Capped Reproduction (DPCR)

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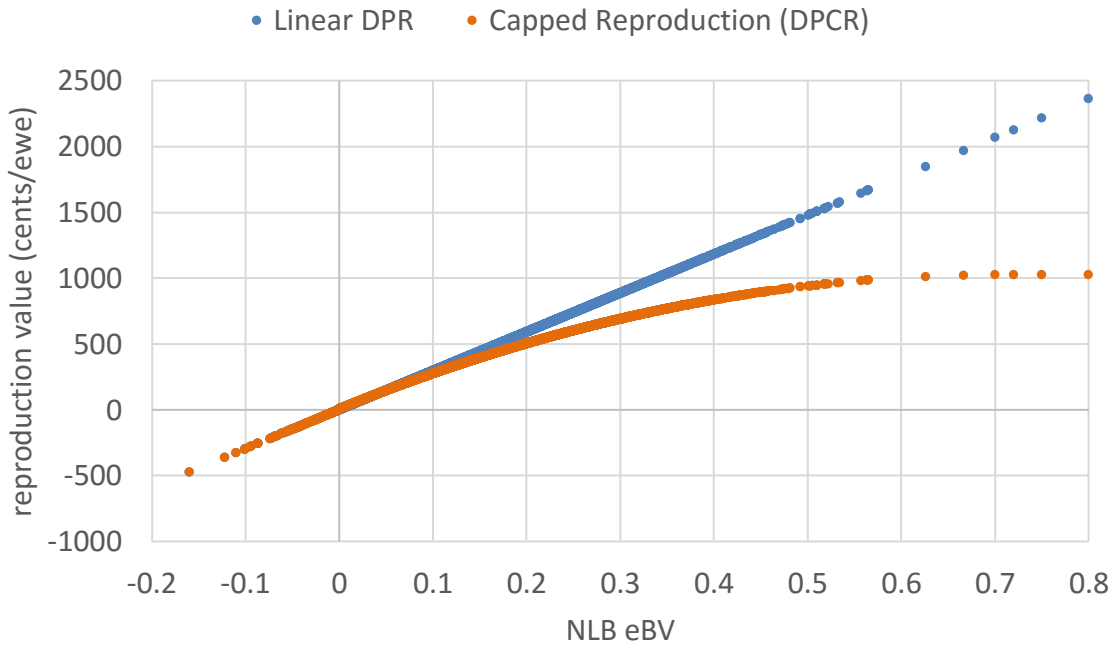
The SIL Capped Reproduction (DPCR) value is a method to value an animal's genetic value for number of lambs born (NLBeBV). This method was developed to correct two problems with the previous linear DPR method: (1) That the DPR over-valued additional multiple lambs, and (2) That the DPR caused highly prolific rams to rank highly on the NZMW index even when they are poor for other traits, such as growth.

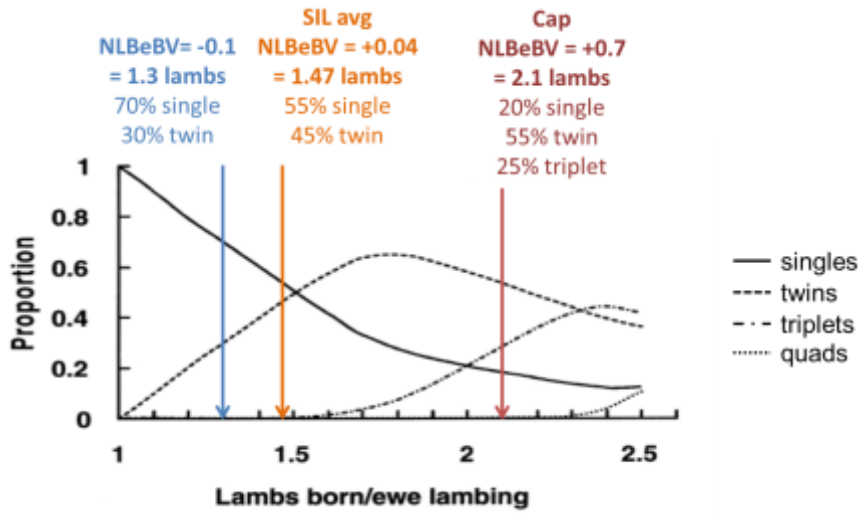
The DPCR formula

The formula for DPCR has three sections. Animals with negative NLBeBV are assigned DPCR equal to DPR, ie. 2954 × NLBeBV. Animals with NLBeBV between 0 and 0.7 are assigned DPCR from 0 to 1024 cents/ewe lambing according to a curve where DPCR values increase, but at a decelerating rate. Animals with NLBeBV at and above the optimum of 0.70 lambs are all assigned a flat cap value of 1024 cents/ewe lambing.

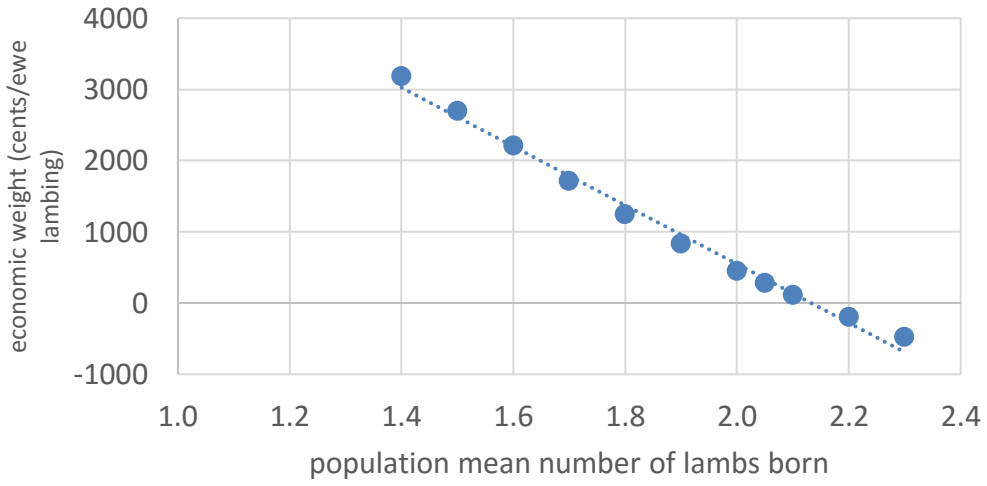


DPCR corrects for over-valued extra lambs

The problem with the linear DPR is that it values each extra lamb equally, regardless of whether it is single, twin, triplet, quad or quint. This is incorrect: most farmers don't want too many triplets, because large litters require more labour and higher risk for ewes. Going from low NLB to moderate NLB has high economic value because it substitutes singles with twins, as shown in the graph below. However, going above moderate NLB causes twins to be substituted with triplets and quads. These additional lambs have less economic value to farmers.



This fact that every additional lamb is worth comparatively less was used in developing the DPCR function. Economic models show that at low prolificacy, NLB has high economic value, but as NLB increases, its economic value goes down, as shown in the plot below. At very high NLB, the economic value becomes negative.



The DPCR is a better method, because it applies less additional value for higher levels of NLB. DPCR is not a penalty. The linear DPR over-values additional triplet and quad lambs.
A sudden cap (broken line function) would not be correct either: the value of extra lambs doesn't suddenly stop at some point. The DPCR curve more accurately reflects biology and economic value of extra multiple lambs, by incrementally reducing their additional value.

In theory, we should penalize high NLB rams. But, in practice, there is still a role for high NLB rams to lift prolificacy in low prolificacy flocks. With DPCR, high NLBeBV still has positive cents value and above optimum NLBeBV still receive maximum cap value. The DPCR is therefore a compromise that recognizes that highly prolific genetics still have use in the diversity of flocks across the NZ sheep industry.

Although an intuitive goal might appear to aim selection at a target optimum NLB, selecting for an intermediate optimum is in fact inefficient in a multiple trait breeding program that is also working to improve other traits such as growth and health.

DPCR ensures that index value reflects other important traits

Many breeders question why highly prolific rams have high ranking on the full NZMW index when they are poor for many other traits, e.g. growth. This can occur if a ram has very high NLBeBV, causing its DPR to swamp out DPG and other components of the index. DPCR also addresses this problem. With DPCR in the NZMW, high NLB rams are still acceptable, but must be good for other traits in order to rank highly on the full index.

Ram	NLBeBV	CWeBV	Index with DPR	Index with DPCR
A	High	Low	High	Mod
B	High	High	High	High
C	Low	High	Mod	Mod

This effect on ranking can be seen in the table below. A large group of proven rams were ranked according to either NZMW with DPR, or NZMW with DPCR, and the top 100 selected. The top 100 rams according to NZMW with DPCR had slightly lower average NLBeBV, but higher average values for Growth, Adult Weight and Survival sub-indexes.

	NZMW with DPR Top 100 rams	NZMW with DPCR Top 100 rams
NLBeBV (lambs)	0.26	0.21
Growth (DPG, cents)	1541	1556
Adult weight (DPA, cents)	-251	-221
Survival (DPS, cents)	315	349
Wool (DPW, cents)	245	246

Implications

- Up to the cap, animals will still rank the same for reproduction but may change in NZMW rank
- DPCR curved-then-flat economic value is an efficient approach for multi-trait selection in diverse populations
- DPCR mitigates the risk of highly-prolific genetics badly overshooting optimum NLB, while improving response in growth, ewe weight, and survival