MPI POLICY
Agricultural Inventory Advisory Panel Meeting
13 November 2012

REVISIONS TO THE PARAMETERS IN THE NATIONAL INVENTORY MODEL FOR NEW ZEALAND DEER

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Main Purpose: ☑ Decide ☑ Discuss ☐ Note

Purpose of Report

1. Seek approval from the Agricultural Inventory Advisory Panel to change parameters in the national inventory for New Zealand deer.

2. Attached to this paper are:

    a. The report "*Report to Deer Industry New Zealand: Estimation of Deer Population and Productivity Data 1990-2012"*.

    b. The review of the above report by Associate Professor G. Barrell.

    c. Response to reviewer's comments (DeerNZ and J. Suttie)

    d. The 2012 report "*Evaluation of the energy equations used by the National Enteric Methane Inventory"*, Bown, M.D., Thomson, B.C., Cruickshank G.J. and Muir P.D. This report also has a number of recommendations for the deer model.

    e. Assessment report by Prof. R.S. Hegarty, University of New England.

Summary

Background

3. New Zealand has an obligation under the United Nations Framework Convention on Climate Change (UNFCCC) to report anthropogenic greenhouse gas emissions and removals every year. Emissions are reported in the annual submission of the National Inventory Report submitted to the UNFCCC. New Zealand also has a responsibility under the Kyoto Protocol to reduce emissions growth and if not successful will incur a financial cost.

4. The National Inventory Report forms the basis of any financial cost that the country may have under the Kyoto Protocol. Reported emissions and removals need to therefore be as accurate as possible. New Zealand has a long standing research

program in estimating country specific emission factors to aid in the improvement of reported emissions and removals from the land based sectors.

5. Changes beyond the default methodology and emission factors in the Revised 1996 IPCC Guidelines and the 2000 IPCC Good Practice Guidance to take account of national circumstances are encouraged and need to be well documented and transparent.

6. As a matter of course the 2006 IPCC guidelines are not currently used in the estimation of emissions from the national greenhouse gas inventory (including agriculture). Until these guidelines are fully adopted, countries must continue to use the Revised 1996 IPCC Guidelines and the 2000 IPCC Good Practice Guidance unless a country can fully justify why they have changed.

7. If a methodology, emission factor or parameter is not available from the current guidelines, but is from the 2006 IPCC guidelines, a country is able to use the information contained in the 2006 IPCC guidelines. Also, if a country has investigated an area and found the values in the 2006 IPCC guidelines are more appropriate to national circumstances, then this too is a justification for changing.

8. As part of this research program, a review of the current assumptions and parameters used for the deer model in the national inventory was completed. This ensures that the assumptions and parameters are used accurately and transparently reflect changes over time in New Zealand deer farming practices and the national deer herd.

9. A wider review of the energy equations for livestock used in the inventory was also completed. A number of deer-specific recommendations were made during this review.

Current Inventory assumptions and proposed changes

10. The inventory model estimates dry matter intake, based on productivity inputs and population models. The current model assumes some parameters for the deer due to the lack of verifiable data. The estimates of methane emissions and nitrogen excretion are then derived from the estimated dry matter intake.

11. Listed below are the parameters used in the inventory model that were reviewed. A number of recommended changes are proposed:

    a. Death rate of 2 percent spread evenly across entire year for all classes – change to 5 percent for animals less than one year old and 2 percent for animals that are older than one year. The recommended spread of mortality is outlined in Table 1.

Table 1: Deer mortality by gender and age

Stock class	**Spread of mortality**	
0-1 year old hinds and stags	65% between March to July	Remainder spread evenly over August to November
Hinds > 1 year old	60% from June to October and 30% in November	Remainder spread evenly from December to May
Stags > 1 year old	80% from March to July	Remainder spread evenly from August to February

b. Calving date 1 December – change to 30 November in 1990 and 19 November in 2008 with a linear change between these dates.

A change to the calving date for deer from the 25 November 1990 to 17 November 2008 was agreed by the Panel in its previous meeting on 15 November 2011[1] based on Thompson *et al*: 2010. This recommendation was based on data provided by Meat and Wool NZ (now Beef + Lamb NZ).

For ease of implementation into the inventory model, officials recommend that a compromise date of 28 November be used for the period 1990-2008. From 2009 onwards 18 November is used.

c. Velvet

i. Yield of 3kgs per velvetting stag – change the annual velvet yield per velvetting stag from 1.94kg/stag in 1990 to 4.0kg/stag in 2011 as shown in Table 2.

Table 2: Velvet yield per stag

Year	Average Annual Velvet Weight per stag (kg)
1990	1.94
1991	1.60
1992	1.63
1993	1.94
1994	2.31
1995	2.61
1996	2.85
1997	3.07
1998	2.99
1999	3.37
2000	2.87
2001	3.46
2002	3.22
2003	3.35
2004	2.95
2005	3.80
2006	2.29
2007	3.62
2008	3.16
2009	3.21
2010	3.22
2011	4.00

ii. Deer ME_{velvet} – Energy requirements for velvet production

Bown *et al*.: (2012) recommend changing the ME requirement for velvet antler growth from 0.75 MJ ME/d to 0.5 MJ ME/day

[1] Agricultural Inventory Advisory Panel recommendations for changes to the Agricultural Inventory 2011. www.maf.govt.nz/Default.aspx?TabId=126&title=Nitrous+oxide+emissions+from+crop+residue+and+savannah+burning&id=1277

d. June 1990 baseline liveweight for hinds of 110 kg – change to a 1990 baseline of 100kg increasing to 113kg in 2011. A change to this parameter was agreed by the Panel in its previous meeting on 15 November 2011 based on Thompson *et al*: 2010. This recommendation was to reduce the 1990 baseline weight to 95kg based on Meat and Wool NZ data. The Suttie report's recommendation (p.43) is based on a wider data source including AgResearch, Invermay and Deer Industry New Zealand.

e. June 1990 baseline liveweight for stags of 150kg – change to a 1990 baseline of 133kgs increasing to 150kg in 2011 as shown in Table 3.

Table 3: Pattern of annual changes in red deer liveweight (stags) 1990-2011

Year	Weight in June (kg)
1990	133
1992	138
1998	145
1999	139
2000	147
2002	148
2003	145
2004	145
2005	150
2011	150

f. Slaughter dates –recommendations affecting all stock classes are outlined in Table 4.

Table 4: Summary of current slaughter parameters and recommended changes

Stock class	Current parameters	Recommendation
0-1 year stags	None – animals are currently presumed slaughtered on 1 December as 1-2 year olds	Change to slaughter date of 1 November from 1990 to current year
1-2 year stags	1 March	No change in date.
2-3 year stags	1 March	Requires new split category from 1990 to current year. • 12% animals slaughter at 1 July • Remainder on 1 December
Mixed age stags	None	Requires new split category from 1990 to current year. • 12% animals slaughters at 1 July • Remainder on 1 December
0-1 year hinds	None	No change
1-2 year hinds	1 March	Up to and including 2003 • Change to 1 October. The report notes that prior to 1999 there are insufficient data to determine appropriate slaughter date. From 2004 – 2011: Change to split-slaughter. • 30% on 1 April • 70% on 1 October
Mixed hinds	1 March	Change to 1 April

g. All deer are farmed on high quality pasture of the same quality as dairy cattle – change to a dynamic system which recognises that the:

- national deer herd are farmed across a range of land use capability (LUC) classes including high producing land (LUC 1-4) using pasture quality parameters from dairy model and lower producing land (LUC 6-7) using pasture quality parameters from sheep and beef models, and

- distribution of animals has changed over time as shown in Table 5.

Table 5: Estimated division of national deer herd between high land classes (LUC 1-4) and low land classes (LUC 6-7)

	1990	1992	1994	1996	2002	2004	2006	2008	2010
Percent of deer herd on high class land (LUC 1-4)	46	45	42	39	37	36	29	20*	10*
Percent of deer herd on low class land (LUC 6-7)	54	55	58	61	63	64	71	80*	90*

* As noted by the report's author - these numbers have been modified from the estimates shown in Table 27 (Appendix I) of the report in order to adjust for unrealistically low outcomes of the synergies of various assumptions used in the methodology.

h. The relative proportions of stock classes within the national deer herd are static – change to a dynamic system which recognises changes in age/ gender class across the national deer herd over time as shown in Table 6.

Table 6: Relative proportions of stock classes across the national deer herd (1990-2011)

	Hinds				Stags			
Year	**MA/ Breeding**	**1-2 years old**	**0-1 years old**		**MA/ Breeding**	**0-1 years old**	**1-2 years old**	**2-3 years old**
1990	0.44	0.09	0.12		0.11	0.16	0.05	0.02
1991	0.38	0.07	0.15		0.12	0.19	0.05	0.02
1992	0.39	0.08	0.13		0.16	0.16	0.05	0.02
1993	0.38	0.08	0.14		0.16	0.15	0.05	0.02
1994	0.38	0.08	0.15		0.16	0.14	0.05	0.02
1995	0.37	0.07	0.16		0.16	0.14	0.05	0.02
1996	0.39	0.08	0.12		0.17	0.15	0.05	0.03
1997	0.41	0.08	0.15		0.14	0.16	0.05	0.02
1998	0.42	0.08	0.16		0.11	0.16	0.05	0.02
1999	0.43	0.09	0.18		0.09	0.17	0.05	0.01
2000	0.44	0.09	0.17		0.09	0.17	0.05	0.01
2001	0.45	0.09	0.16		0.08	0.18	0.05	0.01
2002	0.47	0.09	0.15		0.07	0.18	0.05	0.01
2003	0.45	0.09	0.16		0.08	0.18	0.05	0.01
2004	0.43	0.09	0.19		0.08	0.18	0.05	0.01
2005	0.41	0.12	0.17		0.07	0.17	0.05	0.01
2006	0.41	0.10	0.19		0.07	0.18	0.05	0.01

2007	0.43	0.10	0.17		0.07	0.18	0.04	0.01
2008	0.43	0.09	0.18		0.07	0.18	0.04	0.01
2009	0.43	0.10	0.17		0.07	0.19	0.04	0.01
2010	0.43	0.10	0.18		0.07	0.17	0.05	0.01
2011	0.42	0.10	0.18		0.07	0.17	0.04	0.01

The number of R3 stags is estimated by assuming that the productive life of a stag is 10 years.

i. Stag liveweight and hind liveweight are constant through the year – incorporate seasonal changes in liveweight. The recommendations are:

   i. June minima and March maxima liveweights are accounted for;

   ii. Weight loss in stags is linear from March to June; and

   iii. No stags gain weight from June to September and liveweight gain in stags is linear from September to March.

Officials recommend that further analysis is required. It is likely that these changes will have little, overall impact on total emissions and will be difficult to implement in the Inventory model.

j. Metabolisable energy (ME) demand is determined by calculating the demands associated with maintence, growth and productivity. From this calculation, feed intake is calculated and methane and nitrous oxide emissions determined. Suttie has recommended that the seasonal variation in ME requirements for deer, as shown in Table 7 are recognised in the inventory.

Table 7: Metabolisable energy demand for stags and hinds (MJ ME/day)

		Feed requirement (MJ ME/day)				
		Autumn	Winter	Spring	Summer	Average Stock Units
Stags	Rising yearling	16	21	27	56	1.5
	Rising 2 year old	24	28	31	30	1.8
	Rising 3 year old	24	33	38	36	2.1
Hinds	Rising yearling	15	17	22	21	1.2
	Rising 2 year old	20	23	23	45	1.8
	> 2 year old	23	22	24	47	1.9

This approach, where a defined ME demand is used, is inconsistent with the current structure of the model. Officials recommend that further research is required as noted in (i). No change is recommended at this time.

k. Recommendations have been made that are specific to elk/ wapiti, e.g. slaughter dates and weights. As noted in the Suttie report (Section 2.2.2, p.19), the deer herd is predominantly red deer with elk/ wapiti making up only five percent of the velvet industry and has not grown since 1996/97.

It is likely that these changes will have a very minor, overall impact on total emissions and will be difficult to implement in the Inventory model. Officials propose that no change is recommended.

l. Energy requirements for maintenance – ME_m.

Currently the inventory model calculates energy requirements for maintenance in deer using the equation:

ME_m *(MJ ME/d) =* $C \times (W^{0.75})$

Where:
C = 0.7 (coefficient from Fennessy et al.(1981)
W = liveweight of deer (kg)

As part of their review of the energy equations used in the inventory, Bown *et al* (2012) recommend the adoption of the equation for ME_{basal} with K = 1.4 as given in CSIRO (2007)[2].

ME_{basal} *(MJ/d) =* $K \times S \times (0.28W^{0.75} \times \exp(-0.03A))/k_m$

Where:
K = 1.4 for deer
S = 1.0 for females and castrates and 1.15 for stags
W = liveweight (kg)
A = age in years
K_m *= net activity of use for ME for maintenance = 0.2 x M/D + 0.5*

The recommendation will require a redesign of the deer model. However, the current methodology of ME_m for deer is inconsistent with that used for sheep, dairy and beef cattle which use the CSIRO equation. This would also recognise the differences in maintenance energy requirements between stags and hinds, in that; intact males have 15% higher requirements than females and castrates.

In the review of the energy equations paper, Prof. Hegarty notes that the deer K value does not have a large data set behind it. While he accepts the recommendation to adopt K=1.4, the potential for undetected errors to suggests that this could be a critical value to research.

m. Energy requirements for lactation for deer - ME_l

i. Lactation yield at 242 litres and 121 day lactation length –change to lactation yield of 204 litres (average yield of 1.7 l/d) and lactation length of 120 days. This recommendation is based on New Zealand research and discussions with New Zealand researchers.

This recommendation is also supported by a review on deer lactation yield by Bown, *et al*. (2010). In this report (*ibid*. p.54) the authors note that the value of 242kg per dam used in the national inventory could be an overestimate of annual milk production for 4 month lactation across the national deer herd.

[2] CSIRO (2007). Nutrient Requirements for Domesticated Ruminants. CSIRO Publishing, Melbourne, 270 pp.

Landete-Callistejos *et al*. (2000[3], 2003[4]) are cited in the report (*ibid*. p.46) providing a range of daily lactation yields and lactation lengths including:

- 147 litres (± 13.1 litres) over 105 days (approximate length of the lactation period in Iberian red deer in natural conditions)
- 224 litres (± 21.1 litres) over 238 days and average daily yield of 0.9 litres (± 0.06 l/d) (captive Iberian red deer)

ii. Gross energy content of cervid milk (evl) is currently 5.25MJ/kg.

Bown *et al*. recommend changing the evl to 5.9MJ/kg as cited in Landete-Callistejos *et al*. (2000, 2003).

iii. Energy adjustment for milk diet – Deer z_l. The equation for z_l uses the same lactation length and evl as noted above.

Recommend that these are changed as per recommendations above in m(i) and m(ii).

n. Energy requirements for liveweight gain - ME_g. Currently determined using the following equations:

Hinds ME_g = 56 MJ ME/kg liveweight gain
Stags ME_g = 37 MJ ME/kg liveweight gain

The recommendation from Bown *et al.* (2012) is to adopt the CSIRO (2007) equation for ME_g in deer as applied by Nicol & Brookes (2007)[5]

Recommended:

$$ME_g \text{ (MJ ME/day)} = ((6.7 + R) + (20.3 – R) / [1 + \exp(-6(P - 0.4))]/k_g) \times LWG$$

Where:

R	= adjustment for rate of gain or loss = $[EBC/(4 \times SRW^{0.75})]-1$
EBC	= 0.92 × LWG in g/d
SRW	= the standard reference weight in kg.
P	= current live weight /SRW (maximum value of 1)
LWG	= live weight gain in kg per day
k_g	= 0.042 x pasture ME content + 0.006

[3] Landete-Callistejos, T., Garcia, A., Mollina, P., Vergara, H., Garder, J., and Gallego, L. (2000) Milk production and composition in captive Iberian red deer (*Cervus elaphus hispanicus*): Effect of birth date. *Journal of Animal Science 78*: 2771-2777.

[4] Landete-Callistejos, T., Molina, P., Garcia, A., Gomez, J.A., Gallego, L. (2003). Estimate and production of milk energy in two subspecies of red deer: *Cervus elaphus hispanicus* and *C. e. scoticus*. *Journal of Experimental Zoology* 300A: 152-157.

[5] Nicol, A.M & Brookes, I.M. (2007). The metabolisable energy requirements of grazing livestock. In: *Pasture and supplements for Grazing Animals*. Occasional Publication 14. New Zealand Society of Animal Production.

o. Energy requirements for conception/ gestation – ME_c. Currently ME_c is determined using the equation from Fennessey (1981):

$$ME_c \text{ (MJ ME/d)} = C \times TF \times W^{0.75}$$

Where:
C = 0.7 (as for deer ME_m)
TF = trimester factor (10% for May, Jun: 20% for Jul; 30% for Aug, Sept; 60% for Oct, Nov)
W = maternal liveweight

Bown *et al.* (2012) recommend the adoption of the exponential function based on calf birth weight as used by Nicol & Brookes (2007)

$$ME_c = (BWT/8) \times (-0.5424 + 0.3346 (\exp(0.0217t)))/k_c$$

Where:
BWT = calf birth weight (kg) (BWT/8 = adjusted for SRW calf weight of 8kg)
t = days after conception
k_c = 0.133

Bown *et al* recommend that the length of gestation applied to equation ME_c needs to be validated. As noted by Griffiths *et al*. (2008) cited in the Suttie report (p. 47) the "gestation length in Red deer is highly variable, from approximately 220-250 days".

Report

12. The aim of the reviews was to investigate available information sources and determine if the assumptions within the model could be improved.

Implications to emissions estimates

13. It is difficult to determine the net effect of these changes to the emissions estimates. Some recommendations will decrease emission estimates (e.g. reducing hind and stag baseline liveweights) while other recommendations may increase emission estimates (e.g. changes in deer herd distribution onto lower quality pasture).

    A separate work programme aimed at improving the flexibility of the model code will, in future, provide the ability to determine how changes to model structure and assumptions will affect the emission estimates. The new code will enable the inventory compiler to determine the net effect of multiple changes *a priori*.

Reviewer's comment

Suttie report

14. The reviewer was generally positive about the report and suggested a few other sources of data particularly addressing the impact of pregnancy and lactation on seasonal feed demands.

15. The reviewer did not disagree with any of the report's recommendations. However it was suggested that the hind and stag liveweights may have been too high. As a consequence these were revised downwards slightly.

Bown *et al* report

16. The reviewer was fully supportive of most of the recommendations made in the wider report and notes that the "evaluation is well done and provides a well-reasoned argument for making changes where they are recommended".

Response to reviewer comments – Suttie report

17. The majority of the comments were relatively minor, e.g. table numbering or sort clarification. These were all addressed in the updated report.

Strategic Risks

18. The changes may not be accepted by an expert review team of the *United Nations Framework Convention on Climate Change* (UNFCCC) reviewers. However, if this is the case there is an extensive process which is followed in which New Zealand can state its case or change back to the original IPCC defaults before any penalty would be applied.

Strategic Opportunities

19. New Zealand will be meeting the UNFCCC obligations of continual improvement of the national inventory

20. The new values will make a noticeable difference to the total emissions estimate for New Zealand, and will now be well documented, therefore meeting the UNFCCC requirement for transparency.

21. The change also prepares New Zealand to meet updated reporting requirements agreed in Durban during the Seventeenth Conference of the Parties (COP17) under the UNFCCC. Decision 15/CP.17 *Revision of the UNFCCC reporting guidelines on annual inventories for Parties included in Annex I to the Convention* decides that from 2015 Parties to the UNFCCC will report using the 2006 IPCC Guidelines and Global Warming Potentials from the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.

Recommendations

It is recommended that the Agricultural Inventory Advisory Panel:

22. ***Agree*** *that the recommendations detailed in paragraph 11 (a – h, l, m, and n) should be implemented in the national inventory*

Agree / not agreed

23. ***Agree*** *that the recommendations (i, j and k) require further data and analysis and should not be incorporated into the national inventory at this time*

Agree / not agreed

24. ***Agree*** *that the recommendation (o) be agreed but that implementation be delayed until gestation length can be validated*

Agree / not agreed

OR

Agree *on a specific gestation length of 233 days as noted on the Deer Industry New Zealand website which states that "the red deer gestation period is approximately 233 days with fawning in November & December*[6]*.*

Agree / not agreed

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Chair Agricultural Advisory Inventory Panel

9 April 2013

[6] Red Deer - ***www.deernz.org.nz/n101.html***.