

# The relationship between plasma progesterone concentration during the early luteal phase and embryo survival in dairy heifers

*M.H Parr; M Mullen; J.F Roche; A.C.O Evans; P. Lonergan;  
M.A Crowe; M.G Diskin*





# Introduction



- Early embryo death is a major cause of reproductive wastage in both dairy and beef cattle
- Early embryo mortality can be attributed in part to a number of factors:



# Why do embryos die ?



**Genetic:**

**Chromosomal  
abnormalities**

**Genetic:**

**Maternal/Paternal**

**Oocyte Quality:**

**Aged follicle**

**Environmental:**

**Disease & Nutrition**

**Endocrine:**

**Progesterone**



# Objectives

1. Establish the relationship between concentrations of  $P_4$  during the early luteal phase and embryo survival
2. Repeatability of  $P_4$  concentrations during the early luteal phase from cycle to cycle.



# Materials & Methods



- **Animals:** 118 Holstein Friesian Heifers
- **Oestrous Synchronisation:** 11-day PGF2 $\alpha$  regimen
- **Heat detection:** 5 times daily
- **ESTROTECT™** patches were used as an aid to heat detection
- **Breeding:** Only heifers in standing heat were inseminated using frozen-thawed semen from 1 high fertility sire (FL17)



# Materials & Methods



- **Pregnancy testing:** Ultrasound scanning on day 35
- **Pregnancy termination :** PGF2 $\alpha$  on day 35
- One free oestrous cycle before rebreeding
- **Rebreeding:** Entire protocol repeated
- All Heifers inseminated twice

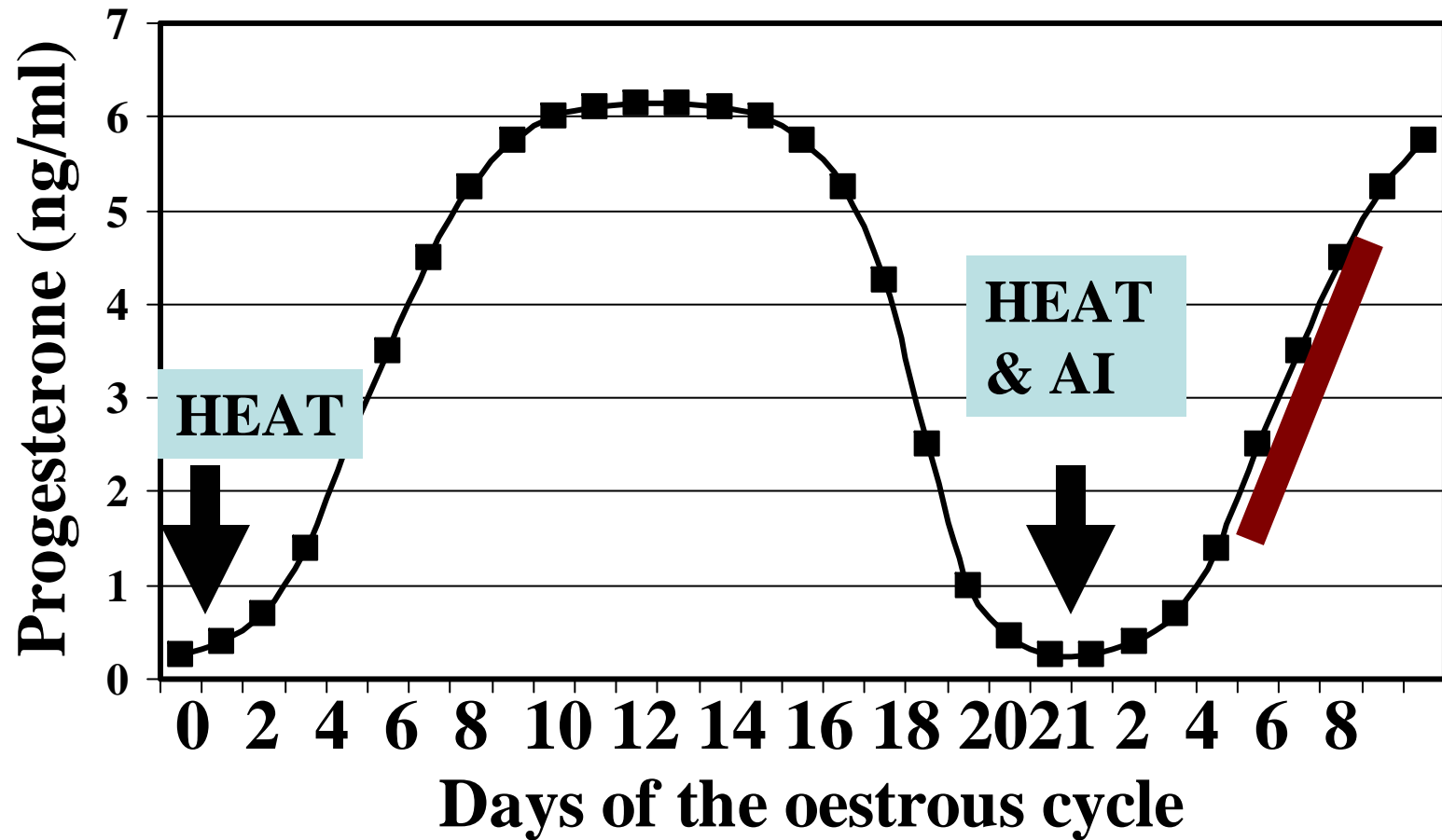


# Materials & Methods



- **Blood sampling:** Twice daily on days 4, 5, 6, 7 after insemination
- **Progesterone assay:** by radio-immunoassay (Coat a Count)
- Mean concentration of  $P_4$  calculated for each day.

# Progesterone (P<sub>4</sub>) in the Oestrous Cycle



# Statistical Analysis

- **Progesterone (Independent variable) Embryo Survival (Dependent variable) Relationship(s)** by Logistic Regression with progesterone fitted as linear and quadratic terms.

- **Repeatability**

$$R_e = \frac{\sigma_B^2}{\sigma_B^2 + \sigma_W^2}$$

- **Progesterone / Day Relationships**  
Regression Analysis



# RESULTS



# Embryo Survival

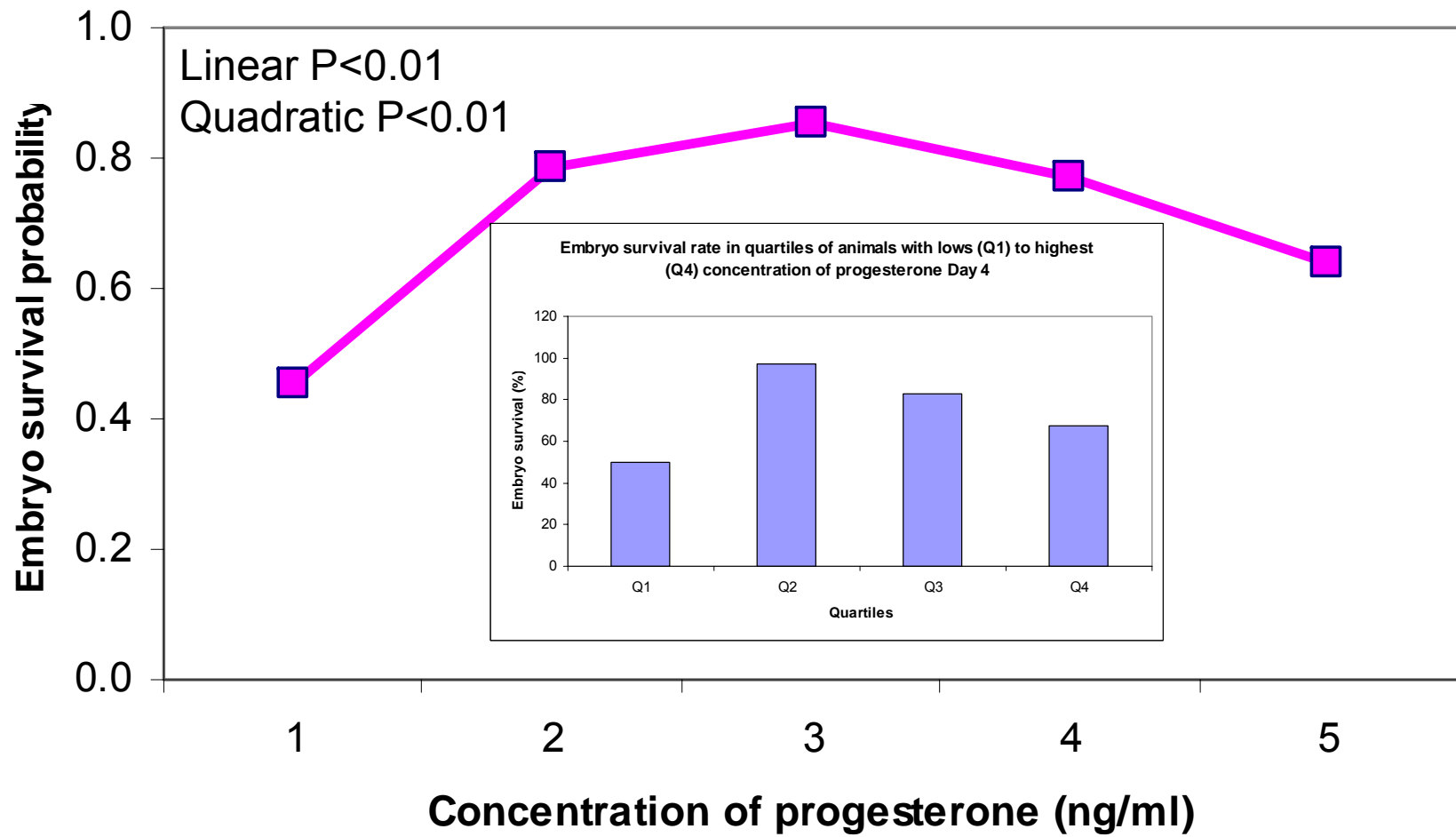


<b>AI Round</b>	<b>Number of animals</b>	<b>Embryo survival %</b>	<b>Sig</b>
1	n=118	68%	P=0.06
2	n=118	79%	

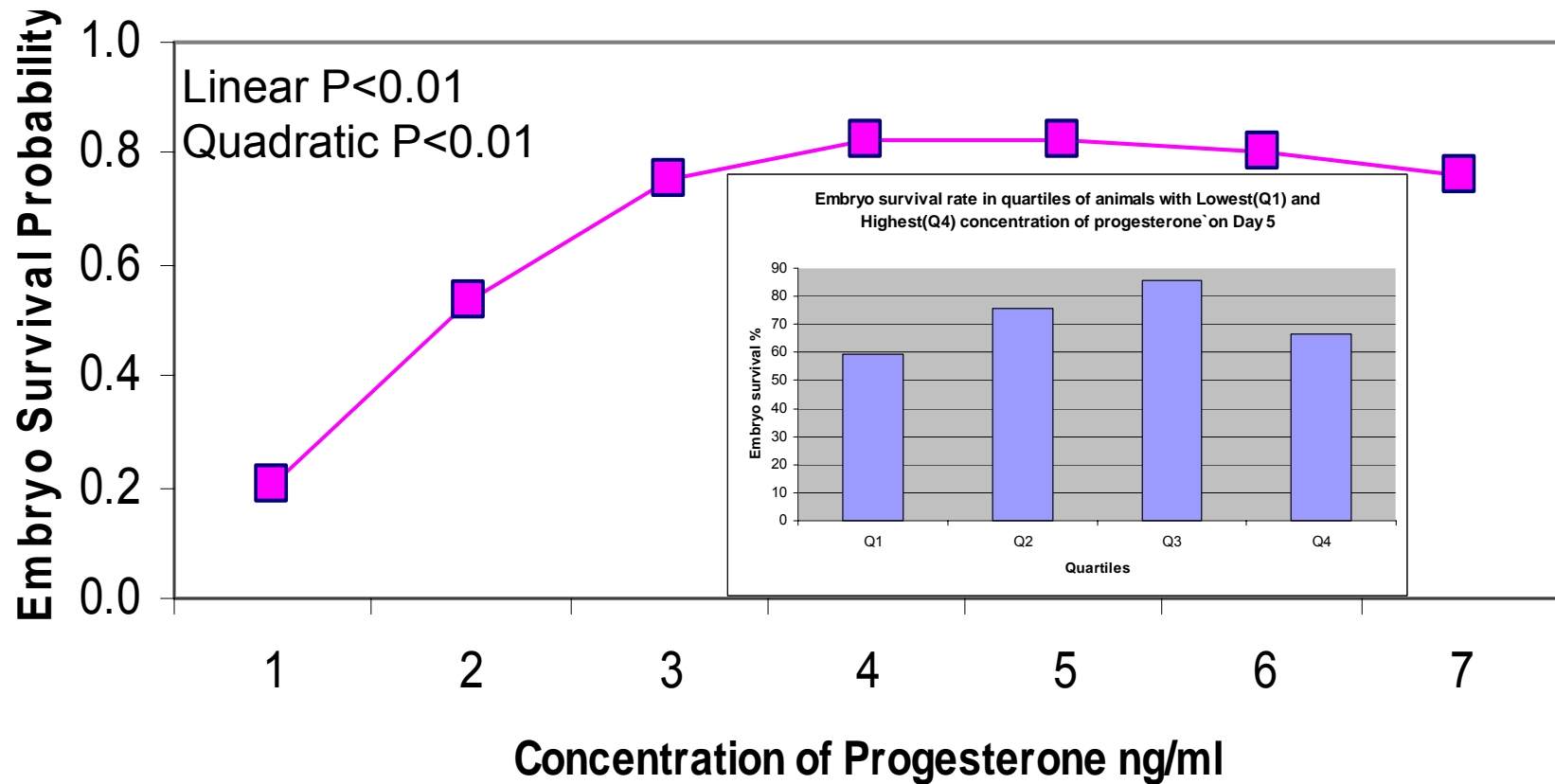
# Progesterone (P<sub>4</sub>) Embryo Survival Relationships (Odds Ratios (OR))

	P <sub>4</sub> Linear		P <sub>4</sub> Quadratic	
	O.R	Sig	O.R	Sig
Day 4	<b>11.986</b>	<b>**</b>	<b>0.554</b>	<b>**</b>
Day 5	<b>5.098</b>	<b>**</b>	<b>0.789</b>	<b>*</b>
Day 6	<b>3.732</b>	<b>***</b>	<b>0.874</b>	<b>**</b>
Day 7	<b>14.803</b>	<b>***</b>	<b>0.770</b>	<b>***</b>
$\Delta$ 4-7	<b>9.810</b>	<b>***</b>	<b>0.723</b>	<b>***</b>

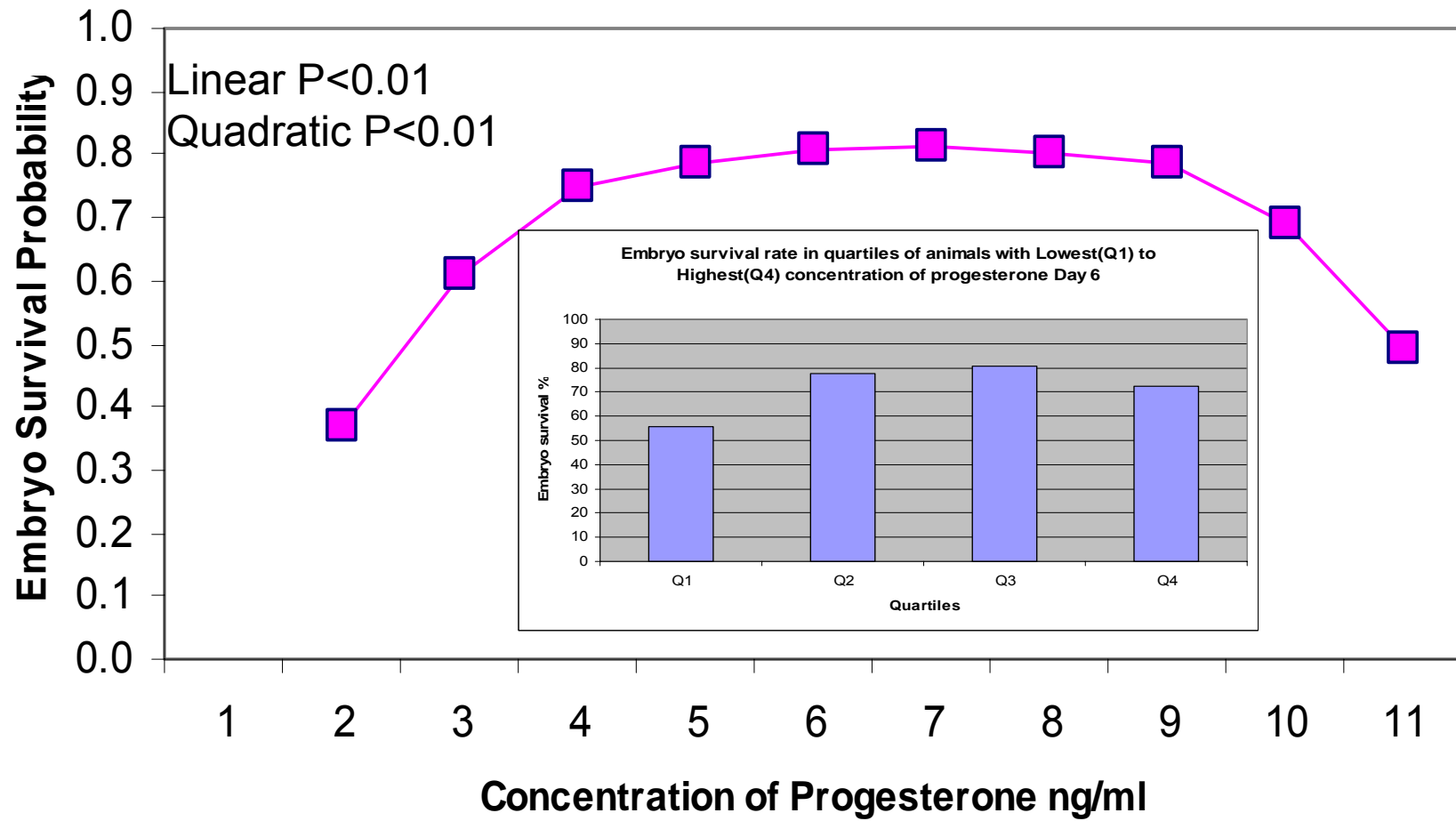
## Predicted embryo survival rate for different concentrations of progesterone on Day 4



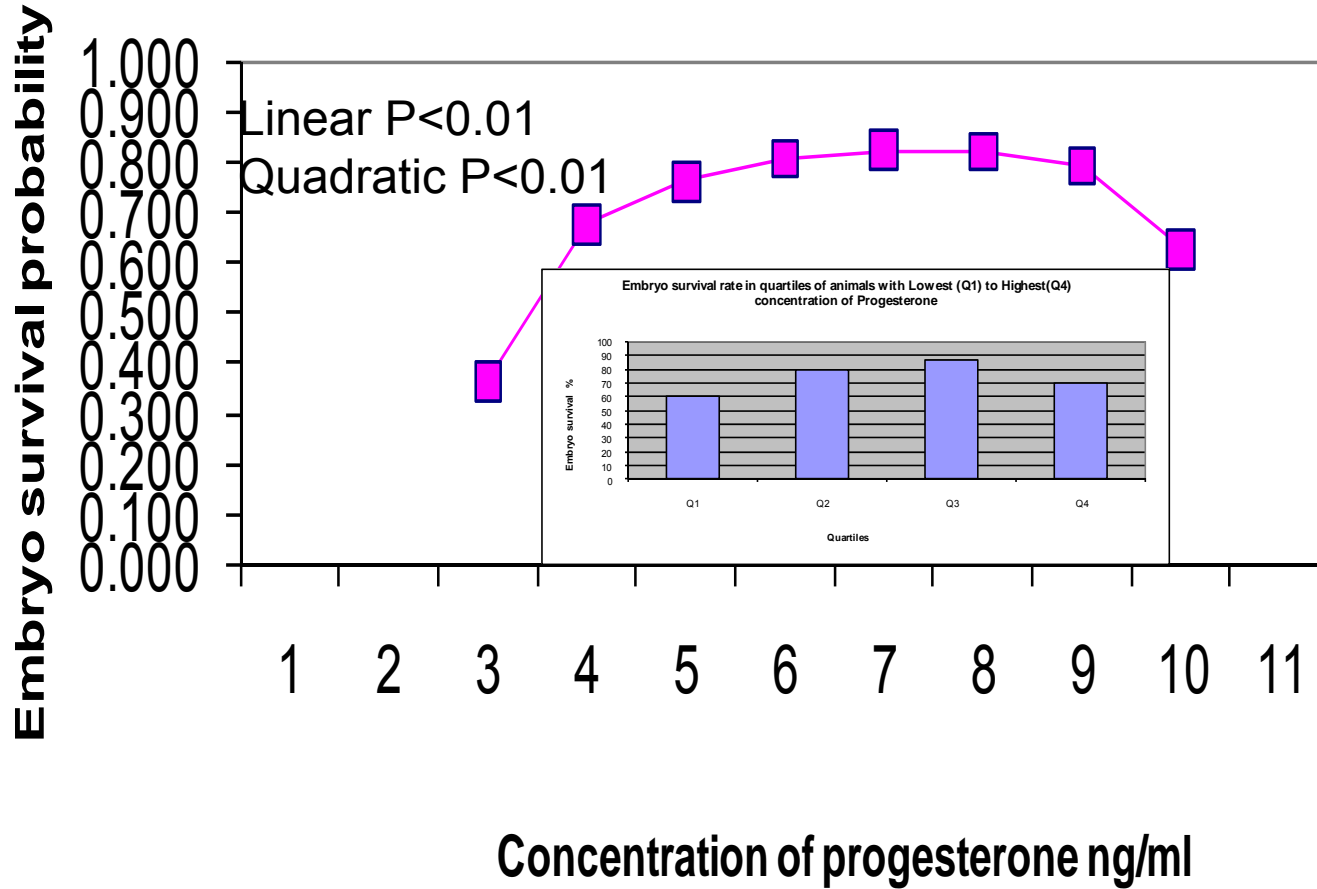
## Predicted embryo survival rate for different concentrations of progesterone on Day 5



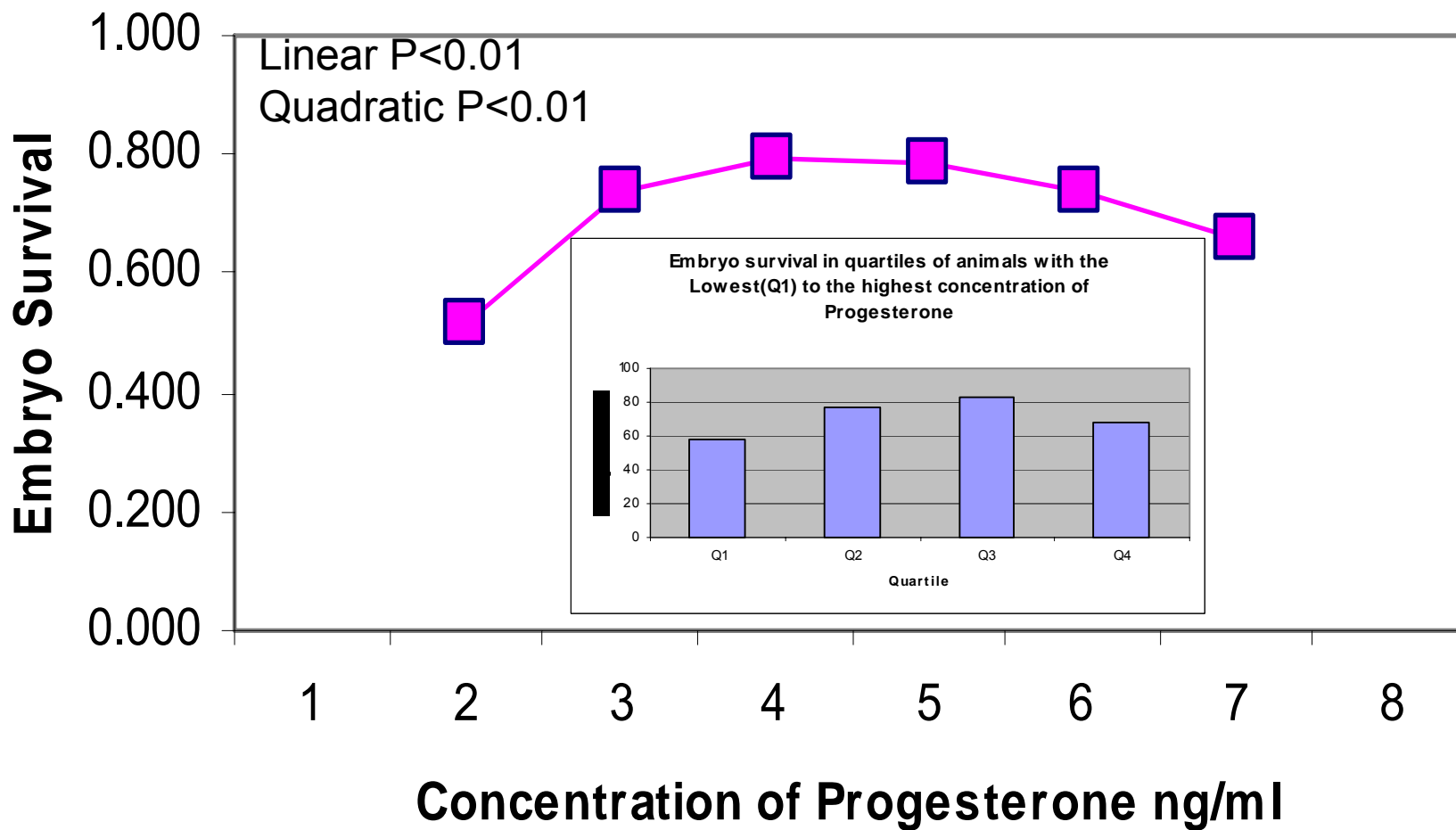
## Predicted embryo survival rate for different concentrations of progesterone on Day 6



# Predicted embryo survival rate for different concentrations of progesterone on Day 7



## Predicted embryo survival for different concentrations of progesterone on days 4 to 7





# Repeatability



- Repeatability estimates for plasma concentrations of  $P_4$  on days 4 to 7 varied from  $R_e=0.05$  to 0.2

# Relationship to Day 7

Dependent variable	Relationship to day 7 concentration	R <sup>2</sup>	Significance
P <sub>4</sub> (Day 7)	3.01+1.94(P <sub>4</sub> on Day 4)- 0.066(P <sub>4</sub> Day 4) <sup>2</sup>	<b>0.22</b>	<b>***</b>
P <sub>4</sub> (Day 7)	1.97+1.14(P <sub>4</sub> on Day 5)- 0.04(P <sub>4</sub> Day 5) <sup>2</sup>	<b>0.39</b>	<b>***</b>
P <sub>4</sub> (Day 7)	1.24+1.066(P <sub>4</sub> on Day 6)- 0.04(P <sub>4</sub> Day 6) <sup>2</sup>	<b>0.57</b>	<b>***</b>



# Conclusion

- There was both a linear and quadratic relationship between concentrations of  $P_4$  on days 4 to 7 and changes in  $P_4$  between these days and embryo survival
- As concentrations of  $P_4$  increases, embryo survival increases
- BUT, embryo survival does decline at very high levels of  $P_4$



# Conclusion

- Early luteal concentrations of  $P_4$  had a low repeatability from cycle to cycle
- Early luteal (days 4-5) concentrations of  $P_4$  are a reasonable predictor of concentrations on day 7
- Could be used to predict animals at risk of embryo loss



# Acknowledgements



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**Thank You...**