The smell of success in snakes: hormonal control of pheromone production in snakes
Sample size!
Chemistry of sex pheromones
Garter snake sex pheromone: a blend of compounds

- 18 unique **methyl ketones**
- ratio of unsaturated (U) to saturated (S) molecules (U:S)
- increased expression of U =
  - intense male courtship
  - more attractive pheromone

Mason et al. 1989 *Science*
LeMaster and Mason 2002 *J Chem Ecol*
Parker and Mason 2011 *RBP Series*
Female sex pheromone is variable

- Short ♀
- Medium ♀
- Long ♀

Experimental manipulation of chemical dimorphism

- Male: testosterone
- Female: estradiol
- Methyl ketones: male and female
Estrogen in males: methods

- Two experimental groups of **males**:
  - SHAM (blank implant)
  - E2 (estradiol implant)
- Surgeries done in lab in summer; all hibernated in lab then taken to **field** for bioassays in spring
Chemistry alone is insufficient
Estrogen makes males attractive

Garter snake skin expresses estrogen receptors

Tissue target of E2?

Ashton et al. 2018 Gen Comp Endocrinol
Parker and Mason 2012 J Exp Biol
Snake behavior is easy to study

Experimental papers:
Parker and Kardong 2005 CSiV X
Parker and Kardong 2006 Herpetol
Parker and Mason 2012 J Exp Biol
Parker and Mason 2014 Horm Behav
Smith, Parker and Bien 2015 Chemoecol
Parker and Kardong 2017 Copeia
Parker et al. 2018 J Chem Ecol

Reviewed in:
Mason and Parker 2010 J Comp Physiol
Parker and Mason 2011 RBP Series

Y-maze

arena trials

field counts

mating ball tests
Robust mating behavior
Castration makes males attractive

Testosterone (T) inhibits pheromone production

Parker and Mason 2014 Horm Behav
Phenotypic gradient

ZZ
male
low/absent methyl ketone expression

ZZ
male
testosterone

low/absent methyl ketone expression

GX
equal blend of S and U methyl ketones

OVEX
blend dominated by U methyl ketones

ZW
female
exclusive expression of U methyl ketones

estradiol implantation

natural experimental
“Nothing in biology makes sense except in the light of evolution.”

Estrogen controls female skin signals (plumage) in basal birds

- Struthioniformes
- Anseriformes
- Galliformes
- Charadriiformes
- Passeriformes

Estrogen dependence
Androgen dependence
Non-androgen dependence (e.g. LH)

Kimball 2006 *Bird Coloration* I
Chemical ecology of invasive snake species

Brown treesnakes

Burmese pythons

Rodda et al. 2008 Biol Invasions
Male Burmese pythons follow female scent trails

- Identified and described several behaviors; will enable testing of potential pheromones

Richard et al. *in review*
Male python behaviors in Y-maze

Head raise: raises head from substrate and cranes (tip of snout bumps ceiling of maze)

Turn: reverses direction of travel completely

Pause: stops movement completely (tongue-flicks, then waits)

Head shake: snake moves head side-to-side slightly (follows pause)

*drawings by Sam Dickinson

Richard et al. in review
Estradiol stimulates ketone expression

Parker et al., 2018 J Chem Ecol
Estrogen activation of pheromone expression: a deep phylogenetic trait?

Redrawn from Pyron et al. 2013 BMC Evol Biol
Questions?

Rocky Parker
parke3mr@jmu.edu