Effects of an anthropogenic disturbance on plasma corticosterone in the desert iguana

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What is an anthropogenic disturbance?

"...any human activity that changes the contemporaneous behavior or physiology of one or more individuals within a breeding colony…"

Nisbet 2000

Corticosterone

- CORT = a steroid hormone
- End product of the Hypothalamic-Pituitary-Adrenal axis
- Released continually at baseline levels
- Increases in response to stress
- Influences behavioral and physiological responses to stress
- Used as a measure of stress

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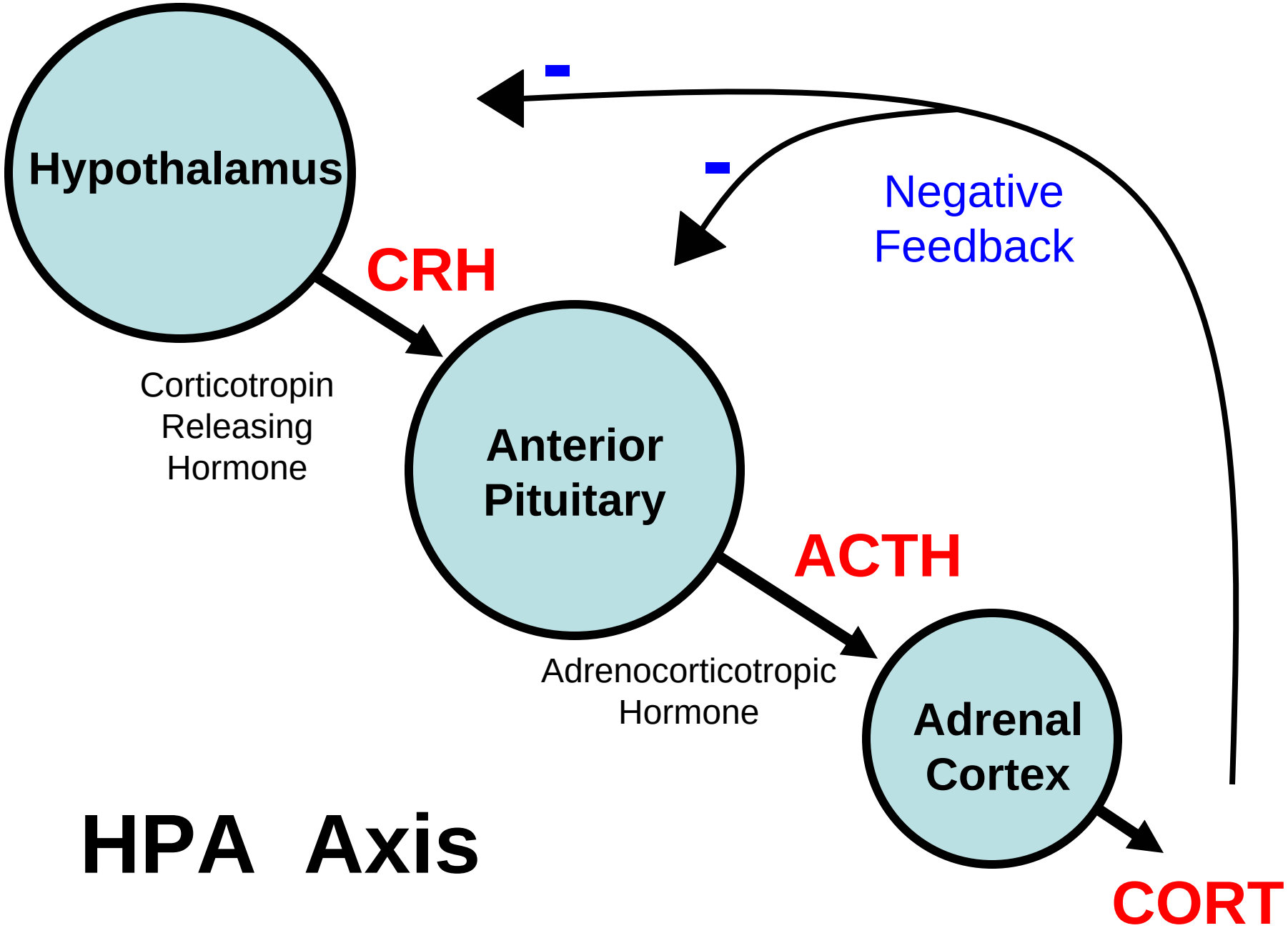

Hypothalamus
-
-
Negative
Feedback
CRH
Corticotropin
Releasing
Hormone
Anterior
Pituitary
ACTH
Adrenocorticotropic
Hormone
Adrenal
Cortex
CORT

HPA Axis

Corticosterone

- CORT = a steroid hormone
- End product of the Hypothalamic-Pituitary-Adrenal axis
- Released continually at baseline levels
- Increases in response to stress
- Mediator of both the behavioral and physiological response to stress

What is Stress?

- any event that can cause an imbalance in homeostasis

Natural:

Food shortage

Severe weather conditions

Presence of a predator

What is Stress?

- any event that can cause an imbalance in homeostasis

Anthropogenic:

- Pollution
- Human presence
- Habitat degradation

CORT and Stress

Short term (adaptive) CORT effect:

- **mobilization of energy (gluconeogenesis)**

CORT and Stress

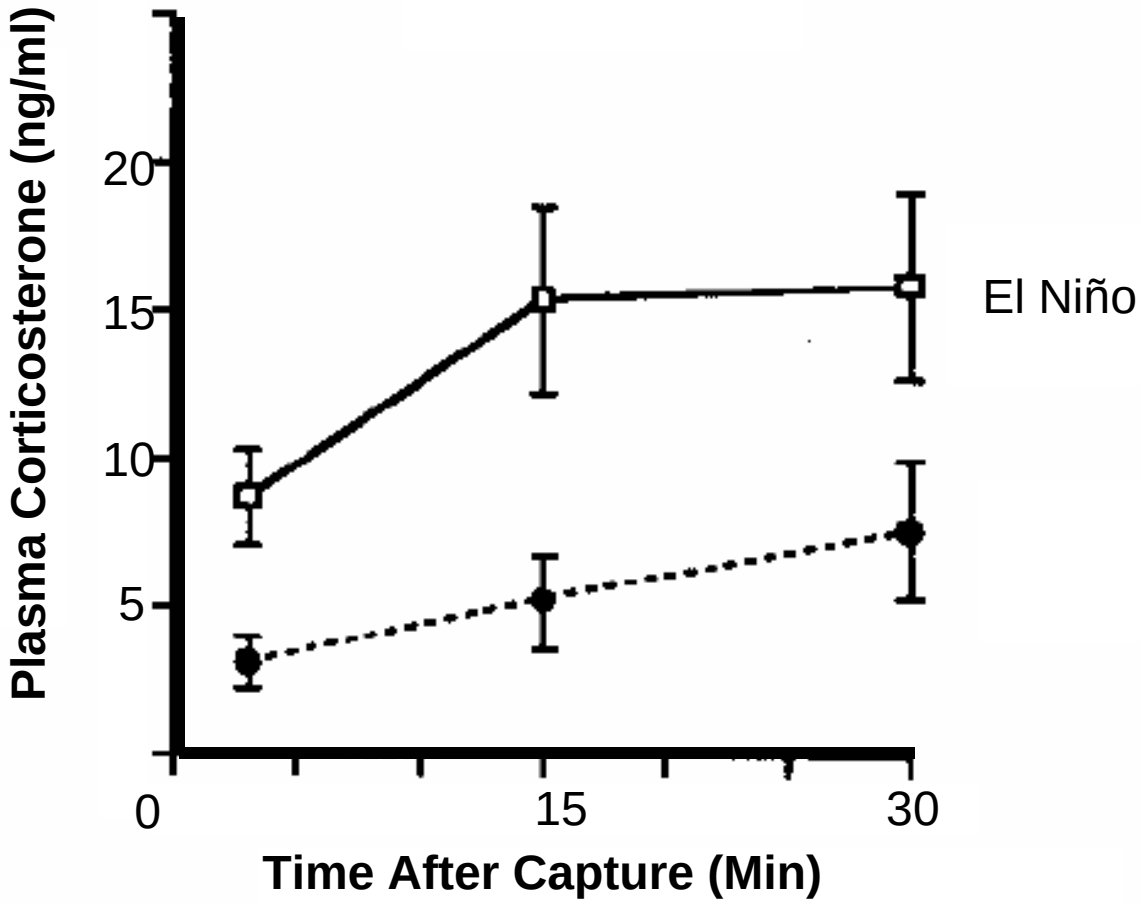
Long term (deleterious) CORT effects:

- **severe protein loss**
- **inhibition of reproduction**
- **inhibition of immune function**
- **neuronal cell death**

Marine Iguanas and Food Shortage

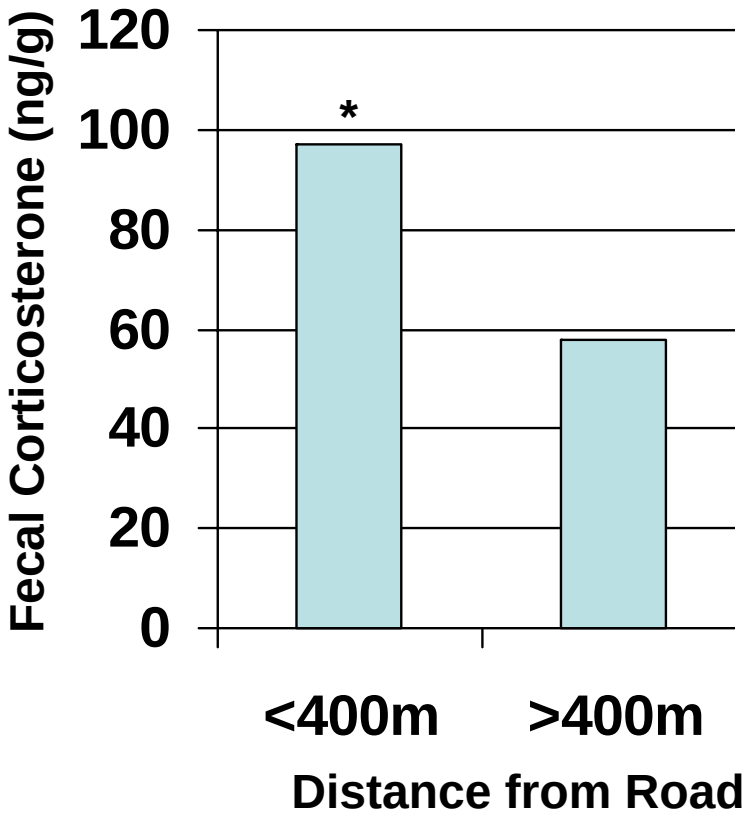
Romero and Wikelski (2001) Proceedings of the National Academy of Science USA

Marine Iguanas and Food Shortage



Romero and Wikelski (2001) Proceedings of the National Academy of Science USA

Spotted Owl and Anthropogenic Disturbance



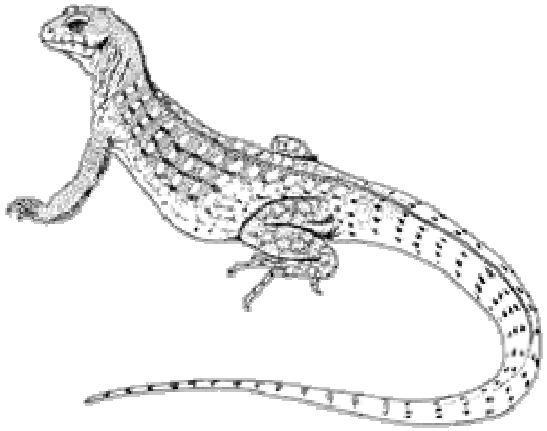
Wasser et al. (1997) Conservation Biology

Specific Question:

Is the presence of a major road associated with elevated baseline or stress-induced CORT levels in a desert lizard?

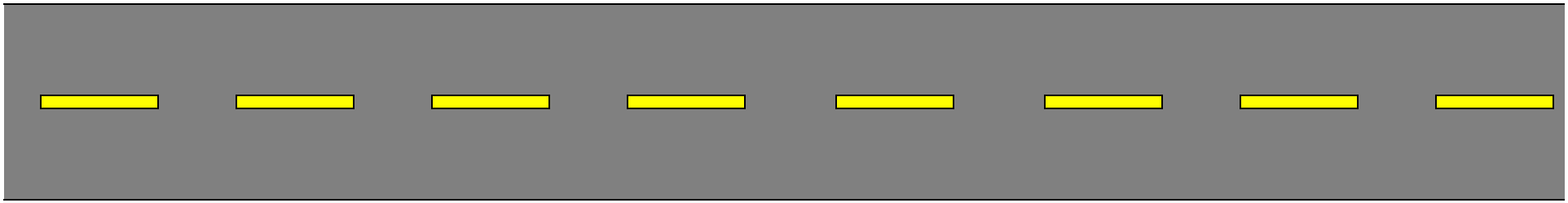
Study Organism

- **Desert iguana, *Dipsosaurus dorsalis***
- **Range: Deserts of the southwestern USA and northern Mexico**
- **Predominantly herbivorous**
- **Sexually mature ~ 100 mm, 50 g**
- **Relatively large body size**



Roads as a Stressor

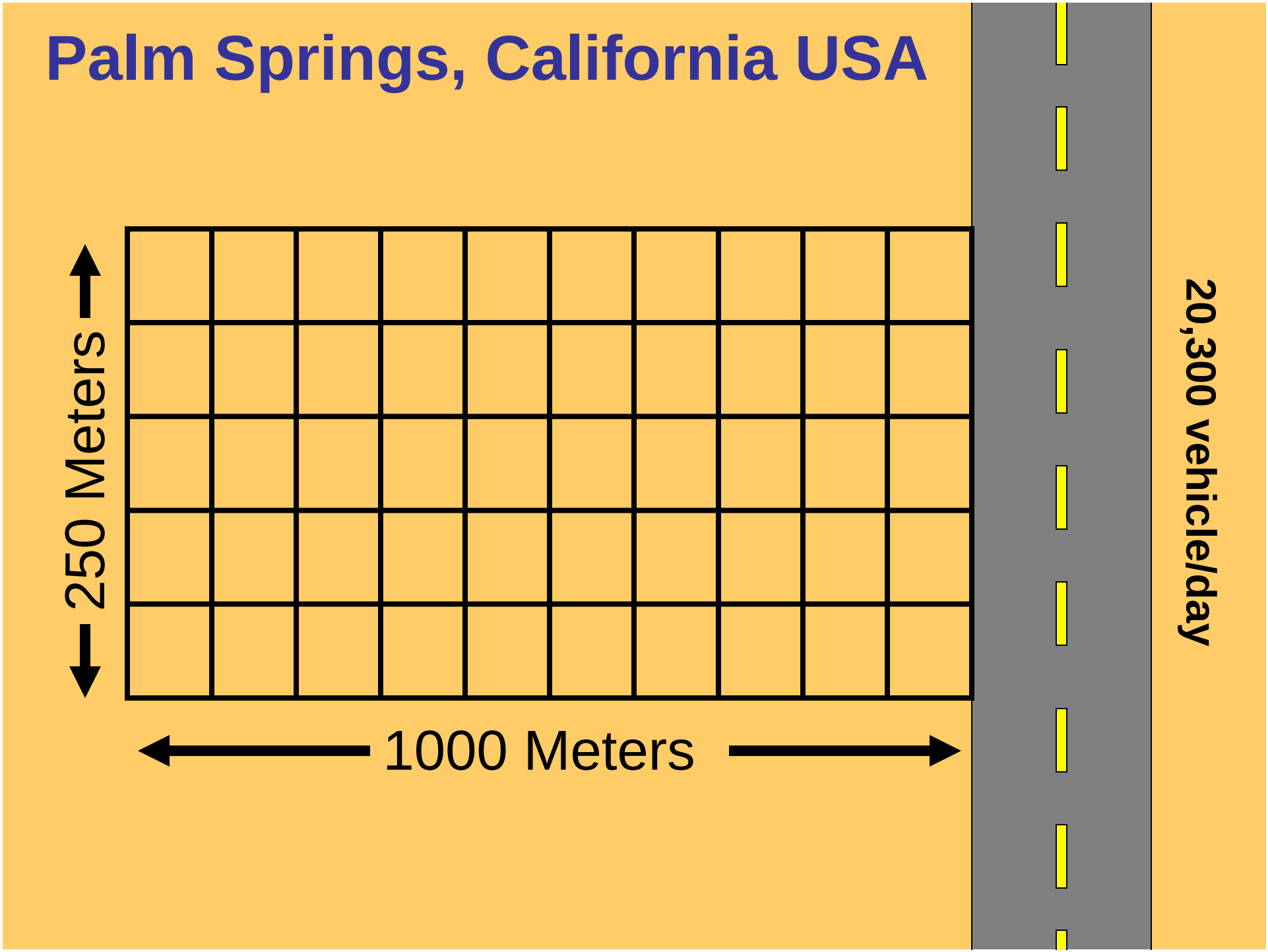
- Noise
- Motion from cars
- Pollutants
- Diminished air quality
- Potential for mortality
- Potentially a chronic stressor



Methods 1

- **Field work conducted April - August 2004**
- **Lizards were located by walking transects 8:00 AM - 1:00 PM**

Palm Springs, California USA



Methods 2

- Lizards were captured by noosing
- Blood was collected through orbital puncture within three minutes of sighting
- Tails were marked with beads

Methods 3

- Distance from road, sex, SVL, mass, and activity were recorded
- 15 minutes after the initial capture, a second blood sample was obtained to gauge response to stress
- Lizard was released
- Plasma samples were assayed for CORT in Henry John-Alder's lab at Rutgers University in New Jersey

Statistical Analyses

ANOVA with Covariates

= with assay as random effect

Main Effect

Sex (Males, Females, Juveniles)

Covariates

Distance from road, Bleed Delay

Time, Hematocrit, Time of Day,

Julian Date

Results: Baseline CORT

ANCOVA in SAS PROC Mixed:

Sex	**P = 0.0039**
Distance (+)	**P = 0.0059**
HCT	**P = 0.4285**

N	Log_{10} Adjusted Means (ng/ml) ± SE	
21	**Juveniles**	**0.42 ± 0.109**
36	**Females**	**0.21 ± 0.097**
110	**Males**	**0.15 ± 0.086**

Results: Baseline CORT

Genus	Species	Baseline	Source
Dipsosaurus	*dorsalis*	1.4 ng/ml males 1.6 ng/ml females	This study

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Genus	Species	Baseline	Source
Dipsosaurus	*dorsalis*	1.4 ng/ml males 1.6 ng/ml females	This study
Boiga	*irregularis*	4.41 ng/ml males 8.71 ng/ml females	Mathies et al. 2001
Cnemidophorus	*sexlineatus*	~20 ng/ml	Grassman and Hess 1992
Sceloporus	*occidentalis*	~ 10 ng/ml	Dunlap and Wingfield 1995
Sceloporus	*undulatus*	~12.0 ng/ml males ~7.5 ng/ml females	John-Alder unpublished
Sceloporus	*virgatus*	~2.5 ng/ml males ~5.0 ng/ml females	Hews and Abell in review
Thamnophis	*sirtalis*	23.5 ng/ml males	Lutterschmidt and Mason 2005
Uta	*stansburiana*	9.78 ng/ml males 18.36 ng/ml females	Wilson and Wingfield 1994

Results: Stress CORT

ANCOVA in SAS PROC Mixed:

	Sex	**P = 0.6923**
	Distance	**P = 0.9913**
	HCT	**P = 0.7923**

N	**Log_{10}Adjusted Means (ng/ml) ± SE**		
2	**Juveniles**	**0.9319 ±**	**0.3125**
7	**Females**	**0.6993 ±**	**0.1336**
80	**Males**	**0.6737 ±**	**0.0685**

Conclusions

- **Juveniles have higher baseline CORT than males or females**
- **Desert iguanas in the population studied have low baseline CORT as compared to other squamates**
- **Proximity to a major road does not correlate with an increase in baseline CORT in this population of lizards**

Future Directions

- **Quantify plant cover across the study area**
- **Compare baseline and stress-induced CORT levels in other lizard species at different distances from major roads**

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