Animal Welfare in extensive livestock industries

Concepts of animal welfare

1. *Freedom from hunger and thirst:* by ready access to fresh water and a diet to maintain full health and vigour.
2. *Freedom from discomfort:* by providing an appropriate environment including shelter and a comfortable resting area.
3. *Freedom from pain, injury or disease:* by prevention through rapid diagnosis and treatment.
4. *Freedom to express normal behaviour:* by providing sufficient space, proper facilities and company of the animal's own kind.
5. *Freedom from fear and distress:* by ensuring conditions and treatment which avoid mental suffering.

From https://kb.rspca.org.au/knowledge-base/what-are-the-five-freedoms-of-animal-welfare/

From https://www.animalhealthaustralia.com.au/what-we-do/livestock-welfare/

Animal welfare and animal rights

Definition of the animal welfare

Animal welfare, animal liberation and animal rights are not synonymous terms. Animal liberation and animal rights represent a wide diversity of philosophical views and personal values.

Animal Heath Australia accepts the agreed international definition of animal welfare from the World Organisation for Animal Health (OIE):

Animal welfare means the physical and mental state of an animal in relation to the conditions in which it lives and dies. An animal experiences good welfare if the animal is healthy, comfortable, well nourished, safe, is not suffering from unpleasant states such as pain, fear and distress, and is able to express behaviours that are important for its physical and mental state. Good animal welfare requires disease prevention and appropriate veterinary care, shelter, management and nutrition, a stimulating and safe environment, humane handling and humane slaughter or killing. While animal welfare refers to the state of the animal, the treatment that an animal receives is covered by other terms such as animal care, animal husbandry, and humane treatment.

https://www.animalhealthaustralia.com.au/what-we-do/livestock-welfare/

Useful reference https://www.ncbi.nlm.nih.gov/pmc/articles/PMC340178/pdf/20030600s00023p496.pdf

Animal welfare regulation

- Large differences between countries on rules regarding how animals may be kept
- Need to understand basic rules of any country to ensure you at a <u>minimum</u> work to that level
- Rules around keeping animals in Australia for example can be regulated at Commonwealth, State or Local level but are mostly state based
- E.g. Commonwealth – Live animal export

State – Codes of Practice (Standards (required) and guidelines (recommended)) in Victoria – Livestock Management Act 2010

Local – range of rules on keeping animals/pets & road movement e.g. pet sheep in general are not allowed on blocks of less than 0.5ha (50m *100m)in Melbourne see https://www.smh.com.au/national/vu-ho-loses-fight-against-greater-dandenong-council-to-keep-his-sheep-baa-20131213-2zcqa.html

https://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/pubs/BriefingBook45p/AnimalWelfare

Animal welfare regulation

- Can be specific rules for different species for particular procedures
- Different spacing allowances for different species
- This space has seen significant change in the past 20 years and will most likely continue to evolve with social change – “social license”

“Social License refers to the level of public trust granted to a corporate entity or industry sector by the community at large and its key consumer base.

Public trust is the belief that activities are consistent with social expectations and the values of stakeholders, and earned through industry engagement, operating practices, and expressed values. Social license is slow to build, but quick to erode. Industry tacitly garners public trust by doing what is right.”

https://croplife.ca/what-does-social-license-mean-for-agriculture/

Regulation versus social change

- Significant animal welfare improvement is often as much about companies moving towards societal expectations
- For example, Dr Temple Grandin's work in abattoirs in the USA is mostly driven by a requirement from companies purchasing from abattoirs that certain welfare standards are met https://veterinary-practice.com/article/improving-standard-in-the-abattoirs
- Important and consistent price signal (or purchase signal) to abattoirs to meet key standards, not driven by government regulation but achieving significant welfare outcomes
- We will discuss more in case study and species lectures/case studies

Does animal welfare change?

- Absolutely
- Within my lifetime there have been massive changes in attitude to animal welfare in extensive livestock – both in minimum standards but also average standards
- Much better access to information technology that can improve animal welfare by better monitoring/recording e.g. noting changes in condition score/body weight via eID to individual animals

From https://www.youtube.com/watch?v=Vb3eQG1Vt7k

Examples of welfare challenges in extensive livestock systems

- Mulesing
- Castration
- Shearing
- Speying
- Live-animal export
- (any intervention may produce a welfare challenge as some degree of stress for livestock being moved e.g stress of dog/person/machine moving them)

Mulesing

- What is mulesing?
- Why do producers mules their sheep?
  - Primarily Merino or Merino derived breeds
- What has changed?
- Short term?
- Long term solutions and pathway to get there?

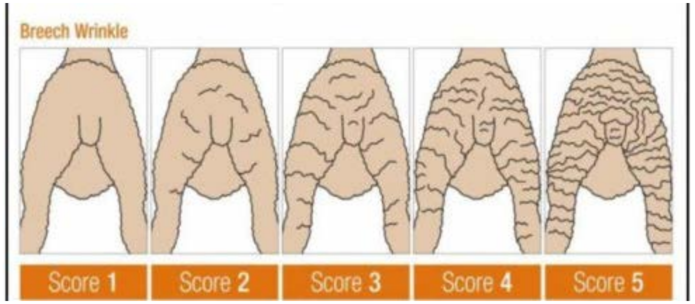

Freshly mulesed lambs


An adult sheep that has been mulesed

https://anzccart.adelaide.edu.au/system/files/media/documents/2019-07/casestudymulesing.pdf


A sheep struck on the body area


A sheep struck on the breech area



https://www.flyboss.com.au/sheep-goats/breeding-and-selection/breech-wrinkle-scoring-and-selection.php

Castration

- What is castration?
- Why is castration performed?
- When is castration performed?
- What method/s?
- Methods to reduce welfare impact?

Shearing

- Fibre goats, sheep and alpaca
- Why is shearing done?
- How is shearing done?
  - Mechanically driven comb/cutter or hand shears
- When is shearing done?
- How long does it last?
- How can welfare be improved?

Spaying

- What is spaying?
- What animals are spayed?
- Why are animals spayed?
- Methods to improve welfare?

https://www.ava.com.au/policy-advocacy/policies/cattle-health-and-welfare/cattle-spaying/

Live Animal Export

- One of the most controversial animal welfare issues
- Why are animals exported?
- Where exported to and when?
- How long does it take?
    - 1-5 weeks (depends on destination)
- What is the welfare issue and measure/report?
- How might it be improved further?
- Can it be improved enough? Social license.

ELSEVIER
Applied Animal Behaviour Science
Volume 179, June 2016, Pages 39-45

Characterisation of Shy-feeding and Feeding lambs in the first week in a feedlot

Maxine Rice[a], Ellen Caroline Jongman[a], Samantha Borg[a], Kym Lloyd Butler[a,b], Paul Hamilton Hemsworth[a]

Show more

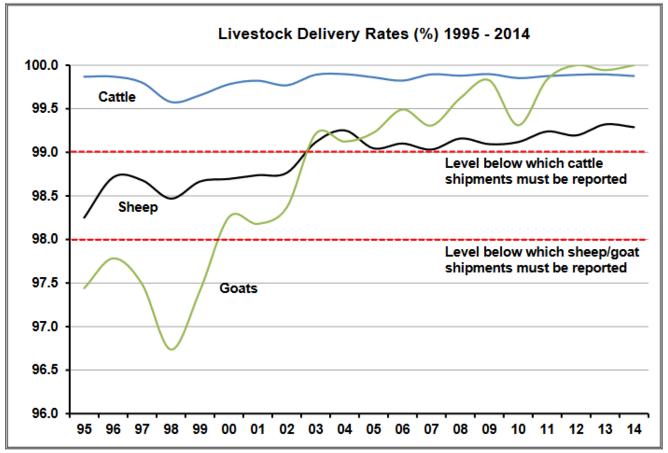
Live export trade assessment

Beth Deards, Robert Leith, Clay Mifsud, Caitlin Murray, Peter Martin and Trish Gleeson

Research by the Australian Bureau of Agricultural and Resource Economics and Sciences

Report to client prepared for the Live Animal Exports Reform taskforce, Department of Agriculture

The graph below shows percentages of sheep, cattle and goats successfully delivered by sea since 1995.



https://www.mla.com.au/contentassets/0ecfc85cc00e4e8db6839f5893ed90b2/w.liv.0288_final_report.pdf

Change in genetics/genomics

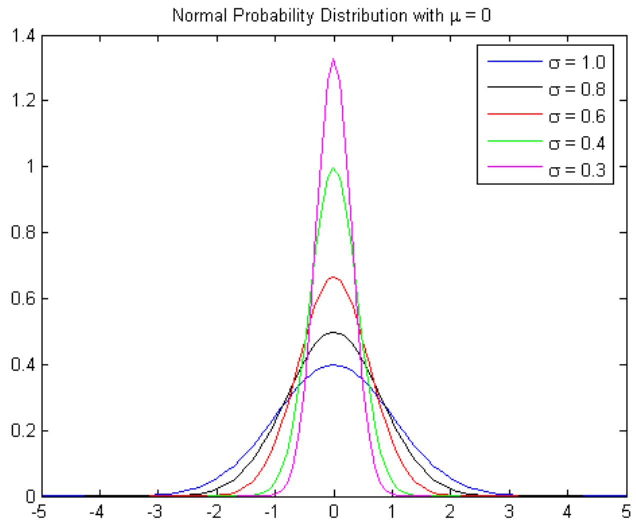
- Some welfare based challenges can be improved through the use of genetics and genomics
- For example using a polled bull (bull with no horns) such as an Angus over a horned Hereford cow results in progeny with no horns. In Bos indicus this genetics is not quite as simple but genomics can help more
- To understand this we need to first understand a bit more about genetics/genomics

Extensive livestock genetics

- Any breeding decision in a self replacing herd/flock has a long term, compounding impact where progeny are retained to contribute to future genetics
- Good decisions on introductions of genetics (male or female) can significantly improve production/welfare, whereas bad decisions can have the opposite impact!
- Almost any animal trait you can think of has some degree of genetic variation e.g. coat colour, birth rate (multiple versus single), seasonality of breeding, muscularity, intramuscular fat, disease resistance traits etc.

Genetic variation

- Genetic differences/variation between animals are due to differences in DNA sequence
- In most populations we observe a distribution of traits e.g. growth rate controlled by multiple genes and can have a normal distribution as below
  - Traits might be qualitative (One or small number of genes) e.g. Poll v Horn, Coat colour (black v red in Angus)
  - Traits may be quantitative (e.g. growth rate), many genes



https://explorable.com/images/normal-probability-distribution.png

Terminology

- Phenotype – appears or performance of an animal (colour, bodyweight, milk production)
- Genotype – animals genetic makeup, all genes influencing a particular trait (expressed in environment as phenotype)
- Simple inherited trait – impacted by single or few genes (horned/polled)
- Polygenic trait – many genes involved e.g. weaning weight, fertility, milk production

Terminology

- Breeding value – value of an animal as a parent due to genetics
- Heritability – measure of strength of relationship between breeding value and phenotypic value ie. High heritability means easier to make genetic progress
- Major genes – gene that has major impact on quantitative trait e.g. Boorola gene in sheep, Double muscled gene in cattle (Belgian Blue)

Variation in quantitative characters

- Phenotype = Genetics + Environment

Ie. Same animal raised in different environment will have different phenotype

- Huge range in potential genotype in offspring from two parents where many (possibly hundreds) of pairs of genes involved
- Inbreeding (mating closely related animals such as father/daughter) decreases variation ie. Population genetically more uniform
- Qualitative traits not influenced by environment e.g. Angus coat colour will always be red or black, not something in between
- Quantitative traits are influenced by environment, often more impact from environment than genetics overall e.g. nutrition
- These environmental differences are NOT transmitted to next generation!

Selection

- How do we choose which animals should contribute to the next generation of animals in an extensive livestock production system – we want to separate genetics from environment but at a sale we are looking at an animal that is a combination of both genetics and the environment they have been raised in
- What we are trying to do is select the animals that have the best genes to improve certain traits e.g. milk production, animal health
- Important to also recognise we don't want to increase frequency of other genes that may cause issues e.g. increased dystocia, poor behaviour etc

Selection

- We move from natural selection to artificial selection to change (hopefully improve) gene frequency
- Might do this naturally, often by purchasing new sires or selecting home bred sires; or artificially by using artificial insemination (AI) or embryo transfer (ET)
- We can select the new generation and cull (sell) older or “off-type” animals and keep the population size static
- Need to weigh up the “balance” of genetics in each animal (may keep some animals that have only average genetics in one area if have excellent genetics in other areas)

Selecting for multiple traits

- Generally selecting for traits of economic importance, but maintaining animal health/reproductive traits
- As number of traits selected for increases progress towards improving each trait will reduce ie. Selection for single trait leads to faster improvement, selection for many will reduce progress on each one (although some may be linked e.g. 200d and 400d growth)
- Need to decide on what traits are most important and how many we want to include in an index (combination of traits to produce an index "number")
- Can solely use "index" or may use combination of individual traits

Setting limits

- With respect to an index as a combination of traits
- Within that index will be a range of separate traits so the same index number may have a very different combination
- If we want to maintain minimum or maximum levels in each area we can set these and then look at maximum index, this can be further enhance if purchasing animals by putting a $ cost on each animal e.g. Manager is willing to pay a certain amount for each different animal based on their genetic package

Selection Indexes

- A range of different genetic evaluation programs are available for different species e.g. Breedplan, Lambplan, Kidplan etc
- These use phenotypic information from the individual animal as well as information from all their relatives
- Importantly when data is collected this is done in groups that have been housed together to reduce/eliminate environmental variation
- Different versions of these are available around the world and these may be expressed differently as EBV or EPD (this will be covered more in different species)

EBVs

- Estimated Breeding Values are calculated for a range of economically important quantitative traits (called ASBVs for sheep industry)
- Often these are combined into a particular index to suit a particular market and different enterprises may use one or more indexes or focus on particular EBVs to progress towards a certain genetic goal
- E.g. if a ram has a dollar index of 105 he will produce $5 extra per progeny so if produces 200 progeny = $1000 extra than a dollar index ram of 100
- Index on right shows same index but

different composition of ASBVs

Ram ID	PWT (kg)	PEMD (mm)	PFAT (mm)	Index
Ram 1	7.6	-0.7	0.8	155
Ram 2	8.4	1.0	3.3	155

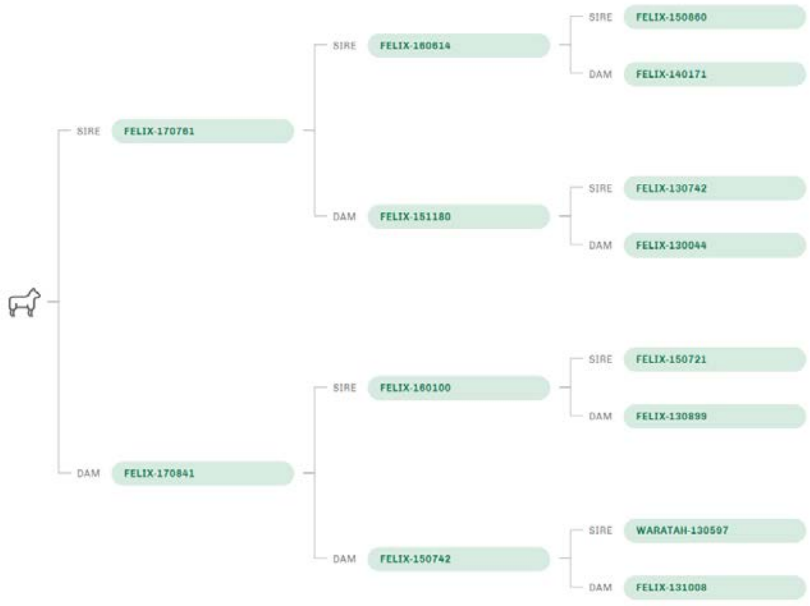
http://www.sheepgenetics.org.au/Getting-started/ASBVs-and-Indexes

Pedigree and ASBV or EBV

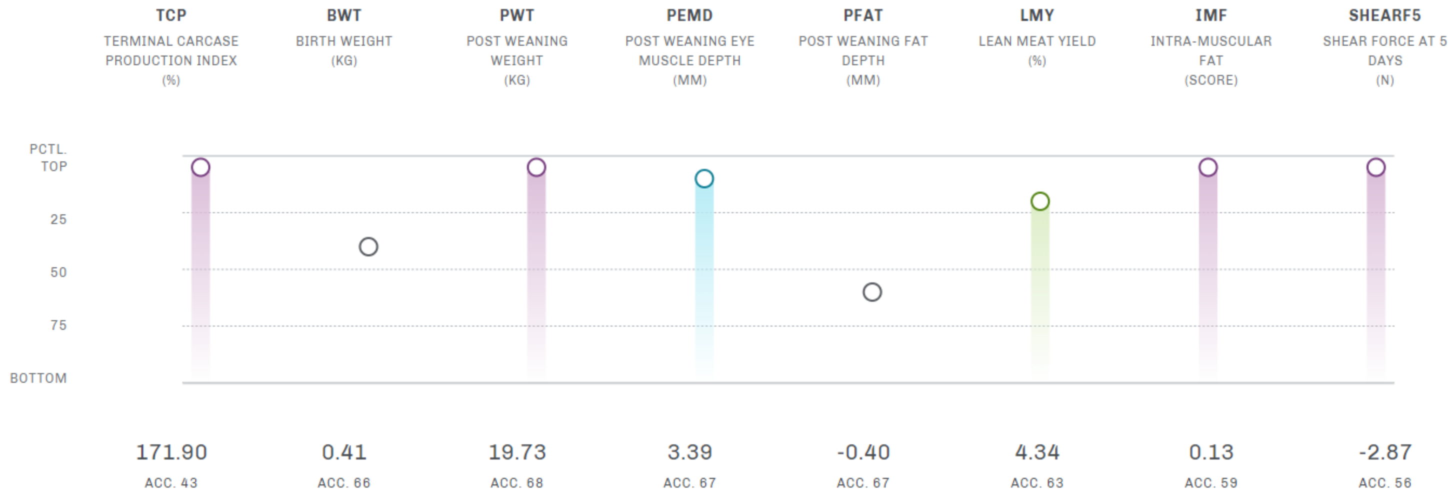
FELIX-191025 GENOMICS	171.90	0.41	19.73	3.39	-0.40	4.34	0.13	-2.87
	ACC. 43	ACC. 66	ACC. 68	ACC. 67	ACC. 67	ACC. 63	ACC. 59	ACC. 56
	TOP 5%		TOP 5%	TOP 10%		TOP 20%	TOP 5%	TOP 5%

ID	230048-2019-191025	**Progeny**	0	**Stud**	FELIX
Breed	WHITE SUFFOLK	**Flocks**	0	**Breeder**	RODNEY WATT (230048)
Sex	Male	**Location**	GREENETHORPE, NSW 2809	**Contact**	—
Drop	2019			**Website**	

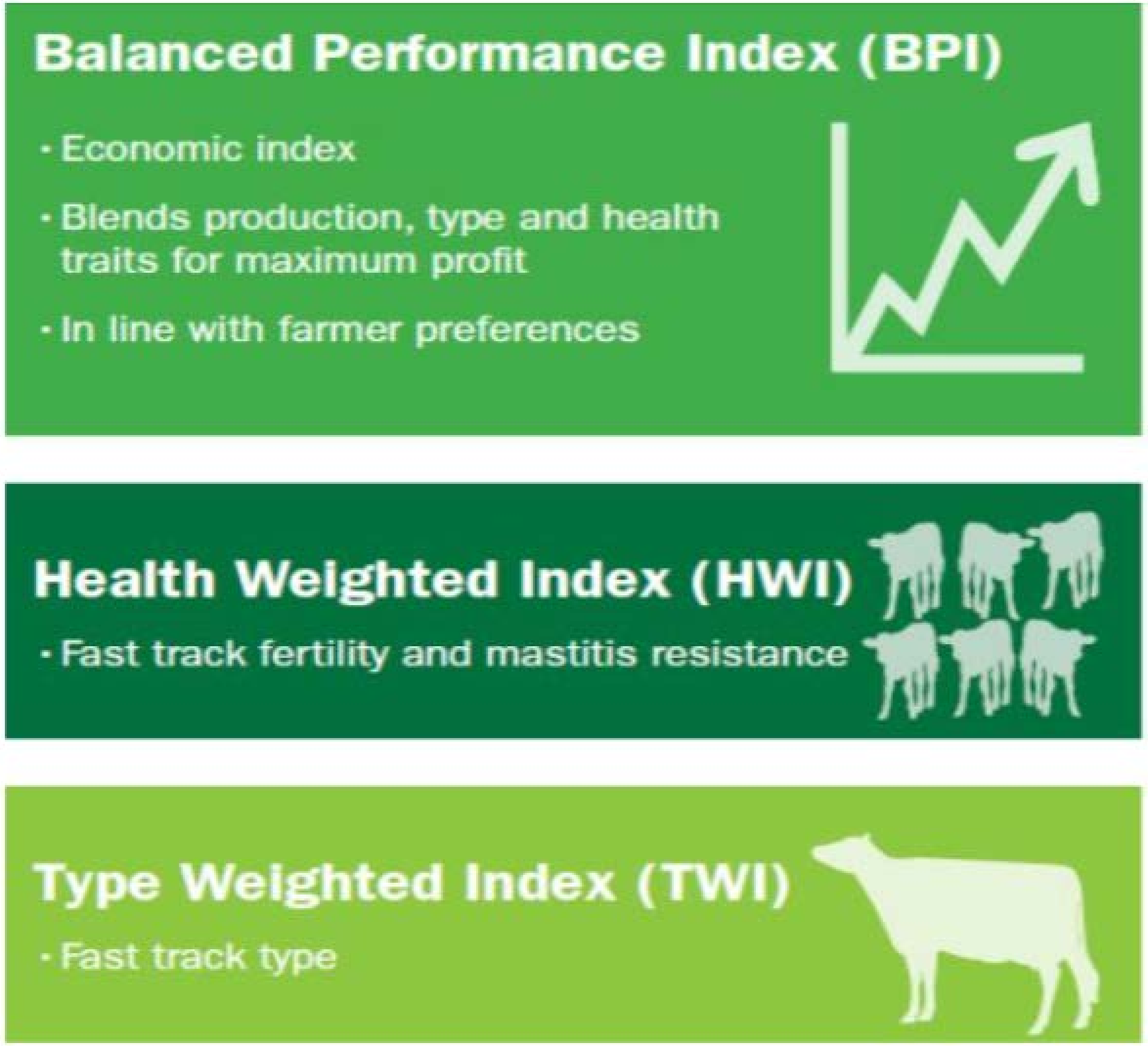
Pedigree



ASBV snapshot



Australian Dairy Cattle Selection Indices



Improving herds an Australian Dairy Initiative

https://www.youtube.com/watch?time_continue=107&v=YsVn33rkY8U

Once we have our males and females how to choose mating groups?

- Could mate best to best and worst to worst or try to even out by mating best to worst and vice versa
- Can be useful for “correct mating” for structural issues where want a mid range phenotype
- Inbreeding – mating animals more closely related than average population (genetically related individuals). Can include for example mating sire with daughter or son with dam
    - Increases homozygosity
    - Can uncover undesirable recessive genes as increase in frequency
    - Tends to reduce fertility and may reduce growth
    - Some breeders use moderately closely related for “linebreeding” to increase genes from particular ancestor
    - Progeny more likely to be like parent

Outbreeding

- Mating between individuals with unlike pedigree
- Crossing inbred lines, different breeds etc
- E.g. mating a dairy animal to beef animal (Friesian cow to Angus bull to produce F1, often used as a vealer dam). Merino mated to Border Leicester = first cross ewe.
- Increases heterozygosity – more variability in progeny
- Usually not common ancestors within 4 generations
- Maintains high levels of performance and get few undesirable recessive genes (but monitor to ensure not present)

Why cross breed

- Breed complementarity
  - E.g. Merino x Border Leicester
  - Firstly, lots of Merino available so mate BL ram to Merino ewe. BL ram for meat characteristics and growth
  - Hybrid vigour
    - Increase in performance in growth, fertility, survivability
    - Amount by which progeny exceed the expected mid point of parents
  - Worthwhile noting don’t just get the best traits of both breeds, can also get worst! Generally good traits tend to be dominant hence crossbreeding more commonly gets good traits.

Cross breeding systems

- Simple system is a two breed cross and then a terminal sire used with all progeny
- More complex systems involving multiple breed rotational crosses to get similar percentage of each breed into the herd/flock e.g. two or three breed rotational cross – can get complex with mating needs but hybrid vigour can be maximised

Genetic defects

- A range of genes can lead to genetic defects
- E.g. dwarfism, BLAD (causes regular bacterial infection and early death), Curly Calf syndrome etc
- Cull carriers from herd/flock, problem is happens in a sire that is used via AI as many impacted

Selection differential

- Generally apply greater selection on males than females only need 1:30 or 1:100 males:females
- Maximum selection pressure in females more like 1:2 (ie keeping half of progeny, depending on species & breed)
- Response to selection depends on heritability, proportion of population kept to breed and variation in population
- Low heritability ranges from 0-20% while moderate ranges from 20-50%

Genomics

- Entire set of genes in an animal
- Can be used to predict genetic merit of animals early in life (based on historical phenotypic records collected and measured against genotype)
- Reduces selection costs as can test using genomics once born and reduce requirements for progeny testing
- Need reference herd/flock to continue to benchmark genomics and performance
- Using 50,000 SNP, or lower test kits, costs are now less than $100 per test

Speeding up gain further

- Artificial Insemination
- Multiple Ovulation and embryo transfer
- Juvenile in vitro embryo transfer
- Sexing semen
- Cloning
- Transgenics