Avian reproductive flexibility in the Sonoran Desert: What studies at the SRER have (or not) taught us…
Light

Hypothalamus

Pituitary gland

Gonads (testes, ovaries)

Reproductive Hormones + Gametes

GnRH

LH, FSH

Testosterone, estradiol, Sperm, ova

GnRH: Gonadotropin-releasing hormone
LH: Luteinizing hormone
FSH: Follicle-stimulating hormone
Annual Cycle – Temperate Region Birds

Winter, early spring: *Photosensitive*

Spring, early summer: *Photostimulated*

Late summer, fall: *Photorefractory*

Post-breeding

Pre-breeding

Breeding
Time Relative sensitivity to day length

High

Long days

Rapid, complete loss of sensitivity to day length

Absolutely photorefractory

Low

Photosensitive

Winter - early summer

Mid- and late summer

Relative sensitivity to day length
Sonoran desert: Average precipitation and temperature (Tucson, AZ)
Pre-monsoon (mid-June)
Monsoon (August)
Sonoran Desert endemic
Sedentary
Socially monogamous
Paired and territorial year-round
Dry open scrubland specialist

Rufous-winged Sparrow
Aimophila carpalis

Lowther et al. 1999
Rufous-winged Sparrow
Annual Testicular Cycle

Testis Diameter (mm)

Day Length (hours of light)

Date

Jul  Nov  Mar  Jul  Nov
• Photostimulation **during gonadal regression** stimulates gonadal recrudescence
• Autumnal gonadal regression **not caused by photorefractoriness**
Relative sensitivity to day length

- High
- Low

Time

- Gradual, partial loss of sensitivity to day length
- Relatively photorefractory
- Absolutely photorefractory

Long days
**Relatively photorefractory?**

**YES!**
Beginning of Monsoon

Jun 10  Jun 20  Jun 30  Jul 10  Jul 20  Jul 30

June-Sept. Precipitation (mm)

0  100  200  300  400

Tucson, AZ  1949-2002

P < 0.05

Less than aver. precipitation
AND
Later than aver. monsoon
Seasonal changes in plasma testosterone are environment-driven.

Yearly differences in monsoon rain patterns correlate with differences in circulating concentrations of reproductive hormone.

Deviche et al., 2006
Post-breeding timing of gonadal regression and onset of prebasic molt vary between years.
Pharmacological approach

$N$-methyl-$D$-aspartate
$=$ glutamate agonist
$=$ NMDA

GnRH

LH, FSH
Light Schedule

8L 13L 15L 13L 16L

NMDA  NMDA  NMDA  NMDA  NMDA

Plasma LH (ng/ml)

Day length (hours of light)

* 

Saline  NMDA
Effect of “visual” cues on reproductive system?

- **Group 1**: Control
- **Group 2**: Simulated precipitation
- **Group 3**: Green vegetation
Exposure to artificial precipitation delays short day-induced reproductive system regression.
Seasonal Predictability

Sonoran Desert Songbirds

Temperate Region Songbirds

Dependency on day length:
Low → High

Dependency on non photoperiodic cues:
High → Low

Photorefractoriness:
Relative → Absolute
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