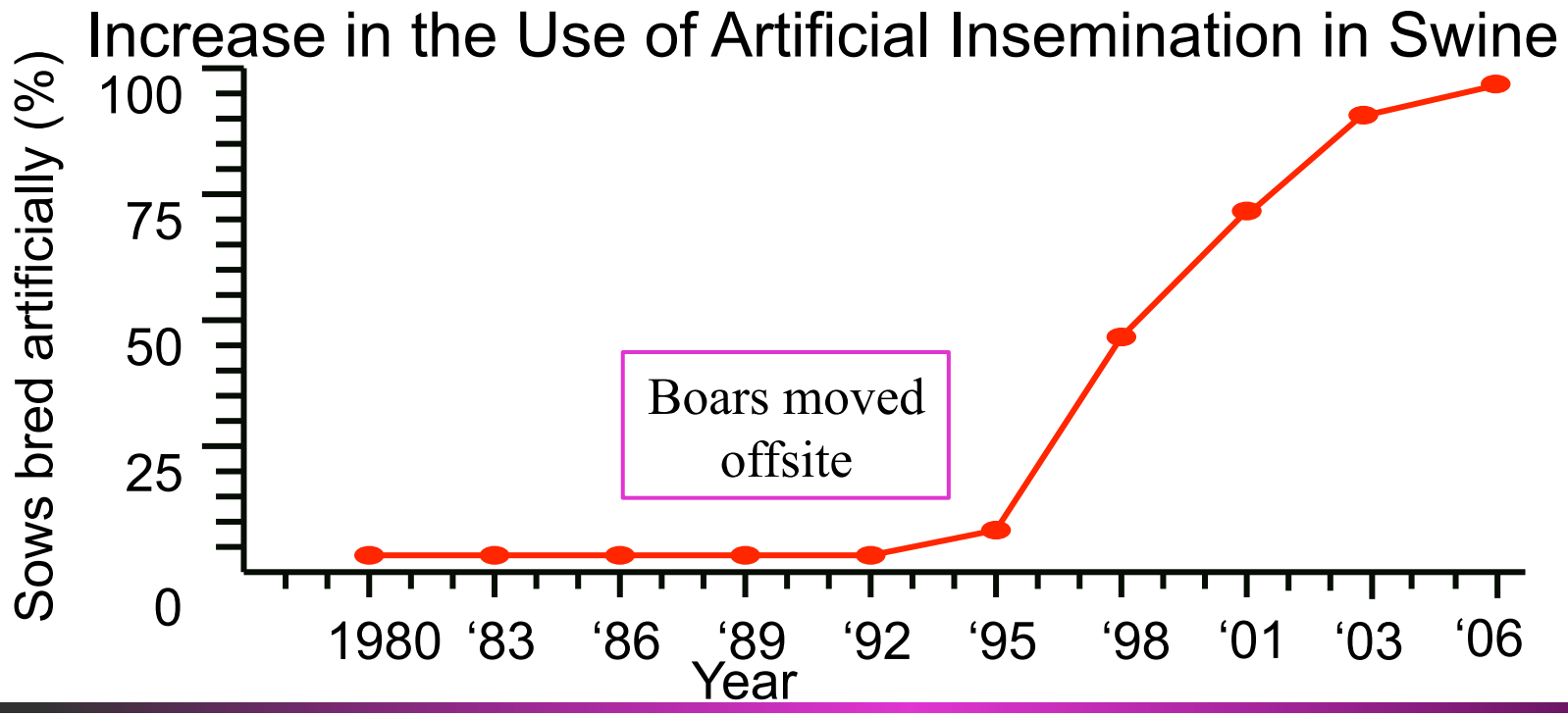
To Pool or Not to Pool

Kara Stewart

MB SWINE REPRODUCTION
Bretanha Importação e Exportação Ltda.
Magapor

Historical Perspective

- Artificial insemination research began in the 1900's in Russia followed by the U.S., Japan, Europe and elsewhere
- AI expanded rapidly in the U.S. in the 1990's
- *GOAL WAS TO MAKE AI AS GOOD AS NATURAL MATING!!*



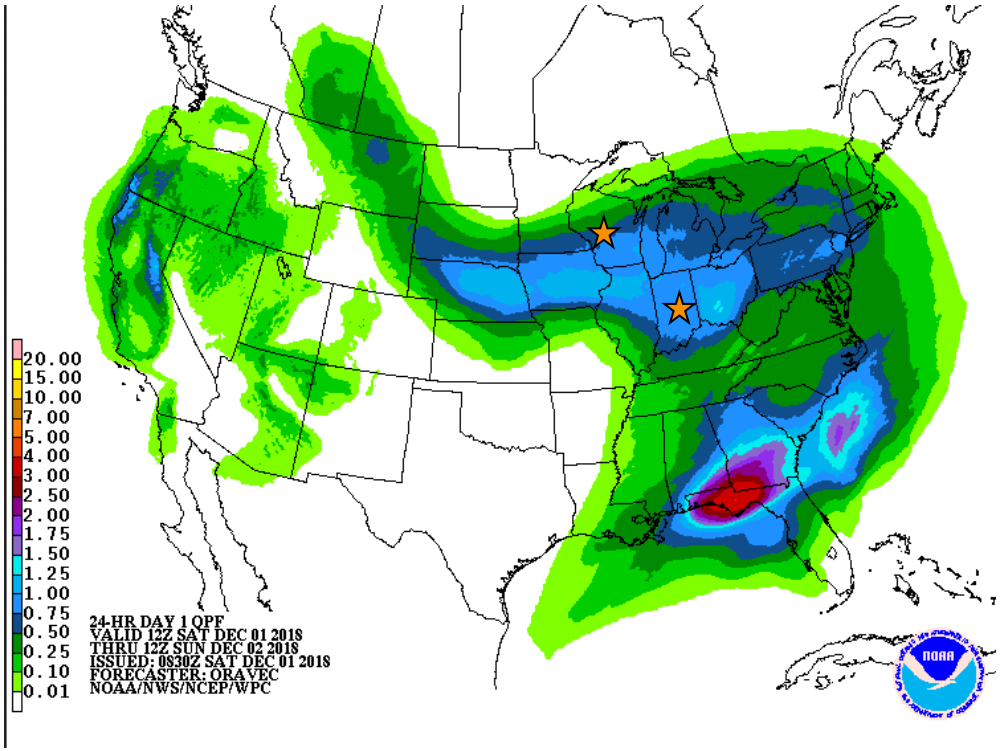
Historical Perspective

- Early work determined optimal concentration to be 5-10 billion/ dose with 2-3 inseminations
- Advancements in extenders, semen quality, etc. have allowed concentrations to go down
  - 1.5 – 2 billion in Europe (Knox, 2016)
  - 2.5-4 billion in U.S. (Knox et al., 2008)
- Discovered that all boars are not created equal…..
  (Colenbradner et al., 1993)
  - Average concentration can vary by as much as 30% /boar / wk
  - Season, collection frequency, age, breed all impact semen output and quality
  - Some boars with acceptable semen quality still had reduced *fertility*
  - *RISKS WERE IDENTIFIED*

Historical Perspective

- What do you do when you have risk????
  - E.g., Driving a car from Indiana to Minnesota in early December

You buy insurance!



Historical Perspective

- What are insurance options for boar studs??

1. *Fertility testing with single-sire matings – "Gold Standard"*

Requires about 50 matings, which takes time

- *Fertility can change over time*

2. *Pool Semen – Average relative risk of individual boar into a pooled semen dose*

3. *Third part quality control – More INDIVIDUAL boar samples monitored, more RISK is managed*

- *Semen quality is not 100% indicative of fertility*

4. *Technology in laboratory – Reduce human error and variation in doses*

- *Semen quality is not 100% indicative of fertility*

A tale of 4 boars……

Individual boar fertility from 50 single-sire matings

Boar	Farrowing Rate (%)	NBA	Fertility Ranking
A	87.4	12.6	2
B	77.4	11.4	3
C	89.3	12.8	1
D	60.2	9.3	4
Average	78.6	11.5	

Every boar bred to 100 females

Boar	Number of piglets produced	Percent of Total
A (2)	1101	30%
B (3)	882	24%
C (1)	1143	31%
D (4)	560	15%
Total	3686	

A tale of 4 boars.....

Pooled semen fertility from same 4 boars

Boar	Farrowing Rate (%)	NBA
Pooled A, B, C, D	85.6	12.0

Pooled semen used to breed 400 females, paternity test offspring

Boar (ranking based on fertility)	Number of piglets produced	Percent of Total
A (2)	2464	60%
B (3)	616	15%
C (1)	821	20%
D (4)	205	5%
Total	4108	

A tale of 4 boars……

Boar	Number of piglets produced INDIVIDUAL	Number of piglets produced POOL
A (2)	1101 (30%)	2464 (60%)
B (3)	882 (24%)	616 (15%)
C (1)	1143 (31%)	821 (20%)
D (4)	560 (15%)	205 (5%)
Total	3686	4108

- More total piglets born with pooling because we have "masked" the subfertile boars
- Relative contribution of each boar to the offspring shifted

A tale of 4 boars……

What if we could identify the subfertile boars and remove them??

Boar	Farrowing Rate	NBA
A (2)	87.4	12.6
~~B (3)~~	~~77.4~~	~~11.4~~
C (1)	89.3	12.8
~~D (4)~~	~~60.2~~	~~9.3~~
Total	88.3	12.7

Boar	Number of piglets produced POOL	Number of piglets produced INDIVIDUAL
A (2)	2690 (60%)	2202 (49%)
C (1)	1794 (40%)	2286 (51%)
Total	4484	4488

A tale of 4 boars……

Boar	Number of piglets produced INDIVIDUAL	Number of piglets produced POOL	Remove Subfertile Boars and INDIVIDUAL	Remove Subfertile Boars and POOL
A (2)	1101 (30%)	2464 (60%)	2202 (49%)	2690 (60%)
B (3)	882 (24%)	616 (15%)		
C (1)	1143 (31%)	821 (20%)	2286 (50%)	1794 (40%)
D (4)	560 (15%)	205 (5%)		
Total	3686	4108	4488	4484

Opportunities and Challenges

Opportunities

- Pooling provides “insurance”
  - Can be VERY important in smaller studs or when selling semen
- Improves overall performance when subfertile boars cannot be identified
- Improves the efficiency of processing and packaging semen

Opportunities and Challenges

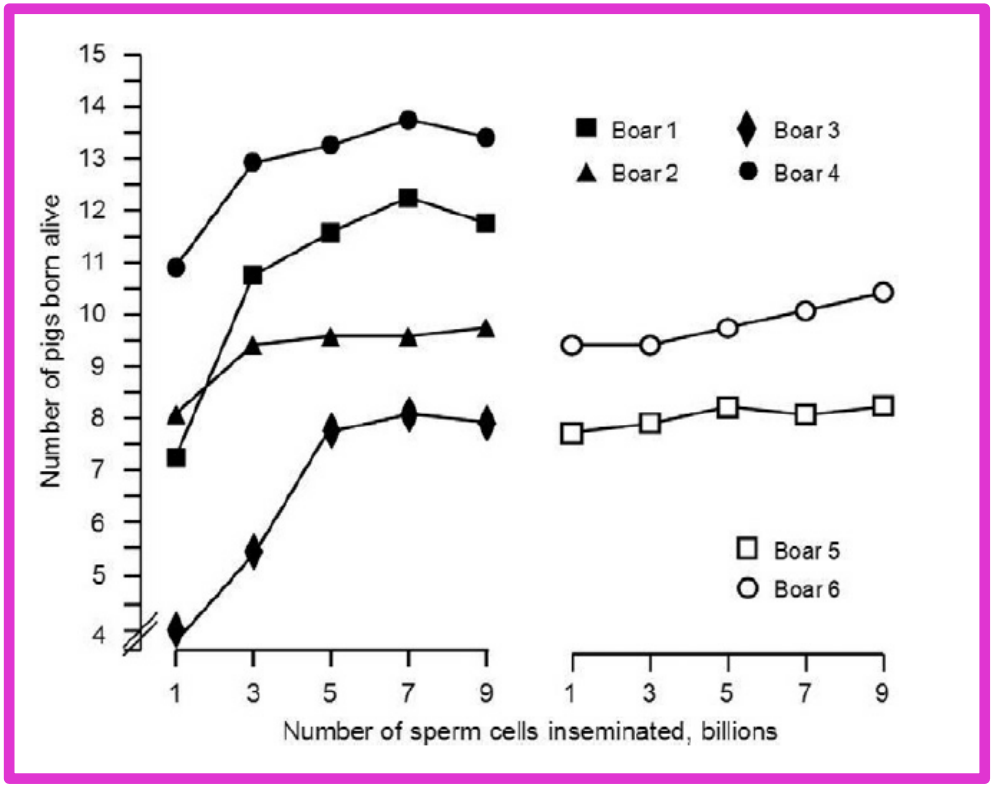
Challenges

- Averages in subfertile boars and leaves them in the population
- Averages BEST boars as well – reducing their overall contribution
- Prevents linking paternity to progeny
  - Would have to record every insemination dose with corresponding sow -RECORDS
- Requires higher sperm doses to “compensate” for subfertile boars

Reminders

At lowered doses, we no longer COMPENSATE for some boars!!

- ***Compensable*** semen traits – those where increasing the sperm number will improve fertility
  - Motility, morphology, capacitation, etc.
  - Typically measured in the boar stud
- Determine the *slope* of the lines



Flowers, 2013

Salisbury and Vandemark, 1961, Saacke et al., 2000

Tips for Pooling

- Quality test individual boars before pooling
- Use 3-6 ejaculates to make a pool
- Extend semen, then pool

	Number of Matings	Farrowing Rate	Total Born Alive	Pigs Born Alive /Mated Female
Single Boar	346	81.5	9.91	8.07
Pooled Then Extended	162	82.1	9.97	8.18
Extended Then Pooled	152	89.17	10.34	9.22

Swine Vet Center, 2005

What does the future hold?

- Research efforts need to:
  - Emphasize identifying subfertile boars
    - Seminal plasma proteomics
    - Proteins on the sperm head
    - Genetic markers of fertility
  - Will require large populations of boars with KNOWN fertility

- Boar studs need to:
  - Continue to mitigate risks – will vary depending on management strategies and ownership of the risk

Thanks!

Kara Stewart

MB SWINE REPRODUCTION
Bretanha Importação e Exportação Ltda.
Magapor