

## New Zealand Society of Animal Production online archive

This paper is from the New Zealand Society for Animal Production online archive. NZSAP holds a regular annual conference in June or July each year for the presentation of technical and applied topics in animal production. NZSAP plays an important role as a forum fostering research in all areas of animal production including production systems, nutrition, meat science, animal welfare, wool science, animal breeding and genetics.

An invitation is extended to all those involved in the field of animal production to apply for membership of the New Zealand Society of Animal Production at our website [www.nzsap.org.nz](http://www.nzsap.org.nz)

[View All Proceedings](#)

[Next Conference](#)

[Join NZSAP](#)

The New Zealand Society of Animal Production in publishing the conference proceedings is engaged in disseminating information, not rendering professional advice or services. The views expressed herein do not necessarily represent the views of the New Zealand Society of Animal Production and the New Zealand Society of Animal Production expressly disclaims any form of liability with respect to anything done or omitted to be done in reliance upon the contents of these proceedings.

This work is licensed under a [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License](http://creativecommons.org/licenses/by-nc-nd/4.0/).



You are free to:

**Share**— copy and redistribute the material in any medium or format

Under the following terms:

**Attribution** — You must give [appropriate credit](#), provide a link to the license, and [indicate if changes were made](#). You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.

**NonCommercial** — You may not use the material for [commercial purposes](#).

**NoDerivatives** — If you [remix, transform, or build upon](#) the material, you may not distribute the modified material.

<http://creativecommons.org.nz/licences/licences-explained/>

## Design and implementation of the Deer Progeny Test (DPT)

JF Ward\*, JA Archer, GW Asher, JM Everett-Hincks and HC Mathias-Davis

*AgResearch Invermay, Private Bag 50034 Mosgiel 9053, New Zealand*

*\*Corresponding author. Email: jamie.ward@agresearch.co.nz*

### Abstract

The Deer Progeny Test (DPT) program was established in 2011, to better measure the venison production genetics available to the New Zealand deer industry and to allow commercial farmers to better utilise them to improve productivity and profitability. The DPT has five principal aims: (1) encourage and improve sire linkage across recorded breeding herds; (2) provide a platform to evaluate breeding values across the breeds of red and wapiti; (3) evaluate new traits and generate genetic correlations to allow optimisation of selection goals; (4) provide a starting point for the evaluation of maternal traits under commercial breeding environments; and (5) establish a well-phenotyped population, for future genomic tool development. The DPT is a three-year breeding program run across three different farms, progeny were born on two farms annually. Three years of artificial insemination (AI) were completed in April 2013 and involved 2417 inseminations, using 35 different sires and 1581 hinds, with an average rate of progeny weaned to hinds inseminated of 68%. All maternal (red) male and terminal (wapiti crossbred) progeny are slaughtered at approximately 11 months of age to measure carcass traits while maternal females are retained into the breeding herd to measure maternal traits. The final progeny slaughter is due late 2014. Seasonal live weights and temperament scores are collected on progeny and dams, while ultrasound eye muscle area, parasite antibody levels and foetal age are recorded on progeny. A subset of core traits is recorded by partner herds who contributed AI sires. Slaughters occur on a single date for each farm and a variety of meat yield and quality traits are assessed. DPT data is uploaded to DEERSelect from incorporation of these data is publically communicated via Sire Summary reports. The DPT has increased the percentage of linked herds recording growth on DEERSelect from 70 to 100%. This means DEERSelect breeding values and economic indexes produced from red deer can be validly compared across herds.

**Keywords:** deer; progeny test; DEERSelect; red deer; wapiti; sire

### Introduction

In 2007 Deer Industry New Zealand (DINZ) implemented a 5-year productivity strategy (Pearse & Fung 2007). This strategy, aimed at making productivity gains for venison, growth, and reproductive traits for farmed deer, as “the deer industry has struggled to achieve any real productivity gains (in these areas) over the previous 10 years” (Pearse & Fung 2007). This strategy has since been revised and the aims of the later document included: “more deer, earlier, heavier” and “the uptake of genetics, technology and techniques by deer farmers” to enable productivity increases (DINZ 2011a).

Tools for quantitative genetic analysis which provide estimated breeding values (EBVs) for genetic selection of deer have been available to breeders since 1998 and across-herd genetic evaluation for red deer became available following the launch of DEERSelect in 2005 (Archer et al. 2005). A Sire Reference Scheme (SRS) operated at Invermay from 2003-2007 (Archer 2003), and was designed to provide sufficient linkage to allow across-herd genetic evaluations for red deer. DEERSelect, using the Sheep Improvement Limited (SIL) genetic engine with evaluation modules written specifically for deer, performed across-herd genetic evaluations for 15 linked red deer herds using the linkage provided by the SRS (Archer et al. 2005). There have been many subsequent developments in

DEERSelect, including the addition of within-herd EBVs for wapiti in 2008 (Archer 2008), new red deer trait modules such as reproduction (Archer 2010), meat yield (Asher 2011) and economic indexes (Archer 2010). There have also been many other updates within the SIL database where DEERSelect resides, such as new methods for reporting genetic connectedness of herds and contemporary groups (linkage) (Visser et al. 2013).

Genetic linkage among herds needs to be maintained as historical links weaken over time. If genetic linkage is inadequate it becomes invalid to compare the genetic merit of animals from different herds (Visser et al. 2013). By 2010, there was concern that linkage established by using common sires in the SRS 2003-2005 birth cohorts had weakened due to the links established not being maintained via ongoing usage of common sires across breeding herds, as had been anticipated (Archer et al. 2011). This was confirmed, when the April 2011 DEERSelect red deer sire summaries were reported, with only 14 out of 20 herds recording growth (live weight) traits adequately connected (under present SIL criteria (Visser et al. 2013)) for across herd reporting (Table 1). Three of the six unlinked herds had contributed sires to the SRS and had been linked in 2005.

Red deer and wapiti are different subspecies with large morphological differences between them as such they are evaluated separately on DEERSelect using

**Table 1** Red deer herds connected (according to SIL criteria) for across-herd Sire Summary reporting (sires of last three-years-progeny cohorts) of different trait groups from DEERSelect before (April 2011) and after (December 2013) the inclusion of data from deer progeny test (DPT) 2011- and 2012-born cohorts.

Trait group	Herds connected		% herds connected	
	Apr 2011	Dec 2013	Apr 2011	Dec 2013
Growth	14/20	24/24	70%	100%
Reproduction	4/6	9/12	67%	75%
Meat-yield*	N/A	9/9	N/A	100%

\*Meat-yield traits not available on DEERSelect until October 2011

different genetic parameters (Archer et al. 2008). This means that EBVs for wapiti crossbreds and red deer are not directly comparable. Commercial deer farmers primarily use wapiti as terminal sires for venison production (Shackell et al. 2003) and the impossibility of directly comparing red and wapiti EBVs has made sire purchase decisions based on EBVs difficult or confusing for farmers.

Venison dominates the deer industry's export revenue, accounting for greater than 75% of recent past annual revenue from 2007-2011 (DINZ 2011b). By contrast, the maximum velvet antler had contributed was 11%; less than the 13% averaged by other products associated with venison production, (e.g. co-products, hides and leather, DINZ 2011b). Popular opinion is that antler traits (velvet antler and trophy) dominate the promotion of breeding stags for sale, which is disproportionate to the revenue generated by antler across the industry.

### Establishment of the DPT

At a meeting held at AgResearch Invermay in December 2010, involving DINZ staff, breeders, scientists, industry geneticists, farm consultants and veterinarians, a proposal to create a centralised genetics resource to achieve multiple outcomes ranging from near-term applied focus (e.g., herd genetic linkage) to longer-term research (e.g., development of resources for genomic research) was presented. At the same time, food processors Alliance Group Limited (AGL) expressed interest in supporting a progeny test for deer to evaluate meat and carcass yield and quality characteristics, similar to the Alliance Central Progeny Test (CPT) for sheep (Campbell et al. 2003). Endorsement by breeders and support from AGL and DINZ lead to establishment of a working party to guide implementation of the DPT project.

Other industry participants, particularly venison processors were invited to be involved in the industry-wide project. Following this, Landcorp Farming Limited (LFL) agreed to contribute funds alongside AGL, DEERResearch, and AgResearch (MBIE Core Funds). Breeders were asked to submit expressions of interest to become partner herds. This involved contributing semen (gratis) from sire stags used heavily in individual herds (and ideally across several

others), in the year of corresponding DPT progeny conception. There was also a committed undertaking to record on DEERSelect for key growth, meat and reproduction traits.

### Goals of the DPT

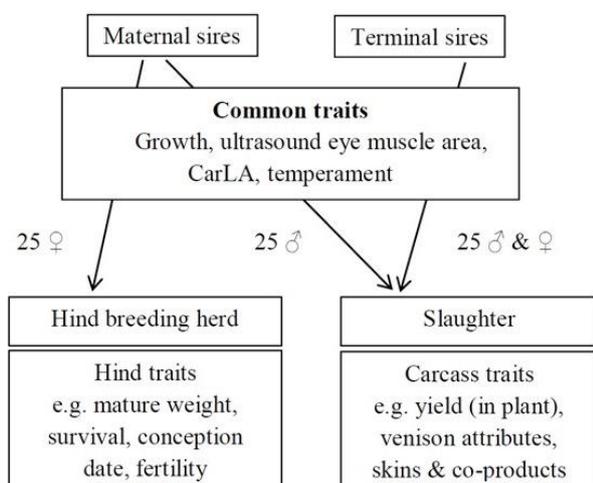
The DPT project is primarily growth and venison focussed, and therefore, both red deer (maternal sire type) and wapiti or wapiti crossbred (terminal sire type) sires were included for evaluation, as the annual contribution of wapiti crossbreds for venison production up to 50% of the annual number of animals slaughtered (Shackell et al. 2003). A range of these sires was used and their progeny evaluated under commercial conditions, such as hill and high-country farms where many commercial breeding hinds are now farmed (Netzer et al. 2009), because farmers question what the most suitable hind genotype is for such environments.

The DPT has five principal aims, to: (1) encourage and improve sire linkage across recorded breeding herds; (2) provide a platform to evaluate breeding values across the breeds of red and wapiti (maternal and terminal); (3) evaluate new traits (especially venison related) and generate genetic correlations to allow optimisation of selection goals; (4) provide a starting point for the evaluation of maternal traits under commercial breeding environments; and (5) establish a well-phenotyped, DNA resourced population, for future genomic tool development.

### Operation of the DPT

The DPT has run for three breeding cycles (2011-2013). Each cycle aimed to provide 25 male and 25 female progeny per maternal sire and 25 mixed-sex progeny of terminal sires across two DPT farms (Fig. 1). It was assumed that the minimum AI conception rate of would be 70%, therefore each maternal sire would require 72 hinds and each terminal sire 36 hinds to be inseminated by trans-cervical AI (Rhodes et al. 2003). The aim was to inseminate 800 hinds across both DPT farms (400 per farm) each year, producing approximately 560 progeny from 11 sires annually, linked by one maternal and one terminal sire across the three years. Each sire was used evenly on both DPT farms and hinds were randomly allocated to sires. All male maternal offspring and all terminal (wapiti) offspring (male and female) are slaughtered, while all maternal (red) female offspring are retained and integrated into the DPT farm's breeding herd (Fig 1). Replacement breeding maternal females are managed as per standard farm practice and all fates and culling decisions recorded to evaluate performance (survival, reproductively) in commercial environments. Each

**Figure 1** Design of deer progeny test (DPT) for numbers of progeny generated per sire of each sire-type, traits measured and planned fates for each sex of those progeny-types.



partner herds used the sire(s) submitted for AI that cycle within their own herds in the same year as the DPT and recorded those and all stud progeny pedigrees and core traits on DEERSelect.

The primary selection criteria of stags submitted for use in the DPT by partner herds was their ability to improve linkage across industry (i.e. the number of recorded progeny, or planned progeny for the coming year). Genetic merit of the sires is also a consideration as the industry and DPT farm owners do expect above average performance. Table 2 shows the genetic merit of DPT red deer sires to be around 40% above the average sire recorded on DEERSelect. Dams on all farms except Invermay are commercial breeding hinds and as such had no previous individual performance data recorded on DEERSelect or otherwise.

The DPT has three categories of trait recording; core traits, venison traits and new (research) traits. Core traits include quarterly live weights, progeny fates, ultrasound-eye-muscle area (EMAUS) and estimated conception date (ECD) via foetal aging (White et al. 2003) and are recorded by the partner herds and DPT farms. Venison traits are measured by

AGL and AgResearch and recorded on progeny slaughtered from DPT farms and one partner herd (partner herds are stud breeding units and retain the majority of stock). Venison traits are primarily focussed on carcass primal cut yield and are quantified non-invasively using VIAscan™ (image-based carcass-yield prediction (Cannell et al. 1999) and by bone-in and bone-out carcass dissection measurements. Data are also collected on venison quality, skin traits and some co-products traits. Research traits are new traits being experimentally evaluated for future inclusion in DEERSelect and are recorded on the DPT farms only. These include temperament (Schütz 2013) and parasite (CarLA) antibody response (Grant 2013).

The three DPT farms operate commercial farm systems rather than stud breeding systems, with Invermay being the only herd with animals previously recorded on DEERSelect. The Invermay deer farm is situated on Eastern Otago hill-country with improved pastures, no irrigation and limited access to flat land. It is situated at the head of the Taieri plains at 45°51.700S, 170°24.500E and rises from 60 to 380m above sea level (asl). Whiterock Station is a Canterbury high-country property which runs along the Rangitata Gorge at 43°45.000S, 171°11.00E. Whiterock Station covers both sides of a ridge system and rises from 400 to 860m asl. The pasture ranges from improved pastures on the flat SW side through to semi-improved indigenous tussock on the steeper hills (Wall et al. 2011). Haldon Station is a high-country property with some irrigated land, situated in the Mackenzie Basin at 44°22.000S, 170°15.600E. The property ranges from improved irrigated flats at 380m asl to unimproved land at 1800m asl.

### Current status of the DPT

Each farm has been involved in two years of AI, Whiterock Station in 2011 and 2012, Invermay in 2011 and 2013 and Haldon Station in 2012 and 2013 (Table 3). A total of 2417 inseminations (from frozen semen) has been carried out on 1581 different hinds, using semen from 35 sires contributed by 13 partner herds (Ward 2013), with each sire used evenly across the two DPT farms each year. Twenty-four of the sires were maternal sires and 11 were terminal sires, there was one terminal and one maternal sire common to all

**Table 2** Mean estimated breeding values (EBVs) and economic indexes of the red deer sires of the 2011 and 2012 deer progeny test birth cohorts and mean of all red sires reported from the DEERSelect December 2013 Sire Summary.

Red sires	Estimated breeding values				Economic indexes	
	W12 (kg)	CW (kg)	MWT (kg)	CD (days)	R-EK (\$)	Term (\$)
DPT Sires	+17.2	+9.0	+14.1	-1.6	+13.69	+29.57
All Sires	+10.2	+5.3	+7.9	-2.1	+8.28	+17.09
Difference	+7.0	+3.7	+6.2	+0.5	+5.41	+12.48

Where W12 = live weight at 12 months of age, CW = carcass weight adjusted for 12-month live weight, MWT = mature live weight of hinds, CD = conception date (negative is earlier conception), R-EK = replacement breeding retaining females and killing males early, and Term = terminal breeding killing all progeny (Archer & Amer 2009).

**Table 3** Summary of the number of hinds artificially inseminated (AI) for the three years of deer progeny test (DPT) and the numbers and percentages of DPT progeny (calves) present at weaning conceived by DPT AI program.

AI Year	DPT Farm	Hinds inseminated	Calves at weaning conceived by AI (%)
2011	Invermay	399	258 (65%)
2011	Whiterock	417	258 (62%)
2012	Haldon	400	287 (72%)
2012	Whiterock	401	308 (77%)
2013	Haldon	403	270 (67%)
2013	Invermay	397	257 (65%)

**Table 4** Summary metrics of red deer sires linked for growth traits (live weights) on DEERSelect from across-herd Sire Summary reporting (sires of last three-years-progeny cohorts) before (April 2011) and after (December 2013) the inclusion of data from deer progeny test (DPT) 2011- and 2012-born cohorts.

	Apr 2011	Dec 2013	Increase %
Number of sires providing linkage	98	112	12.5%
Mean number of herds linked per sire	3.9	5.1	23.5%
Mean number of progeny linked per sire	21.3	24.4	12.7%

three years as links between years. The three birth cohorts produced at total of 1640 progeny surviving to weaning. These progeny were DNA pedigree matched (Tate et al. 1998) by the Genomnz laboratory using either blood (2011) or tissue collected via a tissue sample unit (2012, 2013 TSU: Allflex New Zealand Limited) as offspring of the DPT AI.

At the completion of the three breeding cycles 68% was the overall rate of progeny weaned to hinds inseminated. The highest rate was in 2012 when Haldon and Whiterock achieved better results of 72% and 77% respectively (Table 3). The rate of progeny weaned to hinds inseminated was lower and more variable for terminal than maternal sires, but this was not statistically significant ( $p < 0.05$ ).

### Traits and communication

As of April 2014 the 2011 and 2012 DPT farm-progeny cohorts had all their growth traits (weaning, six weeks post-weaning, pre-winter, post-winter, spring and pre-slaughter live weights and ultrasound-eye-muscle area) measured. All post-slaughter yield and co-product traits have also been recorded. Meat quality and colour stability have been measured for the 2011 and 2012 cohorts, and all skin measurements are incomplete. Maternal females from 2011 have been ultrasound-scanned for estimated conception date at 18-months of age, weighed pre- and post-mating, fates recorded and they have weaned their first progeny 27-months of age. All progeny and dams in the DPT have been temperament scored on at least one occasion. CarLA samples have been collected pre-winter and pre-slaughter for 2011 and 2012, with samples for the 2011 cohort analysed as described by Mackintosh et al. (2012). The 2013 cohort has been weaned and

weighed at weaning, and six weeks-post weaning. All traits accepted by DEERSelect have been uploaded.

The DPT does not publically publish any rankings of the sires used in the DPT. The intent of this is to not distract from the key aim of improving linkage. DEERSelect has been selected as the primary vehicle for communication of DPT information. Data for those traits able to be recorded on DEERSelect is uploaded to DEERSelect to strengthen herd linkage. Quarterly Sire Summary reports of red deer data are publically available via the DINZ website (<http://www.deernz.org/>). The first report incorporating DPT data was released in July 2012. These Sire Summaries report a range of BVs and economic indexes for all recorded breeding sires including DPT sires. Partner herds receive data summaries of DPT progeny twice a year. These are a mixture of confidential raw data e.g. live and carcass weights by sire; analysed data reported to DEERResearch e.g. carcass data by sire type; and updated linkage and genetic trend data from DEERSelect.

### Linkage

In the December 2013 red deer across-herd sire summary report all herds actively recording on DEERSelect were linked for growth ( $n=24$ ) and meat traits ( $n=9$ ) (Table 1), compared to 70% before the DPT. There have also been increases in all metrics associated with the linkage provided by each sire (Table 4), most notably an increase in the mean number of herds linked from 3.9 to 5.1.

Across-herd analysis for wapiti (terminal sires) is not published presently by DEERSelect (as of January 2014) as there are only three breeding herds that meet the SIL connectedness criteria.

## Conclusion

With the final progeny cohort weaned, the DPT is well advanced and large amounts of data have been collected. While there has been preliminary analysis of some data, a full sire genetic analysis requires the data set from all three-year's-progeny cohorts. This will not be available until June 2015 at the earliest. The DPT has already succeeded in focussing the deer industry on better performance recording (S McIntyre pers. comms.) and strengthened the linkage of data reported from DEERSelect, two of the project's primary goals.

For the DPT to be a success and achieve maximum impact in the venison industry a number of practices still need to occur within and alongside the DPT. This includes increased numbers of commercial venison producers purchasing stags from venison-focussed breeders, who are making genetic improvement and using DEERSelect economic indexes to assist breeding stag purchase decisions. These venison-production-focussed breeders and producers need to implement clear venison-focussed breeding objectives. There needs to be on-going sire (genetic) exchange between breeders, to maintain and improve established herd linkage in the future, along with improved recording practices by those breeders. Finally utilisation of DEERSelect needs to be greatly increased across the entire NZ deer industry.

## Acknowledgements

Funders: AgResearch (through MBIE Core Funds), DEERResearch, Alliance Group Limited and Landcorp Farming Limited.

Partner herds: Arawata Partnership, Bates Canterbury Imported Deer, Black Forest Park, Clachanburn Elk, Criffel Station, Deer Improvement Limited, Focus Genetics: (Freestone, Stuart, Raft Creek, Kiroa and Rangitaiki), Peel Forest Estate, Stanfield's European Red Deer, The Steyning, Tikana Totara Park Wapiti, and Wilkins Farming Limited.

DPT Farm Owners, Managers and staff: AgResearch Invermay, Whiterock Station and Haldon Station.

## References

- Archer JA 2003. Genetic improvement of red deer. *Proceedings of the New Zealand Society of Animal Production* 63: 233-236.
- Archer JA 2010. Sire referencing in deer. In: Wilson PR ed. *Cervetec2010. Proceedings of a Deer Course for Veterinarians* 27: 19.
- Archer JA, Amer PR 2009. Breeding objectives for seasonal production systems: an example from New Zealand Venison systems. *Proceedings of the Conference of the Association for the Advancement of Animal Breeding and Genetics* 18: 207-211.
- Archer JA, Ward JF, Fisher PJ, Glass BC 2008. Genetic parameters for growth in Wapiti deer farmed in New Zealand. *Proceedings of the New Zealand Society of Animal Production* 68: 172-173.
- Archer JA, Ward JF, Newman SAN, Cruickshank GJ, Pearse AJ 2005. Implementing genetic evaluation in the New Zealand deer industry. *Proceedings of the Conference of the Association for the Advancement of Animal Breeding and Genetics* 16: 4-7.
- Archer JA, Bell AJB, Everett-Hincks JM 2011. The Deer Progeny Test project. In: Wilson PR ed. *Cervetec2011, Proceedings of a Deer Course for Veterinarians* 28: 31-32.
- Asher GW 2011. Meat Yield Module released in DEERSelect. *Deer Industry News* 50: 35.
- Campbell AW, Knowler K, Behrent M, Jopson NB, Cruickshank G, McEwan JC, Wilson T 2003. The Alliance Central Progeny Test: preliminary results and future directions. *Proceedings of the New Zealand Society of Animal Production* 63: 197-200.
- Cannell RC, Tatum JD, Belk KE, Wise JW, Clayton RP, Smith GC 1999. Dual-component video image analysis system (VIASCAN) as a predictor of beef carcass red meat yield percentage and for augmenting application of USDA yield grades. *Journal of Animal Science* 77: 2942-2950.
- DINZ 2011a. 2009–2014 New Zealand Venison Industry Strategic Intent. *Deer Industry New Zealand, Wellington*
- DINZ 2011b. Annual export returns. *Deer Industry News* 51: 4.
- Grant C 2013. Deer progeny test: the CarLA test for internal parasites. *Deer Industry News* 63: 36.
- Mackintosh C, Tolentino B, Johnstone P, Shaw R 2012. CARLA and parasite resistance in deer. In: Wilson PR ed. *Cervetec2012, Proceedings of a Deer Course for Veterinarians* 29: 47-53.
- Netzer MS, Asher GW, Johnson MGH, Dickinson KJM, Lord JM, Wigham P, O'Neill KT, Ward JF, Clarke D, Littlejohn RP 2009. Spatial distribution and resource utilization by hinds over calving and lactation. *Client Report to DEERResearch Ltd.* 7-38.
- Pearse AJ, Fung L 2007. The Deer Industry's Productivity Strategy: a five-year vision. *Proceedings of the New Zealand Society of Animal Production* 67: 73-77.
- Rhodes L, Pearse AJT, Asher GW 2003. Approaches in developing a successful trans-cervical AI programme for farmed deer. *Proceedings of the New Zealand Society of Animal Production* 63: 258-261.
- Schütz K 2013. Deer temperament scoring system under development. *Deer Industry News* 59: 19.
- Shackell GH, Drew KR, Pearse AJT, Amer PR 2003. A cost-benefit analysis of the value of investment in a wapiti hybridisation research programme and the returns to New Zealand venison producers. *New Zealand Journal of Agricultural Research* 46: 133-140.

- Tate M, McDonald R, Ward J, Dodds K 1998. DNA-matching in deer. Proceedings of a Deer Course for Veterinarians 15: 119-125.
- Visser B, Byrne TJ, Young MJ and Amer PR 2013. Improved reporting method for genetic connectedness. Proceedings of the 20th Conference of the Association for the Advancement of Animal Breeding and Genetics. 2013: 531-533.
- Wall AJ, Asher GW, O'Neill KT, Ward JF, Sirguy P, Littlejohn RP, Cox N 2011. Farmed red deer hind habitat use and behavioural activity patterns in South Canterbury high-country over calving and lactation. Client report for DEEResearch Ltd. 8-9p.
- Ward J 2013. Deer progeny test AI programme, 2011-2013. Deer Industry News 60: 38-39.
- White IR, McKelvey WA, Busby S, Sneddon A, Hamilton WJ 1989. Diagnosis of pregnancy and prediction of fetal age in red deer by real-time ultrasonic scanning. Veterinary Record 124(15): 395-397.