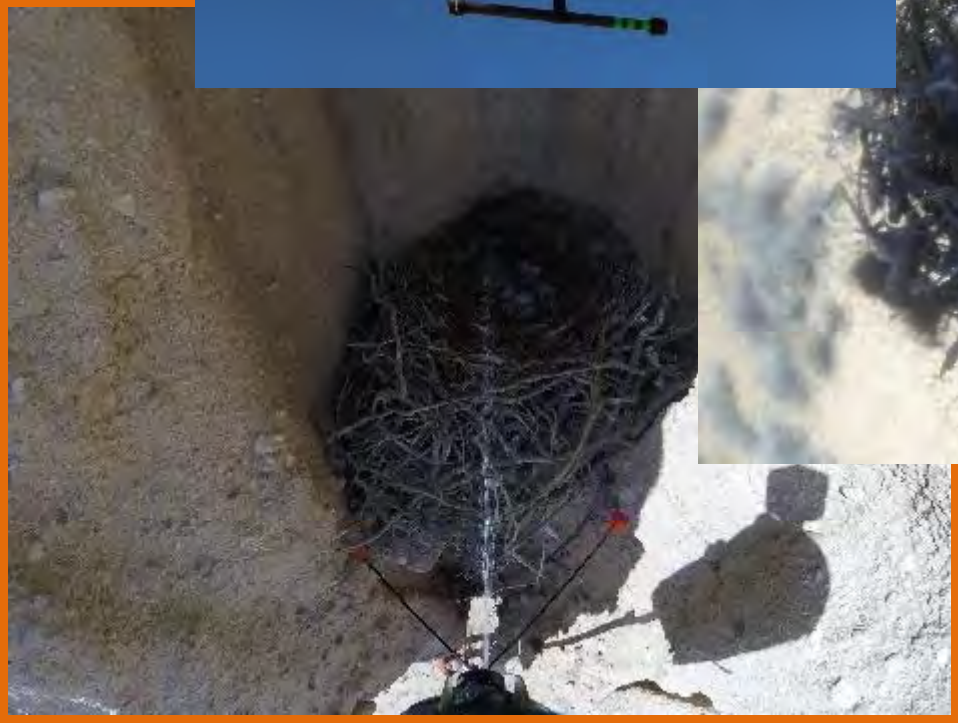
The BMP - a living document

COLLABORATION WITH UTILITIES

- SAFETY MANAGEMENT SYSTEM
- OPERATIONS MANUAL
- TRAINING MANUAL

SCE Demonstration Flight at Workshop, Daggett, CA, 30 May 2018



How We Get Oil on Raven Eggs

Ground-based RFAS- current version can reach 45’
Can treat approx 85% of natural substrate nests

Ground-based Egg Oiling

RESULTS TO DATE: 2016-2018

- All oiled nests, all delivery methods-
  - 67 nests and 71 clutches treated
  - 305/309 treated eggs failed to hatch

LESSONS LEARNED

- Don’t waste money
  - Carefully consider, e.g., the advisability of egg oiling in drought years in low raven density areas
  - Search efficiently for nests. The highest cost of egg oiling is finding nests and determining timing of oiling. Explore other options for remote nest detection and monitoring
  - Collaborate with all parties: experienced field staff, agencies, utilities, other interest groups

Applied Research and Modeling

- Utilizing Raven Monitoring Data 2013-2017, Collaboration with University of Nevada, Reno (Dr. Ken Nussear)

- Modelling the Effects of Egg Oiling, Collaboration with Cornell University (Dr. Brenda Hanley)

The Mathematics of Managing Egg Oiling

Brenda Hanley, PhD., Postdoctoral Research Associate, Cornell Wildlife Health Lab

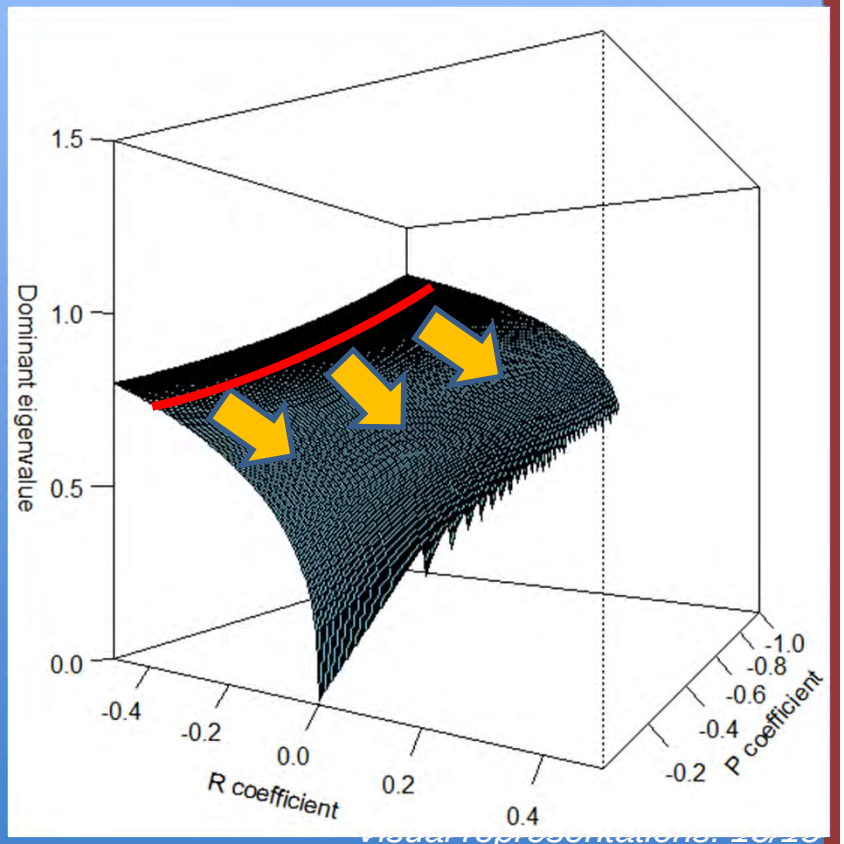
Growth rate surface - Common raven

(ANY COMBO OF VITAL RATES PER LIFE CYCLE STAGE)

$$\begin{bmatrix} 0 & 0 & \downarrow \\ ? & 0 & 0 \\ 0 & ? & ? \end{bmatrix}$$

$\downarrow = R$

$(?) = P$



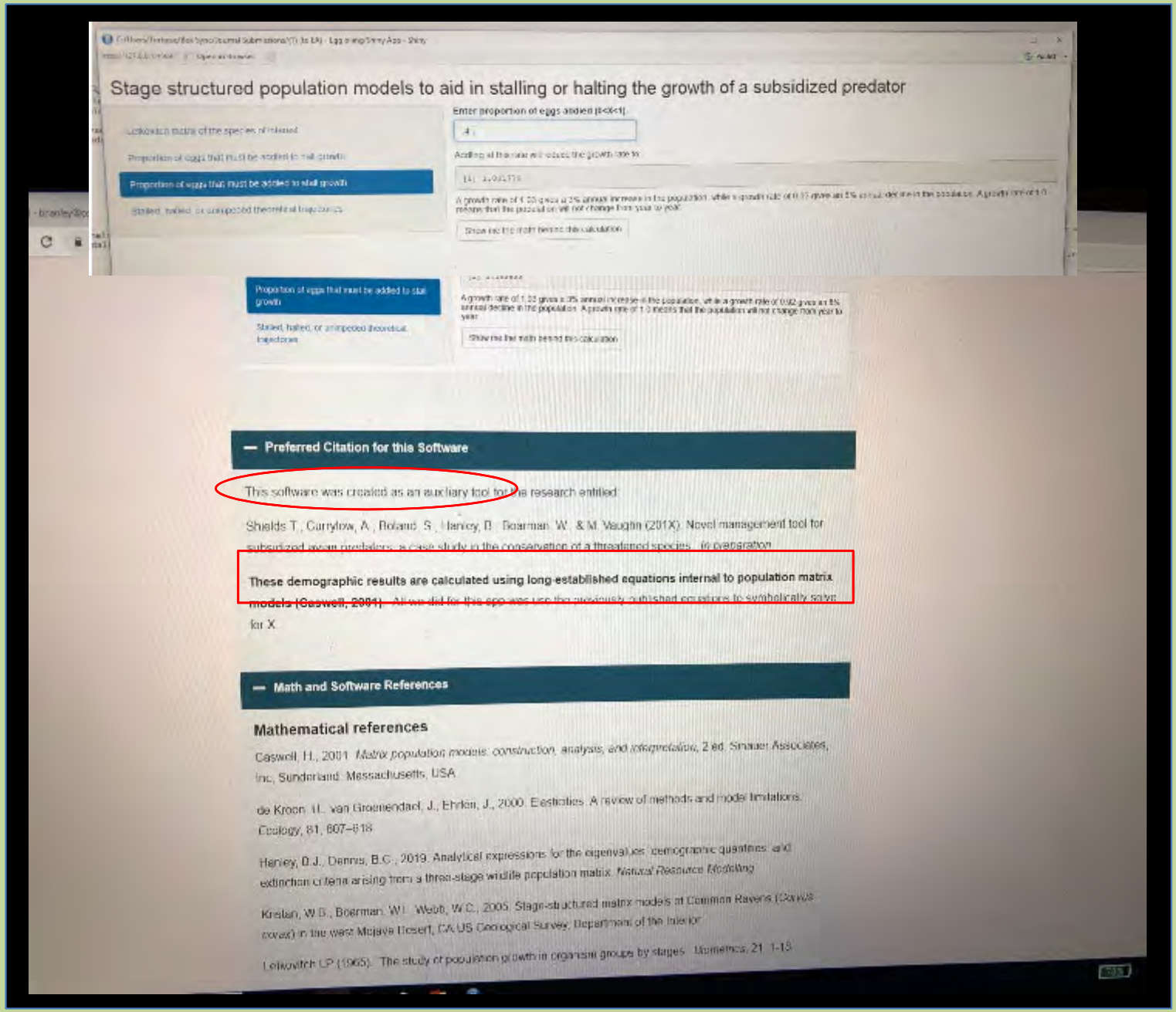
1) <u>IN ALL CASES</u>, decreasing fecundity (egg oiling) <u>WILL decrease the growth rate</u>.

2) We know this from <u>THE SHAPE OF THE MATHEMATICAL SURFACE ACROSS THE ENTIRE SUPERPARAMETER SPACE</u>, even if we do not have precise vital rate estimates.

3) What remains unknown is the EXACT effect that X intensity of egg oiling will have on Y system.

(….BUT! We can derive an equation for that!)

https:\\cwhl.vet.cornell.edu\tools\stallPOPd



Next Steps:

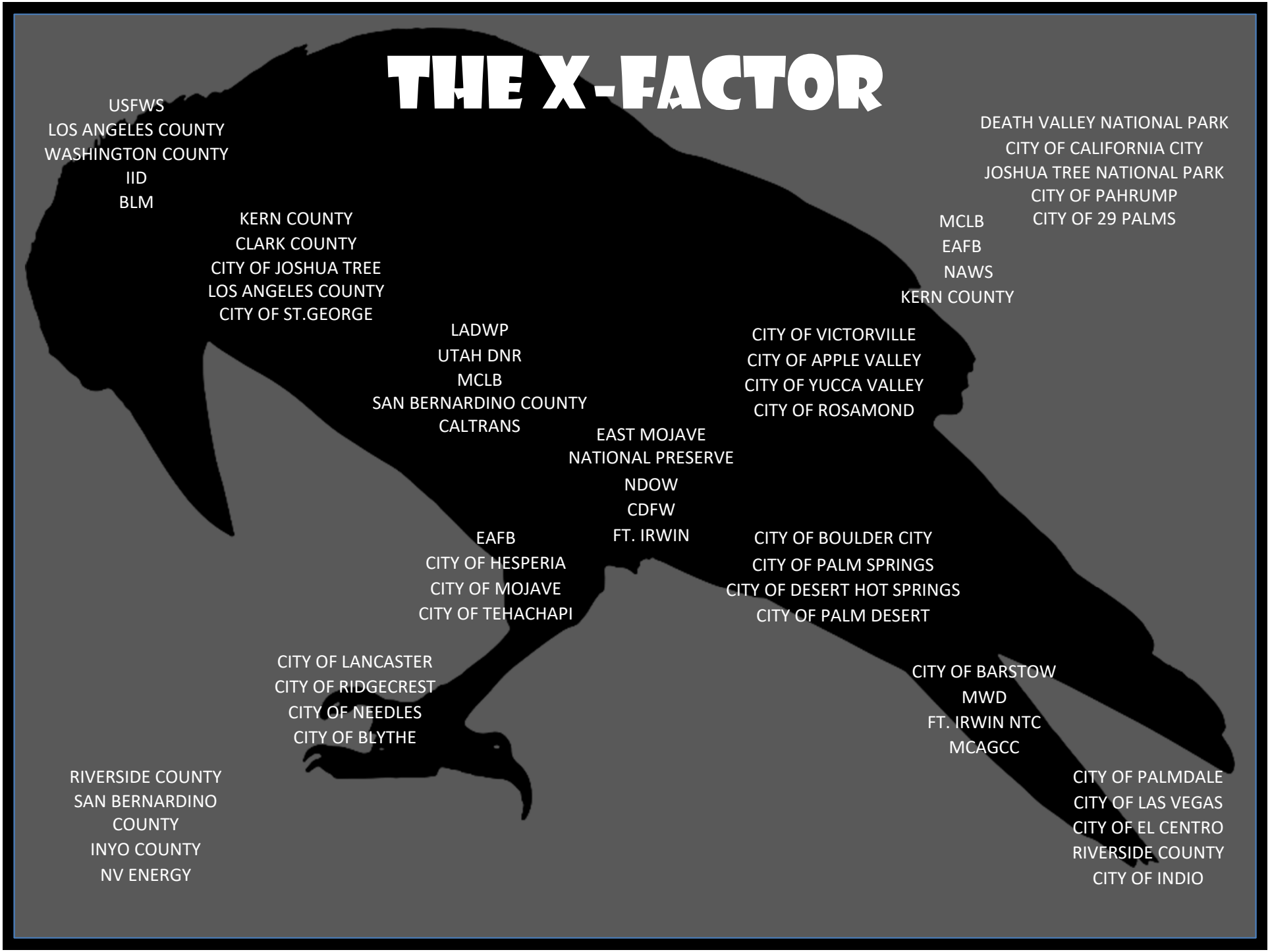
1) Count ravens- consistent methods of counting over large areas essential for population estimates and guiding management
2) Continue and expand subsidy reduction
    - via hazing
        - At food subsidy sites
        - At water sources
        - At roosts
    - Via management of subsidy (e.g. landfill practices)
3) Alter human behavior via increased public education

However, many tools, including new methods, are necessary to buy time for tortoises. Anthropogenic alterations, such as power towers, will subsidize ravens indefinitely and require long-term application of direct raven control.

Next Steps (2):

Thus:

1. Continue to invest in device development
2. Implement REO widely to reduce or reverse raven population growth
3. Refine field techniques and management model
4. Continue collaboration with entities, such as utilities, that have a stake in raven control
5. Assess effect of control methods through use of artificial tortoise models (Techno-tortoises ™) or monitoring of surrogate species
   - Ideal surrogate would be a known raven prey species with a highly detectable fecundity rate
6. **Commit to continue the effort**


THE X-FACTOR
USFWS
LOS ANGELES COUNTY
WASHINGTON COUNTY
IID
BLM
KERN COUNTY
CLARK COUNTY
CITY OF JOSHUA TREE
LOS ANGELES COUNTY
CITY OF ST.GEORGE
LADWP
UTAH DNR
MCLB
SAN BERNARDINO COUNTY
CALTRANS
EAST MOJAVE
NATIONAL PRESERVE
NDOW
CDFW
FT. IRWIN
EAFB
CITY OF HESPERIA
CITY OF MOJAVE
CITY OF TEHACHAPI
CITY OF LANCASTER
CITY OF RIDGECREST
CITY OF NEEDLES
CITY OF BLYTHE
RIVERSIDE COUNTY
SAN BERNARDINO
COUNTY
INYO COUNTY
NV ENERGY
DEATH VALLEY NATIONAL PARK
CITY OF CALIFORNIA CITY
JOSHUA TREE NATIONAL PARK
CITY OF PAHRUMP
CITY OF 29 PALMS
MCLB
EAFB
NAWS
KERN COUNTY
CITY OF VICTORVILLE
CITY OF APPLE VALLEY
CITY OF YUCCA VALLEY
CITY OF ROSAMOND
CITY OF BOULDER CITY
CITY OF PALM SPRINGS
CITY OF DESERT HOT SPRINGS
CITY OF PALM DESERT
CITY OF BARSTOW
MWD
FT. IRWIN NTC
MCAGCC
CITY OF PALMDALE
CITY OF LAS VEGAS
CITY OF EL CENTRO
RIVERSIDE COUNTY
CITY OF INDIO

We’re hoping to avoid using the trained bears…