Wakatipu white-tailed deer carcass survey following 'Battle for our Birds', Department of Conservation aerial poisoning operation, August 2014

Kaylyn McBrearty

Department of Ecology

Lincoln University

Ellesmere Junction, Road/Springs Road

Canterbury, New Zealand

Email: Kaylyn.McBrearty@lincolnuni.ac.nz

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Reviewed by:

Dr James Ross
Senior lecturer in biometrics

Dr Adrian Paterson
Associate professor

Faculty of agriculture and life sciences and wildlife management
Lincoln University

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Project

Intensive ground-based searches for white-tailed deer carcasses in the Dart Valley/Routeburn catchments following the aerial application of 1080 cereal pellets, August 2014, intended to extend protection to mohua by preventing a rodent plague by specifically targeting rat and stoat populations following a beech mast event. This search was conducted in collaboration with the Department of Conservation (DoC), New Zealand Deerstalkers Association (NZDA), Landcare Research and volunteers from the public.

Objective

To determine the potential for major demographic impact on the Wakatipu white-tailed deer herd from the aerial sowing of 6 g RS5 cereal pellets containing 0.15 % conc. 1080 at 1 kg/ha for the 2014 “Battle for our Birds” Dart Valley/Routeburn pest control operation.

Methods

- The habitat range of the Wakatipu white-tailed deer on public conservation land was estimated at 31,402 ha defined using Arc GIS software 10.2 and identified using geospatial data from DoC with adjustments based on personal observation and local hunter observations.
- Therefore, the poison operation covered 48% of this range, including 57% of the area termed the ‘Whitetail Moratorium Area’ and 76% of the permitted white-tailed deer hunting area.
- The area of exposure under the Environmental Protection Agency (ERMA) 2 km buffer zone, for safe hunting of deer following application of 1080 poison, extends the potential 1080 exposure to 79% of the current Wakatipu white-tailed deer range on public conservation land and 89% of the permitted hunting area.

- Four 100 ha search areas, within the 15,215 ha of potential white-tailed deer habitat range of the Dart Valley and Routeburn catchments, were selected for this study after scrutiny of sites for the presence / absence of deer sign, ease of access and safety of traversing terrain for volunteers. Two sites were selected with high density deer sign and two with low density deer sign.

- In addition, 24 trial cameras were systematically placed a minimum of 1 km apart, nineteen within the drop zone and five outside of the drop zone for a period of five days prior to and five days following the control operation to assist in site selection and for statistical comparison of white-tailed deer observations before and after the control operation.

- All search areas were within the 15,663 ha which were subjected to aerial dispersal of 6 g RS5 cereal pellets containing a nominal concentration of 0.15% 1080 at 1kg/ha without the use of deer repellent. The toxin drop was preceded by a pre-feed operation of non-toxic 6 g RS5 cereal pellets at a rate of 1 kg/ha, one week prior.

- Three weeks after the application of toxic baits, members of the NZDA, public volunteers, Landcare Research and DoC staff conducted four days of intensive ground grid searches equating to 190 km of transect search effort. Searchers recorded sightings of both live and dead deer with tissue samples and jaw bones collected from any dead deer discovered. Sightings of live kākā, Kākāriki or kea and any dead birds or possums or rodents were also recorded.

- Muscle samples from dead deer were removed and tested to confirm exposure to 1080. Tooth eruption and wear were assessed to determine age of dead deer.

- In the week prior to the grid searches 100 deer-sized brown paper bags were placed in each search area to imitate deer carcasses. Paper bags located/observed during the search efforts were recorded and used to estimate the actual number of deer carcasses within the search areas.

Results

- The difference between white-tailed deer detection events on the nineteen trail cameras placed within the drop zone and the five trail cameras placed outside of the drop zone for five days prior to the operation (3 and 2 white-tailed deer respectively) and five days following the operation (1 and 2 white-tailed deer respectively) was not statistically significant (P= 0.5913).
- Four white-tailed deer carcasses were discovered within the search grids (a buck aged 2 ½ years; 3 does aged 6-9 months, 2 ½ and 4 ½ years). An additional carcass (a buck aged 6-9 months) was observed but excluded from the analysis as it was discovered outside of the search grids. On average, one deer carcass was observed every 63 km of search effort, and, on an area basis of 1.28 dead deer/km^2.
- Four possums, 1 chaffinch, 1 blackbird and five mice were found dead. Four live white-tailed deer were seen outside the search blocks (but within the control area), and one pair of Kākāriki, one kākā and one mouse inside of the search blocks.
- All of the white-tailed deer carcasses discovered were confirmed to have muscle tissue containing traces of 1080 (range: 0.41 – 1.06 µg/g).
- On average, 78% of paper bags deployed were found during the grid search. The actual adjusted number of dead white-tailed deer, assuming a detection probability of 0.78 was 5.13 ± 1.13 (95% CI) in 400 ha (1.28 deer/km^2).

Conclusions

- The searches unequivocally confirmed that aerial 1080 poisoning using 0.15 % conc. 1080 in 6 g RS5 cereal pellets at 1 kg/ha sowing rate for the control of rats and stoats did cause mortality to white-tailed deer in the Dart Valley / Routeburn catchments.
- Both sexes were susceptible.

- If the number of carcasses found in the four searched blocks were representative of the total operational area, simple extrapolation suggests that there could have been 195 ± 43 (95% CI) dead white-tailed deer in the 15,215 ha control area that was considered white-tailed deer habitat.

- In the absence of any current estimate of the herd size or average density, we are unable to determine what proportion of the overall population was killed.

- A low white-tailed deer density is suspected based on the very low numbers of white-tailed deer detected by the 19 trail cameras placed within the drop zone over the five days prior and following the control operation.

- As there has been no clear indication of any change in deer density under the 1983 moratorium, we assume deer densities remain at or below that inferred level (2-4 deer/km^2), in which case the observed by-kill is potentially demographically significant.

- It is suggested that the lack of evidence of deer mortality from the much smaller informal surveys conducted by DOC in 2006 and 2009 are more likely to simply reflect low deer density rather than an absence of deer by-kill.

Recommendations

- As the Wakatipu white-tailed deer herd is a likely candidate to be made a 'herd of special interest' in the future, it is essential to assess the level of impact pest control operations have on the herd and its likely length of time for recovery. As such, further research needs to be conducted on the density, spatial habitat use, herd structure and reproductive success of white-tailed deer in areas exposed to aerial 1080 compared to those not exposed. Only then we can attempt to determine the significance of the mortality caused by the 2014 pest control operation.
- Further research on the effectiveness of Epro Ltd deer repellent specifically for repelling white-tailed deer consumption of 1080 containing baits should also be conducted. Sufficient notification of potential aerial operations in the area needs to be given so that deer repellent may be applied at the time of

manufacture in order to prevent unnecessary extra transportation costs. Furthermore, alternative deer repellents, such as that developed by Pest Control Research should be assessed for effectiveness and then evaluated as a cost-effective alternative. If a repellent is deemed to be effective, its use is recommended in all future aerial 1080 operations within the habitat range of this herd.

- Continued partnership between DoC, NZ hunters both within and outside hunting groups, local land owners and wild game animal and biodiversity ecologists is actively recommended and encouraged.

Introduction

Intensive ground-based searches for white-tailed deer carcasses were conducted on the 18th - 21st of September 2014, following the department of conservation 'Battle for our Birds' pest control operation in the Dart Valley/Routeburn catchments, 31st of August 2014. The pest control operation was intended to extend protection to resident mohua populations by the aerial application of 1080 cereal pellets targeting rats and stoats to prevent a predicted rodent plague following a beech mast event in the autumn of 2014. The searches were conducted in collaboration with the Department of Conservation, New Zealand Deerstalkers Association, Landcare Research and members of the public. This report was commissioned by the Safari Club International (SCI), New Zealand Chapter.

Background

Wakatipu white-tailed deer

Nine white-tailed deer *(Odocoileus virginianus)* were liberated at the head of Lake Wakatipu in the Rees Valley (three bucks and 6 does) in 1905 (Donne, 1924; Harris, 1981). To encourage population expansion, the white-tailed deer released into the Rees Valley were strictly protected from hunting until 1920, with hunting by permit only until 1925 at which time all protection was lifted, though no assessment of herd status appears to have been conducted (Jacobs, 1993). The herd was believed to have remained confined to the Rees Valley and lower Dart Valley until the 1970s, when the herd range was discovered to have expanded further up the Dart Valley, as well as into the Forbes and Humboldt Mountain Ranges of Mount Aspiring National Park (Banwell, 2006; Bathgate, 1976). While the white-tailed deer range had expanded by the 1970's, the actual population size appeared to be in decline (Jacobs, 1993). A population census was conducted by the New Zealand Forest Service during September 1974 by pellet count survey (Bathgate, 1976). From these counts the highest deer density was estimated in the Earnslaw Burn at 13.2 deer / km^2 and the lowest in the Dart Valley at 3.7 deer / km^2. Overall deer density was estimated at 7.8 deer / km^2 with an estimated total population size of 840 ± 420 (90% CI). As can be seen by the large confidence interval, the power of this survey was weak. Even so, it was concluded that due to the

small herd size and only slow expansion in range, “control of noxious animals be solely by recreational hunters” (Bathgate, 1976).

Local farmers and recreational hunters raised concern about the long-term future of the herd and in 1983 the New Zealand Forest Service responded by extending protection to the Wakatipu white-tailed deer herd from hunting through the voluntary non-issuing of permits for all crown land, excluding Mount Aspiring National Park, coined the ‘Whitetail Moratorium Area’. This was a significant agreement as it recognised the value of an individual deer herd outside of the Recreational Hunting Area (RHA) framework. Ten RHAs were created between 1980 and 1986, in response to a dramatic decline in national deer populations and concern from recreational hunters that opportunities for hunting were being severely restricted by commercial activities. Two of these areas (Waiotapu and north-west Nelson) no longer operate as RHAs. The term ‘noxious’ was abandoned under the Wild Animal Control Act 1977 with those animals which were labelled ‘noxious’ now being considered ‘wild animals’. A follow up survey in the Dart State Forest 1984 showed further decline of the deer population with a 73% reduction in deer pellet frequency since 1980 and concluded Wakatipu white-tailed deer no threat to forest health (Armstrong, 1984). It was recommended that pellet transects be repeated on a bi-annual basis and that the moratorium on white-tailed deer remain in force until the herd is deemed fit for recreational hunting. The Forest Service and the Department of Lands and Survey were officially amalgamated in 1987 to form the Department of Conservation (DoC). The WAC 1977 enables DoC to control wild animals generally and to eradicate wild animals where necessary and practical. Due to their low density white-tailed deer in the Wakatipu region have not been deemed to have a major detrimental impact on the biodiversity of the area they inhabit, nor has any method been implemented for their targeted control by DoC since its formation (DoC, 2014d).

Despite more than 30 years of protection from recreational and commercial hunting on crown lease land, anecdotal evidence from locals and hunters suggests the white-tailed deer population in the Wakatipu area has remained low and the herd has failed to greatly expand its range. However, this cannot be confirmed while the status of the herd remains unknown, as the bi-annual pellet counts recommended by Armstrong

(1984) were never conducted. Despite the lack of knowledge on the status of this herd and whether or not it could be deemed fit for recreational hunting, the unofficial moratorium on white-tailed deer was removed from the draft Central Otago Conservancy Management Strategy in 2014.

Aerial 1080 poisoning of rats for mohua protection

The mohua (*Mohoua ochrocephala*) is a "nationally vulnerable" endemic forest bird with an estimated population of less than 5000 individuals with approximately 30 localised populations in the South Island and Stewart Island (DoC, 2015d). Despite an increased conservation effort and research over the past 20 years, mohua populations have continued to decline and their distribution has reduced with five local extinctions (Babbage et al., 2015).

One of the relict populations is located in the Dart Valley, Otago. In 2006 there was a moderate beech seed fall (~4000 seeds/m^2) (DoC, 2014e) in the Dart Valley and rat and mouse numbers rose dramatically in response. Because such rodent plagues are known to threaten the existence of relict mohua populations, protection of the Dart Valley mohua population from mammalian pests was undertaken by the aerial application of cereal pellets containing 0.15% conc. 1080 poison over 5,600 ha in the Dart Valley at a sowing rate of 3 kg/ha by DoC (DoC, 2014d). Sodium fluoroacetate (hereafter referred to as 1080) is a vertebrate pesticide, adopted for aerial application in the 1950s and principally used for the control of mammalian pests in New Zealand and Australia (Eason et al., 2011; Kalmbach, 1945).

DoC reported a mohua decline of 23% in the Dart Valley between 2006 and 2007 in areas that were treated with 1080, but a 100% decline in the nearby untreated Mill Flat forests following this moderate beech mast event (DoC, 2014f). Following another moderate beech mast event in 2009 an aerial 1080 operation was repeated at the lower sowing rate of 1 kg/ha (DoC, 2014d). Following this operation mohua populations were reported to have remained steady (DoC, 2014b). Another moderate beech mast event was reported in 2011, though DoC did not undertake an aerial pest control operation following this mast. A reduction of 75% of the mohua population in the Dart / Routeburn valleys was reported (DoC, 2014b). A predicted moderate beech

mast occurred early in 2014 in the Dart/ Routeburn Valleys at the head of Lake Wakatipu (DoC, 2014c). The appropriate response to a moderate beech mast event is reported to be localised pest control for at risk species (DoC, 2014e). However, widespread protection of mohua from mammalian pests in the Dart Valley was undertaken as part of the 'Battle for our Birds' conservation initiative by using aerial dispersal of 6 g RS5 cereal pellets (Animal Control Products Limited, Wanganui) containing 0.15 % conc. 1080 at 1 kg per ha over 15,663 ha, a significantly larger area of than in previous operations (Appendix 1). 'Battle for our Birds' is a $21 million conservation initiative designed with the intention of protecting endangered species of native birds which are reported to be under threat by rodent plagues and increases to stoat populations following beech mast events (DoC, 2014a). An 89% nesting success rate for monitored mohua was reported for the 2014–2015 nesting season (DoC, 2015a), suggesting that either the rodent plague had not eventuated or had been prevented. Within the 1080 drop zone rat tracking from 28 lines was 1% (footprint tracking index) in February and reached a high of 13% in August falling back to 1% following the 1080 operation (DoC, 2015b). Outside of the 1080 drop zone, rat tracking from 7 lines was 5% (footprint tracking index) in February, reached a high of 30% in August and declined to 20% by February 2015. The rat tracking reaching only 30% and the decline following this confirm the mast was only partial (DoC, 2015b). Outside the drop zone 13 lines were not used or were thrown out as they were deemed too close to or were inside the treated area. The resulting 7 lines were all at low altitude (below 500 m absl) and within close proximity to roads and human habitation, suggesting the reported rat tracking index outside of the drop zone may overestimate the potential rat tracking index % over the drop zone in the absence of pest control.

Incidental by-kill of deer during aerial 1080 poisoning

The use of aerially dispersed 1080 baits in mammalian pest control operations can result in significant by-kill of wild deer (Speedy, 2005). Most formal research to date on non-target deer by-kill has been conducted on red deer (*Cervus elaphus scoticus*) and the use of 1080-coated carrot baits with population mortality/by-kill ranging from 5% to 93% (Eason et al., 2011).

The by-kill of fallow deer (*Dama dama*) following 1080 operations was also investigated in a study conducted in the Blue Mountains, Otago. Following aerial sowing of 0.15% conc. 1080 at 2 kg/ha RS5 cereal pellets, by-kill was estimated at between half and two thirds of the fallow population in the drop zone (Nugent and Yockney, 2004). By-kill appeared to be greatest for the younger deer particularly in areas with the highest deer density and the most open understorey. Nugent et al. (2001) reported that deer mortality following aerial 1080 operations varies considerably and there appears to be no consistent pattern in the number of deer deaths based on bait type, sowing rate or toxic loading, suggesting that other external factors may be important. The only formal research regarding the impact of 1080 on white-tailed deer occurred on Stewart Island in the summer of 1980-81, where a toxic hydrophilic gel formulation containing 10% 1080 applied on broadleaf leaves was found to be an efficient method of substantially reducing deer numbers in the short term (Batcheler and Challies, 1988; Challies and Burrows, 1984). However, this is more than 60 x the concentration of 1080 used in cereal pellets for targeting rats.

While a reduction in wild deer density may benefit conservation in some situations (Coulson, 1999; DoC, 2001), non-target by-kill can generate significant public opposition to mammalian pest control by 1080. A review by Fraser (2006) discussed the findings of a national UMR survey, undertaken in 2001, in which species specificity was a major public concern with 60% of respondents noting a lack of specificity as the basis for their opposition to aerial 1080 (UMR is a full-service market research and evaluation company specialising in corporate reputation, issue management, policy, evaluation, social and rural research). A report in 2007 by the Environmental Protection Agency noted that public opinion generally opposes aerial delivery of poisons (ERMA, 2007). This concern was highlighted in 2011 in a study on community attitudes towards the use of 1080 for pest control (Bidwell, 2011). Furthermore, this study identified issues of trust and distrust in the way pest control was managed by the local and national authorities of DoC and the Animal Health Board (AHB; now TBfree New Zealand) to be contributing to the opposition for the use of 1080 for mammalian pest control. The report recommended the need for changes to community engagement and increased transparency on the part of DoC and the

TBfree. However, despite DoC and TBfree becoming more focused on developing strong community partnerships and major improvements made in the targeting of 1080 (Nugent and Morriss, 2013; Nugent et al., 2012), its use for mammalian pest control remains controversial (Green and Rohan, 2012).

Deer by-kill following 1080 operations is now largely avoidable since the development of deer repellent by Epro Ltd, an integrated wildlife management and research company based in Taupo (Speedy, 2005). Following initial screening of the repellent by Epro Ltd, the AHB funded its development and field testing. DoC allows the use of this deer repellent in recreational hunting areas (RHA), though its use is usually funded by TBfree New Zealand. The bait coating which remains palatable to possums and rodents significantly reduces the non-target deer by-kill (Morriss and Nugent, 2008). A follow up study in 2008 on the fallow deer of the Blue Mountains investigated fallow deer by-kill after the aerial application of 1080 containing RS5 cereal bait coated with deer repellent and estimated an 87% reduction in the density of dead deer compared to the 2001 operation (Morriss and Nugent, 2008). The cost of using the deer repellent varies for each operation. In the case of the 2014 Dart / Routeburn operation the cost was estimated by DoC to be approximately $140,000 (appendix 4) or $9 / ha, based on the DoC estimate divided by the 15,663 ha operation. This included the transportation of cereal pellets from Otago (already having been transported from Wanganui) to and return from Taupo for repellent coating.

Implications for deer management

Recently, a further amendment to the WAC Act has been made under the Game Animal Council Act 2013. The Minister may, by notice in the *Gazette*, designate any species of game animal in a specified area on public conservation land to be a herd of "special interest", subject to conditions of section 16, GAC Act 2013. The Game Animal Council (GAC) is a statutory body that was established on the 28th November 2013 under the Game Animal Council Act 2013. It represents the interests of the hunting sector and aims to improve the management of hunting resources while contributing to positive conservation outcomes. The Wakatipu white-tailed deer herd is a likely candidate for 'of special interest' status. It is the only wild herd of white-tailed deer on

the mainland of New Zealand, one of only two populations in the South Pacific, uniquely isolated from the original population without any documented addition of new stock for 110 years. In addition this herd, if under management, has the capacity to consistently supply quality trophies to New Zealand and overseas hunters. Residing in one of New Zealand's most picturesque locations, the Dart and Rees Valleys and surrounds, animal sightings may be enjoyed by overseas visitors and add to the tourist experience of the already booming Wakatipu region tourist trade. In contrast to other deer populations in New Zealand, this herd appears to have struggled to maintain sustainable numbers for harvest and has never reached numbers high enough to cause concern for biodiversity, though this has never been formally assessed. As such, the GAC on behalf of New Zealand hunters, petitioned for the use of the Epro Ltd deer repellent on cereal baits distributed over the white-tailed deer range as a precautionary measure in the 2014 aerial 1080 operation (Appendix 3). This petition for deer repellent was rejected by DoC with the main reasons being: the cereal bait was already produced and shipped to Otago and the expense, estimated at $140,000, and extra time to coat the already transported bait in repellent was not justifiable (Appendix 4). DoC also quoted the lack of evidence showing by-kill of white-tailed deer by aerial 1080 poisoning in the past. Following the mammalian pest control 1080 operations in the Dart Valley in 2006 and 2009, DoC staff walked 26 x 500 m rat tracking lines and 10 x 1 km mohua monitoring transects, totalling 23 km and 26 x 500 m pest tracking lines and 15 x 1 km mohua monitoring transects totalling 28 km, during which no dead deer were observed (Appendix 4). On the surface this would appear to suggest there was no by-kill of white-tailed deer. However, if the density of white-tailed deer within the operational area was low (currently unconfirmed), so too would be the probability of observing deer carcasses. Therefore, it is unsurprising that no carcases were found during non-systematic searches with only 23-28 km of search effort over a broad area (2200 ha) with an expected low density of deer. In addition, it was noted that the 2014 aerial operation would only cover half of the estimated white-tailed deer herd feral range. However, this area included the majority of the permitted open hunting area and approximately half of the 'Whitetail Moratorium Area' on public conservation land.

This study

The concern raised from hunters and the GAC that the aerial pest control operation for the protection of mohua could have a major adverse effect on the valued white-tailed deer herd, was observed and the assessment of this effect was included as an objective within a PhD study initiated in May 2014. The objective first aimed to confirm that white-tailed were killed by the aerial 1080 operations used to prevent rodent plagues. If this was found to be the case the next aims were to determine whether the number of deaths caused were demographically significant in terms of herd genetics and population trends and whether such mortality could be reduced by use of deer repellent. This report focuses on the first component, with the investigations into significance and mitigation still to be completed (expected PhD completion date of 2017).

Instead of using deer repellent for the Dart / Routeburn 2014 operation, DoC supported this research by providing significant funding and workers to unequivocally determine if white-tailed deer mortality occurs due to aerial application of 1080 cereal baits for the control of rats and stoats.

Objective

To determine the potential for major demographic impact on the Wakatipu white-tailed deer herd from the aerial sowing of 6 g RS5 cereal pellets containing 0.15 % conc. 1080 at 1 kg/ha for the 2014 “Battle for our Birds” Dart Valley/Routeburn pest control operation.

Methods

<u>Operational Area and Logistics</u>

White-tailed deer habitat range

The current range of the Wakatipu white-tailed deer herd was determined using open access geospatial data from DoC 2007 and then modified based on personal observation and hunter observation using Arc GIS 10.2 software. The range of white-tailed deer was divided into public conservation land (31,402 ha) and private land

(19,051 ha). Recreational hunting is permitted on public conservation land, excluding the Whitetail Moratorium Area, being the Lower Dart Conservation Area, Mt Alfred, Earnslaw Burn, and Diamond Lake Reserves (DoC, 2015c), and 500 m either side of the Rees/Dart and Routeburn tracks to a total of 20,097 ha. Of this 17,112 ha is within the Dart/Routeburn Valley catchments. The remaining 2,985 ha in the Rees Valley requires the crossing of private land by paper road and on foot. Aerially-assisted trophy hunting (AATH) is permitted within two areas totalling 2,150 ha within the white-tailed deer habitat range. Wild Animal Recovery Operations (WARO) are permitted within Mount Aspiring National Park except between the 22nd December and 5th January and the 23rd of March and 20th of April. WARO is not permitted in Slip Stream of the Dart Valley and the Whitetail Moratorium Area.

The maps produced which specifically define the range of the Wakatipu white-tailed deer are embargoed till further notice and are not included in this report.
For the purpose of this section of research the 'herd' shall refer to white-tailed deer only on public conservation land, with the reasons being; the deer residing on private land are not accessible by the majority of recreational hunters, and therefore cannot be classified as a public resource. Furthermore, any recommendations given cannot be applied to private land without land owner consent.

Control operation

The total area outlined for the 2014 'Battle for our Birds' pest control operation in the Dart and Routeburn catchments was 15,663 ha (Appendix 1). When overlaid with the modified white-tailed deer habitat range above, white-tailed deer were estimated to inhabit approximately 15,215 ha (97% of the operational area). The Environmental Protection Agency (ERMA) recommends an absolute minimum 2 km buffer zone for safe hunting of deer following application of 1080 poison be applied for a period of four months or two months if more than 100 mm of rain has fallen. As such, exposure to 1080 was defined as the 1080 operational area plus an additional 2 km buffer zone within the potential white-tailed deer habitat range. Therefore, the exposure zone is equivalent to 29,156 ha or 93% of white-tailed deer range on public conservation land and 89% of the permitted hunting area.

The outlined aerial operation occurred on the 30th of August 2014 with 6 g RS5 cereal pellets containing 0.15% conc. 1080 dispersed at 1 kg/ha over 15,215 ha of potential Wakatipu white-tailed deer habitat without the use of deer repellent. The poison drop was preceded by a pre-feed operation of non-toxic 6 g RS5 cereal pellets at a rate of 1 kg/ha, on the 26th of August 2014. More than 10 days of fine weather (without substantial rain, <100 ml) followed the aerial operation.

Survey design

Searches for deer carcasses were undertaken using New Zealand Deerstalkers Association volunteers, Local hunter and land owner volunteers, DoC staff, and a Landcare Research Field Technician. To obtain some insight into the total numbers of deer potentially killed, these searches were formally structured as systematic searches of a sample of four 100-ha blocks. Within those blocks search effectiveness was formally measured by determining the percentage of a known number of deer-like objects (large paper Kleensacs) deliberately placed within the blocks before the carcass searches were conducted (Morriss and Nugent, 2008).

Determining the presence / absence of white-tailed deer to assist search block selection

Equipment

- Trail cameras; 14 Bushnell trophy camera brown model number 119537, 10 LTL Acorn scouting camera camo model number 5210A.
- Garmin GPS Oregon 650
- Computer programs; ARCGIS 10.2 and Garmin BaseCamp 4.4.2

Camera placement

Nineteen trail cameras were placed within drop zone and five outside of the drop zone to record the presence / absence of white-tailed deer five days prior to aerial operation and in the five days following. The length of monitoring time was restricted by the short time between confirmation of the control area boundaries and commencement of the control operation, as well as the time required to plan, acquire equipment and place in field. Cameras were systematically placed a minimum of 1 km

apart on a tree at 1.5 - 2 m height, north facing with a minimum of 5 m visibility. Cameras took three consecutive pictures when triggered by movement with a 5 minute interval between trigger events. The density of deer sign (faecal pellets, browse, footprints / deer trails) at camera placement sites (within a 10 m radius) was observed and recorded as high, moderate or low. In addition, notes on difficulty level of the terrain were taken as easy, moderate, hard and hazardous. The information collected was used to help determine the location of search blocks subject to the below considerations;

- The search blocks needs to be easily traversable / low gradient to allow for the differing fitness levels and capabilities of search volunteers
- Search blocks needs to be accessible by walking (at the time of choosing search blocks it was unknown whether transportation by helicopter would be possible due to financial constraints) and can be accessed, searched and returned from in a single day.
- An equal proportion of the high and low density areas needed to be searched to prevent over estimating mortality.
- The outside edge of the search blocks need to be a minimum of 200 m distance within the outside edge of the planned drop zone.

Search blocks for carcass search and control placement

The four 100 ha areas within the Dart Valley and Routeburn drop zone (Appendix 2) chosen for the systematic carcass searches were outlined for ground grid search using ARCGIS (version 10.2) and Garmin BaseCamp (version 4.4.2) computer programs. Two search blocks had a high density of deer sign and two had a low density of deer sign.

Paper bag controls

Five individuals assisted in the placement of 100 deer-sized brown paper bags (395x125x890 mm 2 Ply Kleensacs, Shardlows, Christchurch) in each search cell over three days within the week prior to the search. Three workers were DoC Wakatipu staff, one was a New Zealand Deerstalkers Association (NZDA) Southern Lakes Branch member and one was a local hunter volunteer. The workers who assisted in both the paper bag control placement and the grid search did not participate in the carcass

search for the block which they distributed paper bags controls. Kleensacs distributed on Surveyors flat were delivered free of charge by Southern Glacier Helicopters a few days prior to placement and stored in dry conditions at a DoC Bivouac. Paper bags were filled with leaf litter/sticks to simulate three dimensionality of a carcass at the site and placed at randomly generated distances (20-200 m) along four or five transects perpendicular to the search lines. The percentage of paper bags found during post poison searches was used to estimate the detection probability and then used to estimate actual deer mortality.

Operational logistics

A total of 38 individuals were involved in the carcass searches over the four consecutive days. Of these, 30 conducted the ground grid searches with two team leaders who searched over the four consecutive days; one from Landcare Research and one from DoC Wakatipu (who also was a DoC Health and Safety Officer). Five individuals were assigned under each team leader on each day to make up two teams of six, designated Alpha and Bravo.

A logistics team remained at the DoC Glenorchy Field Centre during each day of grid searches. The logistics team consisted of three individuals each search day, two being DoC Wakatipu staff, the DoC Wakatipu partnerships manager and one operational manager/planning and Intelligence (me). The logistics team was responsible for morning briefing, health and safety briefing, assigning training for use of GPS, radio and other equipment, volunteer and equipment checks, providing lunch and water to searchers, transportation to and from search sites or pick up, drop off points, manning the radio station and recording all reports of sightings and data retrieval.

Transportation to and from search cells was provided by DoC Wakatipu in the form of three 4WD vehicles on the 18th and 19th of September, 2014. Helicopter transportation to and from search sites occurred on the 20th and 21st of September. This was made possible by contributions of funding from the Wellington Branch NZDA, DoC and one hour free flying time donated by Helitours, Queenstown.

Equipment supplied to each volunteer;

- Garmin GPS with defined route (various models)

- UHF Radio for communications back to base
- High visibility safety vest
- Lunch pack and water
- Sampling instruction sheet
- Plastic snap lock bags
- Disposable latex gloves
- Vivid marker

Equipment provided by volunteers;

- All clothing and tramping gear
- A knife
- A day sized back pack
- A camera

Other Equipment used;

- 400 395x125x890 mm 2 Ply Kleensacs (Shardlows)
- Base for operational planning and communications
- Recording book

Grid search

Once deployed to the search site, team leaders dropped off the five accompanying searchers to their individual grid line start point, spaced at 20 m increments. Once the team leader arrived at his start point radio communication was made back to base and the team set off simultaneously along their transect searching for dead deer and brown paper bags. At the end of the grid lines, communication was made back to base and the team members moved to the next set of start points, again with the team leader dropping off searchers to their individual grid line start points. This was repeated between 4 and 6 times depending on the shape of the search cell. At the end of the search the team leaders led their team to a predesignated pick up point marked on their GPS, for team extraction by either 4WD or helicopter. Upon arrival at base all equipment and samples were collected.

Sampling

Sample collection

A sampling instruction sheet was provided to all volunteers. When a paper bag, animal carcass, or other sighting of interest was made, the GPS location of the point from which the initial sighting was made was recorded, followed by the actual position of the observation. Paper bags had no further sampling. All dead birds found were collected and brought back to base for species identification. Three pictures were taken of any deer carcass observed, the lower jaw bone removed, and a 0.5 kg piece of hind quarter muscle removed, which was placed in a labelled snap lock bag for transportation back to base. Once at base, dead deer samples were placed in a freezer at -10°C. Muscle samples were sent in individual packaging within a chilly bin with cool packs by same-day delivery for 1080 testing by Landcare Research at Lincoln.

Sample analysis

Jaw bones were boiled, dried and sent to John Delury (Stewart Island Whitetail Research Group, Chairman, Rakiura Hunter Camp Trust, Life Member Southland Branch NZDA and experienced NZ white-tailed teeth analysis ager) for comparative age analysis.

The 1080 analysis was conducted at the Landcare Research Toxicology Laboratory, Lincoln which has International Accreditation New Zealand (IANZ) accreditation. The limit of detection is 0.001 µg/g from a 5-g tissue sample.

Data analysis

Fisher's exact test was used to determine if there was a significant difference between detections by trail cameras before and after the control operation inside the operational areas compared to those placed outside of the operational area.

Given the previous observations by DoC it was expected that low numbers of dead deer would be observed, so the observation of preplaced brown paper bags filled with sticks and leaves was used as a proxy for estimating the probability of detecting dead deer.

To estimate the absolute number of dead deer present in the searched area, estimates for recapture probabilities (i.e. the proportion of sacks rediscovered) were used in the following formula (Davidson and Armstrong, 2002):

$$\hat{N}_i = n_i / p_i$$

where n_i = number of individuals caught on occasion *i*

and p_i = recapture probability for occasion *i*

An approximate 95% confidence interval for each population estimate is given by: $\hat{N} \pm 2\,se$

where $se(\hat{N}) = n(se[p])/p^2$

Estimates of potential total by-kill are given by multiplication of white-tailed deer habitat range over the operational zone and the 1080 exposed range by the actual number of dead deer within 1 km^2 produced from the carcass search. Confidence intervals were similarly extrapolated from the error margins determined using the above formula. The results are subject to the following assumptions; i) the density of white-tailed deer within the search areas was representative of the density of white-tailed deer over the entire operational zone, and ii) the bait was evenly distributed over the entire operational area.

Results

<u>Determining the presence / absence of white-tailed deer</u>

Only three white-tailed deer were detected by the 19 trail cameras within the drop zone in the 5 days prior to the operation and only one white-tailed deer was observed in the 5 days following the operation. There were two white-tailed deer detected on the five trail cameras outside of the drop zone both in the 5 days prior to the operation and in the 5 days following. The difference between detections before and after the drop when comparing drop zone with outside the drop zone is not statistically significant (P= 0.5913, df=1) mostly due to the low number of detection events and the low number of cameras outside the drop zone.

Table 1 *Observations of terrain difficulty, accessibility and density of deer sign to assist in the selection of carcass search blocks. Also shown is the number of deer observed by trail camera in the five days prior to and following the aerial application of cereal bait containing 1080 on the 31st of August 2014 both within and outside of the drop zone.*

Search Block	Terrain difficulty	Accessibility	Density of deer sign	Deer observations by trail camera		# Trail cameras
Inside the drop zone				Before	After	
RB	Moderate	Short walk	High	0	0	1
DP	Moderate - Hard	Short walk	High	1	0	2
SF	Easy - Moderate	Long walk	Low	0	0	3
LS	Hazardous	Short walk	Moderate	2	0	5
LD	Hard	Helicopter	Low	0	0	3
CF	Moderate	Helicopter	High	0	1	5
Totals				3	1	19
Outside the drop zone				Before	After	
UD	Hard	Helicopter	Low	0	0	2
EB	Hard	Long Walk	High	2	2	3
Totals				2	2	5

RB – Sugarloaf, DP - Dan's paddock, SF - Surveyors flat, LS – Lake Sylvan, LD – Lower Dart, CF – Cattle Flat, UD – Upper Dart, EB – Earnslaw Burn.

Possible search blocks within the Lake Sylvan area were considered due to the ease of access and the two white-tailed deer observed by trail camera. However, the presence of major bluff systems and difficulty of the terrain raised concerns for the safety of volunteer searchers and resulted in this area not being selected for search.

Dan's Paddock was selected for search due to the ease of access, the observation of high density deer sign and confirmed presence of a white-tailed deer by trail camera. The difficulty of terrain was moderate – hard due to a gorged creek running through the centre of the search block. However, this would mostly affect only two out of the

twelve searchers and could be navigated around, so did not prevent the area from being selected for search.

The Sugarloaf was selected for search due to ease of access, moderate terrain, and the observation of high density deer sign. While no deer were detected by trial camera on the Sugarloaf, only one camera was placed in this area and the low level of white-tailed deer detection by trail camera overall suggested the lack of a confirmed deer presence was not indicative of deer absence, particularly given the high density of deer sign that was observed.

The Lower Dart and Cattle Flat were not selected for search as at the time of search block selection it was unknown whether transportation by helicopter would be possible due to financial constraints. In addition, terrain in the Lower Dart was hard and the density of deer on cattle flat was high. As high density deer sign was observed in both Dan's paddock and the Sugarloaf search blocks, the third and fourth search blocks required low density deer sign to prevent overestimation of mortality.

Surveyors flat was selected and split into the third and fourth search blocks, as this area was accessible by walking (though with difficulty), easy to moderate terrain and had a low density of deer sign and no observations of white-tailed deer by trail camera.

Carcass search

Carcass searches were conducted from the 18-21th of September 2014. The search block DP was not able to be completed on the 19th due to difficult terrain and was completed on the 20th. A total of 190 km of search lines were conducted over the 4 days within the 400 ha search area.

- 18/09/2014 RB search grid
- 19/09/2014 majority of the DP search block
- 20/09/2014 last of the DP search block and all of SF1 Search block
- 21/09/2014 SF2 search block

Four white-tailed deer carcasses were found within the search blocks and one outside of the search blocks. One of those inside the search block (a doe aged at 6–9 months) was found prior to the grid search during the deployment of Kleensacks 14/09/2014 and was not re-found during the DP grid search 19-20/09/2014. This doe, was not pregnant and muscle tissue sampled was found to contain 0.94 µg/g 1080 poison (Figure 4, Appendix 5). Therefore, only three white-tailed deer were found during 190 km of search effort or 1 per 63 km, as follows:

1. A doe carcass found during the first search was located on the far edge but inside of search grid RB on the 18/09/2014. This doe was aged at 4 ½ years old and upon dissection was found to be carrying twins. Muscle tissue was found to contain 0.41 µg/g 1080 poison (figure 5, Appendix 5). Two live does were observed by a volunteer on his return to the drop point, outside of the search grid. One other deer carcass was found but outside the RB search grid on the 18/09/2014 while volunteers were making their way back to the drop-off point. This buck was aged 6-9 months with muscle tissue containing 1.06 µg/g 1080 poison (Figure 6, Appendix 5).
2. The next carcass was found in the DP search grid on the 19/09/2014. This doe was aged at 2 ½ years with muscle tissue found to be containing 0.83 µg/g 1080 poison (Figure 7, Appendix 5).
3. Another carcass was located only 50 metres away from the previous carcass in the DP search grid, also on the 19/09/2014. This buck also aged at 2 ½ years old had muscle tissue found to be containing 0.51 µg/g 1080 poison (Figure 8, Appendix 5). Two live deer were observed during the completion of DP outside the search block on the 20/09/2014.

No deer carcasses or live deer were observed on the 20/09/2014 or 21/09/2014 in search grids SF1 and SF2. Four possums (*Trichosurus vulpecula*), one chaffinch (*Fringilla coelebs*), one blackbird (*Turdus merula*) and five mice (*Mus musculus*) carcasses were also observed. Live birds observed included one pair of Kākāriki (*Cyanoramphus novaezelandiae*), one kākā (*Nestor meridionalis*) and one mouse (*Mus musculus*) inside of the search blocks.

Figure 4 Doe carcass found during paper bag placement, aged at 6-9 months old, muscle tissue containing 0.94 µg/g 1080.

Figure 5 Doe carcass found in RB grid search, aged 4 1/2 years, pregnant with twins, muscle tissue containing 0.41 µg/g 1080.

Figure 6 Buck carcass found outside of RB block, aged 6-9 months, muscle tissue containing 1.06

Figure 7 Doe carcass found in DP search, aged 2 1/2. Muscle tissue containing 0.83 µg/g 1080.

Figure 1 Buck carcass found during DP search, aged 2 1/2 years. Muscle tissue containing 0.51 µg/g 1080.

On average 78% of paper bags deployed were found during the grid searches. Using this detection probability the actual number of dead white-tailed deer was estimated at 5.13 ± 1.13 (95% CI) over the 400 ha of search area or 1.28 ± 0.28/km^2 per 100 ha. The estimated mortality within operational drop zone that was potential white-tailed deer habitat (15,215 ha) is 194.7 ± 42.6 (95% CI) dead white-tailed deer.

Table 2 *Dead deer observed inside four search blocks within the Wakatipu white-tailed deer habitat range following the aerial application of cereal bait containing 1080 on 31st of August 2014. Also shown are the number of paper bags (simulated deer carcasses) placed in the week prior to the carcass search, the number of those found during the carcass searches, the percentage detection estimated from all searches and the estimated actual number of dead deer in each search block.*

Search Blocks	Area search ha	Walk lines	Control Bags placed	Control bags found	Detection Probability	Dead deer #	Actual dead deer	SE	CI (95%)
RB	100	62	100	66	0.66	1	1.52	0.52	1.03
DP	100	72	100	80	0.80	3*	3.75	0.75	1.50
SF1	100	96	100	82	0.82	0	0.00	0.00	0.00
SF2	100	72	100	84	0.84	0	0.00	0.00	0.00
Total	400		400	312	0.78	4	5.13	1.13	2.26

RB - Routeburn, DP - Dan's paddock, SF1 - Surveyors flat block 1, SF2 - surveyors flat block 2. ha -hectares. Walk lines - number of transects in search blocks. SE – Standard error. CI (95%) – 95% confidence interval.

* includes one dead deer observed during control bag placement but not rediscovered on walk lines.

Conclusions

The searches unequivocally confirmed that aerial 1080 poisoning using 0.15 % conc. 1080 in 6 g RS5 cereal pellets at 1 kg/ha sowing rate for the control of rats and stoats did cause mortality for white-tailed deer in the Dart Valley/Routeburn catchments.

Both sexes were susceptible.

If the number of carcasses found in the four searched blocks was representative of the total operational area, simple extrapolation suggests that there would have been 195 ± 43 (95% CI) dead white-tailed deer in the 15,215 ha control area that was considered white-tailed deer habitat. However, it is unknown whether this figures over or under

estimates the actual mortality, as white-tailed deer spatial habitat use, assumed in this study as 50% of the range, is itself only an estimate. In addition, the mortality rate in the 1080 2 km buffer zone is unknown and likely adds a few more to the tally. Nonetheless, based on inspection of topographical maps and field observations of deer sign during the study, there appear to be substantial areas likely to have had deer densities in the same range as in the four searched blocks. If so, then the above estimate is realistic but requires a more in-depth study of deer density in the control area.

In the absence of any current estimate of the herd size or average density, we are unable to determine what proportion of the overall population was killed. The density of carcasses (1.28/km^2) found was very low compared to that recorded for similarly-sized fallow deer in the Blue Mountains in 2001 when non-repellent cereal 1080 bait was used for TB-possum control, with densities of 2.2–38.6 carcasses/km^2 being found in that survey (Nugent and Yockney, 2004). The difference could reflect either a much lower kill rate or a much lower density (or even both). A much lower deer density is suspected to be more likely the case based on the minimal number of white-tailed deer detected by the 19 trail cameras placed within the drop zone over the five days prior and following the operation. In addition, in 1974, Bathgate (1976) estimated density at 3.8 deer/km^2. Subsequently a major decline (73% reduction in deer pellet frequency since 1980) lead to the imposition of the moratorium (Armstrong, 1984), which presumably implies a post-decline density of less than 2–3 deer/km^2. As there has been no formal monitoring of the white-tailed deer population since the 1980's we can only estimate by the anecdotal evidence; that there has been no indication of an increase in deer density under the moratorium, and assume deer densities remain at or below that inferred level. Should this be the case then the observed kill has the potential to be demographically significant.

Both fallow and white-tailed deer in New Zealand forest rely heavily on fallen leaf litter as a food source (Nugent & Challies 1988, Nugent 1990), and are conditioned to pick up food from the ground such as cereal bait. The two species are both moderately-small deer, and have broadly similar diets, so it is reasonable to expect that the impacts on non-repellent 1080 bait would be similar for the two species. That

expectation is considerably strengthened by the confirmation from this study that a number of white-tailed deer were killed in 2014, even though we can only guess at the proportion of the population killed. Thus we conclude that the lack of evidence of deer mortality from the much smaller informal surveys conducted by DOC in 2006 and 2009 are more likely to simply reflect low deer density rather than an absence of deer by-kill.

Recommendations

As the Wakatipu white-tailed deer herd is a likely candidate to be made a 'herd of special interest' in the future (Appendix 3), it is essential to assess the level of impact pest control operations have on the herd and its likely length of time for recovery. As such, further research needs to be conducted on the density, spatial habitat use, herd structure and reproductive success of white-tailed deer in areas exposed to aerial 1080 compared to those not exposed. Only then we can attempt to determine the significance of the mortality caused by the 2014 pest control operation.

Further research on the effectiveness of Epro Ltd deer repellent for specifically repelling white-tailed deer consumption of 1080 containing baits should also be conducted. Sufficient notification of potential aerial operations in the area needs to be given so that deer repellent may be applied at the time of manufacture in order to prevent unnecessary transportation costs. Furthermore, alternative deer repellents, such as that developed by Pest Control Research should be assessed for effectiveness and then considered as a cost-effective alternative. If a repellent is deemed to be effective, its use is recommended in all future aerial 1080 operations within the habitat range of this herd.

Continued partnership between DoC, NZ hunters both within and outside hunting groups, local land owners and wild game animal and biodiversity ecologists is actively recommended and encouraged. Recent partnerships between community groups, local councils, TBfree and DoC in the design of pest control operations have been a success, for example; the Aorangi predator control plan called 'Haumaku kia Haumoko' (TBfree, 2014). In this case the use of deer repellent has resulted in the

support and assistance from hunters for regular pest control operations with a focus on biodiversity gains. Similar cooperation between DoC, recreational hunters and the local community for the monitoring and protection of mohua and other native bird species in the Dart / Routeburn catchments would be of benefit to both the biodiversity of the area and in easing public tension during future DoC pest control operations.

Acknowledgements

The Department of Conservation is gratefully acknowledged for their contribution of financial assistance and in-kind help for this research, particularly John Roberts (Conservation Services Manager), Greg Lind (Conservation Partnerships Manager), Mark Mawhinney (Senior Ranger Biodiversity) and all the Wakatipu Conservancy staff and nearby conservancies staff involved in the search. Thank you to Lincoln University and Landcare Research for technical support, in particular Dr James Ross (Senior Lecturer, Lincoln University), Dr Adrian Paterson (Associate Professor, Lincoln University), Grant Morriss and Morgan Coleman (Field Technicians, Landcare Research). I also thank Grant Morriss & Graham Nugent (Research/Capability Leader, Landcare Research) for constructive comments on an earlier draft of this manuscript/report. I would also like to acknowledge the New Zealand Deerstalkers Association for their support. In particular, the Wellington Branch for the financial assistance towards helicopter costs and the Southern Lakes Branch for their support and contribution to the search. I would like to thank HeliTours Queenstown for the donation of 1 hour free helicopter time for the transport of volunteers to search sites and Southern Glacier Helicopters for dropping brown paper bag used for the control into the Surveyors flat bivouac. Finally, I would like to say a big thank you to all of the volunteers both Locals and those who came from far and wide to assist in the searches and placement of controls.

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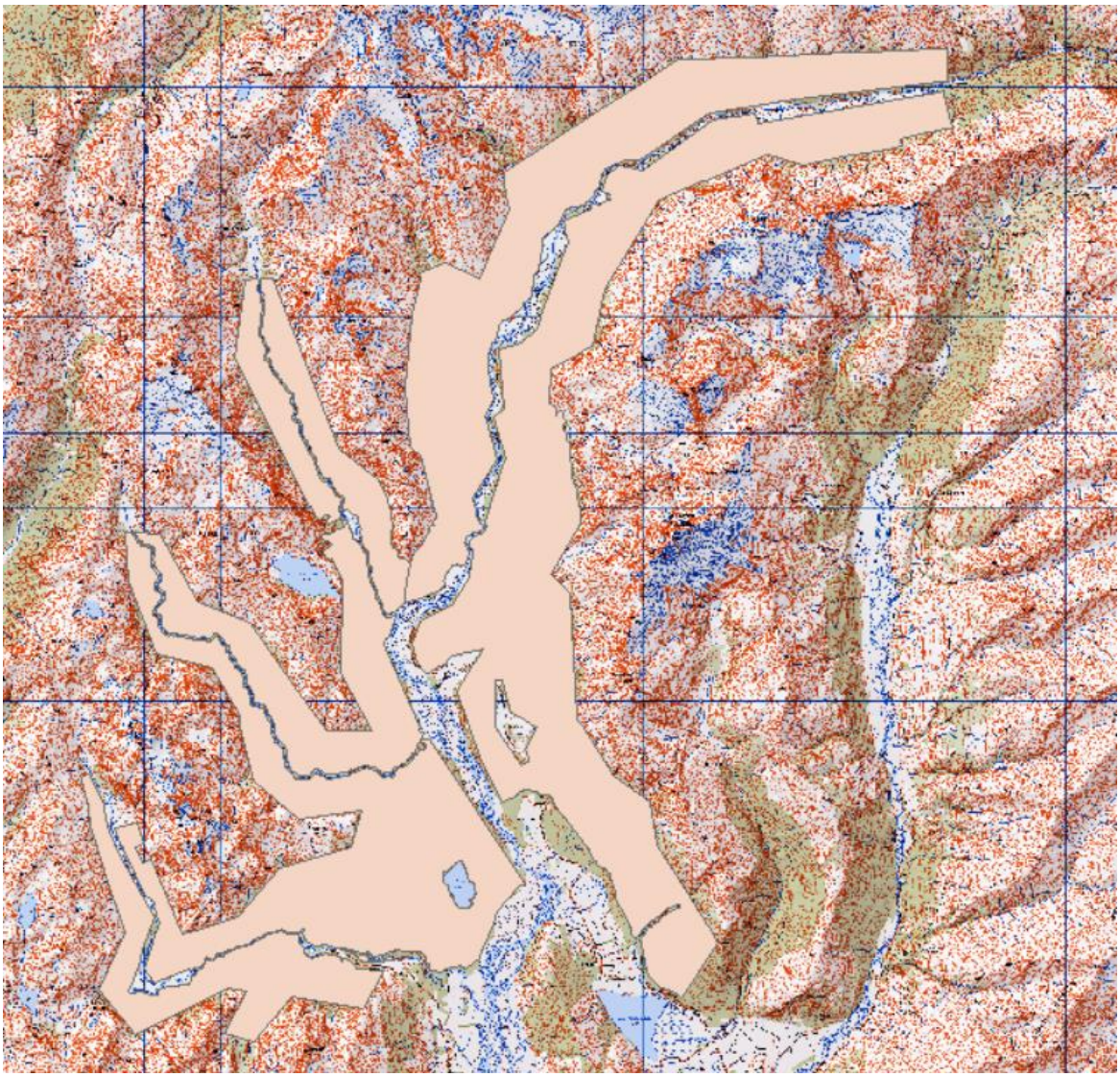
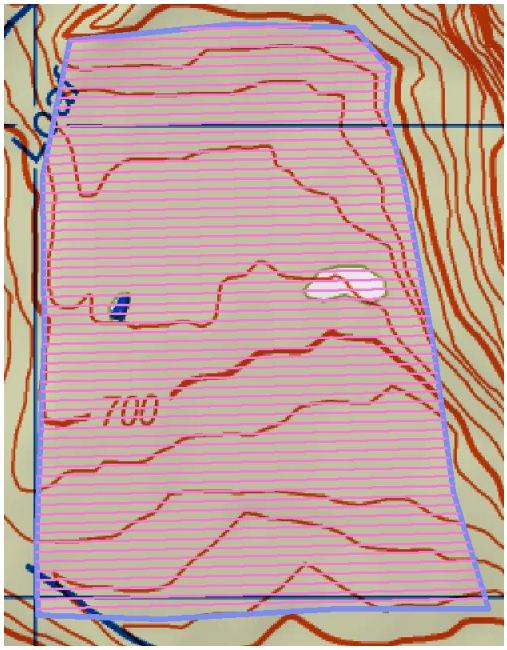
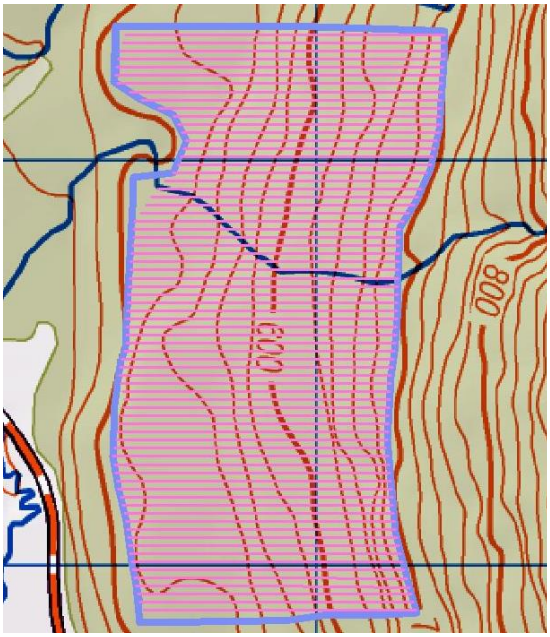
Appendix 1. Dart/Route Burn operational 1080 drop zone 2014 (beige).



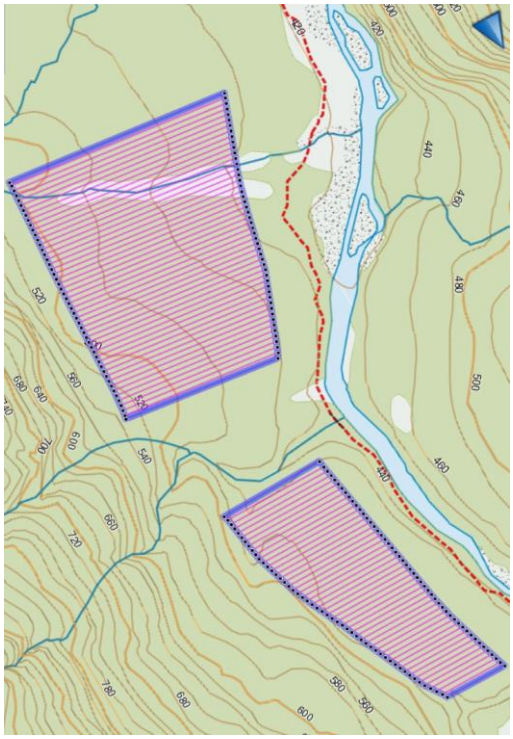
Appendix 2. Search grids from carcass search September 2014. Search lines (pink), defined search area (purple)



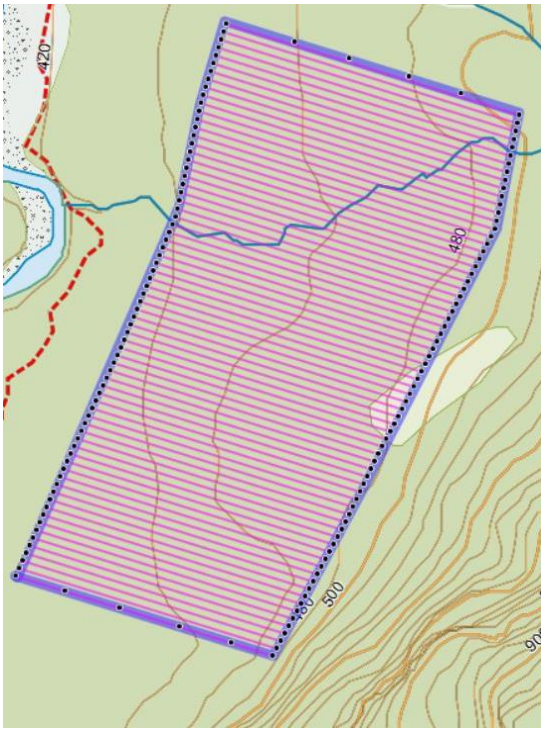
Routeburn (RB) 100 ha Search Block and Grid



Dan's Paddock (DP) 100 ha Search Block and Grid



Surveyors Flat 1 (SF1) 100 ha Search Block and Grid



Surveyors Flat 2 (SF2) 100 ha Search Block and Grid

Appendix 3. Letter from the NZ Game Animal council to Department of Conservation requesting the use of Deer repellent.

NZ Game Animal Council
PO Box 1715, Rotorua 3010
don.hammond@nzgac.org.nz

Game Animal Council
NEW ZEALAND

4 August 2014

Director General
Department of Conservation
Wellington

ATTENTION: KEVIN O'CONNER

Dear Kevin

RE: WAKATIPU WHITETAIL HERD – BATTLE FOR OUR BIRDS

Members of the Game Animal Council (GAC) recently discussed the BfOB programme being conducted by the Department of Conservation, with particular reference to the Wakatipu Whitetail deer herd.

The Council is fully supportive of DoC's work to protect our native fauna from the threats posed due to the current beech mast, and the implications this has for rodent and mustelid numbers, and hence the need for control.

However in the case of the Wakatipu Whitetail herd the Council does have concerns.

A unanimous resolution was passed at the GAC meeting that DoC be asked to use deer repellent on the baits to be applied in the whitetail area in the upcoming operation.

Director General Lou Sanson addressed the inaugural meeting of the GAC in May and advised that DoC understood the concerns about the widespread use of 1080 and would make available resources to protect some special herds by using deer repellent. At that stage he was not able to indicate the locations that might be considered, or the process for such consideration.

I understand DoC has since identified a couple of areas where deer repellent will be used after discussion with interested parties such as NZ Deerstalkers Association. This same Association is represented on the GAC and has strongly endorsed the call for the use of deer repellent in the Wakatipu whitetail area.

The size of the whitetail herd and the extent of its habitat is not well established but there does appear to be some evidence that absolute numbers are low, meaning the viability of the herd is at risk from any further reduction in numbers. In recognition of the small scale of the herd a moratorium on hunting the species has been in place since 1983, although the current CMS proposal seeks to remove this.

It is generally well known that Whitetail is an inquisitive species and do not roam far. As a result they are very susceptible to the presence of poison baits in their habitat. Additionally, the herd is very localised which in turn means that it is not able to recolonise from outside the area as other species such as red deer can.

Currently a PhD student has commenced studies of the herd which will in part assist in developing a Management Plan for a Herd of Special Interest in this location. The research will confirm the extent and population of the herd along with many other base line data.

The Game Animal Council is charged with identifying and recommending for gazettal, 'Herds of Special Interest". While this process has yet to formally begin, there has been considerable discussion about potential Herds of Special Interest, and in every discussion this particular herd gets mentioned, just behind wapiti and tahr. For a range of reasons, it is likely that this herd will meet the criteria to be recommended as a herd of Special Interest, once that process formally gets underway.

It can be taken from this that the Game Animal Council considers this to be a significant herd and it is therefore important that future options for its status are protected.

Additionally there is considerable local cultural value placed on this herd as being the only herd of whitetail on the mainland making it a unique aspect of this location.

Anecdotally the use of deer repellent baits has shown these baits are more attractive to rodents than the non-repellent bait, presumably due to the omnivorous nature of the rodents. The result therefore is an improved kill of target species and reduced by kill of non-target species, ie the whitetail.

We therefore seek confirmation from DoC that the Whitetail herd area that is to be treated during these operations will be carried out with deer repellent baits. We believe that this precautionary approach is appropriate given the likely future status of the herd as being a Herd of Special Interest and the inherent risk the operation poses to the viability of the herd.

I am happy to discuss this further with you and to see how the GAC can assist DoC going forward, not only with this operation but other activities.

Yours sincerely

Don Hammond
CHAIRMAN, NZ GAME ANIMAL COUNCIL

cc Lou Sanson, Director General, DoC

Appendix 4. Letter from Department of Conservation to NZ Game Animal Council declining the request for use of deer repellent.

Department of Conservation
Te Papa Atawhai

17 August 2014

Don Hammond
Chairman
NZ Game Animal Council
P O Box 1715
ROTORUA 3010

By email; don.hammond@nzgac.org.nz

Dear Don

Thank you for your letter of the 4th August regarding the Department's use of deer repellent in the Whitetail area in the Wakatipu Basin.

I note that there has been a previous communication with you on this matter with Ben Reddiex on the 30th July.

I would like to make the following comments:

1. There is no moratorium on hunting the Whitetail deer. There is however currently an area of lands south of the Chinamans Bluff area in the Dart, extending around to the Earnslaw Burn and including parts of Mt Alfred that are known as the 'Whitetail Moratorium Area'. The moratorium area has no legal standing and is managed simply by a local management arrangement of non-issuing of hunting permits for this area.

2. Whitetail deer are known to inhabit land catchment well outside this area and particularly north into the Dart beyond Chinamans and into the Rees. The planned 2014 operation will apply bait to only about half of the whitetail feral range.

3. Whitetail deer numbers are unknown.

4. In 2009 aerially applied 1080 was used in the Dart, including approximately one third of the moratorium area. Following the operation, 26 pest tracking lines (13 km total) in the Dart were subsequently visited and 15 x 1km mohua transects were walked through here (4 times). No deer carcasses were found and it is worth noting that the team doing this work were asked to look out for them.

Department of Conservation
Conservation House *Whare Kaupapa Atawhai*
P O Box 10420, Wellington 6143
Tel: +64 3 4710726 Fax: +64 3 381 3057 www.doc.govt.nz

5. Another operation in 2006 regarding the effects of previous operations on deer numbers locally is found in the Caples RHA, for fallow deer. This was part of our aerial 1080 operation that year. In the course of our work following the 1080 operation in the Caples, the unsuccessful ground bait stations spread over 500ha were emptied, 3 x 500m pest tracking tunnel lines were visited and 10x 1km mohua transect lines were walked. In all of this 'on the ground' work, only one deer carcass was found. The cause of death was not determined. Further, hunter kill returns after the 2006 operation indicate no effect on deer numbers. Of significance also is that the 2006 operation was conducted using 3kg bait/ha. The 2014 operation plans to use only 1kg bait/ha.

6. Similar lack of evidence supporting deer mortality was found in the Dart in 2006. In the Dart 26 x 500m tracking lines and 10 x 1km mohua transect lines were walked after bait was laid, and the bait station network covering 2200ha was cleared. There was no evidence of deer mortality found in any of this ground work.

7. I note the comment in your letter that anecdotally the use of deer repellent baits has shown these baits are more attractive to rodents than the non repellent bait. We have no evidence to support this idea and our ecologists believe that there is no material difference to rodents with or without repellent.

8. I am of course aware that there is a view held by some that 1080 operations have had a negative effect on deer numbers in the proposed drop area but we have no evidence to support this view.

9. DOC is actively working with a Lincoln University PhD study led by Kaylyn McBrearty into the Dart whitetail deer herd. DOC has offered to support field surveys into determining the extent and the numbers of the whitetail both pre and post the Battle for our Birds operation. This data will, as you point out in your letter, potentially be very useful in developing a future Management Plan for the area.

10. Before committing to any additional expense of deer repellent in future drops DOC have agreed that the Lincoln study should first determine if there is an effect. This seems to me to be an entirely appropriate response, given the differing views and this has been well discussed with the NZDA at a local level.

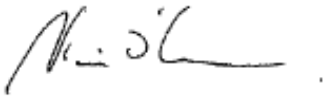
11. DOC has ordered, and has stored locally some 20,000 kg of pre-feed with no deer repellent added and the toxic bait has been ordered and due to be delivered shortly. Our planned date to begin the aerial operation of the pre-feed is 25 August, we would hope to then begin the bait application sometime around the 30th September and the timing for both applications will of course be weather dependant.

Given the above I now intend to direct that operation to proceed as planned and that is not using deer repellent. The planned 2014 operation using 1 kg/hectare of toxic bait is, I believe, very unlikely to result in any material deer by-kill. Also please note that the additional cost of applying deer repellent bait would be approximately $140,000. To acquire the deer repellent bait would also require a delay to the operation by some 7 weeks as the

bait factory has to reorganise their manufacturing to produce this product and they have to manufacture other non deer repellent orders they are already committed to for other clients first. This delay would then prevent our ability to apply the bait as the Great Walk tramping season and other significant visitor usage of the area will be ramping up making the operation too difficult to proceed with at this time and therefore entirely losing the opportunity.

I am of course very happy to discuss this further with you.

Regards



Kevin O'Connor
for the Director General - Department of Conservation

Appendix 5. Muscle tissue 1080 concentration laboratory results.

Manaaki Whenua
Landcare Research

Gerald Street
P.O.Box 69040
Lincoln, 7640
Ph: +64 3 321 9999
Fax: +64 3 321 9998

Toxicology Laboratory Analysis Report

Report No: T5713

CLIENT: ., Kaylyn McBrearty, 1925 State Highway 6, RD1 Whataroa South Westland 7886
CLIENT REFERENCE No.: **Telephone No:**
SAMPLES: Five muscle samples
REQUIREMENT: Examine for 1080
RECEIVED: 27 November 2014

Sample/s were received for analysis. The details were entered into the laboratory sample system and the sample/s given a reference number. The sample details and results are as follows:

No. samples: 5

LabNo.	Description	1080, µg/g
18848	Muscle tissue, RB-A1	1.06
18849	Muscle tissue, RB-A5	0.41
18850	Muscle tissue, DP-A1	0.51
18851	Muscle tissue, DP-ME	0.94
18852	Muscle tissue, DP-A6	0.83

All results are reported to two significant figures.

The determination was carried out using TLM005, the assay of 1080 in water, soil and biological materials by GLC. The method detection limit (MDL) is 0.001µg/g and the uncertainty (95% c.i.) is ± 9%.

TESTED BY: leb **WORKBOOK REF:** 92/3
TEST PERIOD: 1-3/12/14

AUTHORISED BY:

L.H.Booth, L.E. Brown

Date: 4/12/2014

547 ilac-MRA laboratory
All tests reported herein have been performed in accordance with the laboratory's scope of accreditation