University of New England

Reproductive technologies

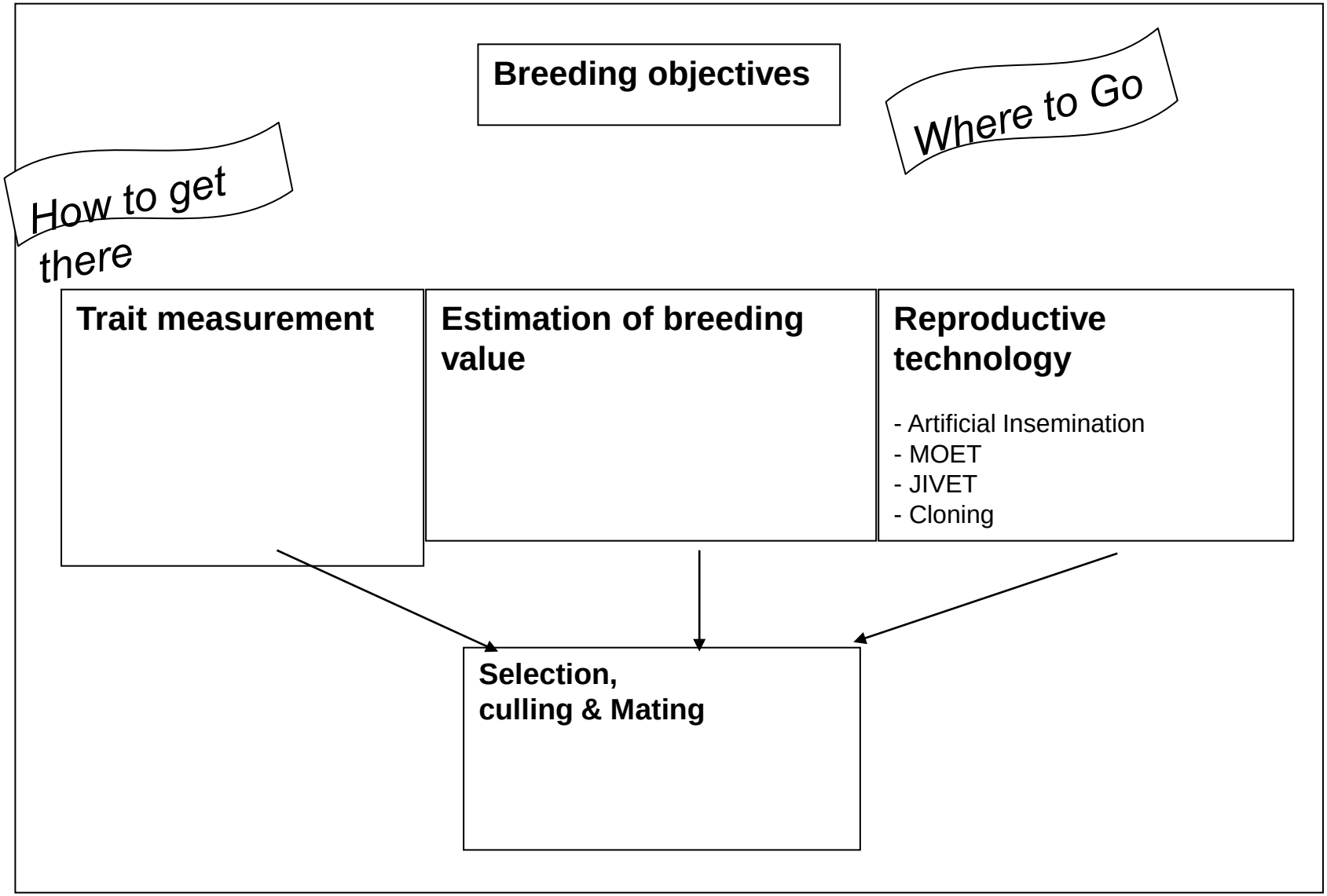
Lecture 15

Introduction to Breeding and Genetics

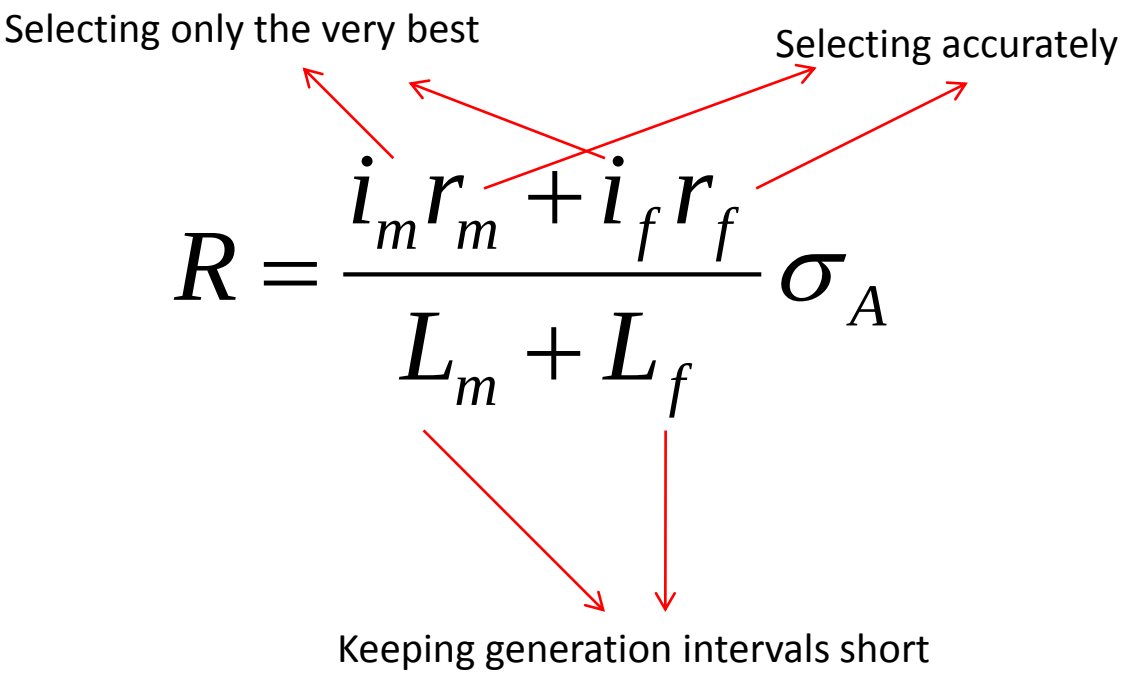
GENE 251/351

School of Environment and Rural Science (Genetics)

Animal Breeding in a nutshell



Making genetic progress is about



Reproductive rates affect all of the above!

Reproductive technologies

- Reproductive boosting
  - Artificial insemination, AI
  - Multiple Ovulation and Embryo Transfer, MOET
  - Oocyte Pickup
  - Juvenile In Vitro Embryo Transfer, JIVET
- Sexing of semen and embryos
- Cloning
- Whizzy Genetics - breeding in a test-tube

Reproductive technologies

- Increases selection intensities
- Increases accuracy of EBVs
- Decreases generation intervals
- Increases inbreeding

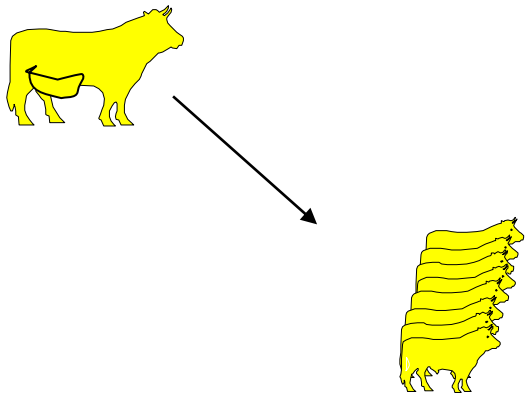
Artificial Insemination

- More intensive use of best sires
- Use of overseas bulls
- Establish links between herds
- Progeny testing

- More rapid dissemination of superior genes

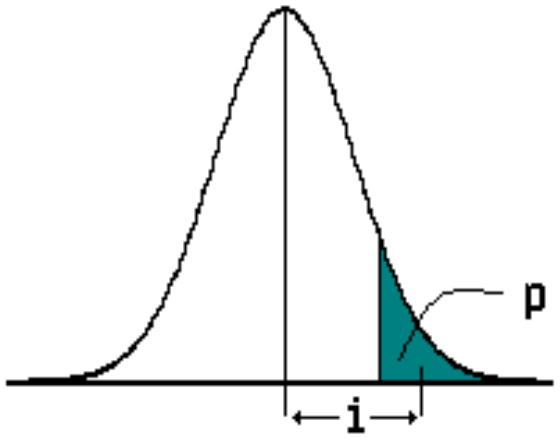
Multiple Ovulation and Embryo Transfer - MOET

- More intensive use of best cows
  - *"turns a cow into a sow"*
- Use of overseas cows



AI and MOET

- Increased selection intensity
- Reduced generation interval
- Increased accuracy of EBV's



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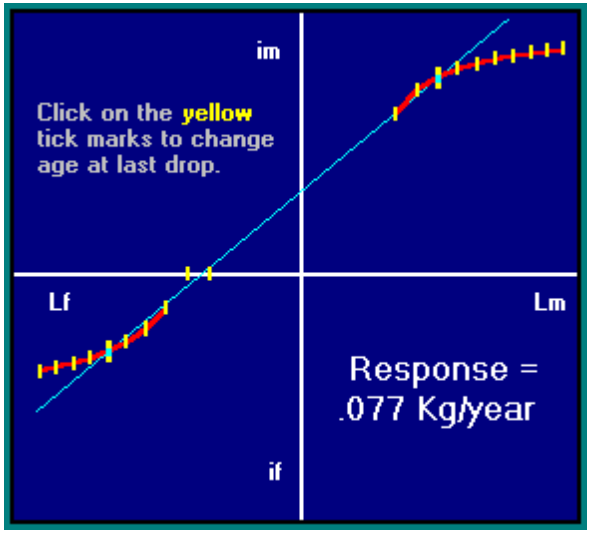

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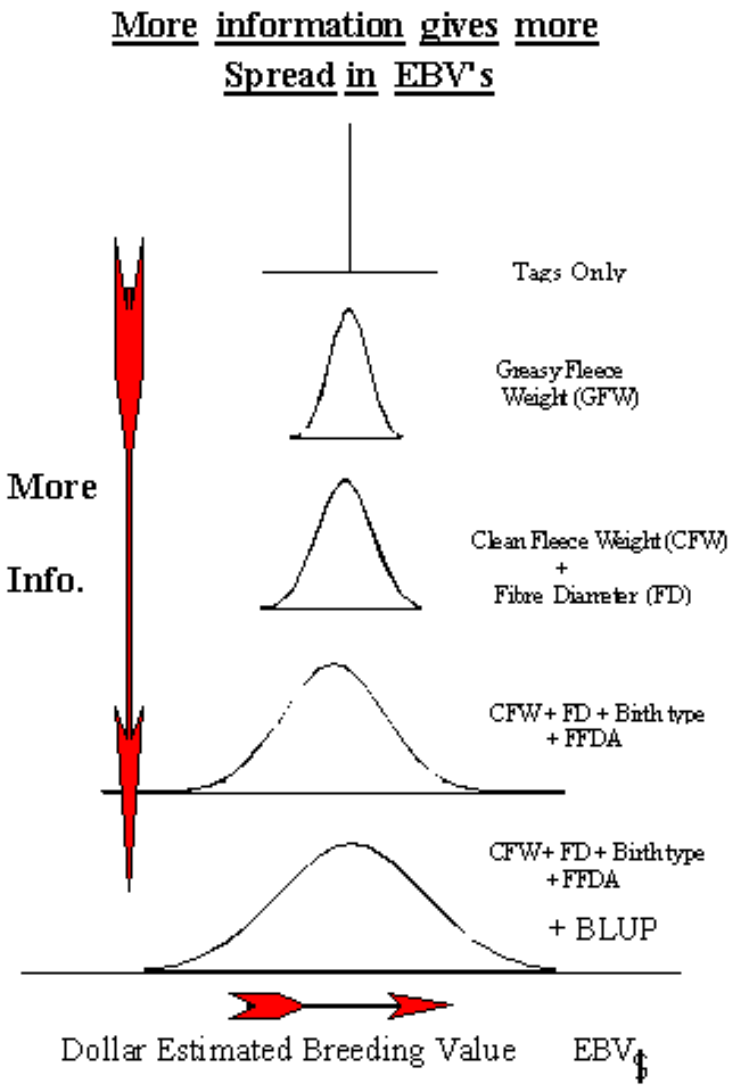
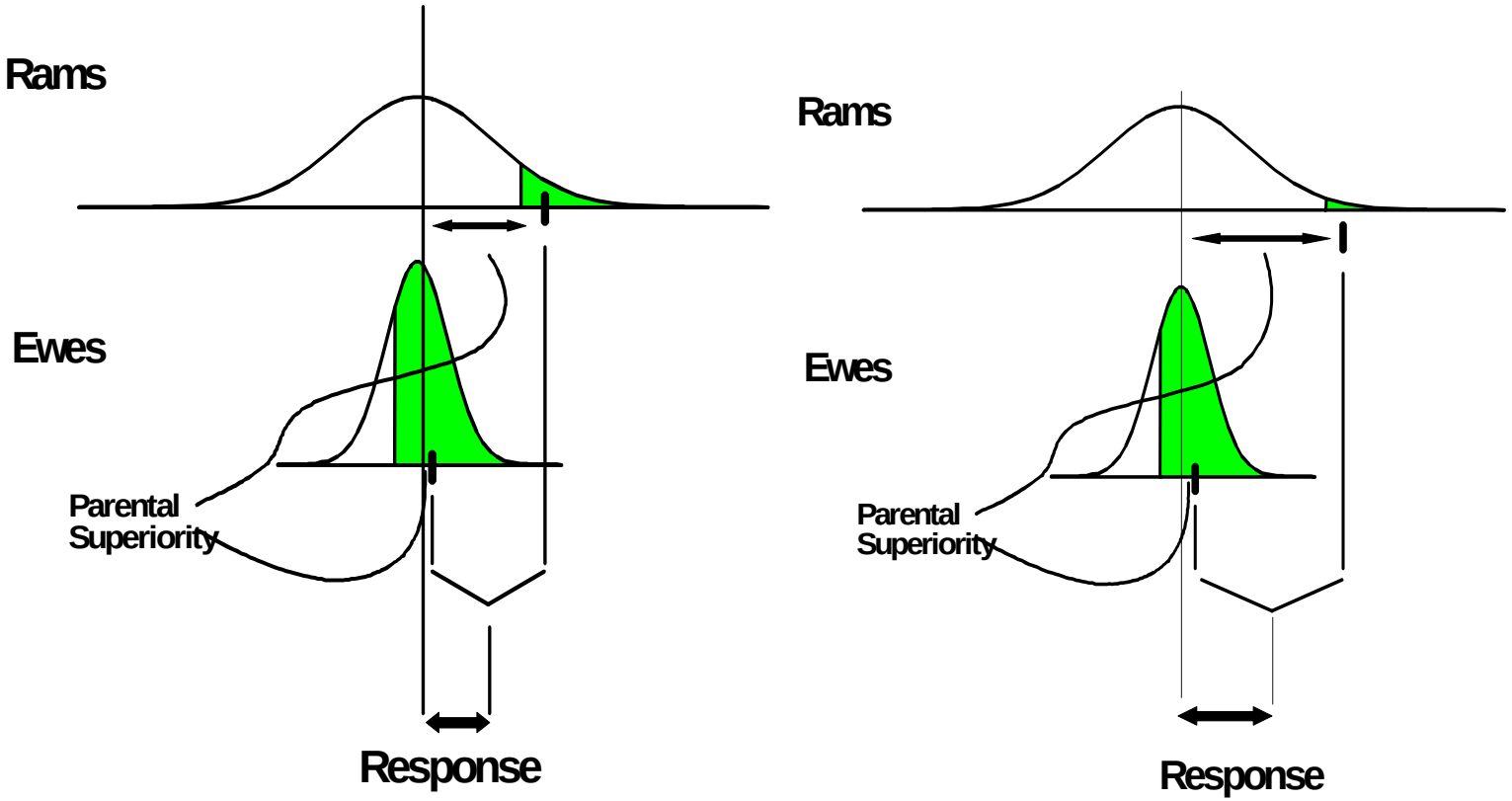
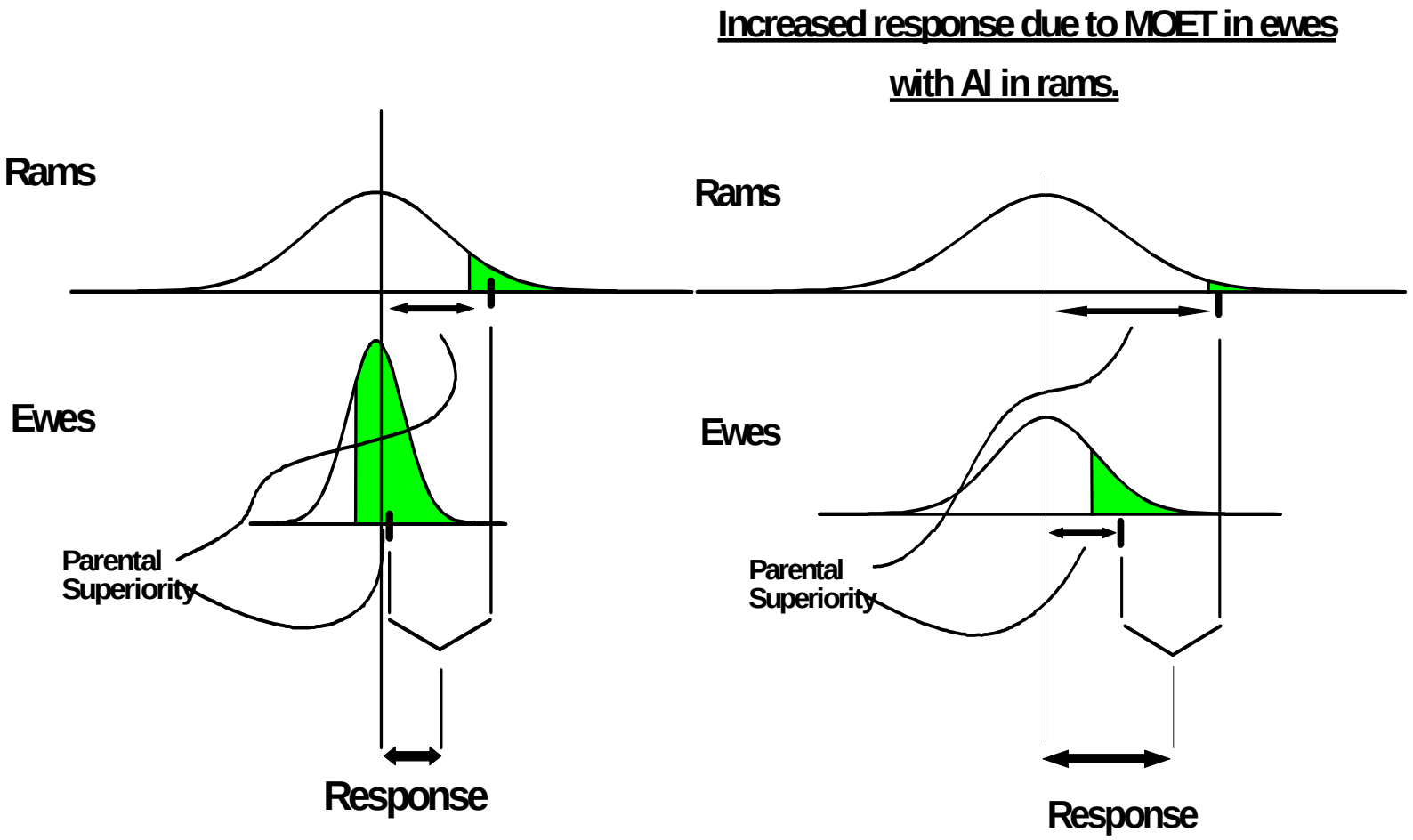


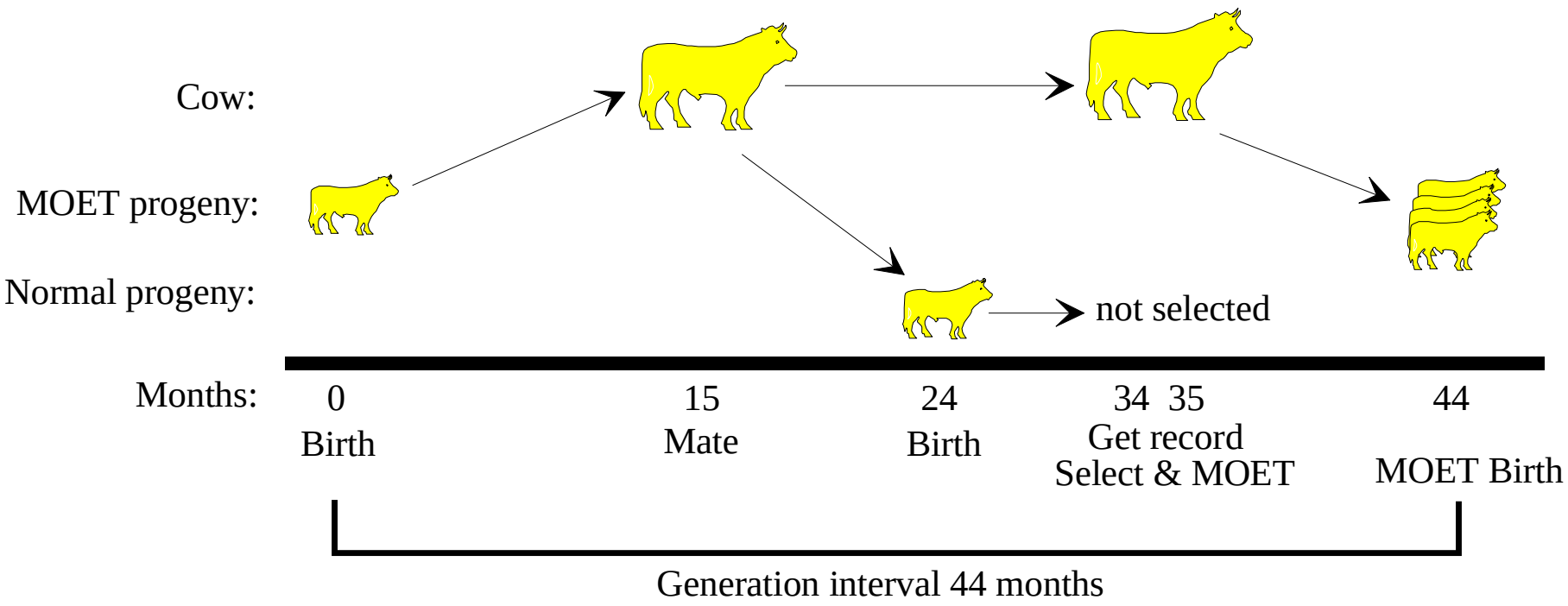
Increased intensity and accuracy ...



Increased intensity and accuracy ...

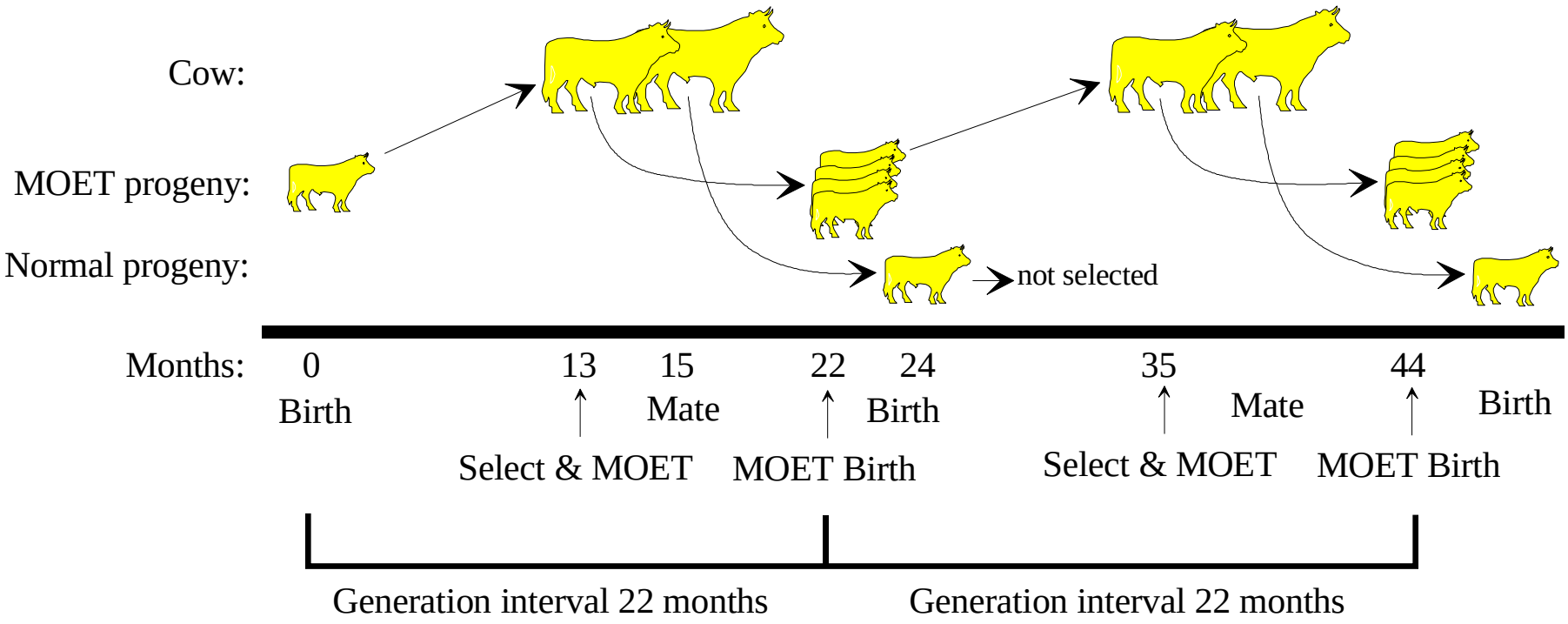


Adult dairy MOET scheme



More offspring of top cow *after* testing it

Juvenile dairy MOET scheme



More offspring of top cow *before* testing it

Select base on parent average

Oocyte pickup and In Vitro Fertilization

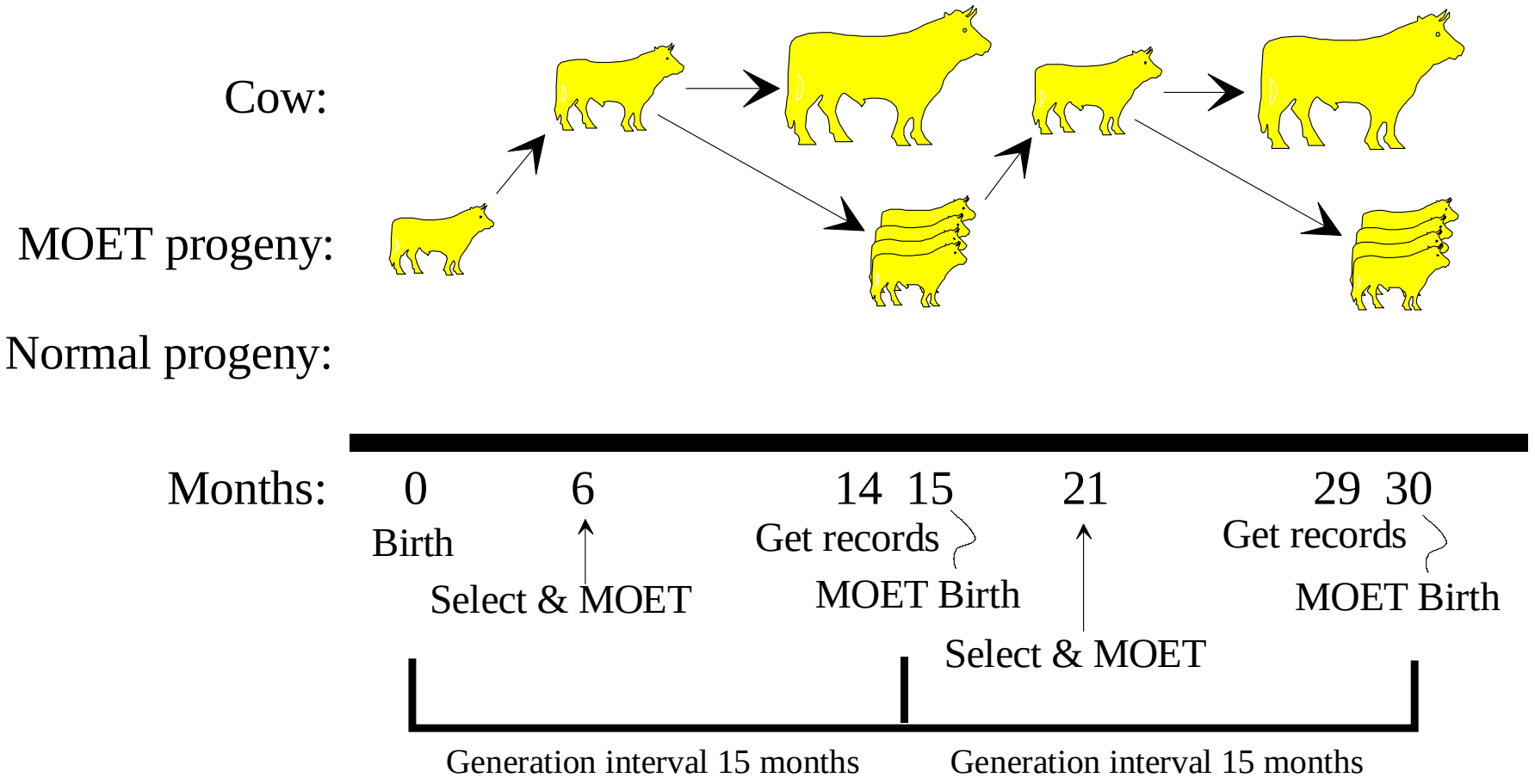
Juvenile In Vitro Fertilization and Embryo Transfer - JIVET

- Obtain oocytes before sexual maturity
- Selection based on parent average
- Less accuracy but much lower generation interval

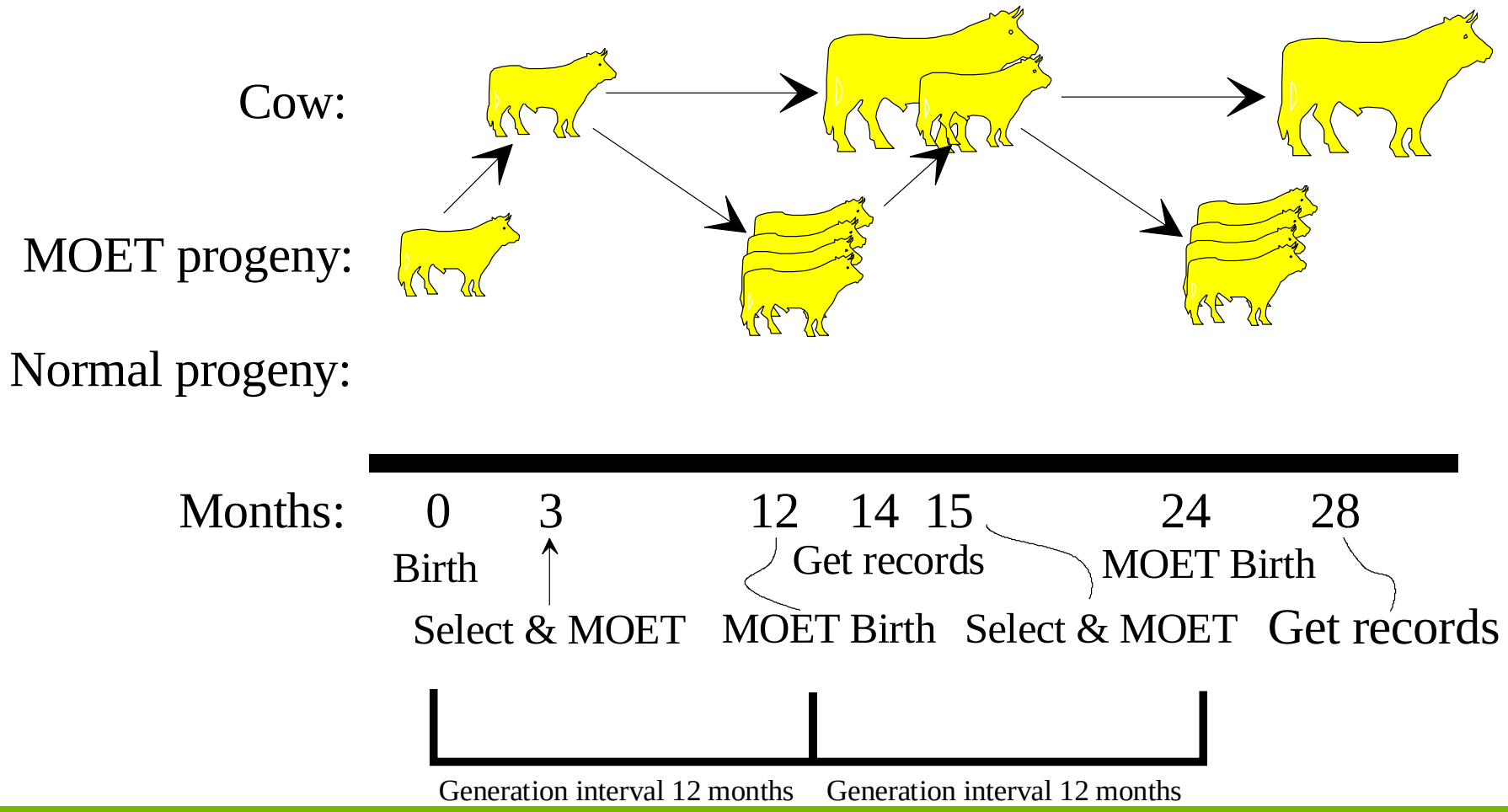
Australia 1999:

32 lambs born from a 6 mo old ewe

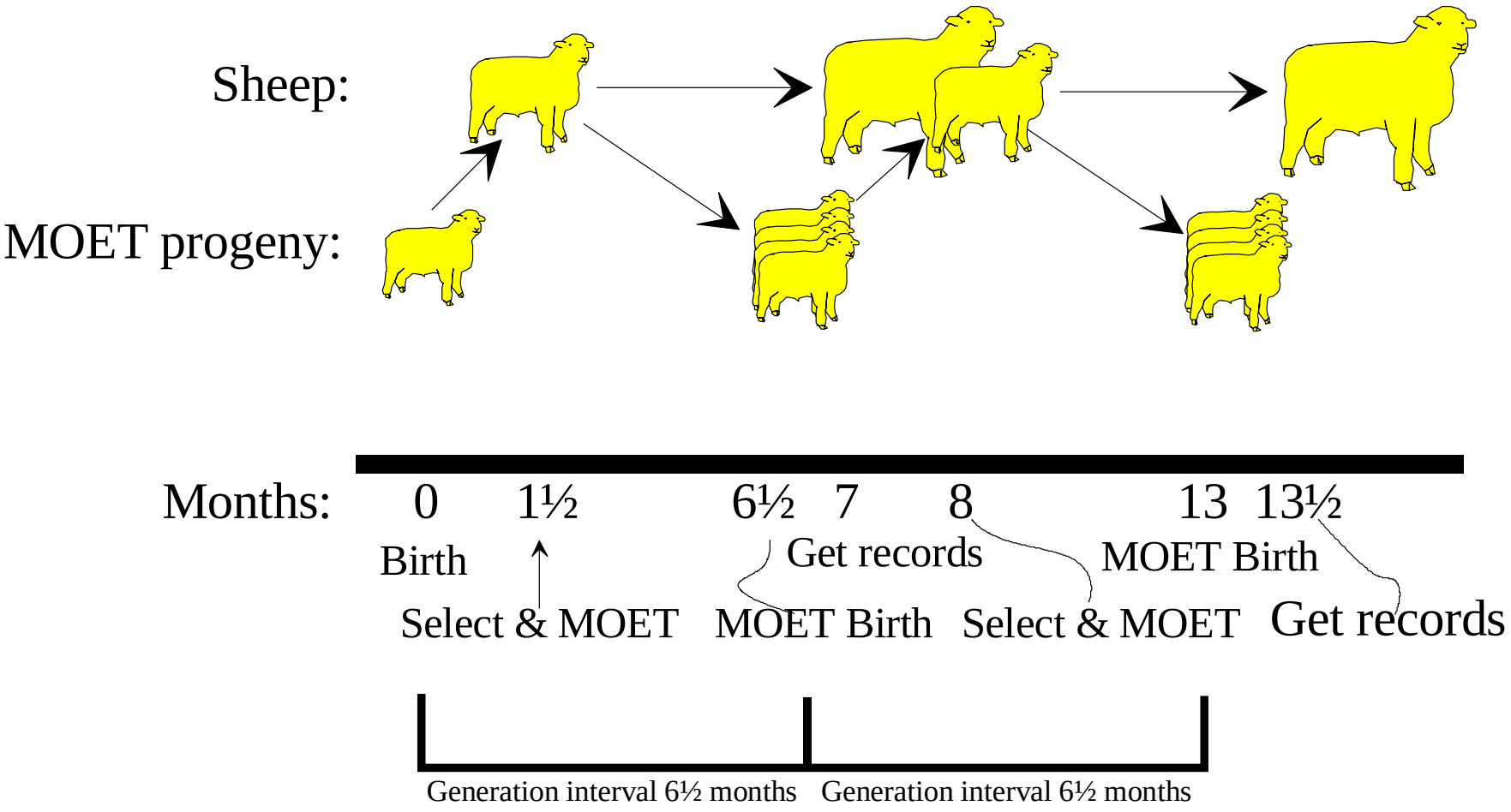
Juvenile beef MOET/JIVET



Even more juvenile beef MOET/JIVET



Juvenile sheep MOET/JIVET



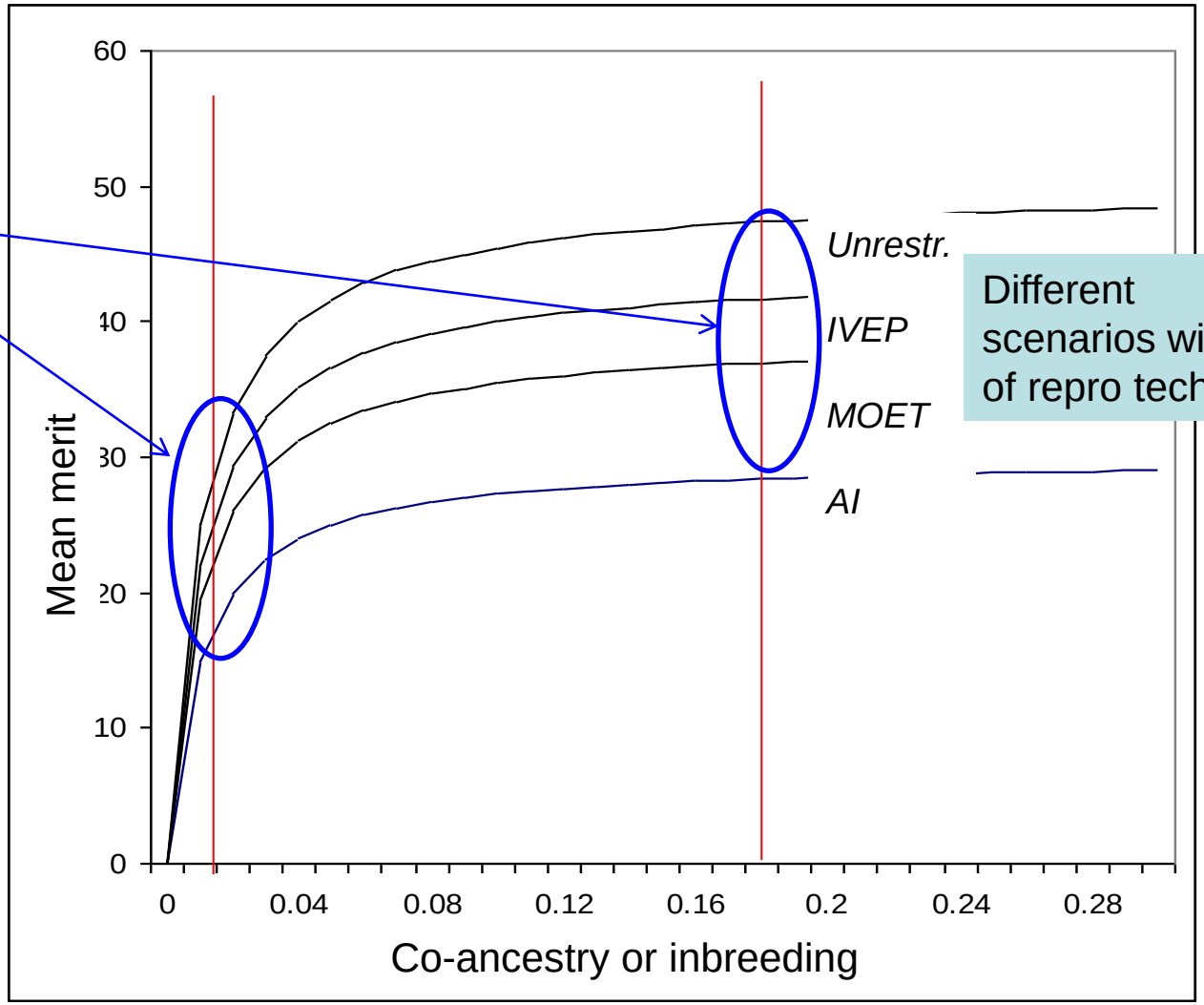
Genetic gain versus genetic diversity

- Sustainable breeding programs require optimal selection balancing genetic gain and genetic diversity

- Potential short term benefits from reproductive technologies are inhibited by the need to maintain diversity

The balance between increased merit and inbreeding

Difference between scenarios much smaller if we have to keep inbreeding low



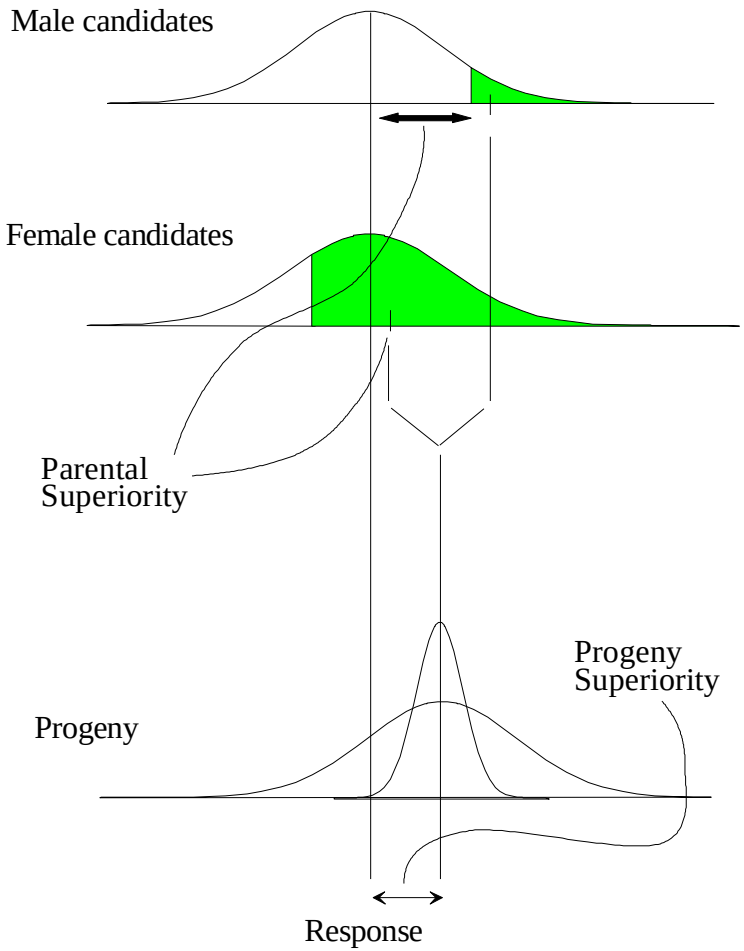
Different scenarios with use of repro technol.

Sexing semen or embryos

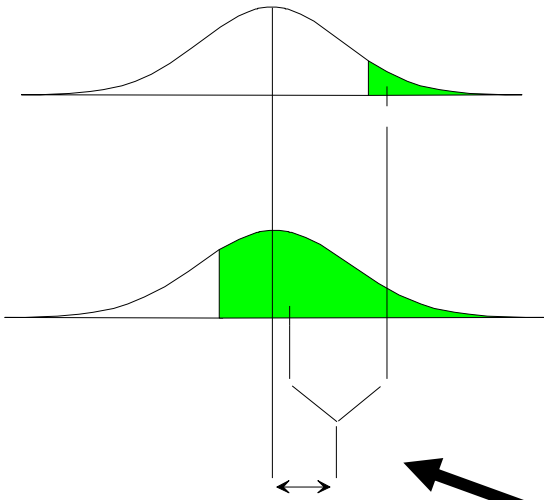
- Ability to sex semen makes little difference to rates of genetic gain:
  - usually less than 5% extra genetic gains
  - About 10% in dairy (sex limited, progeny testing)

- However, effect on commercial production efficiency can be dramatic:
  - eg. Using “male semen” from terminal sires

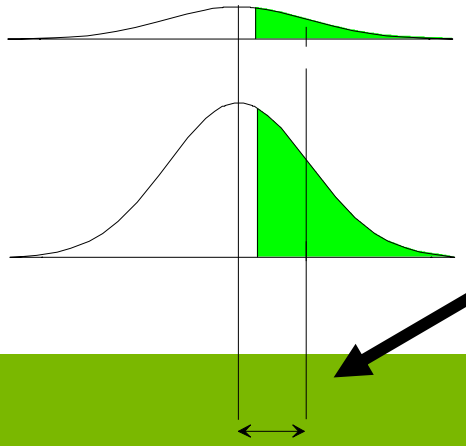
The value of semen sexing in a breeding program



50:50 sex ratio



20:80 sex ratio



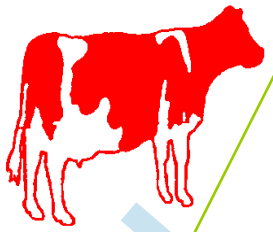
Small difference in response

See also Genup / Ages

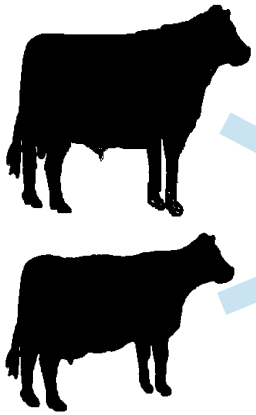
Cloning in animals

- Cloning from embryos, adults and cell lines.
  - Cell lines $\rightarrow$ easy genetic manipulation.
- Evaluate individuals via their clones ...
  - evaluations can be biased
  - fewer genetic individuals as candidates.
- Clone elite individuals for use in industry
  - eg. beef bulls for natural mating.

- Impact on rate of genetic improvement is minimal!



Salvage eggs from abattoir cows



Get embryo from elite parents

Grow embryo in the lab

Embryo cleavage

Remove genes

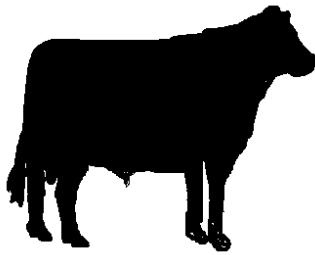
Break embryo into 20-30 identical cells.

Electric pulse merges the two parts

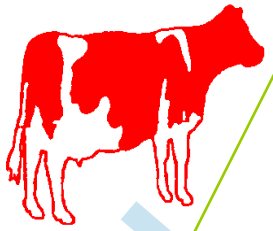
Transfer to recipients when enough have been made. Some can be frozen for later use.

Some embryos start to develop

5 to 10 times more embryos each 4 days.



Monash IRD / Genetics Australia EMT System
from Sandy McClintock



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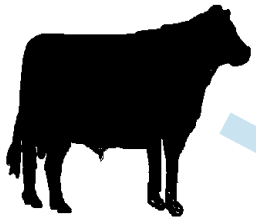
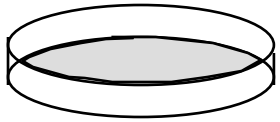


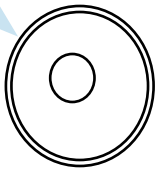
Get tissue sample from an elite animal. Eg skin

Grow cells in the lab



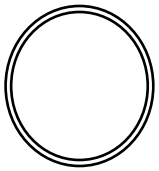
Tissue culture

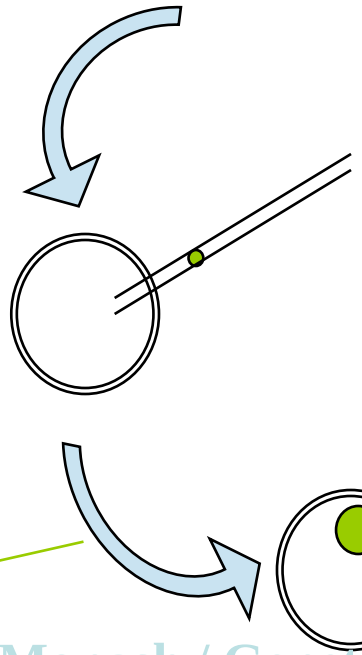
From cell lines



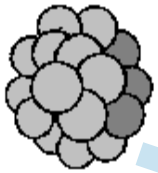
Remove genes

Take a cell from a culture with a million identical cells.





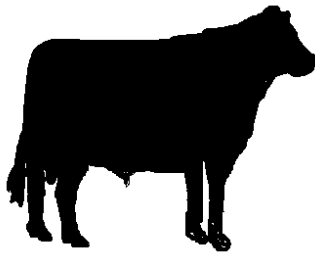
Direct Injection merges the two parts



Transfer to recipients

Some embryos start to develop

Some embryos ready for freezing



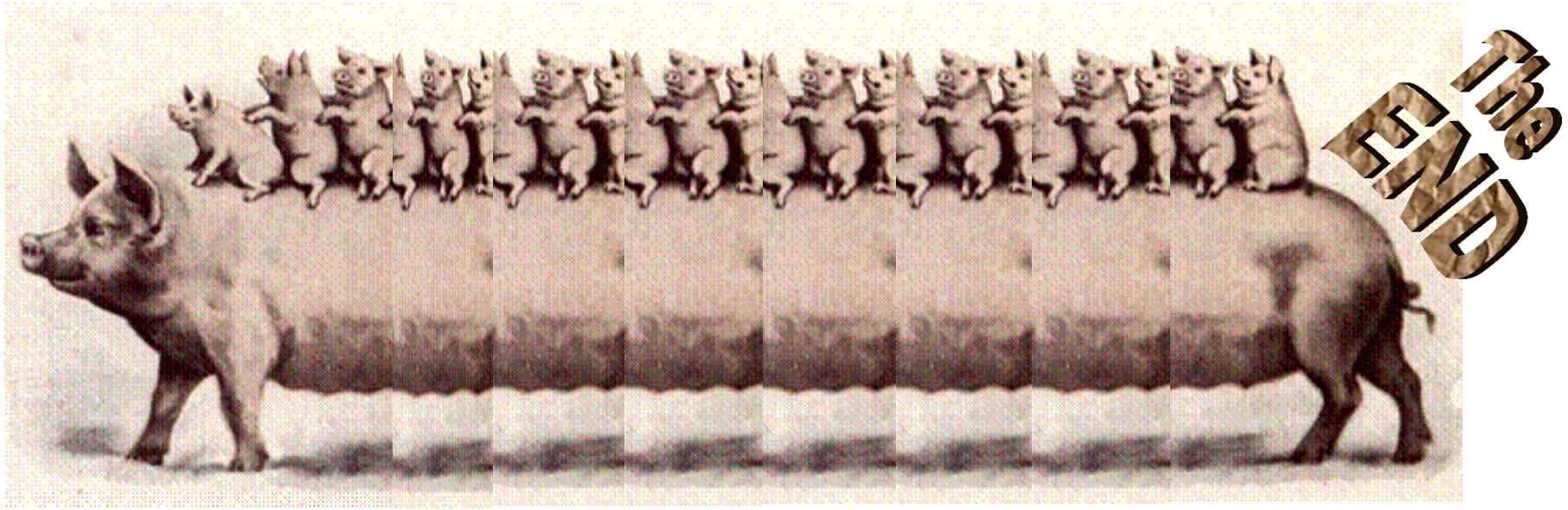
Alternative Monash / Genetics Australia EMT System

from Sandy McClintock

Summary Reproductive Technologies

Usage in breeding industry

	Benefit to rate of genetic improvem.	Dairy	Beef	Sheep	Pigs
AI	++	+++	++	++	++
MOET	++	+++	++	+	
JIVET	+++	+			
Sexing	+	+	-	-	-
Cloning	-				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