Deer Carcass Breakdown Monitoring

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Introduction:

This research project monitored 1080 residue breakdown in muscle, skin, bone and stomach samples for two sika deer (*Cervus nippon)* carcasses during the period October 2010 to May 2011. These deer were located immediately following a possum control operation undertaken on the 23/10/2010 using aerially-delivered 1080 bait.

The analysis of 1080 residue data was conducted by Landsdowne Ventures Ltd during the period August-February 2012. All field work was conducted by Haley McCoskery of the Hawkes Bay Regional Council and this research project was contracted by the Animal Health Board (AHB).

Background:

The New Zealand Deer stalkers association (NZDA) raised concerns regarding the risk from 1080-poisioned deer carcasses, following aerial 1080 operations, for non-target species (i.e. domestic dogs) during the consultation stage of the "Industry Guidelines for Aerial 1080 Application".

The AHB recognised that traditional post operation monitoring for when areas are considered "safe" are partially based on possum carcass monitoring. Following discussion within the AHB, they accepted that the decay rates of a deer carcass and the levels of 1080 toxin within them should be investigated in conjunction with the traditional possum (*Trichosurus vupecula*) carcass monitoring currently being undertaken.

Accordingly, this research report has been designed to provide a quick assessment of secondary poisoning risk from deer carcasses and will assist the AHB in determining if further research is warranted. This could have implications for when signs should be removed following 1080 control operations as currently only possum carcasses are monitored to determine when an area is considered no longer toxic (ERMA, 2010).

Objectives:

- To provide a quick assessment on the breakdown rate of 1080-poisioned deer carcasses following an aerial control operation on Timahunga Station; and
- To determine if the breakdown rate of deer affects when warning signs can be removed following an aerial 1080 operation.

Methods:

Three Sika deer, which were confirmed killed by lethal ingestion of 1080 poison, in Boyds Bush on Timahunga Station (Fig. 1) were located and monitored over a total period of 213 days by staff from the Hawkes Bay Regional Council.

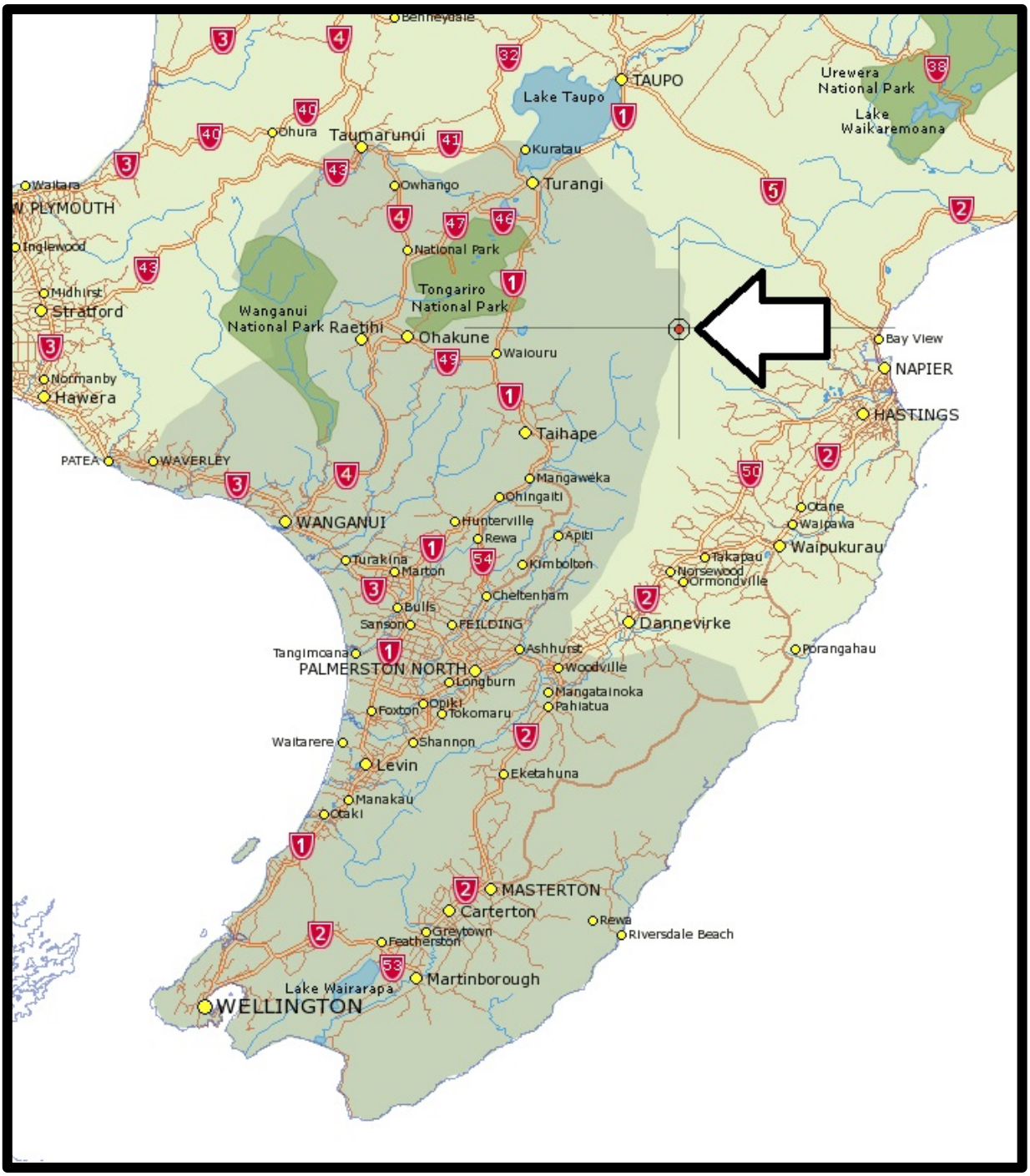

Fig 1. Location of the Boyds Bush study site, Central North Island, New Zealand.

Samples from the muscle tissue, bone marrow, skin and stomach contents were collected from one of the carcasses. Muscle tissue, skin and bone were also collected from the second carcass while the third was left undisturbed and observed over time. At each collection point care was taken to not unduly increase the rate of decay by opening the carcass during sample collection. In total, 30 individual samples were collected and sent to the Landcare Research Toxicology Laboratory, Lincoln for testing. The collection days following the 1080 operation are detailed in Table 1.

Table 1. Days following 1080 aerial control where samples were collected from two deer carcasses. Carcasses are labelled by number.

Days	Muscle	Skin	Stomach	Bone
0				
9	1,2	1,2	1	1
18	1,2	1,2		1
30	1,2	1,2		1
40		1,2	1	1
58		1		
83		2		1
116		1,2		1,2
213				1,2

In addition to the deer samples a 1080 bait and a maggot feeding on one of the deer carcasses was collected on Day 40. All assay testing was carried out using the gas chromatography method TLM 005, "*Assay of 1080 in water, soil, and biological materials by GLC*". This method was developed by Landcare Research Lincoln, based on the work of Ozawa & Tsukioka (1987, 1989). The method detection limit is 0.0001 mg/kg.

The half-lives (t ½ days) were determined from the regression model as ($\log_e(2)/b$), where b is the slope of the regression of $\log_e$(concentration) against time (Brown et al. 2007). Where levels has reduced to below the minimum level of detection (MDL) a value of one half of the MDL was used.

Results:

The 1080 residue values from the samples are detailed in Table 2. The highest concentration was found in the stomach samples followed by muscle, skin and bone. Most concentrations had markedly decreased by day 40 and the invertebrate sample was below MDL. The exception was the bone samples which actually increased at Day 40. This value was excluded from the half-life estimate in Table 3 and is commented on in the Conclusions section.

Table 2. 1080 residue results (mg/kg) from deer, bait and invertebrate samples collected up to 213 day following a 1080 aerial control operation. MDL is 0.0001 mg/kg.

Days	**Muscle**	**Skin**	**Stomach**	**Bone**	**Invertebrate**	**Bait**
9	1.70,1.08	1.29,1.43	12.8	0.79		
18	1.77,1.20	1.42,0.97		0.47		
30	1.89,1.33	1.83.0.90		0.59		
40		0.42,0.11	5.66	2.3*	<MDL	0.026
58		0.01				
83		<MDL		0.01		
116		<MDL,<MDL		0.02,0.07		
213				0.12*, 0.04		

* See the Conclusions section for an explanation of these high values.

Using the above data the following half-life values are provided in Table 3. We did not calculate a half-life value for the muscle samples as the values hadn't markedly decreased and no further samples could be obtained beyond day 30 due to carcass decomposition (see Cover photo). For the stomach, skin and bone samples there was a notable decrease in concentration levels and the half-life estimates suggest that the residues decreased fastest in skin followed by stomach and bone.

Table 3. 1080 half-life estimates for samples collected from 2 deer carcasses.

Sample Source	Half-lives
Deer Stomach	26.33 days
Deer Bone	37.89 days
Deer Skin	16.49 days

Conclusions:

The purpose of this study was to provide a quick assessment of the breakdown rate of 1080 in deer carcasses. As detailed above, there was a concern that 1080 residues may persist longer in deer than possum carcasses. The risk of secondary poisoning to non-target wildlife depends on: i) the likelihood of exposure, ii) the susceptibility of different species and; iii) the pharmacokinetics of 1080 in these species (Eason et al. 2007). Of most concern is the risk to dogs as they have a unique susceptibility to 1080 and are likely to be in recreational hunting areas following 1080 control. Whilst 1080 is quickly metabolised in living animals with a half-life of 9 hours in sub-lethally-dosed possums (Eason et al. 1994) previous studies have demonstrated that residues can persist in possum carcasses for months (Meenken & Booth 1997) and can continue to pose a secondary poisoning risk to dogs.

In the above study 30 residues samples were collected for a period extending out to 213 days following an aerial 1080 control operation. These values indicate that greatest initial risk is from the stomach samples, but they had more than halved by day 40 and no more samples from either muscle or stomach tissue could be taken due to carcass decomposition. Also, invertebrates collected feeding on the deer carcasses at the day 40 mark had no detectable residues and the bait had very low levels of 1080 remaining. Residues did persist for longer in the skin and bone with the skin sample dropping below the MDL by day 83. At the four month point all the deer carcasses were mainly skeletal bone and bone sampling continued out to 213 days. The bone results were much more variable than the other samples and actually increased for the day 40 and 213 samples. After talking to the researcher who collected the bone marrow she advised that it was often difficult obtain marrow without making a fresh cut into the bone. Both times a fresh cut was made it resulted in elevated residue levels on days 40 and 213. Certainly the overall 1080 concentration was decreasing and the highest reading on day 213 is still much lower than initial concentrations.

To roughly compare the risk of secondary poisoning between deer and possum carcasses we used data from a possum carcass study conducted in the Wairarapa in 1994. In this study stomach content samples from 32 dead possums were taken over the winter months with a mean 1080 residue concentration of 30.6 mg/kg on day 25 and 7.7 mg/kg on day 75. Whilst

rates of 1080 breakdown are likely to be influenced by the prevailing weather conditions (our study was conducted over summer) these values are much higher than the stomach samples taken from the deer. To compare the risk I have calculated how much a 20 kg dog would need to eat to have a 50% chance of death (i.e. the LD_{50}; Table 4.).

Table 4. Estimated amounts (g) needed to be consumed for a LD_{50} dose. Values calculated for a 20 kg dog and a LD_{50} dose of 0.07 mg/kg. Possum 1080 stomach values and the dog LD_{50} value obtained from Meenken & Booth (1997). Abbreviations are as follows: SNC sample not collected, NR no risk due to decomposition or below MDL, <MDL are values below the minimum level of detection 0.0001 mg/kg.

	Day 25	**Day 30**	**Day 40**	**Day 75**	**Day 83**	**Day 116**	**Day 213**
Possum Stomach	46	SNC	SNC	286	SNC	SNC	SNC
Deer Stomach	SNC	SNC	247	**NR**	**NR**	**NR**	**NR**
Deer Bone	SNC	2372	608	SNC	SNC	31111	17500
Deer Skin	SNC	SNC	1025	SNC	**<MDL**	**<MDL**	**NR**
Deer Muscle	SNC	813	**NR**	**NR**	**NR**	**NR**	**NR**
1080 Bait	SNC	SNC	53846	SNC	SNC	SNC	SNC
Invertebrate	SNC	SNC	**<MDL**	**NR**	**NR**	**NR**	**NR**

What Table 4 highlights is that the greatest risk from both possum and deer comes from the stomach contents. By day 75 a dog would only need to eat 286 g of possum stomach contents for a LD_{50} dose. In our study by day 40 a dog would need to consume 247 g of deer stomach contents for a LD_{50} dose. For the deer in this study there was no further risk from the stomach contents past day 40 due to decomposition. In the possum study the carcasses remained relatively intact for the first 39 days but by day 75 it was commented that decomposition was well advanced (Meenken & Booth 1997). Due to this rapid decomposition Table 4 concludes no secondary poising risk from stomach contents, muscle and skin by day 83. Whilst the bone marrow still had some 1080 residues out at day 213, using an average value of 0.08 mg/kg, a 20 kg dog would need to consume over 17 kg of bone marrow for a LD_{50} dose.

In conclusion, this report has indicated that deer can have measurable 1080 residues in bone marrow out to 213 days. This result confirms that deer carcasses pose a secondary poisoning risk and more research on the comparative decay rates of deer and possum carcasses is warranted. Given the large amounts of bone marrow that would need to be consumed by a dog for a LD_{50} dose (at days 116 and 213) this study does not conclude that the current warning signage timeframes are unsafe and require alteration. Certainly comparisons made between possum and deer in Table 4 are speculative given the differences in geographical location, the time of year and that the possum study was conducted almost 20 years ago. Due to these issues we recommend that a formal research plan is developed by the AHB and NZDA to investigate the decay rates of deer, and any if funding permits other “at-risk” game species such as feral pigs, in direct comparison with possum carcasses. These studies should be replicated throughout New Zealand given climatic differences (i.e. temperature and rainfall) and the likely influence of these on decay rates. We also highlight that there may be interspecies differences for deer and this should be considered when formulating the experimental design. Finally, research costs could be

reduced if these studies were attached to existing control operations; however, the exact location of any study site needs to be assessed and approved by all parties involved.

Recommendations:

Based on the above research results we recommend that:

1. A formal research plan is developed between the AHB and NZDA to investigate the comparative decay rates of deer and possum carcasses. Depending on the availability of funding this could also include other game species such as feral pigs.
2. Any future studies should be replicated throughout New Zealand to account for climatic differences and assess any interspecies differences for deer.
3. Future trials should include measures of bone marrow and run until samples return a value below the MDL.
4. Portable data loggers should be placed next to the carcasses to measure temperature, relative humidity and rainfall. This will enable researchers to quantify the effect of weather on decay rates.

Acknowledgements:

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