

# Sperm Mobility: A Quantitative Trait in Poultry

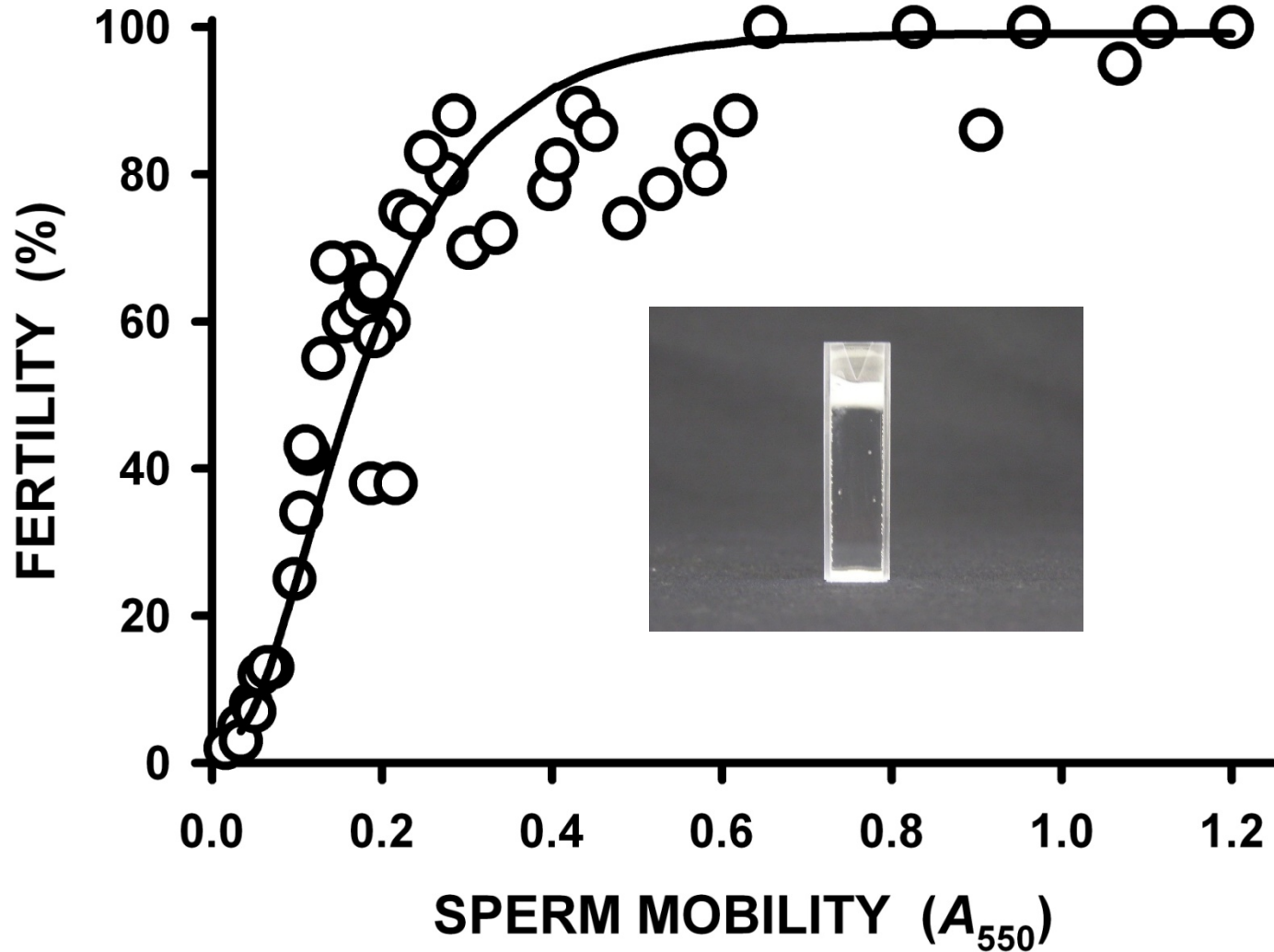
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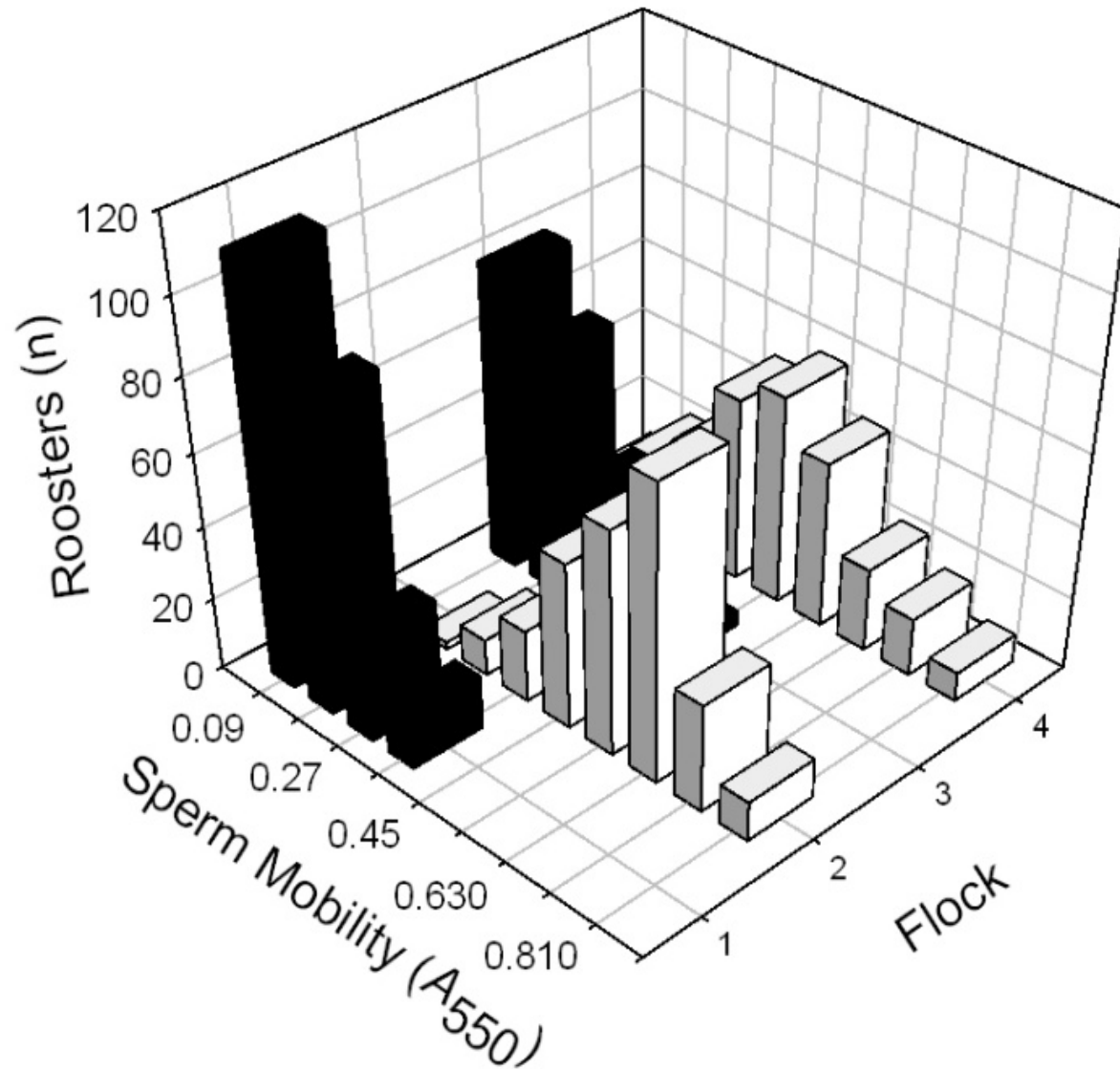


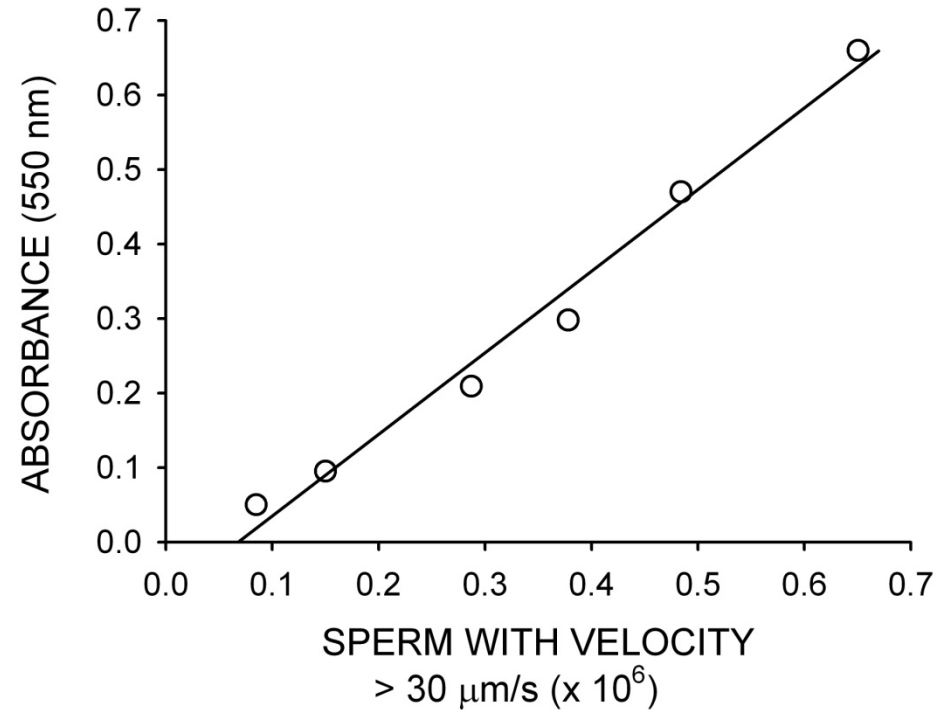
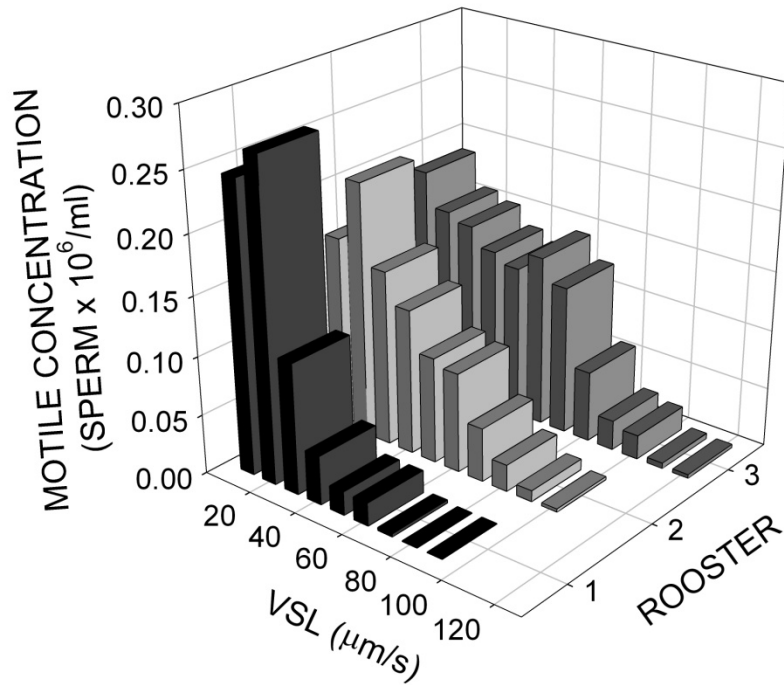
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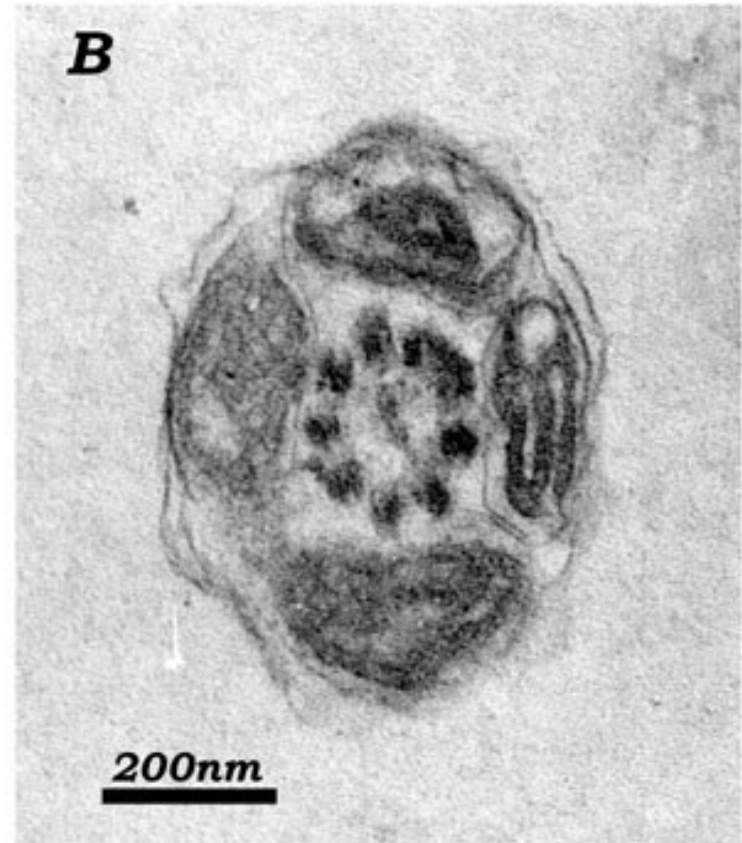
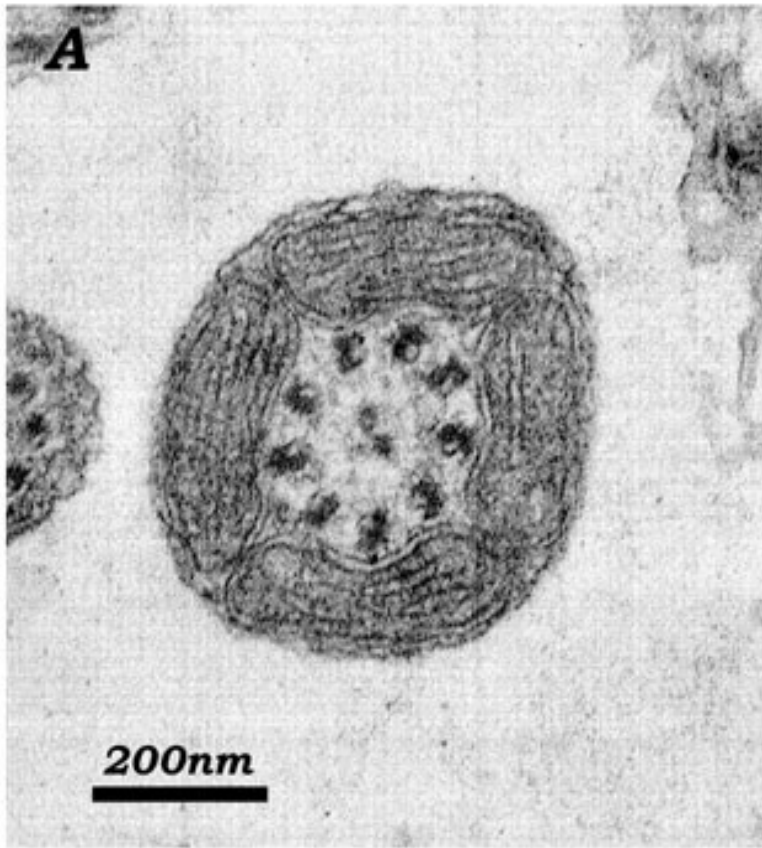
Data from "Sperm mobility: A primary determinant of fertility in the domestic fowl" by Froman et al. in *Biology of Reproduction* (1999).



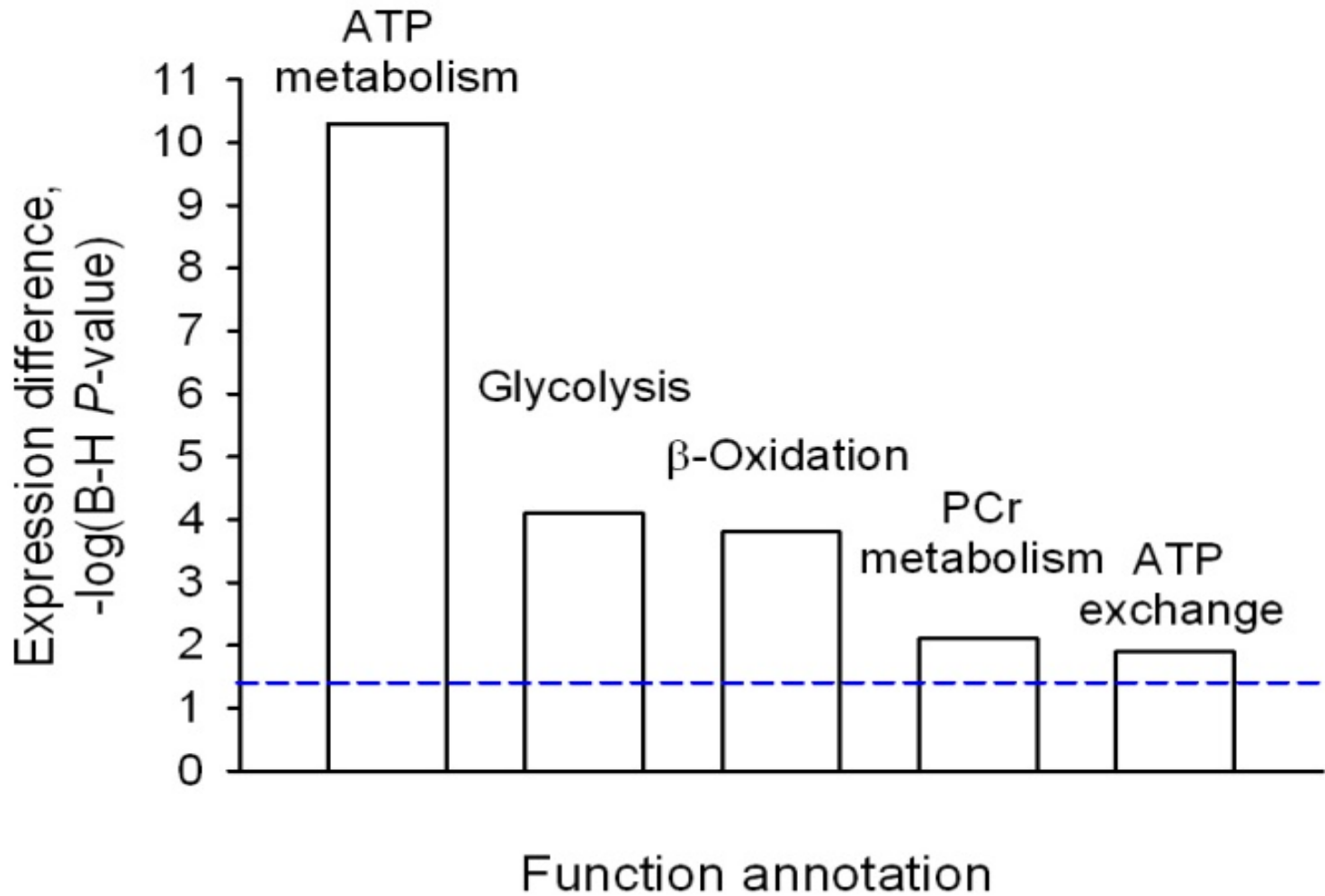


Relationship between the *shape* of a VSL distribution and in vitro sperm mobility.

Data from “Sperm mobility phenotype not determined by sperm quality index” by Froman et al. in *Poultry Science* (2003).



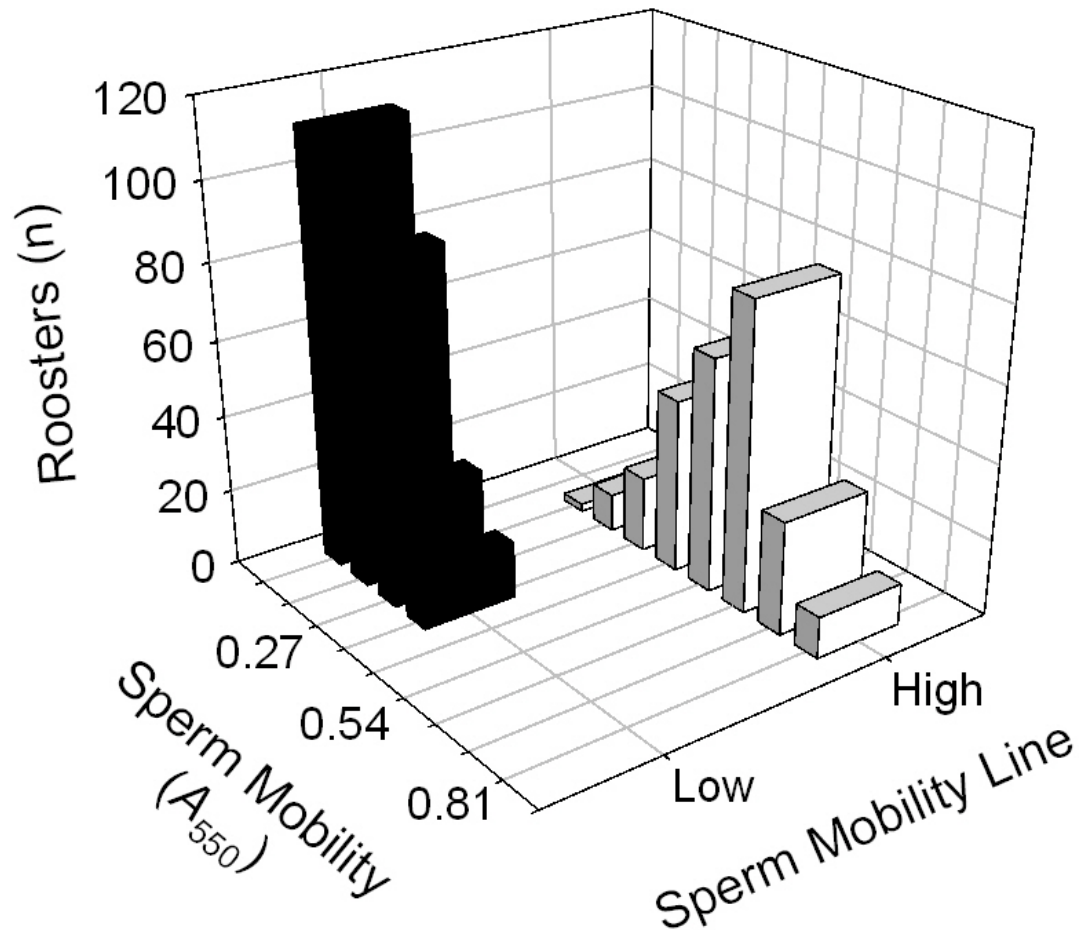
Images from "Sperm mobility: Phenotype in roosters determined by mitochondrial function" by Froman and Kirby in *Biology of Reproduction* (2005).



Data from “A proteome-based model for sperm mobility phenotype” by Froman et al. in *Journal of Animal Science* (2011).

Protein ( <i>Gallus gallus</i> )	P-value <sup>1</sup>
Glucose transporter 3	<0.0001
Phosphoglucose isomerase	<0.0001
Phosphofructokinase	<0.0001
Aldolase	<0.0001
Triose phosphate isomerase	<0.0001
Glyceraldehyde-3-phosphate dehydrogenase	<0.0001
Phosphoglycerate kinase 1	<0.0001
Phosphoglycerate mutase	<0.0001
$\alpha$ -Enolase	<0.0001
$\beta$ -Enolase	<0.0001
$\gamma$ -Enolase	0.0263
Pyruvate kinase, muscle	<0.0001
Lactate dehydrogenase, A chain	<0.0001
Lactate dehydrogenase, B chain	<0.0001

<sup>1</sup>Between line difference in which expression was up-regulated in the high sperm mobility line.



**Hypothesis:** mitochondrial failure stems from a set of conditions that affect sperm in a stochastic manner.



Line	Source of roosters <sup>1</sup>	Daily sperm production (x 10 <sup>6</sup> sperm / g testis) <sup>2</sup>	Sperm concentration within deferent duct (x 10 <sup>9</sup> sperm / mL) <sup>2</sup>	Deferent duct transit (d) <sup>2</sup>
Low	Mode	92 ± 8.8	6.5 ± 1.23	2.2 ± 0.54 <sup>A</sup>
	Upper tail	91 ± 6.2	6.3 ± 1.18	1.4 ± 0.04 <sup>B</sup>
High	Lower tail	95 ± 11.7	5.0 ± 1.26 <sup>a</sup>	1.2 ± 0.60
	Upper tail	91 ± 10.5	4.2 ± 0.55 <sup>b</sup>	1.1 ± 0.44

<sup>1</sup> n = 18 roosters per region per line.

<sup>2</sup> Each value is a mean ± SD.

<sup>a,b</sup> Different at  $P < 0.05$ .

<sup>A,B</sup> Different at  $P < 0.0001$ .

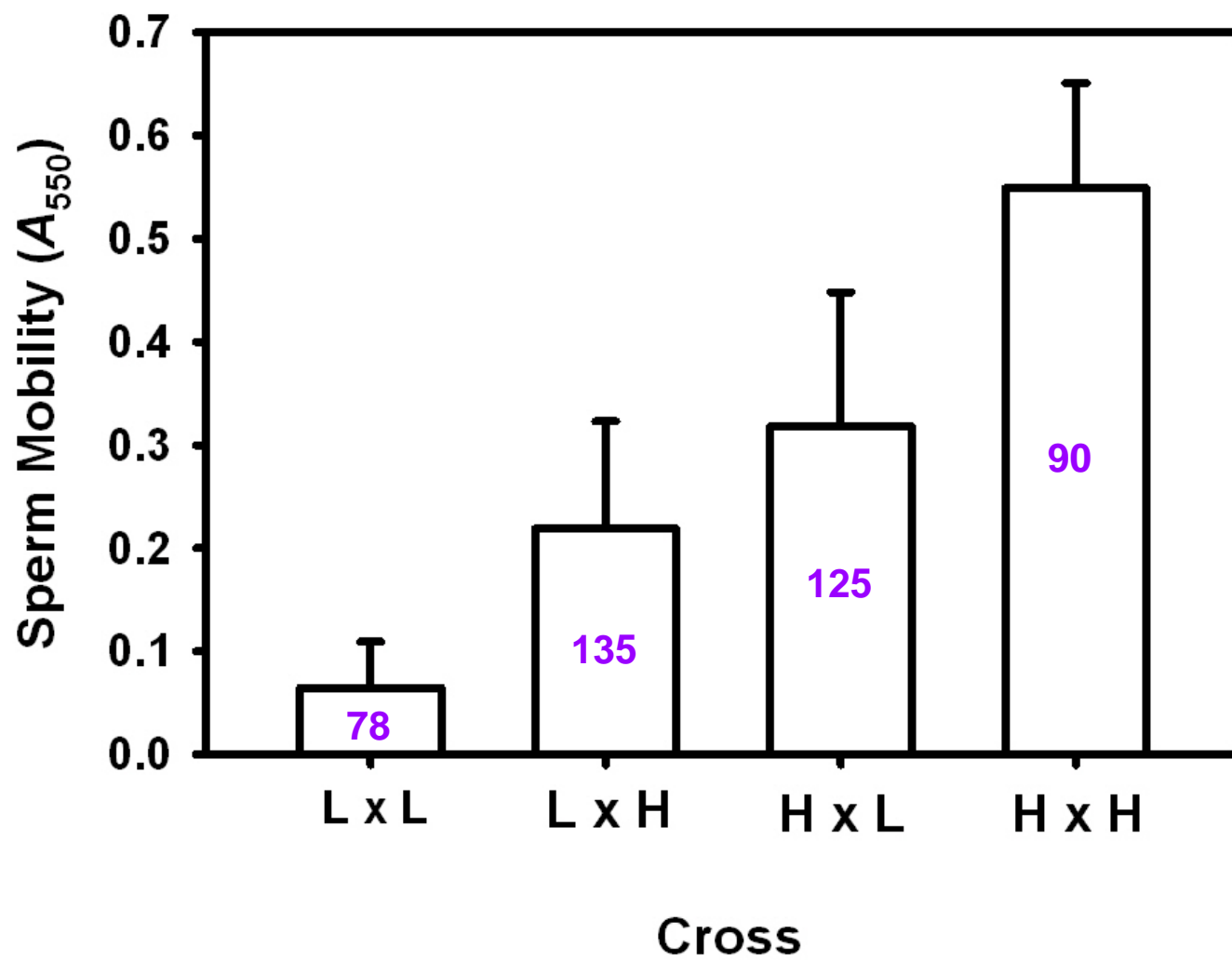
Line	Observed <sup>1</sup>			Predicted	
	Combined testicular output (x 10 <sup>9</sup> sperm/d)	Deferent duct transit (d)	Mobile sperm (p)	Reproductive tract throughput <sup>2</sup> (x 10 <sup>9</sup> sperm/d)	Mobile sperm output <sup>3</sup> (x 10 <sup>9</sup> sperm/d)
Low	3.9 ± 0.55	1.8 ± 0.38	0.11 ± 0.043	2.2	0.2
High	3.0 ± 0.87	1.0 ± 0.20	0.66 ± 0.097	3.0	2.0

<sup>1</sup> n = 10 roosters from the **mode** of each line; each value is a mean ± SD.

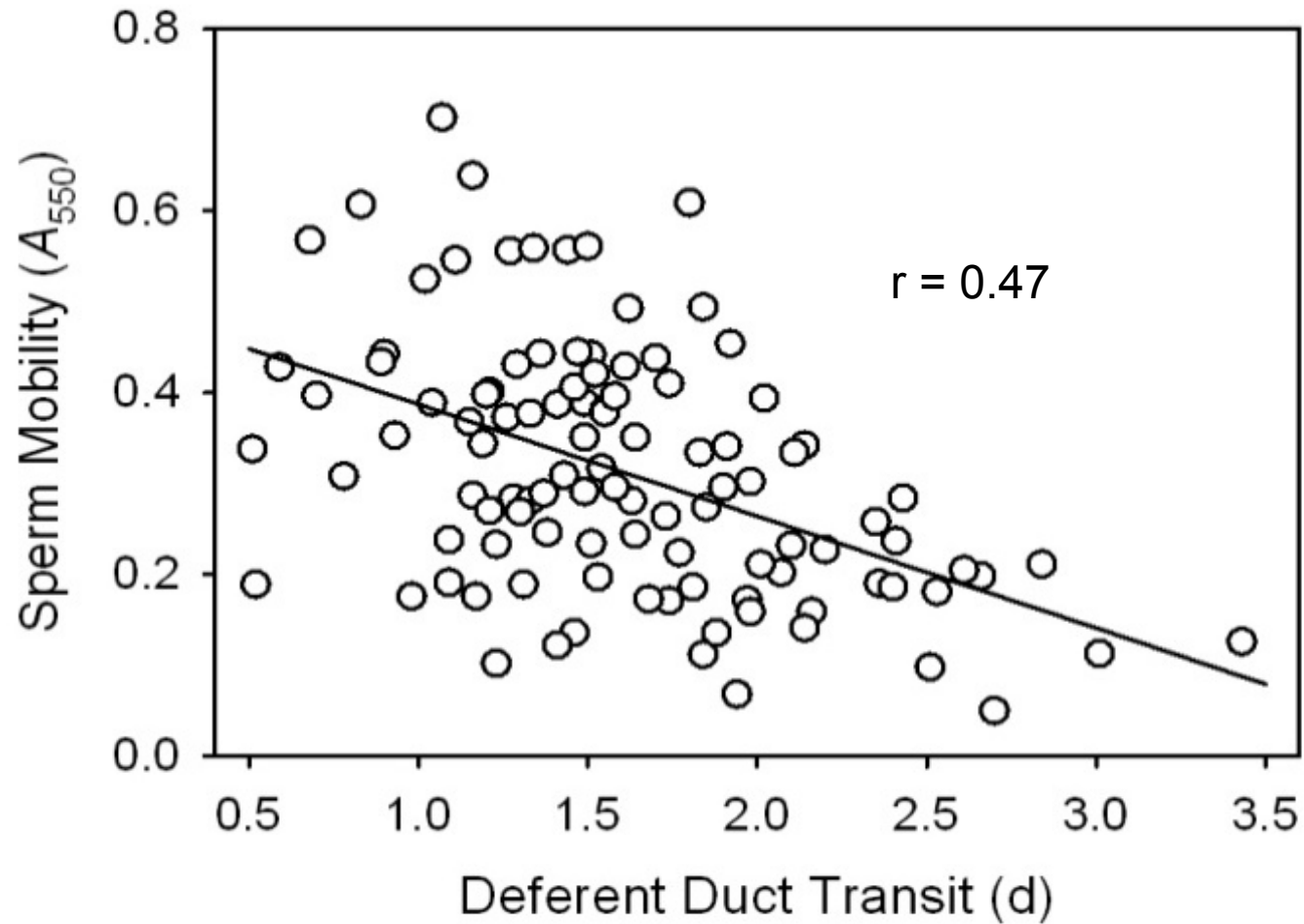
<sup>2</sup> Throughput = testis output ÷ deferent duct transit time.

<sup>3</sup> Mobile sperm output = *p* x throughput.





male progeny from H x L cross



# Summary

- Sperm mobility is a primary determinant of fertility
- Sperm mobility is subject to genetic selection
- Semen quality can be defined quantitatively as the number of mobile sperm produced per male per day
- Semen production can be understood in terms of systems biology
- Our long-term goal is predicting male reproductive potential using DNA from chicks at hatch