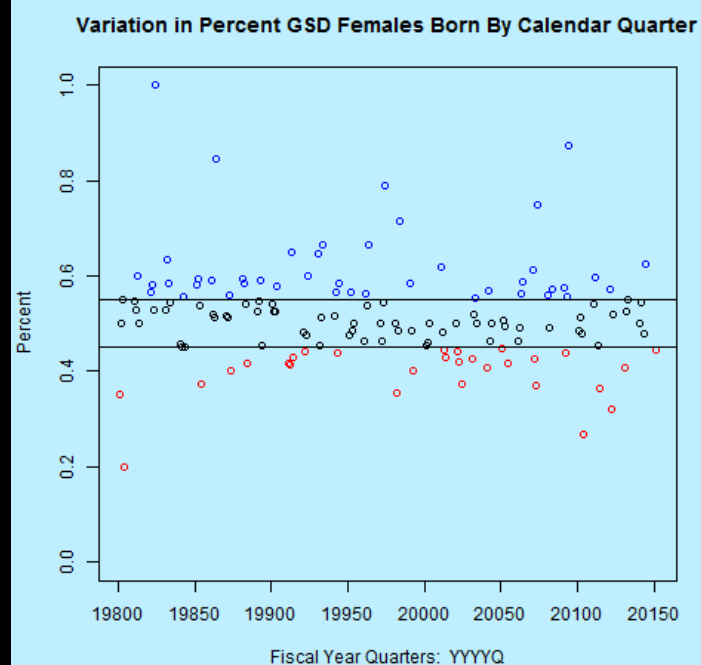
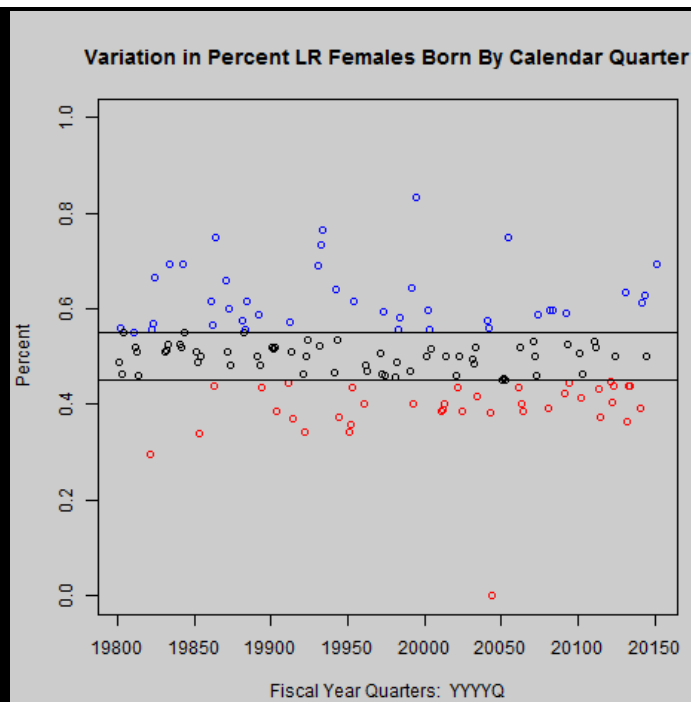


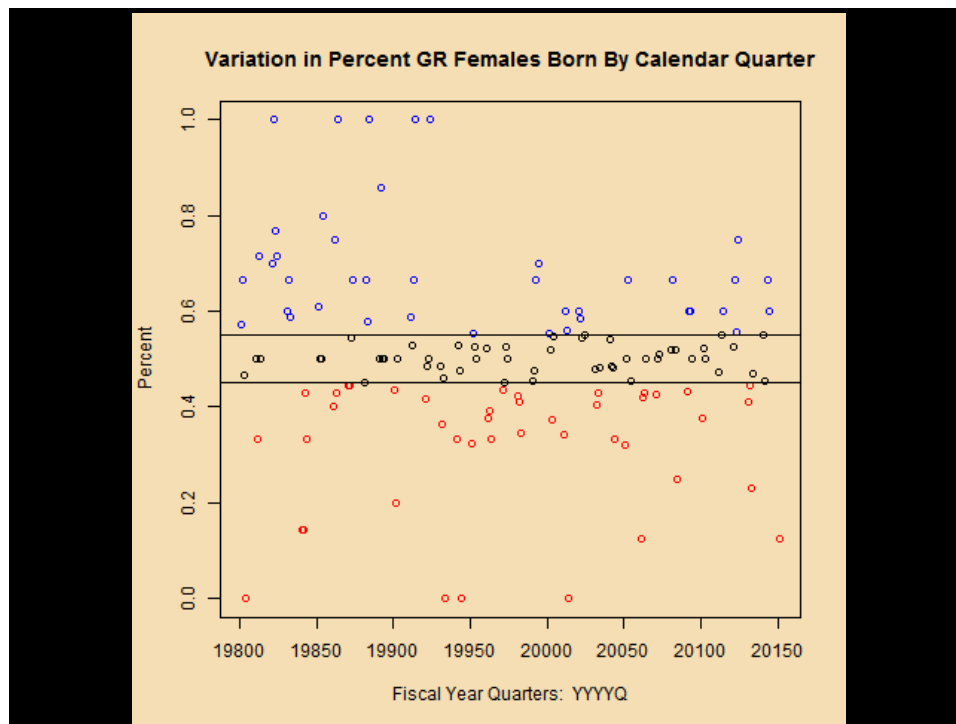
## Sex ratio: Is it always 1:1?

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	Total Quarters Observed	# Qtrs When Sex Class Produced More Puppies		Advantage to Females
		Females	Males	
GSD	136	82	54	60%
LR	138	77	61	56%
GR	135	75	60	56%





Breed	Female	Male	Total
GSD	3436	3268	6704
	51%	49%	100%
LR	3329	3292	6621
	50%	50%	100%
GR	1551	1626	3177
	49%	51%	100%

## Sex Ratio and Cryptorchids

- Cryptorchid: male puppy with undescended testicle(s)
- Description of data, from prior to 2008:
  - In dogs, 1,339 litters from 4 breeds
    - 12.8% of litters had 1 cryptorchid puppy
    - 3.1% of litters had 2 cryptorchid puppies
  - In pigs, 119,920 litters from 14 breeds
    - 2.2% had 1 cryptorchid piglet
    - 0.2% had 2 cryptorchid piglets

### Cryptorchidism and sex ratio are associated in dogs and pigs<sup>1</sup>

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**ABSTRACT:** The objective of this study was to investigate whether the occurrence of cryptorchidism in a litter is associated with the sex ratio in this litter. The analysis included for dog 1,339 litters of 4 different breeds, of which 12.8% had 1 and 3.1% had 2 cryptorchids, and for pig 119,920 litters of 14 different populations, of which 2.2% had 1 and 0.2% had 2 cryptorchids. The data were analyzed using the GLIMMIX procedure of SAS. In dog, the presence of cryptorchids in a litter does not affect litter size or the stillborn rate. In pig, litter size increases significantly with an increasing number of cryptorchids in a litter. The stillborn rate in pig is larger in litters with cryptorchids than in litters with-

out cryptorchids. To characterize the imbalance of the sexes in a litter, the sex ratio, defined as the number of live males divided by the number of live offspring, and the sex difference, defined as the number of live males minus the number of live females, were used as dependent variables in the analyses. In both dog and pig, the presence of 1 or 2 cryptorchids in a litter clearly goes together with a shift in both the sex ratio and the sex difference in a litter, in favor of male offspring. Our results in dog and pig suggest a common underlying mechanism affecting both cryptorchidism and sex ratio, which may hold true in other mammals as well.

**Key words:** cryptorchidism, dog, pig, sex ratio

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## Key Findings: Sex Ratio & Cryptorchids

### Dogs

- No effect on:
  - litter size
  - stillborn rate
- Associated with:
  - Sex ratio shift in favor of males (+7.1%, with 1; +11% with 2 cryptorchids)
- Breed effect on litter size
  - LR litters averaged 6.5
  - GS litters averaged 6.2

### Pigs

- Associated with increased:
  - Litter size
    - 1 cryptorchid: +0.13 males
    - 2 cryptorchids: +0.56 males
  - higher stillborn rate
- Breed and Year affected litter size

## Sex Ratio and Umbilical Hernias (UH)

- Description of data:
  - 3 breeds born between 1992 and 2012
  - 1,181 litters
  - 8,247 puppies, mostly < 24 months when umbilical hernia diagnosis was made
  - Litter incidence, by breed, of 1 or more UH:
    - 8% of 137 GR litters
    - 34% of 532 GSD litters
    - 20% of 512 LR litters

## Key Findings: Sex Ratio and UH

### Factors explaining no significant portion of sex ratio variation

- Litter size
- Parity of dam (no. previous litters)
- Season of year
- Year of litter's birth
- Presence of stillborn puppies
- Sire or dam, but without considering pedigree relationships

### Factors that do explain a significant portion of sex ratio variation

- Breed
- Presence of UH
- Presence of cryptorchid(s)

## Key Findings: Sex Ratio and UH, Continued

- Litters with UH in only:
  - Female puppies:
    - Sex ratio = 0.458 males
  - Male puppies:
    - Sex ratio = 0.632 males
  - Both male and female:
    - Sex ratio = 0.530 males
- Litters with no UH in either sex:
  - Sex ratio = 0.531 males

## Conclusions

- Sex ratio within litter is associated with:
  - presence or absence of UH
  - presence or absence of cryptorchids
- Implications:
  - Cryptorchid affected males cannot be considered as breeder candidates.

## Next Steps

- Are UH and CRYPT inherited?
- Would selection against either UH or CRYPT be effective?
- Dream BIG
  - Easy to implement technique to alter sex ratio in dogs:
- My preference
  - 70% females
  - 30% males

## Thank You!

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  - The Seeing Eye, Inc.
    - Litter birth records
    - EAL's employment

Questions?