Modeling the Economics of Sow Longevity

Banff Pork Seminar

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How do you decide whether to make investment in improving sow longevity?

Right tool for the job is a cost-benefit analysis

- Process of weighing all costs and benefits of an intervention
- Purpose is to make an informed decision
  - To implement (or not) an intervention
- There must be a common unit of measurement for all costs and benefits
  - Money
  - Expressed in terms of a particular time (e.g. present value)

Cost-benefit analysis is an old, well established tool

DJIA 17788.69 0.57% S&P 500 2066.94 0.70% Nasdaq 4783.00 0.72% U.S. 10 Yr 22/32 Yield 1.799% Crude Oil 43.35 3.19% Euro 1.1522 0.11%

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Why the Government Puts a Dollar Value on Life

To analyze the benefits of high-cost regulations, pricing the priceless is a necessary calculation

When the U.S. Department of Transportation considered requiring truckers to log their hours electronically to help cut back on fatigue-related crashes, the agency had to do a cost-benefit analysis weighing the costs of implementation versus the benefits using the value of a statistical life. The rule was implemented in December. Here, a truck stop in Emerson, Ga. PHOTO: ASSOCIATED PRESS

By JO CRAVEN MCGINTY

77 COMMENTS

"Analyzing the benefits of high-cost regulations"

What is the value of a life?

- $9.4 million (US Transportation Department)
- $9.1 million (US Environmental Protection Agency)
- $7.9 million (US Food and Drug Administration)

A case study

- Retrospective cost-benefit analysis of investments in a gilt management program to improve sow longevity
  - Are we getting a return on our investments in gilt development?

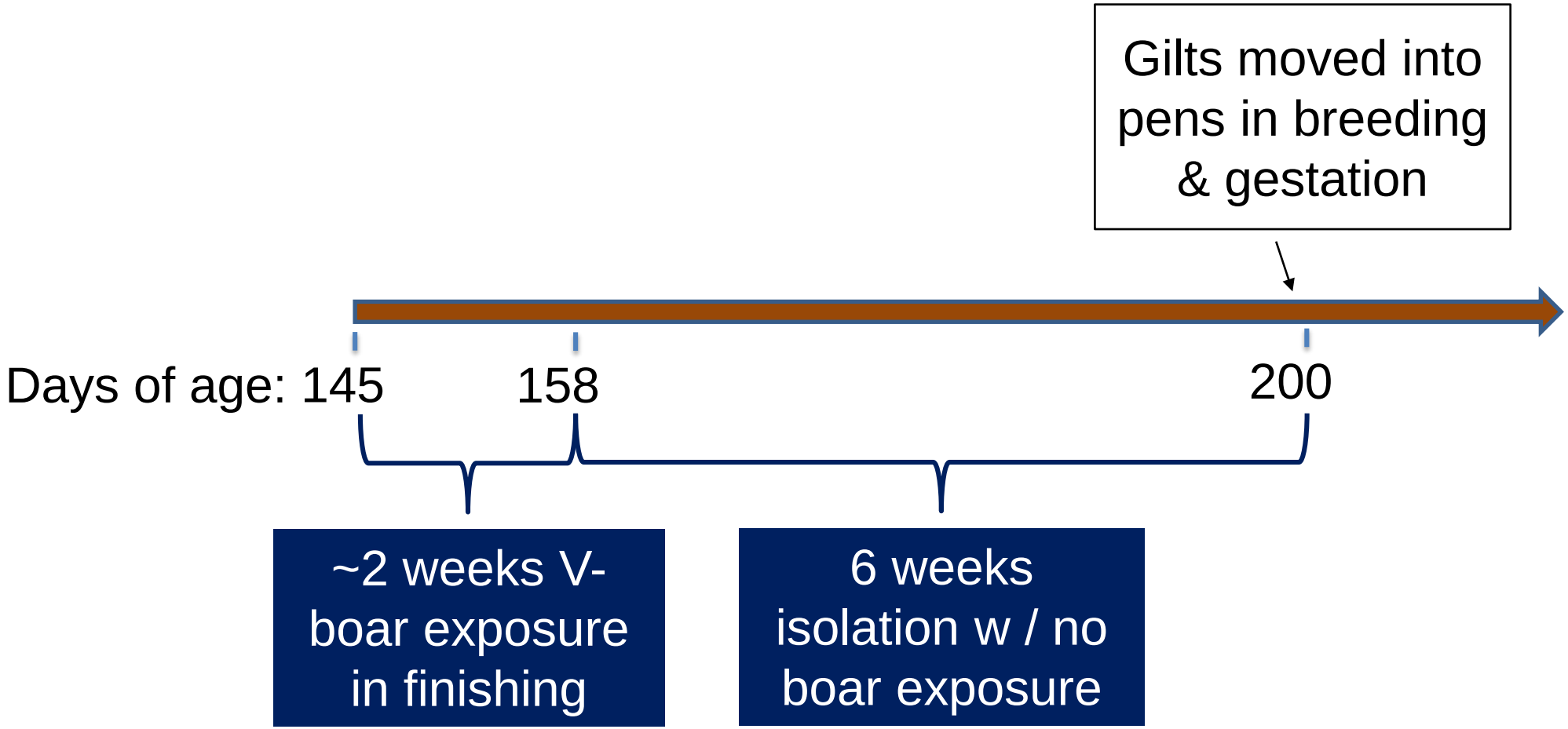
Objective

- Estimate the costs and benefits of improving sow longevity
  - Intervention was gilt management program using
    - Boar exposure
    - Altrenogist (Matrix®)
    - Combination of eCG (400 IU) and hCG (200 IU) PG600®
  - Sow longevity measured by parity removal distribution

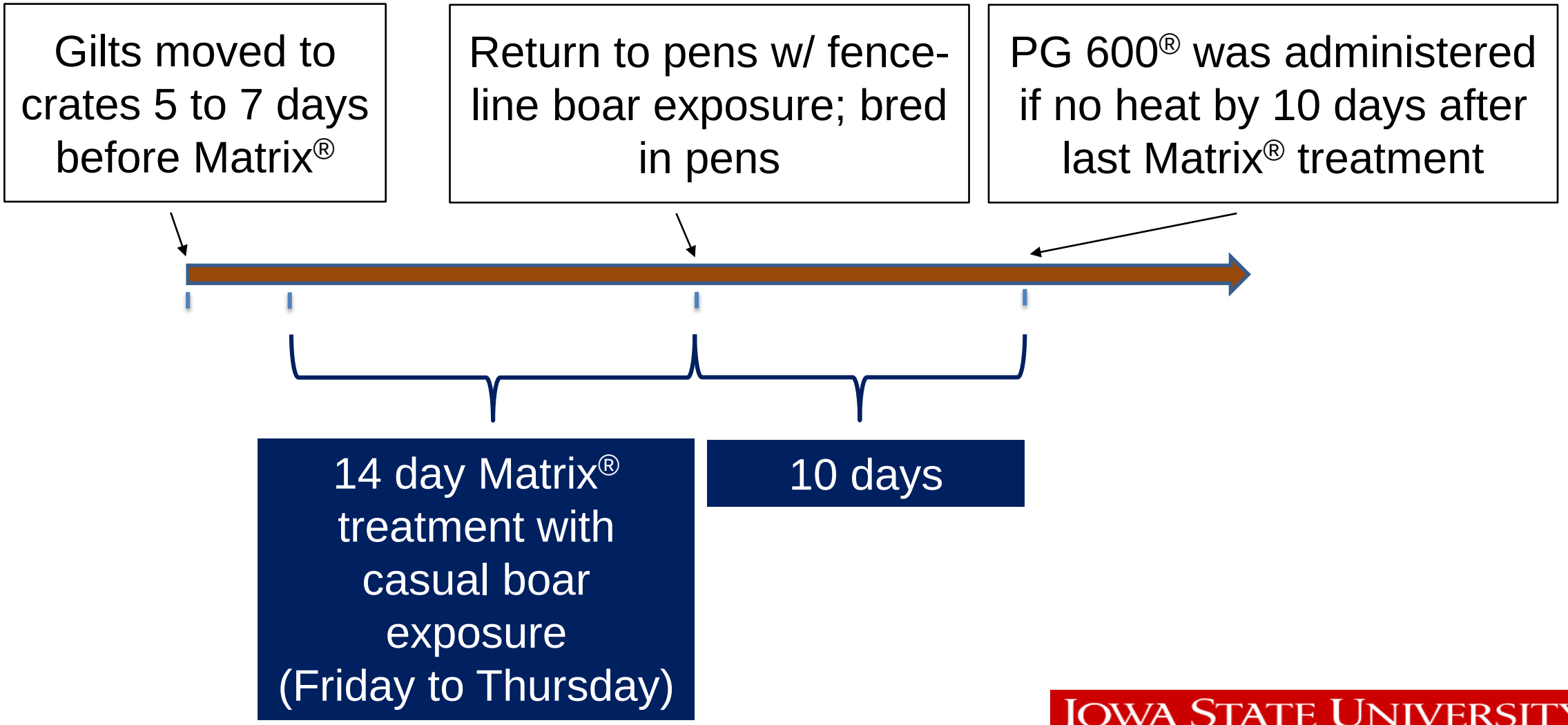
Study herd

- 2,400 sow farm
- Group-housed gestation
- PRRSV positive stable (category II)
- Gilts were isolated off-site six weeks prior to entry

Gilt management program



Gilt management program



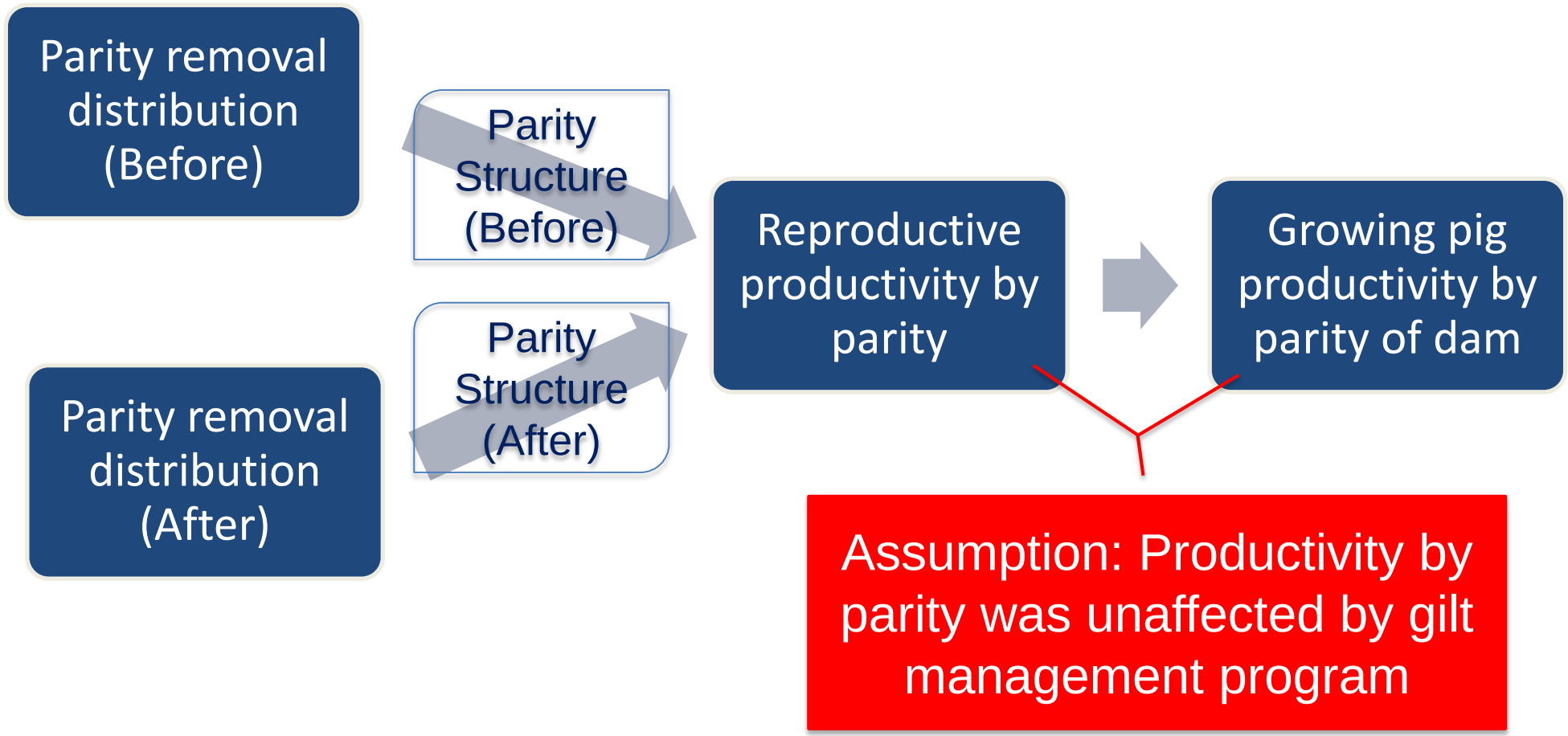
Data and comparison periods

- Gilt management program was initiated in July of 2004
- Summary of lifetime reproductive performance was obtained for the study farm
  - 30 months before the gilt management program was implemented (Before)
  - 30 months after (After)

Summary of results for gilt management program (After)

Parameter	Value
Number of weeks	120
Number treated with Matrix	3650
Percent served, after Matrix	81.5%
Percent treated with PG600 (0.3% not treated)	18.2%
Percent culled (no heat)	5.7%
Percent served, total	94.2%

Key productivity indicators
Before and After the program was implemented



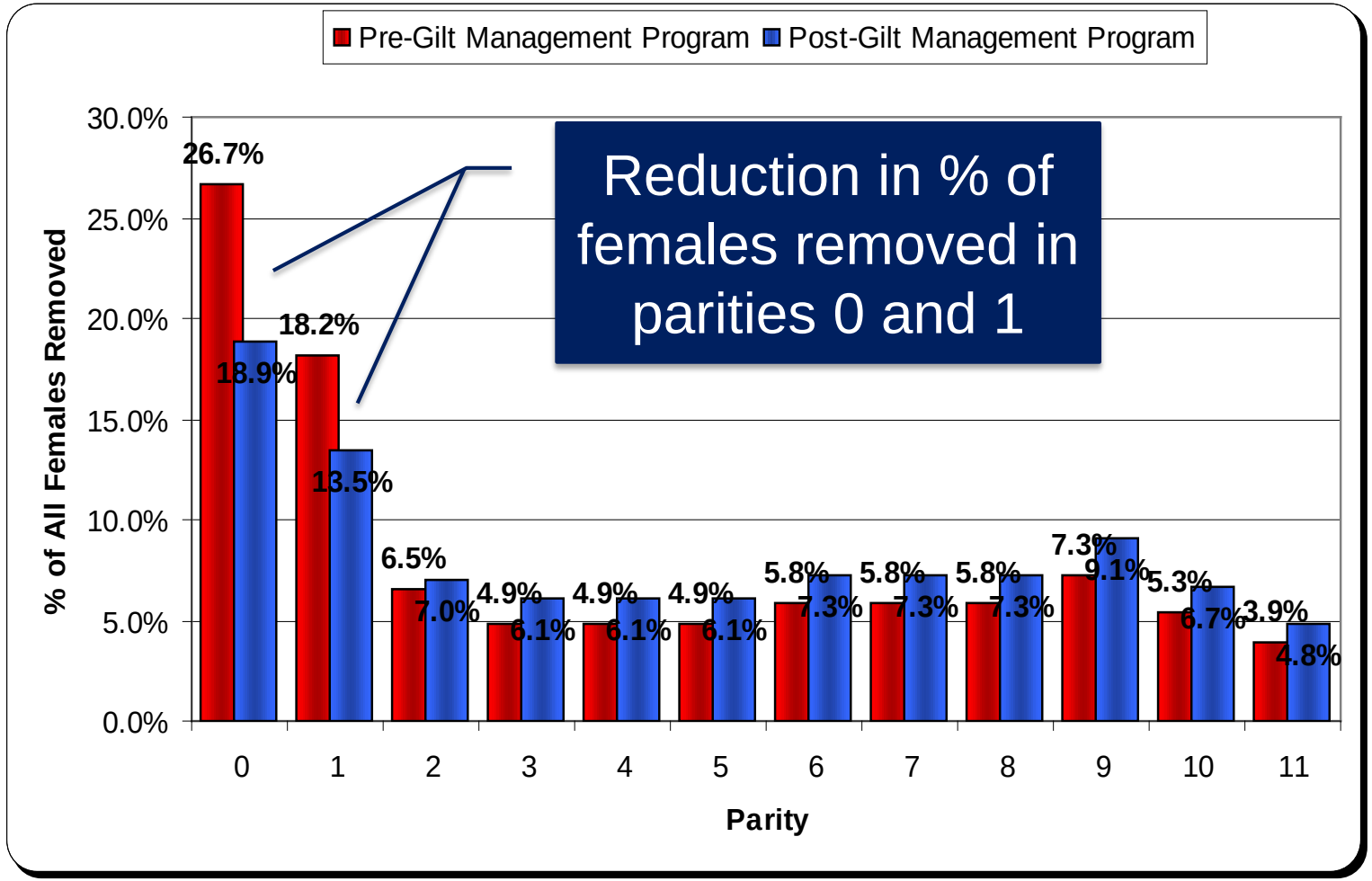
Key productivity indicators – data sources

- Parity removal distribution
  - Source: Summary of lifetime reproductive performance from the study farm
- Reproductive performance by parity
  - Source: Dhuyvetter, K.C. (2000). What does attrition cost and what is it worth to reduce? In: Proceedings of the 2000 Allen D. Leman Swine Conference, pp. 110-116.
- Growing pig performance by parity of the dam
  - Source: Moore, C. (2001) Segregated production: How far could we go? *In:* Proceedings of the 2001 Allen D. Leman Swine Conference, pp. 203-206.

Key productivity indicators
Before and After the program was implemented

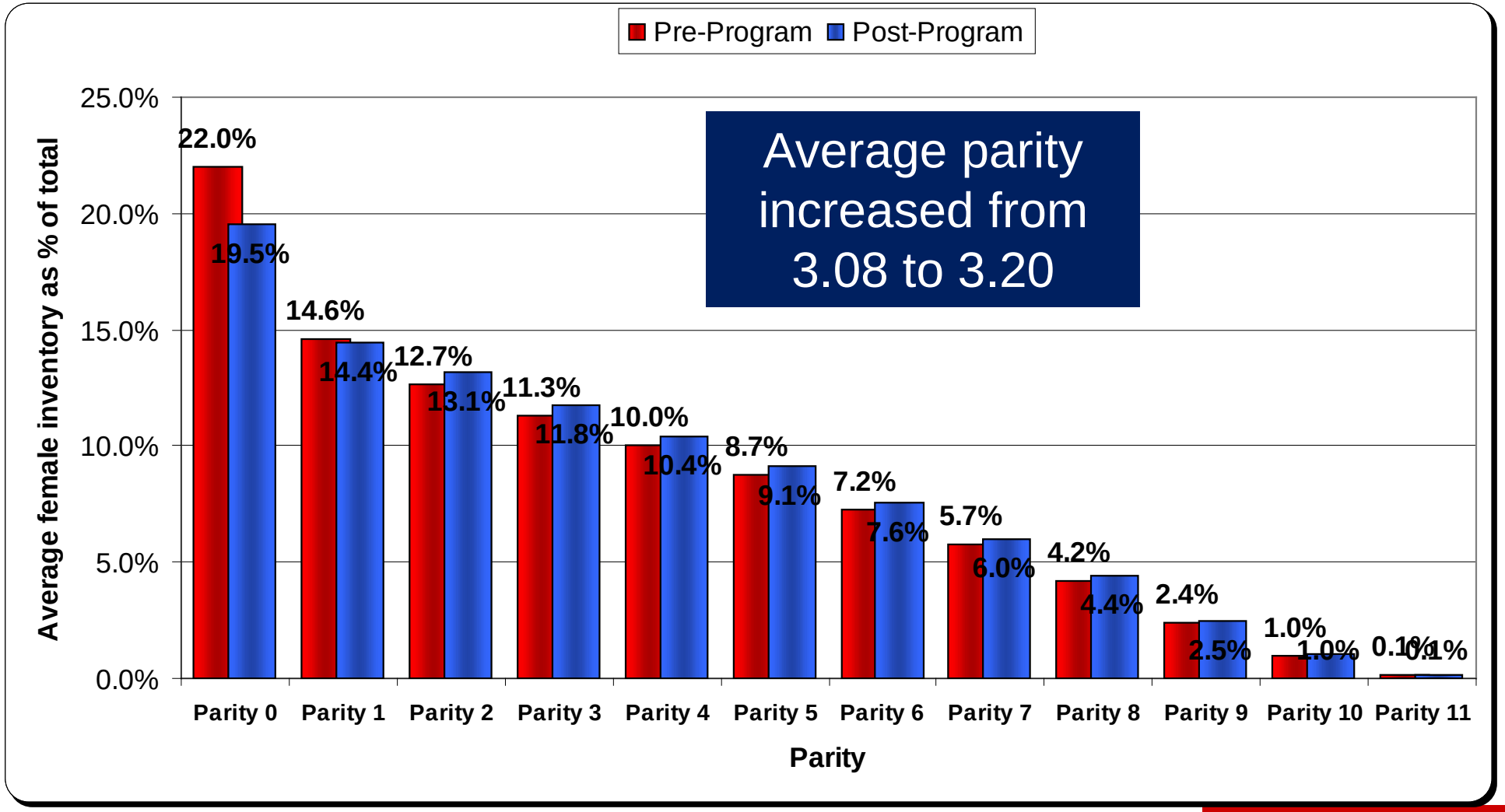
- Parity removal distribution
  - Source: Summary of lifetime reproductive performance from the study farm

Parity removal distribution
Before and After the program was implemented



Labels are percentage of females removed in each parity

Changes in the parity removal distribution shifted the parity structure of the herd to the right



Reproductive performance by parity
(Dhuyvetter, 2003)

Parity[1]	Born alive per litter farrowed	Prewean mortality (% pigs placed)	Average weaning weight (lb)	Average farrow (entry for gilts) to farrow interval	Average farrow (entry for gilts) to removal interval	Average weight of females culled (pounds)	Average cull price ($/cwt)
1	9.3	14.0%	11.7	156	55	325	$37.87
2	9.5	12.0%	12.5	141	45	380	$37.87
3	9.7	13.0%	12.5	147	45	425	$37.87
4	9.8	13.8%	12.5	147	45	475	$40.64
5	9.9	14.3%	12.5	146	45	485	$40.64
6	10.0	14.5%	12.5	145	45	495	$40.64
7	10.0	14.8%	12.5	142	45	505	$40.62
8	10.1	15.0%	12.5	139	45	515	$40.62
9	10.1	15.3%	12.5	140	30	525	$40.62
10	10.0	15.3%	12.5	135	20	535	$40.62
11	10.0	15.3%	12.5	130	15	545	$40.62

[1]Parity of female after litter was farrowed

Growing pig performance by parity of the dam
(Moore, 2001)

		Wean-to-finish mortality	Wean-to-finish cull rate	Wean-to-finish average daily gain	Wean-to-finish feed conversion
Parity[1]	**1**	7.34%	3.4%	1.40	2.71
	2-11	5.42%	2.5%	1.46	2.60

[1]Parity of dam after litter was farrowed

Production and economic model

- Breed-to-wean and wean-to-market production and economic models
- To simulate the profitability under alternative parity removal distributions
  - Populations of females within each parity were sub-modeled separately in the breed-to-wean model
  - Pigs from dams in each parity were sub-modeled separately in the wean-to-finish model
- Results from both models were combined to summarize for breed-to-market

Screenshot of breed-to-wean model (entire model not shown)

Production Model	Parity 0	Parity 1	Parity 2	Parity 3	Parity 4	Parity 5	Parity 6	Parity 7	Parity 8	Parity 9	Parity 10	Parity 11	Totals
	0	1	2	3	4	5	6	7	8	9	10	11	
Herd Inventory and Turnover													
Breeding Female Inventory													
Average female inventory in parity	527	351	304	271	240	210	174	138	101	57	24	3	2400
Parity structure of the herd	22%	15%	13%	11%	10%	9%	7%	6%	4%	2%	1%	0%	100.0%
Average mated female inventory	1,873												
Unmated gilts entered per year	1492												
Number of females starting parity per year	1492	1094	822	725	653	580	508	421	334	247	138	58	7070
Number of females promoted to next parity per year	1094	822	725	653	580	508	421	334	247	138	58	0	5578
													1492
Proportion of females removed in parity (After gilt management program implemented)	26.7%	18.2%	6.5%	4.9%	4.9%	4.9%	5.8%	5.8%	5.8%	7.3%	5.3%	3.9%	100.0%
Number of females removed in parity	398	272	97	73	73	73	87	87	87	109	80	58	1492
Number of females deaths in parity	19.9	13.6	4.8	3.6	3.6	3.6	4.4	4.4	4.4	5.4	4.0	2.9	74.6
Number of females culled in parity	378.5	258.0	92.1	68.9	68.9	68.9	82.7	82.7	82.7	103.3	75.8	55.1	1417.5
Breeding, Farrowing and Weaning Performance													
Annual female replacement / removal rate (% of breeding herd/year)	62%												
Replacement gilts entered per year	1492												
Pigs born alive/litter farrowed	9.25	9.49	9.68	9.83	9.93	10.01	10.04	10.06	10.05	10.03	10.03		
Prewean mortality	14.0%	12.0%	13.0%	13.8%	14.3%	14.5%	14.8%	15.0%	15.3%	15.3%	15.3%		
Pigs born alive per year to females in parity	10119	7802	7020	6413	5762	5079	4225	3357	2479	1381	582	0	54,219
Prewean piglet deaths per year from females in parity	1417	936	913	882	821	736	623	504	378	211	89	0	7,509
Pigs weaned per year from females in parity	8702	6784	6105	5568	4993	4394	3651	2897	2137	1190	501	0	46.922

Parity removal distribution (**Different** Before and After)

Reproductive performance by parity (**Same** Before and After)

Parameter values that were held constant for both scenarios (all values in US$)

- Average gestation diet cost = $186/ton
- Average lactation diet cost = $222/ton
- Cost of replacement gilt = $200/gilt
- Market hog price = $0.65/lb. carcass wt
- Average wean-to-finish diet cost = $186/ton

Benefit of the gilt management program

- Difference between scenarios (After vs. Before) is benefit of improved sow longevity due to implementation of gilt management program
  - Benefit = Profit After ($) - Profit Before ($)

Cost of the gilt management program ($US)

	Matrix®	P.G. 600®	Total
Treatment period (days/unmated gilt)	14	1	
Unmated gilts entered / year	1,492	1,492	
Percentage of unmated gilts treated (%)	100.0%	18.2%	
Product cost of intervention per day ($/day treated)	$0.92	$6.00	
Administration cost of intervention per day ($/day treated)	$0.05	$0.05	
Annual cost of product and labor for administration ($ / year)	$20,221	$1,643	$21,864
Labor for boar exposure (hours / gilt entered)			0.25
Wages and benefits ($ / hour)			$15.00
Annual cost of labor for boar exposure ($ / year)			$5,595
Annual cost of gilt management program ($ / year)			**$27,459**

Total annual cost of gilt management program

Productivity Before and After - breed-to-wean phase of production

	Before	After	Difference
Average breeding female inventory	2400	2400	0
Annual female replacement / removal rate (% of breeding herd/year)	62%	52%	-10%
Replacement gilts entered per year	1492	1248	-244
Average parity of herd	3.08	3.20	0.12
Nonproductive days per female per year	64.1	58.1	-6.0
Litters farrowed per female per year	2.32	2.36	0.04
Pigs born alive per female per year	22.59	23.01	0.42
Prewean mortality (% of piglets born alive)	13.85%	13.85%	0.00%
Pigs weaned per year	46922	47803	881
Pigs weaned per female per year	19.55	19.92	0.37

Productivity Before and After – wean-to-market phase of production

	Before	After	Difference
Wean-to-market mortality (% of pigs placed)	5.78%	5.75%	-0.03%
Wean-to-market average daily gain (pounds/pig marketed/day)	1.439	1.440	0.001
Wean-to-market feed to gain ratio (pounds of feed/pound of gain)	2.619	2.618	-0.002
Number of finished pigs marketed per year	42,960	43,789	829
Average live weight at market (pounds/pig)	258.2	258.4	0.2
Total live weight of pork marketed per year (pounds)	11,092,711	11,315,020	222,310

Benefit – Reduced cost of replacement gilts, net of salvage value ($US)

	Before	After	Difference
Cost of replacements purchased ($/year)	$298,419	$249,615	
Salvage value of females culled ($/year)	$243,117	$214,771	
Cost of replacements purchased net of salvage value of females culled ($/year)	$55,301	$34,844	**$20,457**

Benefit – Improved breeding herd productivity ($US)

	Before	After	Difference
Total annual cost of production($/year)	$1,360,354	$1,360,124	
Annual revenue from weaned pigs ($/year)	$1,407,663	$1,434,084	
Total annual profit ($/year)	$47,309	$73,961	**$26,652**

Benefit – Improved growing pig productivity ($US)

	Before	After	Difference
Total annual cost of production($/year)	$4,861,720	$4,953,844	
Total annual revenue from market pigs ($/year)	$5,549,766	$5,660,990	
Total annual profit ($/year)	$688,046	$707,145	**$19,099**

Benefit – Summary and total ($US)

	Benefit
Reduced cost of replacement gilts, net of salvage value ($/year)	$20,457
Improved breeding herd productivity ($/year)	$26,652
Improved growing pig productivity ($/year)	$19,099
Total ($/year)	**$66,208**

Total annual benefit of gilt management program

- $1.21 / pig marketed
- $27.59 / breeding female / year

Return on the investment in the gilt management program to improve sow longevity?

- **Benefit:cost ratio was 2.41:1** = *$66,208 / $35,781*
- **Return on investment (ROI) was 141%** = *($66,208 - $27,459) / $27,459*

Reminder

- Total annual cost of gilt management program: $27,459
- Total annual benefit: $66,208

Key points and caveats

- Parity removal distribution is a useful measure for estimating the value of sow longevity
- Pro-forma estimates of reproductive productivity by parity and growing pig productivity by parity of the dam to isolate value of sow longevity
  - Improvements in productivity not related to sow longevity were ignored in the analysis
  - Benefit:cost ratio and ROI estimated may be higher (lower) if the gilt management program increased (decreased) productivity independent of the parity removal distribution

Key points and caveats

- Time value of money was ignored
- Since some of the benefits were realized after more than one year, discounting the value of those benefits would have been appropriate
  - Would have lowered the benefit:cost ratio and ROI estimated for the program
  - In the current low-interest rate environment and given the benefits would all have been achieved within 3 to 4 years, the results would not have changed substantially

Acknowledgements

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