### Coral Glow (aka Banana) Ball Pythons (*Python regius*): Sex-linked Inheritance with Genetic Recombination





Images from: Mallery and Carrillo, 2016. Phyllomedusa 15: 29-42.







#### **Coral Glow Data**



Figure edited from: Mallery and Carrillo, 2016. Phyllomedusa 15: 29-42.



# **Coral Glow is Sex-linked**

- Orange will be the Coral Glow Allele
- Beige will be the Wild Type Allele
- Pink will be the Sex Determining Region of the Female Sex chromosome (the X chromosome)
- Blue will be the Sex Determining Region of the Male Sex chromosome (the Y chromosome)





**Crossing Over** presumably occurs, but does not result in any **Recombinants** regarding the alleles of interest here, so it is not depicted



Chromosomes





Coral Glow related Genotypes for All possible crosses involving Coral Glows\*

- O WT female (X<sup>WT</sup>X<sup>WT</sup>) WT mab (X<sup>WT</sup>Y<sup>WT</sup>)
- CG female (X<sup>CG</sup>X<sup>WT</sup>) Super CG male (X<sup>CG</sup>Y<sup>CG</sup>)
- Super CG female (X<sup>CG</sup>X<sup>CG</sup>)CG hale
  (female maker; X<sup>CG</sup>Y<sup>WT</sup>)

CG male (male maker; X<sup>WT</sup>Y<sup>CG</sup>)

\*Punnett Squares for all possible crosses involving Coral Glows are depicted in the following slides; these also appear in Mallery, 2014, within *The Ultimate Ball Python: Morph Maker Guide* by K. McCurley, though percentages are altered herein in accordance with data from Mallery and Carrillo, 2016.



# x X<sup>WT</sup>X<sup>W</sup>



Possible Chromosomes and	50% Х <sup>WT</sup>		50% 50%	
Alleles in Gametes			Y'	NT
50%	25%		25%	
XWT	<mark>Χ<sup>₩Τ</sup>Χ</mark> ₩Τ		Ϫ <sup>ͺϒϒ</sup> ϒ	
50%	25%		25%	
XWT	<mark>Χ<sup>₩Τ</sup>Χ</mark> ₩Τ		Ϫ <sup>ͺϒϒ</sup> ϒ	

# Parents: X<sup>WT</sup>Y<sup>WT</sup>







Possible Chromosomes and Alleles in Gametes	50% Х <sup>WT</sup>	50% Ү <sup>wт</sup>
50%	25%	25%
X <sup>CG</sup>	x <sup>cg</sup> x <sup>wt</sup>	χ <sup>CG</sup> γ <sup>WT</sup>
50%	25%	25%
Х <sup>WT</sup>	X <sup>WT</sup> X <sup>WT</sup>	χ <sup>ωτ</sup> γ <sup>ωτ</sup>

Parents: X <sup>CG</sup> Y <sup>WT</sup> X <sup>KWT</sup> X <sup>WT</sup>						
Possible Chromosomes and Alleles in Gametes	46.7% X <sup>cg</sup>	3.3% Х <sup>WT</sup>	46.7% Υ <sup>ωτ</sup>	3.3% Υ <sup>CG</sup>		
50% х <sup>wт</sup>	23.35%	1.65%	23.35%	1.65%		
<b>50%</b>	23.35%		23.35%			
X	X~~X	X''X''	Χυγνι	Χυγου		

Parents: X <sup>WT</sup> Y <sup>CG</sup> x X <sup>WT</sup> X <sup>WT</sup>						
Possible Chromosomes and Alleles in Gametes	46.7% Х <sup>wт</sup>	3.3% X <sup>cg</sup>	46.7% Υ <sup>cg</sup>	3.3% Υ <sup>ωτ</sup>		
50%	23.35%	1.65% 📀	23.35%	1.65% 🐲		
Х <sup>WT</sup>	X <sup>WT</sup> X <sup>WT</sup>		χ <sup>ωτ</sup> γ <sup>cg</sup>	Х <sup>พт</sup> ү <sup>w 1</sup>		
50%	23.35%	1.65% 📀	23.35%	1.65%		
X <sup>WT</sup>	X <sup>WT</sup> X <sup>WT</sup>		χ <sup>ωτγcg</sup>	χ <sup>ωτ</sup> γ <sup>ωτ</sup>		

Parents: X <sup>CG</sup> Y <sup>WT</sup> X X <sup>CG</sup> X <sup>WT</sup>						
Possible Chromosomes and Alleles in Gametes	46.7% X <sup>cg</sup>	3.3% Х <sup>WT</sup>	46.7% Υ <sup>ωτ</sup>	3.3% Υ <sup>cg</sup>		
50% X <sup>cg</sup>	23.35%	1.65% 📀	23.35%	1.65% χ <sup>cg</sup> γ <sup>cg</sup>		
50% Х <sup>WT</sup>	23.35% X <sup>CG</sup> X <sup>WT</sup>	1.65% Х <sup>мт</sup> Х <sup>w</sup> i	23.35% χ <sup>ωτ</sup> γ <sup>ωτ</sup>	1.65% 📀 Х <sup>wтүсс *</sup>		

\*If you get a male CG, it would need to be proven out: 93.4% X<sup>CG</sup>Y<sup>WT</sup>, 6.6% X<sup>WT</sup>Y<sup>CG</sup>

Parents: X <sup>WT</sup> Y <sup>CG</sup> X X <sup>CG</sup> X <sup>WT</sup>						
Possible Chromosomes and Alleles in Gametes	46.7% Х <sup>WT</sup>	3.3% X <sup>cg</sup>	46.7% Υ <sup>cg</sup>	3.3% Ү <sup>wт</sup>		
50% X <sup>cg</sup>	23.35%	1.65%	23.35% χ <sup>cg</sup> γ <sup>cg</sup>	1.65% Χ <sup>ϹĠ</sup> Υ <sup>WT</sup> *		
50% Х <sup>wт</sup>	23.35% X <sup>wT</sup> X <sup>wT</sup>	1.65% 📀	23.35% χ <sup>ωτ</sup> γ <sup>cg</sup> *	1.65% Х <sup>wт</sup> ү <sup>wт</sup>		

\*If you get a male CG, it would need to be proven out: 6.6% X<sup>CG</sup>Y<sup>WT</sup>, 93.4% X<sup>WT</sup>Y<sup>CG</sup>

Parents: X <sup>CG</sup> Y <sup>CO</sup>	G The second sec	XWTX	w	
Possible Chromosomes and Alleles in Gametes	50% X <sup>CG</sup>		50 Y	<b>)%</b> cg
50% Х <sup>WT</sup>	25% X <sup>CG</sup> X <sup>WT</sup>	)) ) ) ) ) ) ) ) ) ) ) ) ) ) ) ) ) ) )	5% <sup>ωτ</sup> γ <sup>cg</sup>	
50% Х <sup>WT</sup>	25% X <sup>CG</sup> X <sup>WT</sup>	) ) ) ) ) ) ) ) ) ) ) ) ) ) ) ) ) ) )	5% <sup>ωτ</sup> γ <sup>cg</sup>	

\*Original image of homozygous CG by Kevin McCurley, edited and reproduced for education purposes only

# Parents: X<sup>wT</sup>Y<sup>wT</sup>





Possible Chromosomes and Alleles in Gametes	50% Х <sup>wт</sup>		0% 50% ντ γ <sup>ωτ</sup>	
50% X <sup>CG</sup>	25% X <sup>CG</sup> X <sup>WT</sup>		25% Χ <sup>ϹϾ</sup> ϒ <sup>Ϣͳ</sup>	
50% X <sup>CG</sup>	25% X <sup>CG</sup> X <sup>WT</sup>		25% Χ <sup>ϹϾ</sup> ϒ <sup>Ϣͳ</sup>	

Parents: X <sup>CG</sup> Y <sup>CG</sup>	G R X XC	GXW
Possible Chromosomes and Alleles in Gametes	50% X <sup>CG</sup>	50% Y <sup>CG</sup>
50%	25%	25%
X <sup>CG</sup>	X <sup>CG</sup> X <sup>CG</sup>	χ <sup>cg</sup> γ <sup>cg</sup>
50%	25%	25%
Х <sup>WT</sup>	x <sup>cg</sup> x <sup>wt</sup>	χ <sup>ωτγce</sup>

Parents: X <sup>CG</sup> Y <sup>WT</sup> $\bigvee$ x X <sup>CG</sup> X <sup>CG</sup>						
Possible Chromosomes and Alleles in Gametes	46.7% X <sup>cg</sup>	3.3% Х <sup>wт</sup>	46.7% Υ <sup>ωτ</sup>	3.3% Υ <sup>cg</sup>		
50% X <sup>cg</sup>	23.35%	1.65% 📀	23.35% χ <sup>cg</sup> γ <sup>wτ</sup>	1.65% χ <sup>cg</sup> γ <sup>cg</sup>		
50% X <sup>cg</sup>	23.35%	1.65% 📀 X <sup>CG</sup> X <sup>WT</sup>	23.35% χ <sup>cg</sup> γ <sup>wτ</sup>	1.65% χ <sup>cg</sup> γ <sup>cg</sup>		

Parents: X <sup>WT</sup> Y <sup>CG</sup> X X <sup>CG</sup> X <sup>CG</sup>						
Possible Chromosomes and Alleles in Gametes	46.7% Х <sup>WT</sup>	3.3% X <sup>cg</sup>	46.7% Υ <sup>cg</sup>	3.3% Υ <sup>₩Τ</sup>		
50% X <sup>cg</sup>	23.35%	1.65%	23.35% χ <sup>cg</sup> γ <sup>cg</sup>	1.65% Х <sup>сс</sup> үwт		
50% X <sup>cg</sup>	23.35% X <sup>CG</sup> X <sup>WT</sup>	1.65% X <sup>CG</sup> X <sup>CG</sup>	23.35% χ <sup>cg</sup> γ <sup>cg</sup>	1.65% Х <sup>сб</sup> ү <sup>wт</sup>		

Parents: X <sup>CG</sup> Y <sup>CG</sup>					
Possible Chromosomes and Alleles in Gametes	50 X <sup>0</sup>	<b>%</b> CG	50 Y <sup>0</sup>	% CG	
50% X <sup>CG</sup>	25% X <sup>CG</sup> X <sup>CG</sup>		25% Χ <sup>ϹϾ</sup> ϒ <sup>ϹϾ</sup>		
50% X <sup>CG</sup>	25% X <sup>CG</sup> X <sup>CG</sup>		25% Χ <sup>ϹϾ</sup> ϒ <sup>ϹϾ</sup>		

### Pedigree of all CG crosses



- WT female  $(X^{WT}X^{WT})$
- Super CG female (X<sup>CG</sup>X<sup>CG</sup>)
- CG female (X<sup>CG</sup>X<sup>WT</sup>)

**W**T male  $(X^{WT}Y^{WT})$ 

- Super CG male (X<sup>CG</sup>Y<sup>CG</sup>)
- CG male (female maker; X<sup>CG</sup>Y<sup>WT</sup>)

CG male (male maker; X<sup>WT</sup>Y<sup>CG</sup>)

#### References

Mallery, C.S., Jr., and Carrillo, M.M. 2016. Coral Glow, a case study of sex-linkage in the Ball Python, *Python regius* (Serpentes: Boidae), with new insights into sex determination in Henophidia. Phyllomedusa 15: 29 – 42.

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 Mallery, C., Jr. 2014. Following the chromosomes of inheritance and sex-linkage: an explanation of coral glow/banana. Pp. 115 – 132 *in* K. McCurley, *The Ultimate Ball Python: Morph Maker Guide.* Ecouniverse Herpetological Publishing and Distribution, Rodeo, New Mexico, USA.