Natural History and Seasonal Activity of the California Kingsnake (*Lampropeltis californiae*) in the Native Range.

Robert Fisher
USGS

Las Palmas
May 8, 2014

When people take so many resources or degrade so much habitat that another species is driven extinct, we have taken or damaged too much, and brought a valuable and meaningful story to an untimely end.

Cafaro and Primak, 2014

Thank you for inviting me to participate on this project. I really hope for the success of the program through snake eradication.

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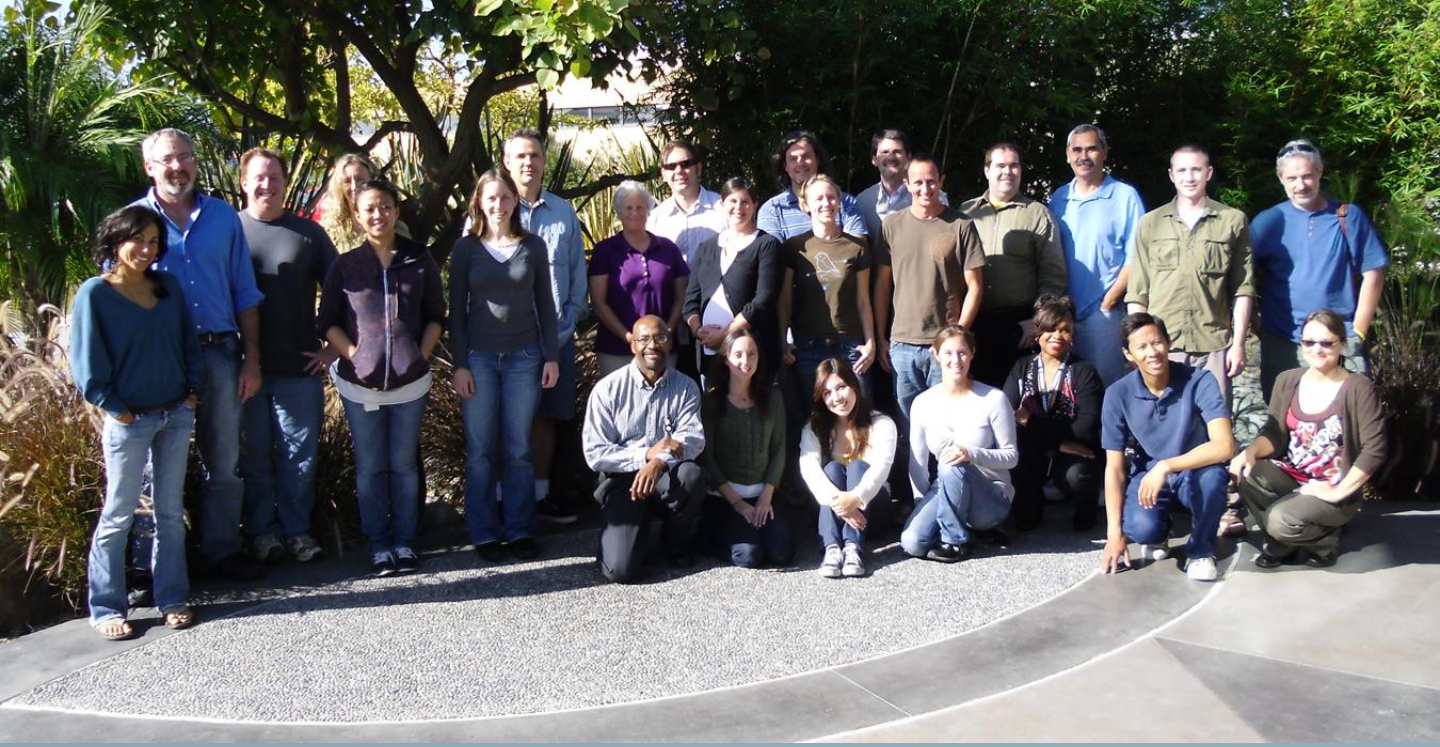

Recent team photo – field and lab crew

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Terms I'll Use:

I/Me = We; We/Us = They;
They = Something I heard about

Natural History of California Kingsnake in Native Range – San Diego, California

- Background on region and habitat
- Reptile sampling technique – pit fall trap arrays
- Basic activity and growth patterns – comparison to Gran Canaria
- Kingsnake movement patterns
- Kingsnake as predators
- Kingsnake as prey
- Control tools (i.e. dogs)
- Biocontrol – emerging infectious diseases (i.e. snake fungus)

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High biodiversity (last remaining populations of some species)














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Many snake species occur naturally

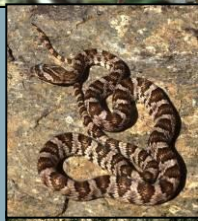
Possibly competition is important driver in southern California in controlling kingsnake numbers

Little research has been completed on this issue.

Good reference is Hubbs 2009







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Diverse habitats (some almost gone)

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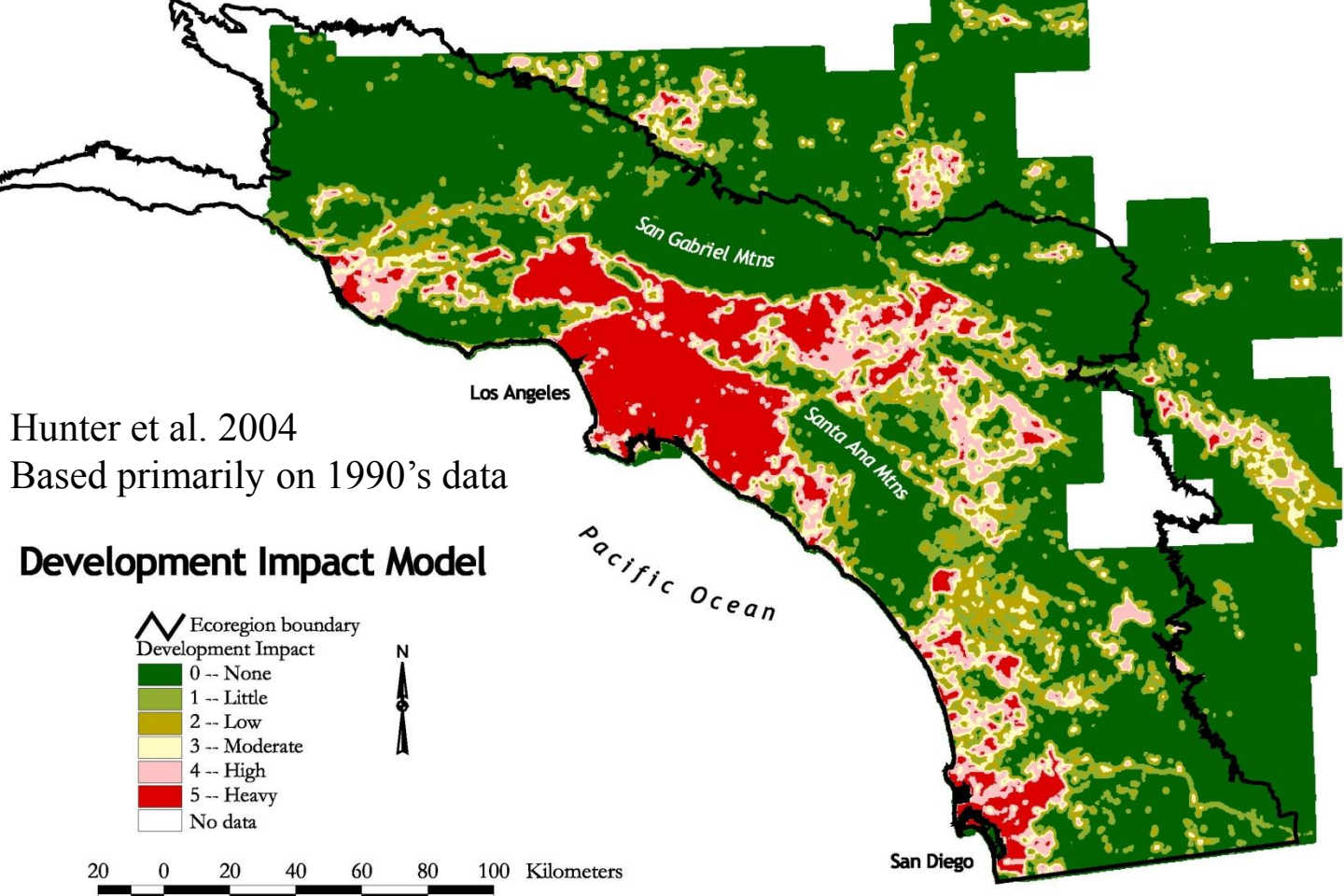

Hunter et al. 2004
Based primarily on 1990's data

Stratify by threat category

In west –
Fragmentation
Connectivity
Invasives

In east –
Disturbance
Past land use
Invasives

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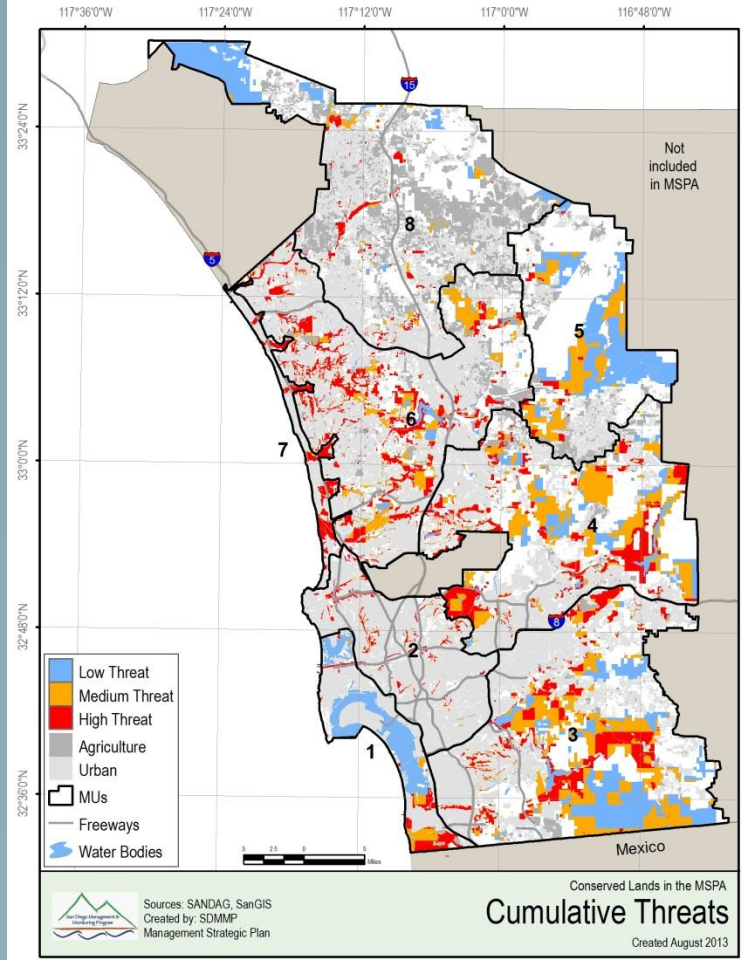

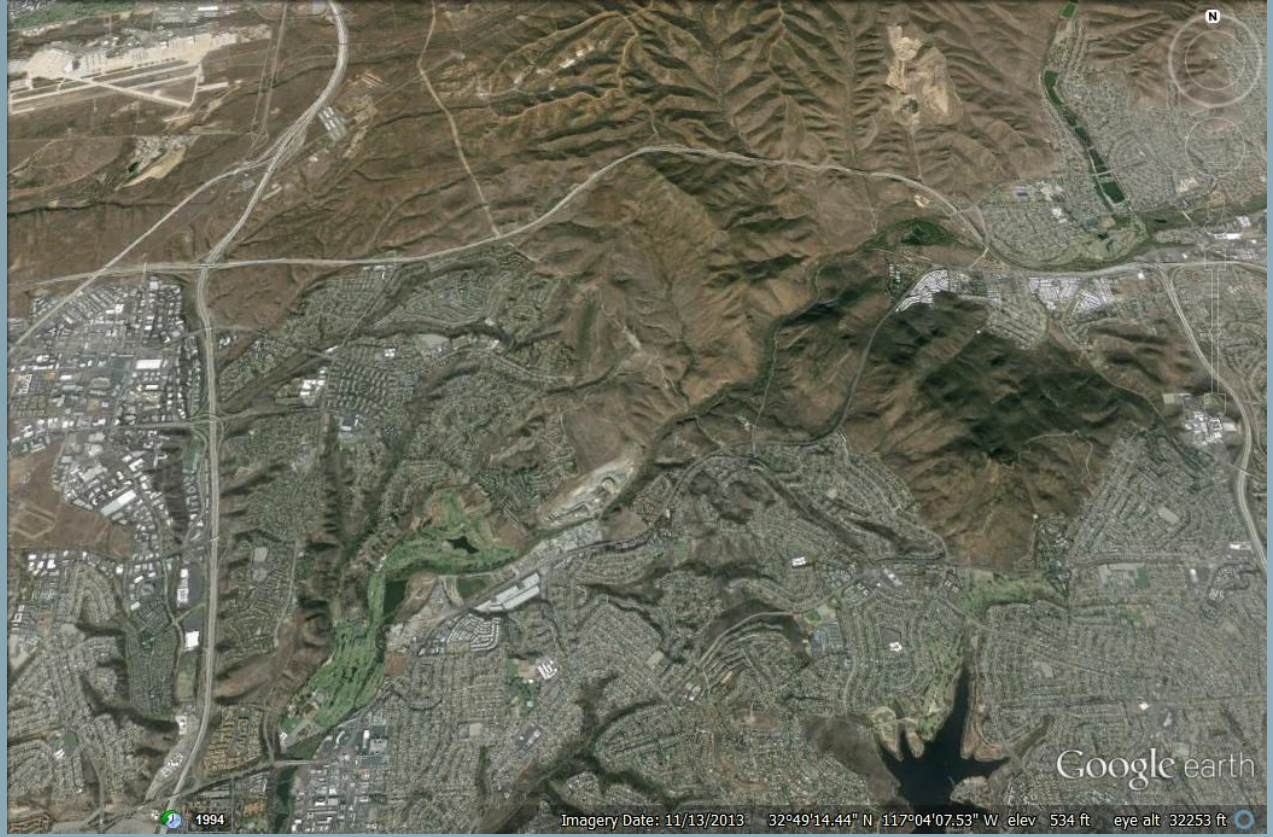

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Example of habitat patchs and similarity to Gran Canaria

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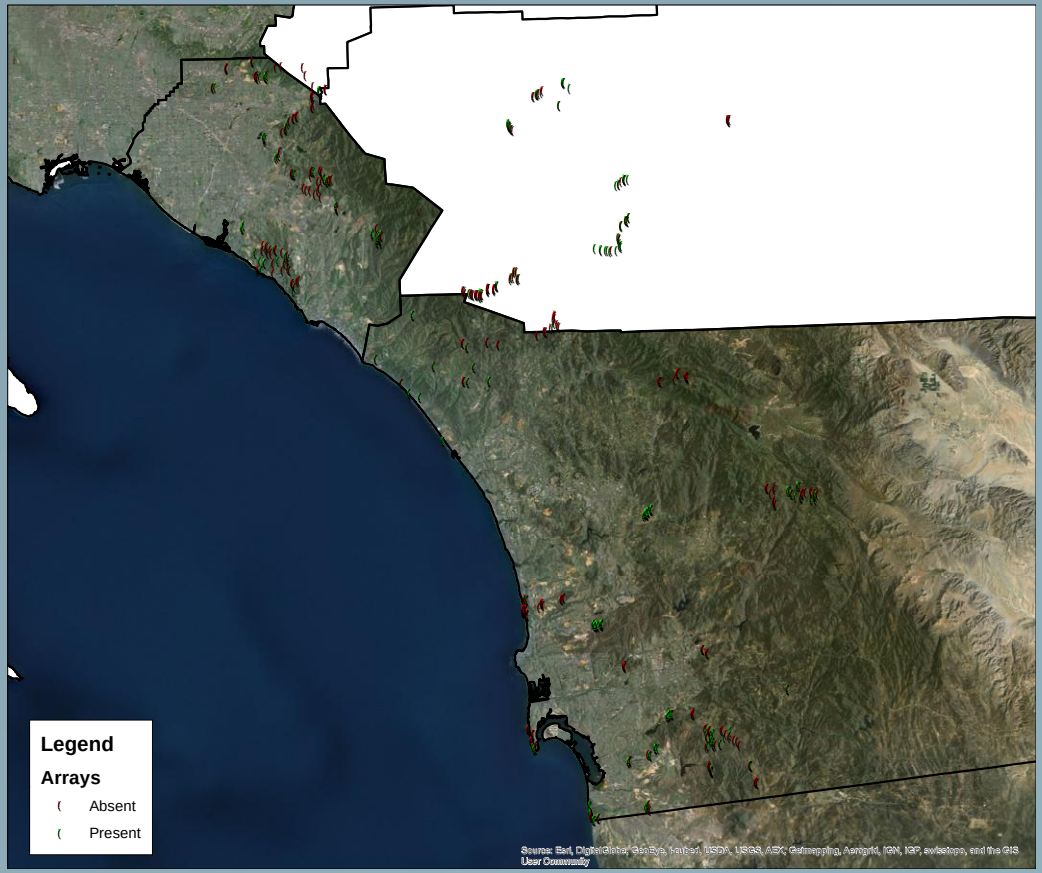
Trampas a mi casa. Caught snake last week in one standing up.

Pitfall sample locations where systematic efforts have been used to sample reptiles and amphibians across Southern California.



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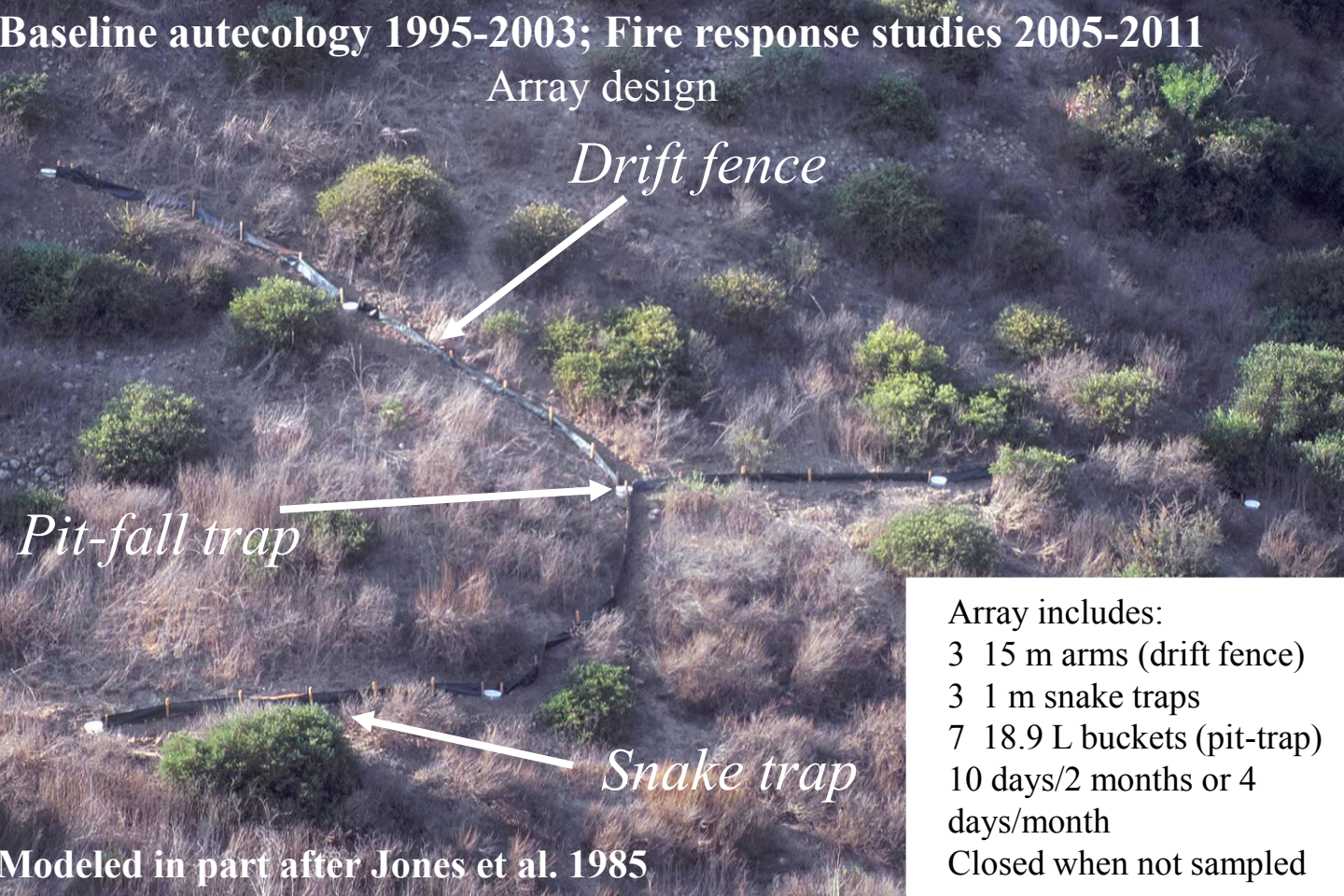
Baseline autecology 1995-2003; Fire response studies 2005-2011
Array design
Drift fence
Pit-fall trap
Snake trap
Modeled in part after Jones et al. 1985
Array includes:
3 15 m arms (drift fence)
3 1 m snake traps
7 18.9 L buckets (pit-trap)
10 days/2 months or 4 days/month
Closed when not sampled

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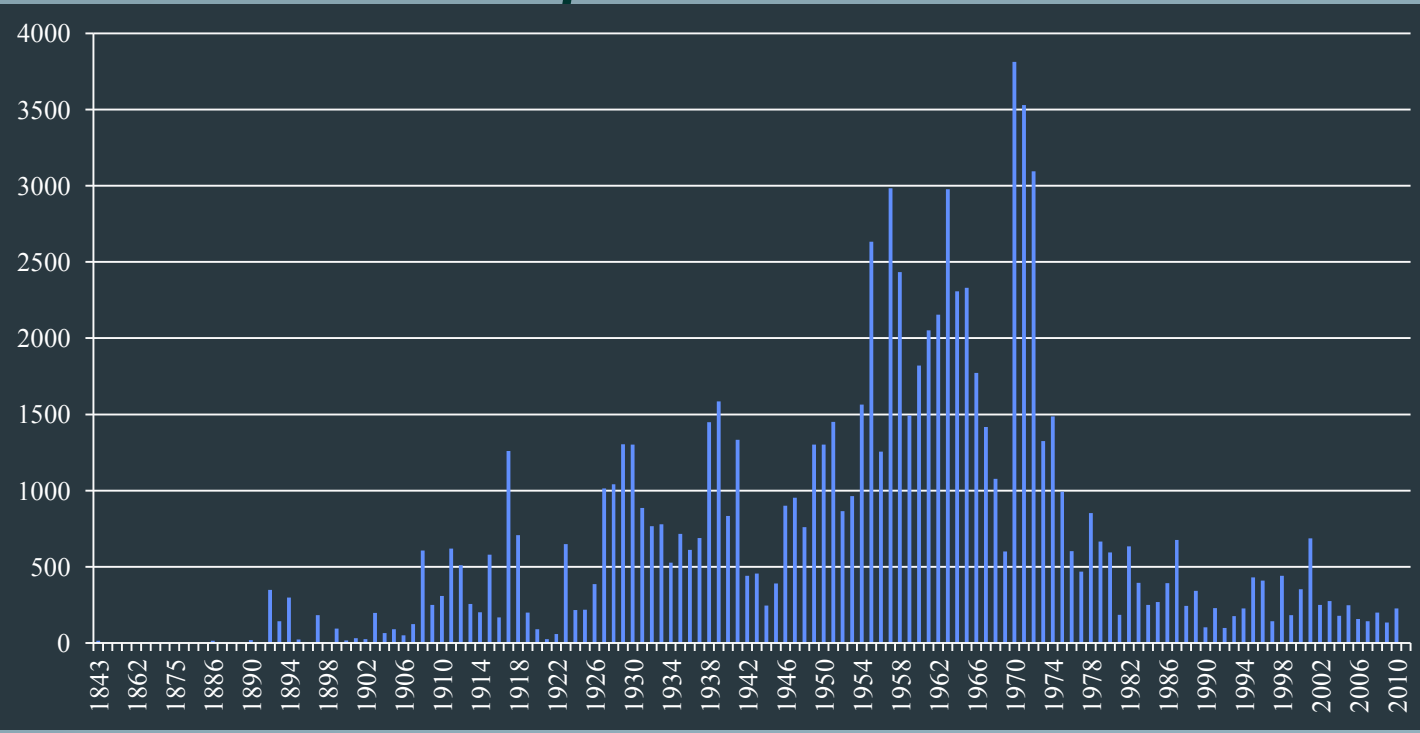
Museum Records from 5 So. Cal. Counties



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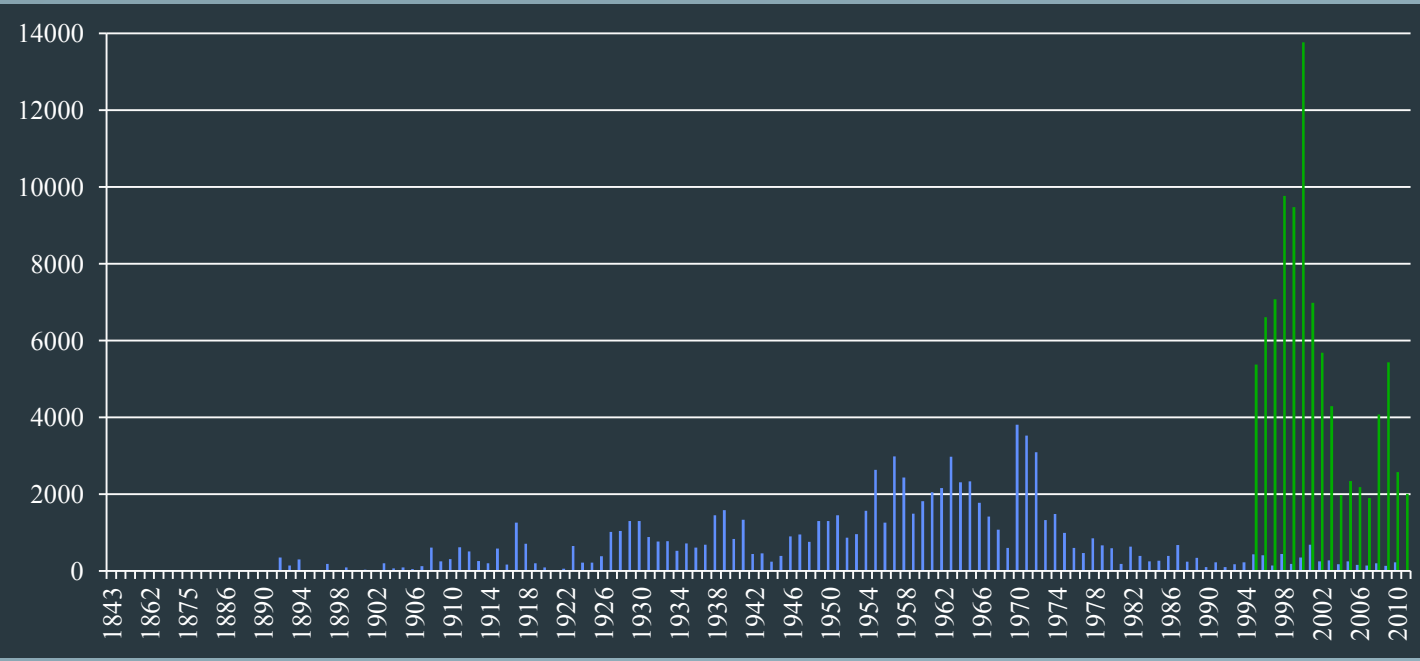
N = 90,918 historic specimen records over 170 years
From Herpnet: MVZ, CAS, LACM, SDNHM, etc.

USGS Pit-fall Trap Captures only, same counties



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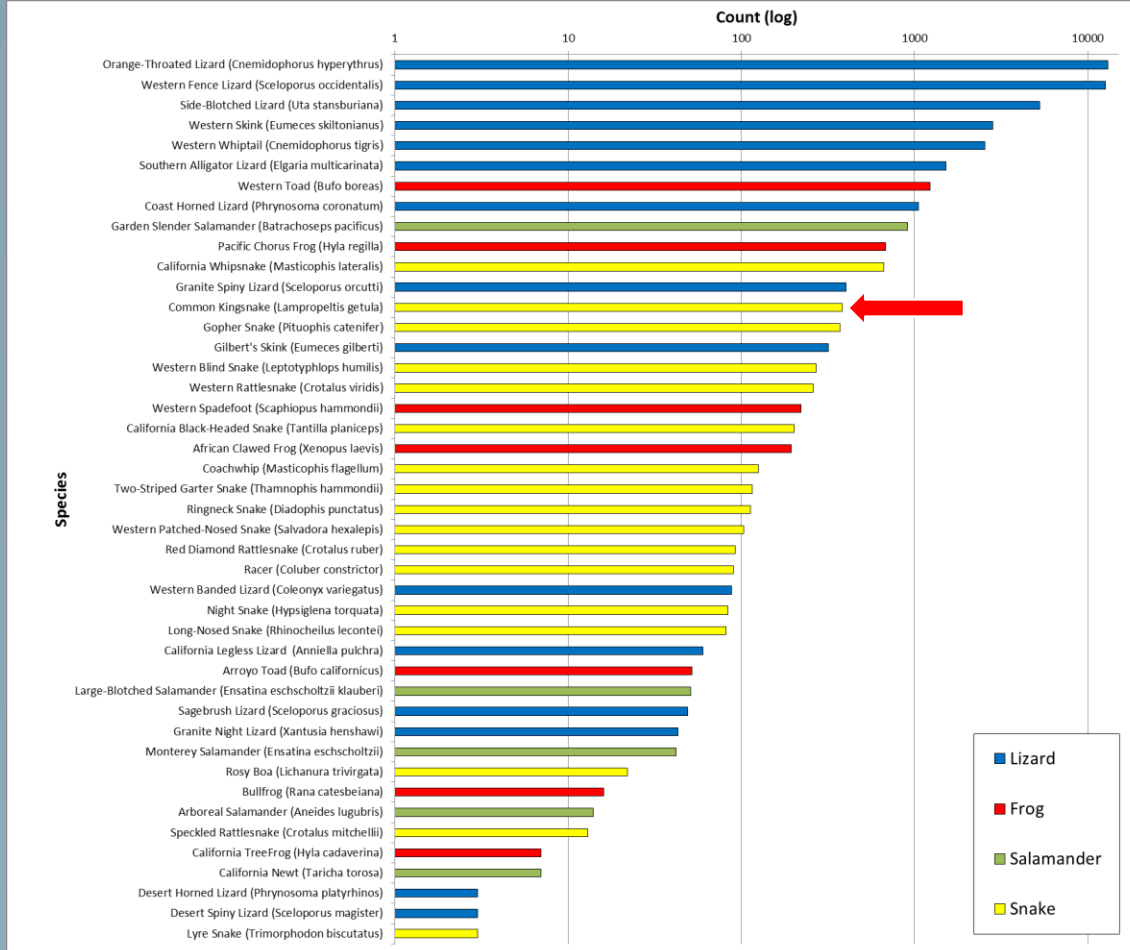
N = 90,918 museums; N = 91,541 from USGS surveys

In San Diego County pitfall trapping efforts.

Captures by species and taxonomic group.



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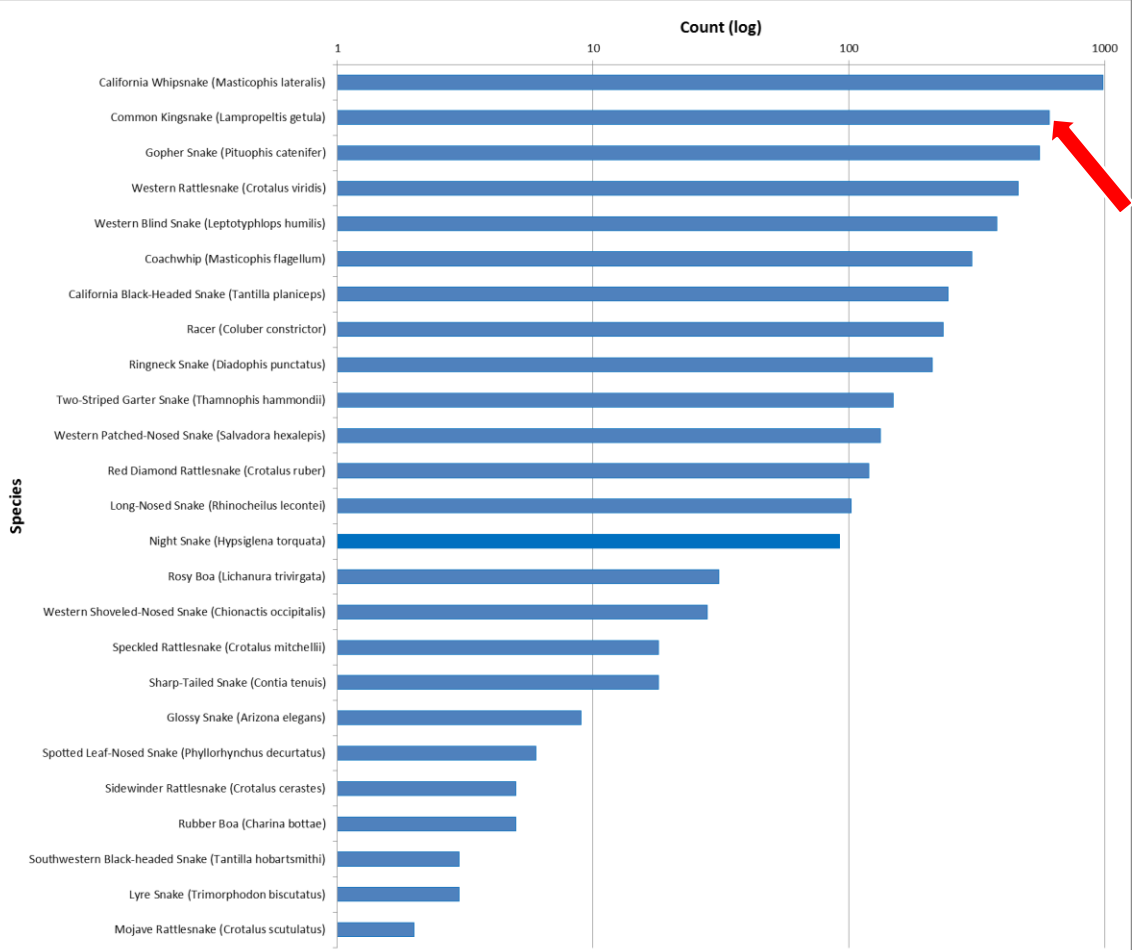
All snake captures in Southern California.

Kingsnake is second most common species.



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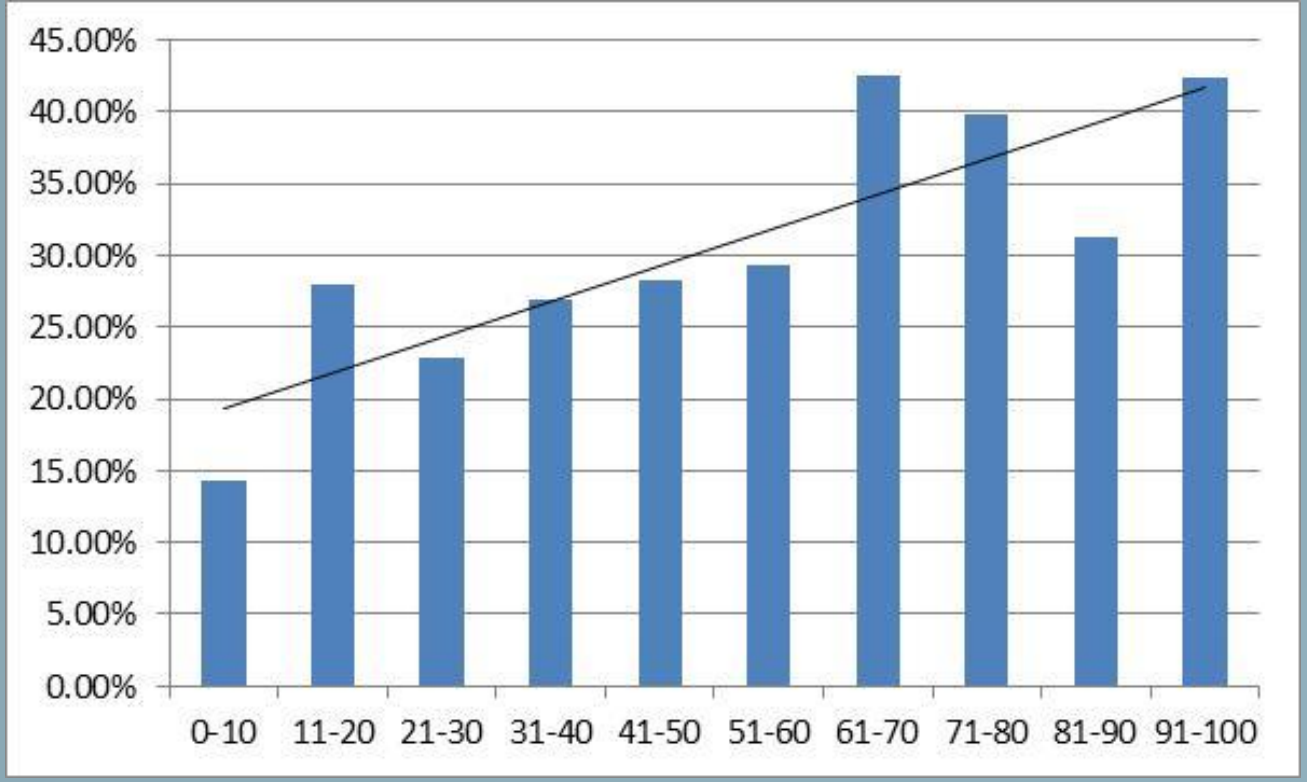

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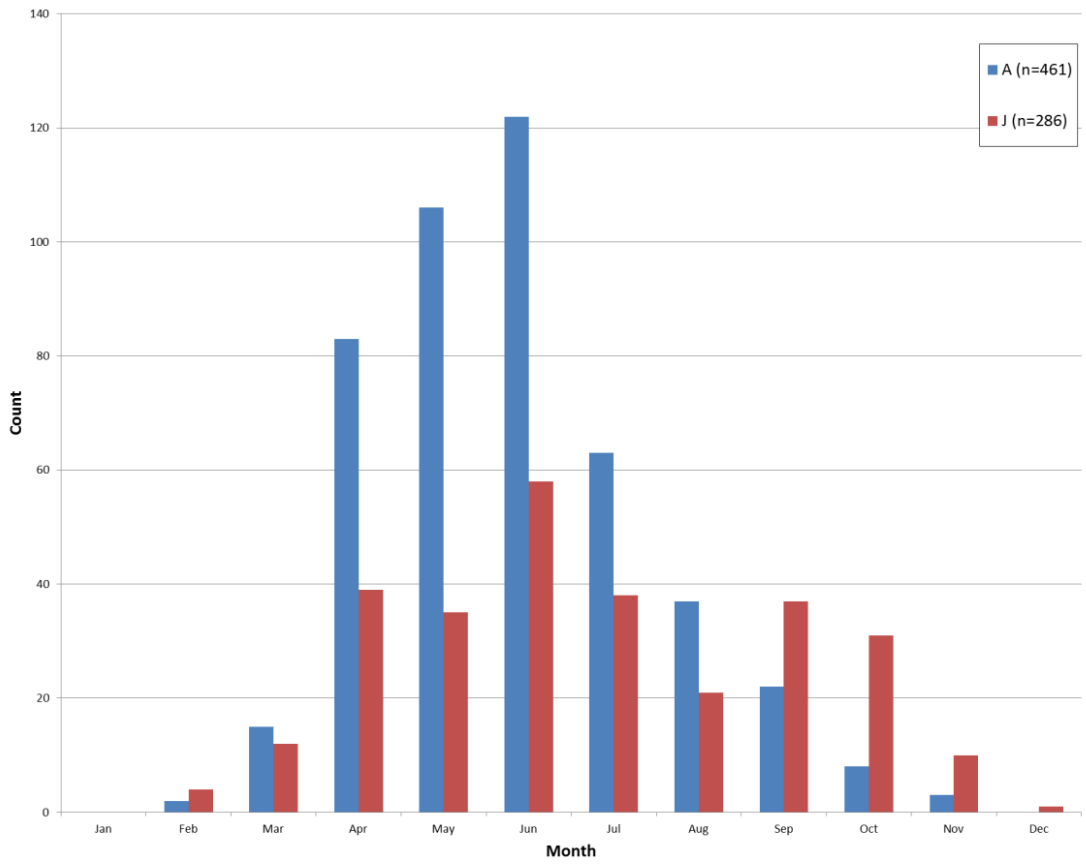
Percentage invasive grass at pitfall sample locations and percentage of traps where kingsnakes were detected in that category.

Monthly detection patterns for adults (>500 mm) and juveniles.

1995-2012



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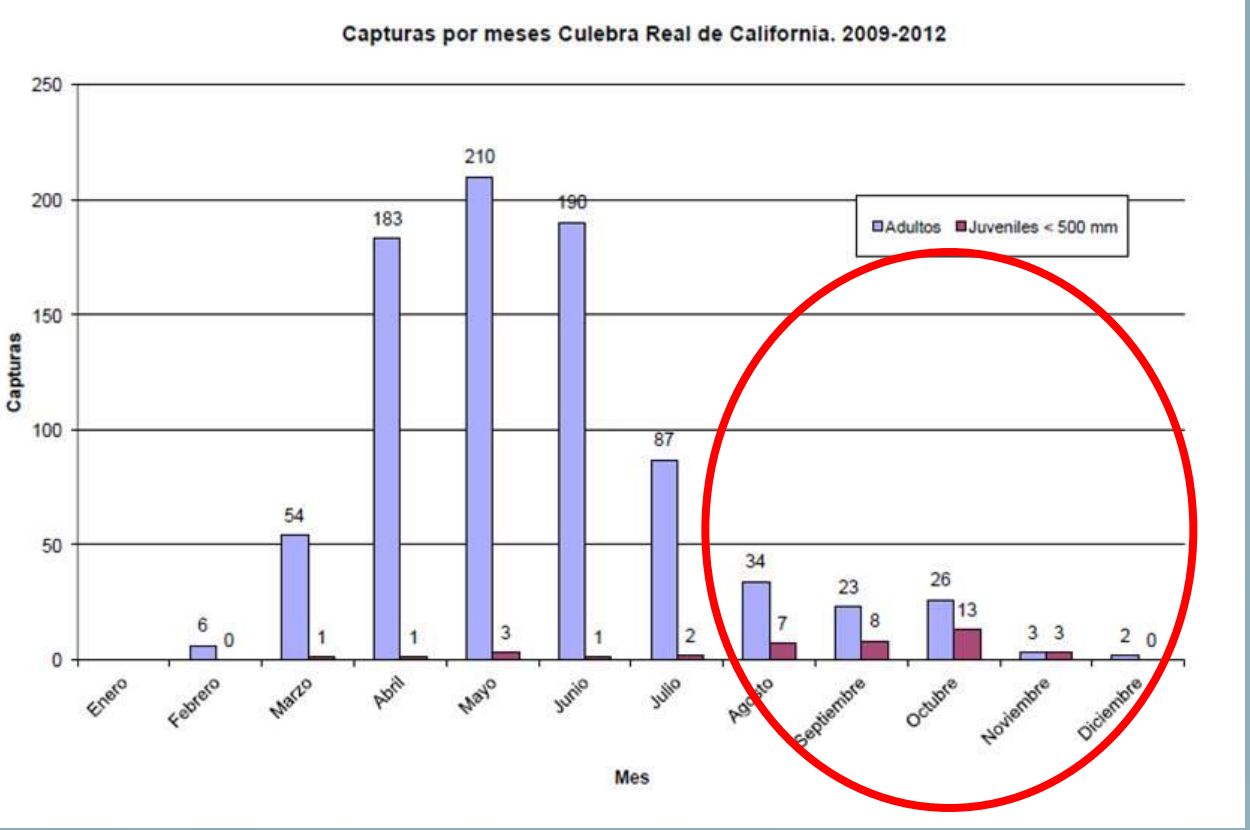

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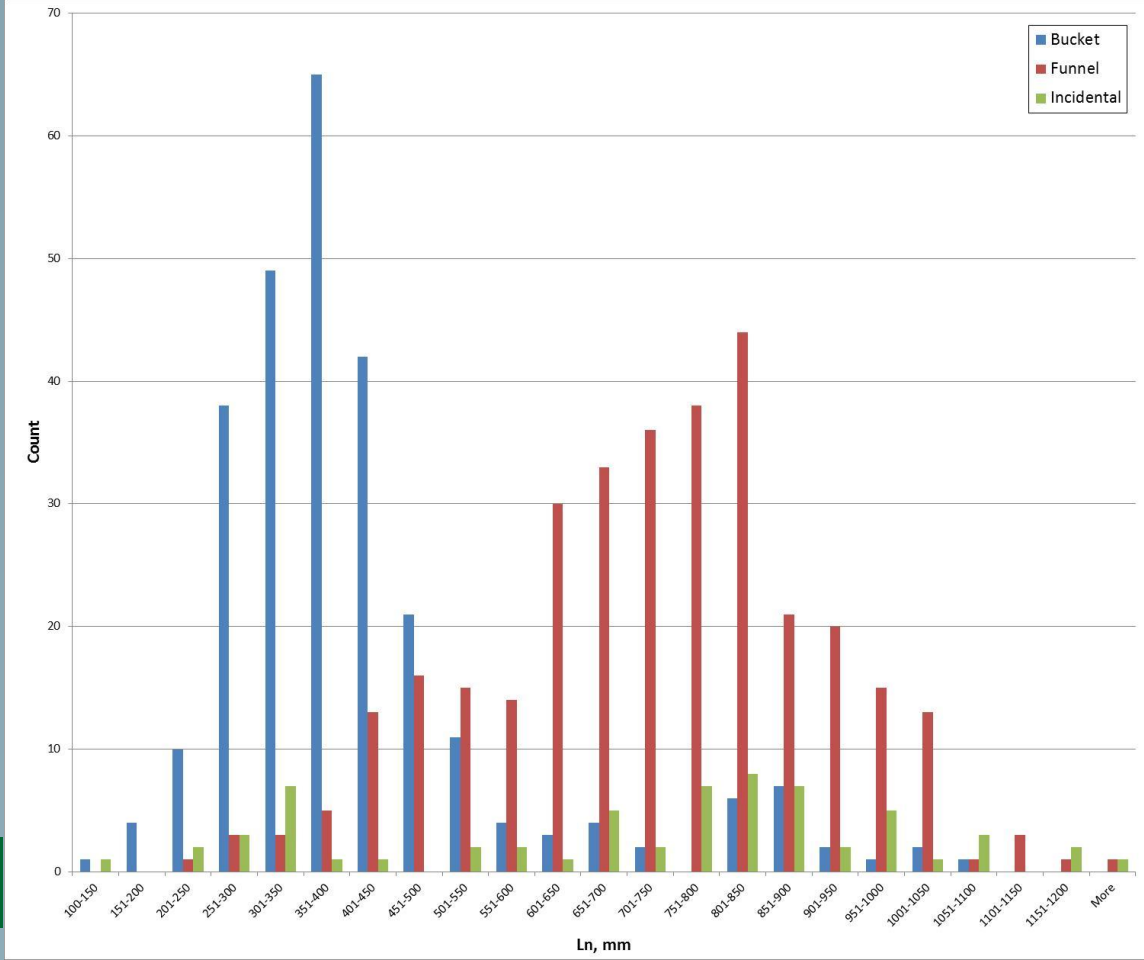
Data for Canary Islands from Ramon

Is there a detection issue with juveniles or predation?

Body size of kingsnakes by trap type.

50 mm breaks in size groups.



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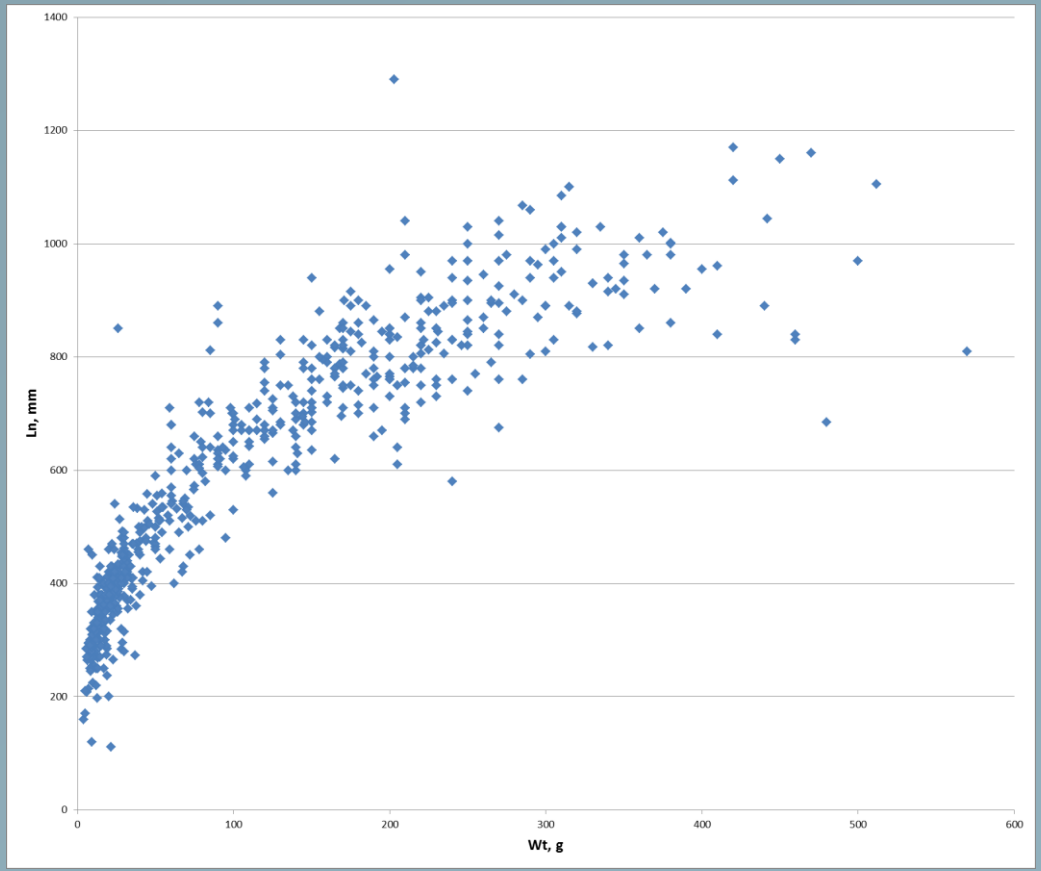
Growth curve for California kingsnake in Southern California.



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Mi casa en San Diego, California

Galdar, Gran Canaria
Muy grande!!!
GMO snakes.

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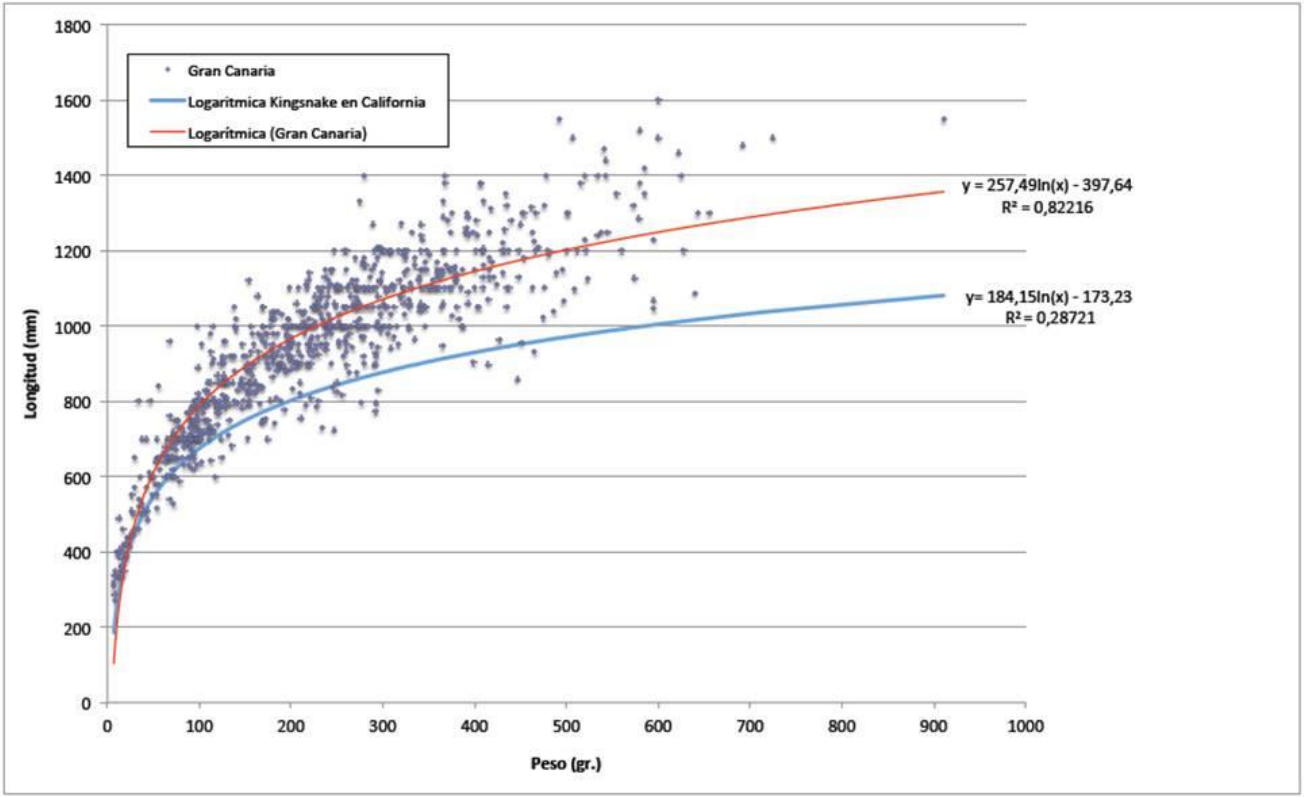

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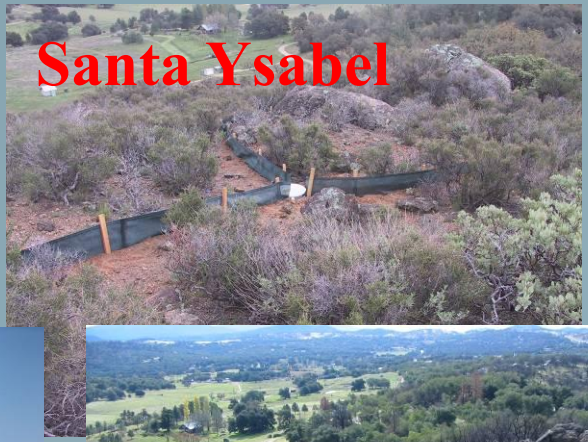
Canary Island versus California


2003
Southern California Firestorms

Southern California wildfires, October 22, 2007, NASA MODIS image



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Pre-fire vs. Post-fire Vegetation

Fire effects - All Snakes at Elliot Reserve

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Natural History:

Kingsnake movement patterns

Anguiano and Diffendorfer, *in press*, Journal of Herpetology

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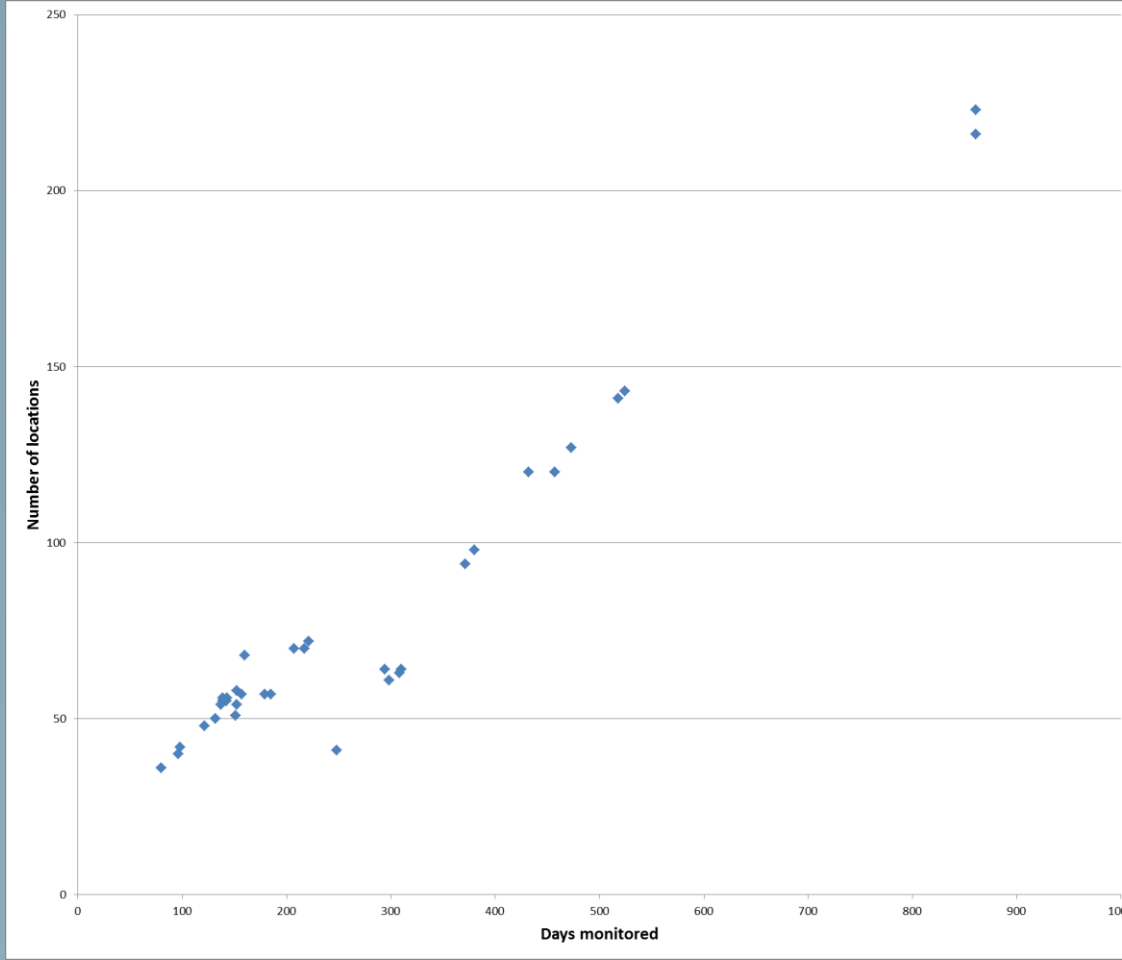
Sample effort showing that some animals were tracked for nearly 3 years and more located at 200+ locations.



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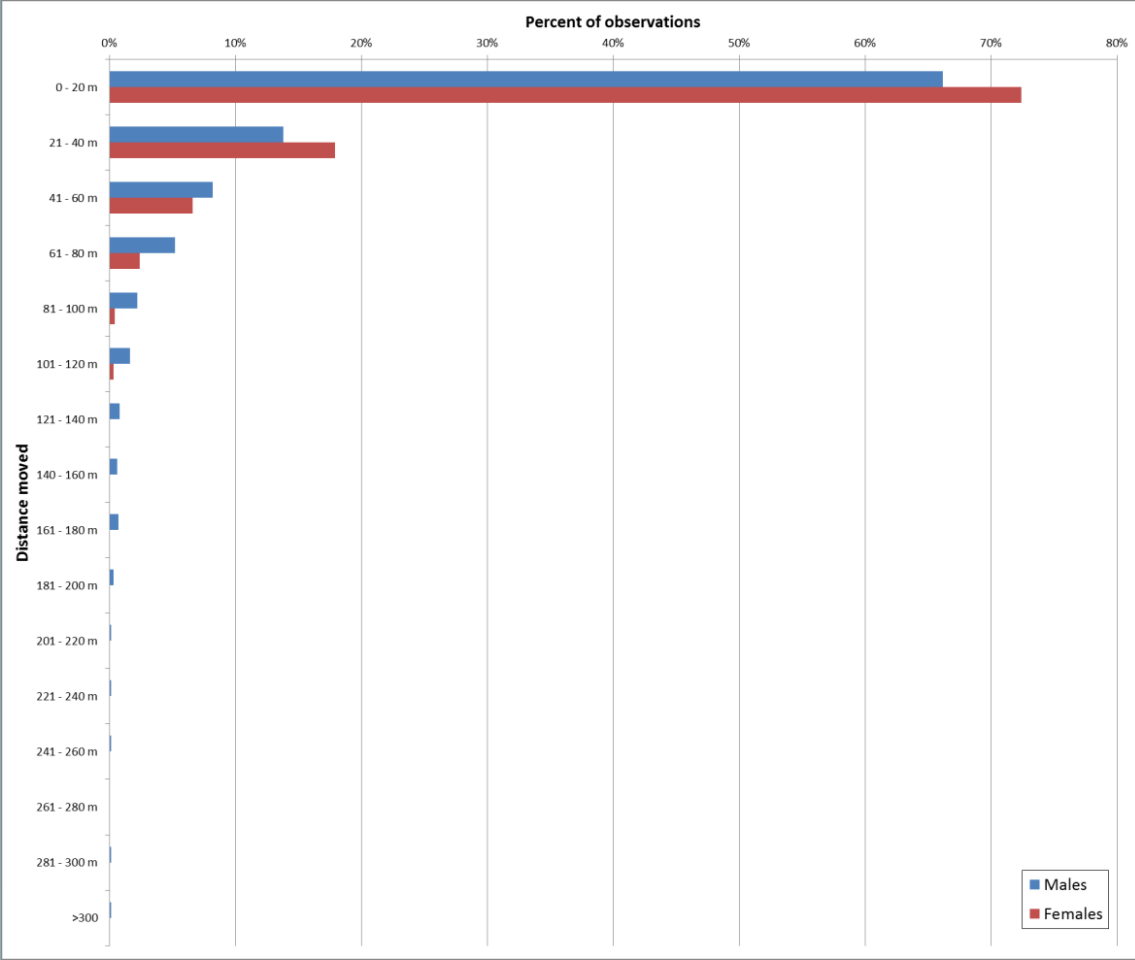
Movements differed between the sexes. Males made more long distance moves than females.



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MTLB-1
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MTLB-3
MTLB-4
MTLB-5
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
200
Meters

Natural History:

Example of kingsnake as predators

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PLATE 1. Video documentation of a California king snake depredating Rufous-crowned Sparrow nestlings. The nest is located at the center of the frame; the snake is coiled on top of it. In the foreground, the color-banded male parent attempts, unsuccessfully, to thwart the attack.

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70% of recorded nest predations were from kingsnakes. Morrison and Bolger, 2002.

Natural History:

Example of kingsnake as prey

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Diverse large mammal communuity

Changes with fragmentation

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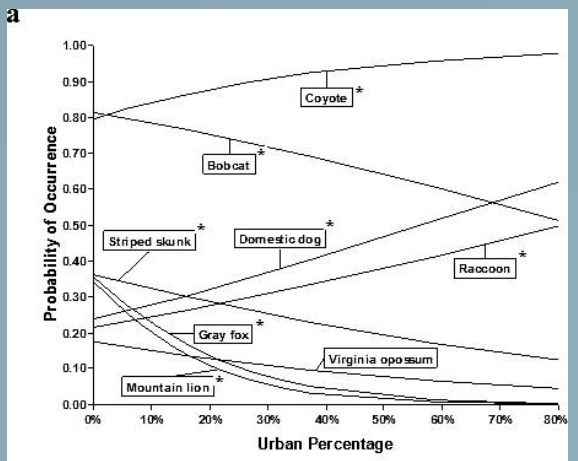

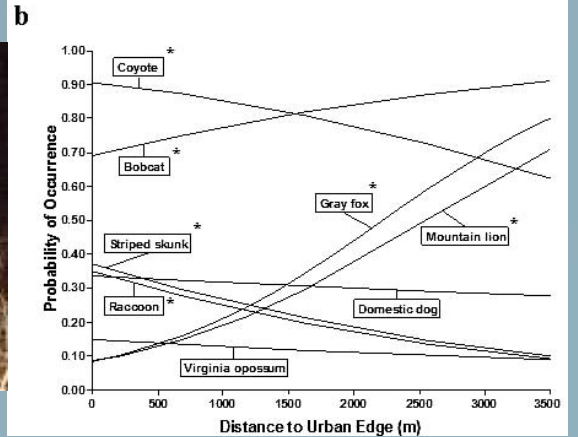

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Control Techniques:

Use of dogs for snakes (direct capture)

Feces (for determining boundaries of range)

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Using dogs for detecting and monitoring critically endangered species (Conservation Canines – UW)

Control Techniques:

Biocontrol investigations

Emerging Infectious Diseases - Zoonotics

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Snake Fungal Disease (SFD) *Ophidiomyces ophiodiicola* – snake specific fungus. Other fungi also utilize other reptiles.

Caused 50% decline in imperiled rattlesnake population between 2006-2007. Clark et al. 2011.

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Possible control plan

- **Traps across landscape every 150 m (???)**
  - This will capture snakes and give data on where populations appear greatest.
- **Baited traps in spring with female snakes every 500 m**
- **Use GPS on dogs to determine where they are sampling exactly and where detections are occurring**
  - Can the edge of the expansion be identified and managed with traps and dogs?
- **Take males and remove hemipenes (phallectomy), put radios in them and utilize them to find females (possibly).**

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References for hemipene removal:

Mader D., 2009. Methods for altering reproductive status in green iguanas (*Iguana iguana*).2009 Proceedings Association of Reptilian and Amphibian Veterinarians. Pp. 61-62

Rivera S., Divers S.J., Knafo S.E., Martinez P., Cayot L.J., Tapia-Aguilera W. and Flanagan J. 2011. Sterilization of hybrid Galapagos tortoises (Geochelone nigra) for island restoration. Part 2: phallectomy of males under intrathecal anaesthesia with lidocaine. Veterinary Record Vol.168 issue 3. Pp. 78

With removal of hemipene but not testes, snakes will seek out females but cannot inseminate them

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Difficult Problem

Many questions

Requires aggressive actions

Hopefully success to conserve biodiversity
















Riparian impacts less understood

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Habitat Fragmentation in So Cal







Has many different ecological effects and can be segregated by three different axes:

Temporal scales

Spatial scales

regional patterns

local small scale patterns




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Inventories based on presence of species

Management can be informed with data

Protocols can be refined and optimized

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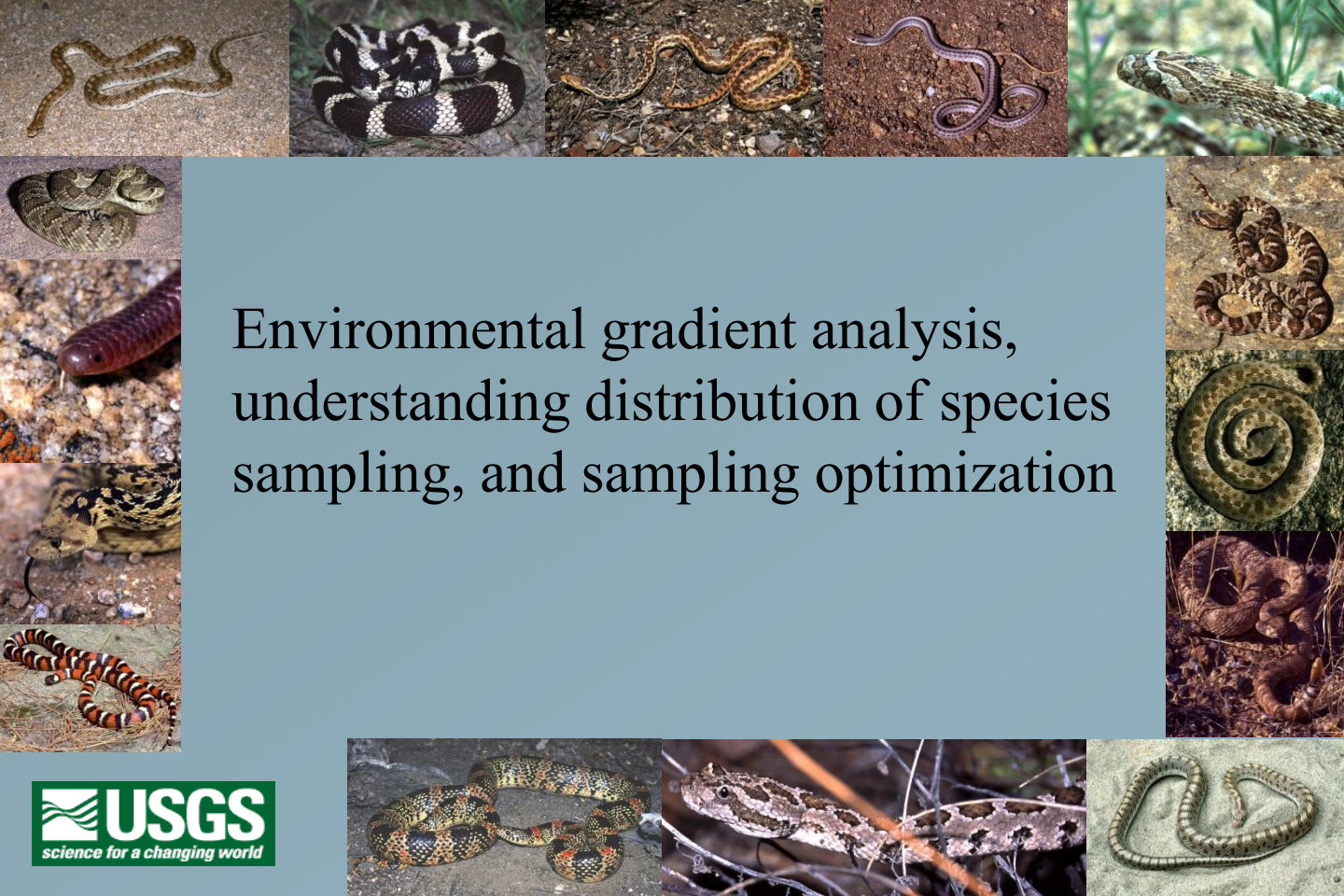

Environmental gradient analysis, understanding distribution of species sampling, and sampling optimization

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Local patterns: Responses of biodiversity to roads and fragmentation

Impacts of edges on function of reserves





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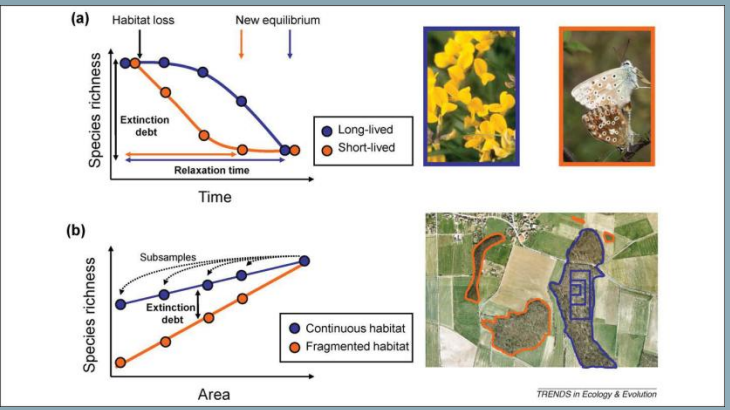
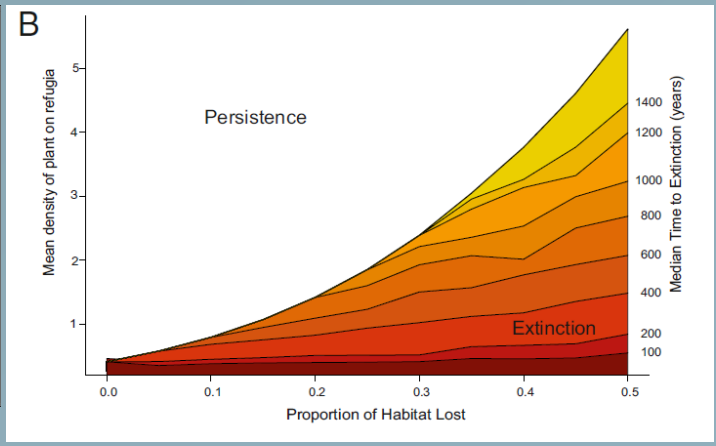
Extinction debt: In ecological communities, the number or proportion of extant specialist species of the focal habitat expected to eventually become extinct as the community reaches a new equilibrium after environmental disturbance such as habitat destruction, climate change or invasion of exotic species. In single species, the number or proportion of populations expected to eventually become extinct after habitat change.





Kuussaari et al. 2009

Gilbert and Levine, 2012

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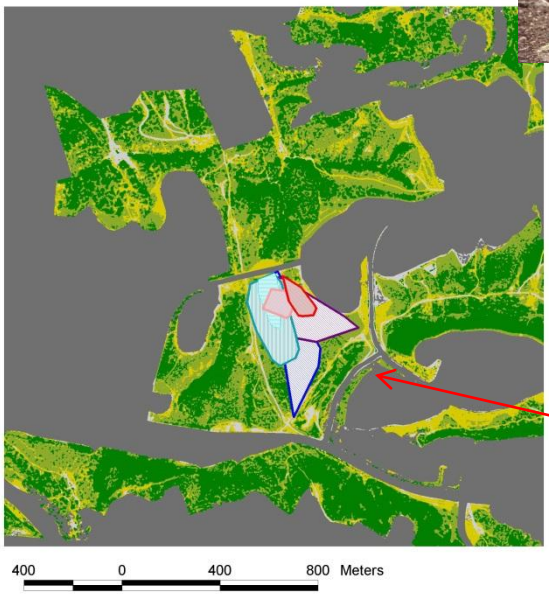
Which species are in debt and where?

Several examples: i.e. pond turtle, golden eagle, etc.

Extinction Debt –example
Red-diamond rattlesnake

Terra Nova



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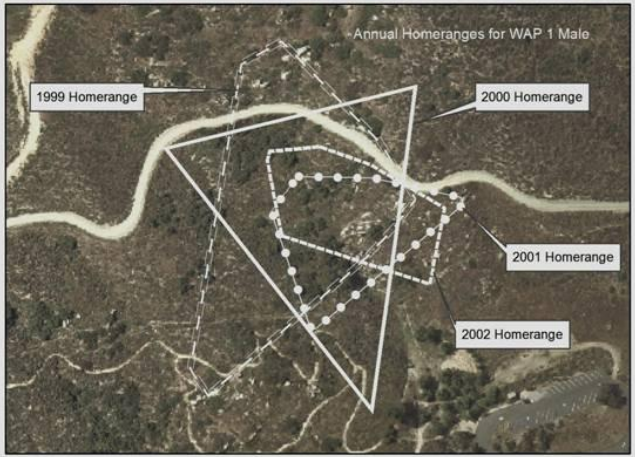
Tracey 2000

Movement of individual rosy boas across years



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