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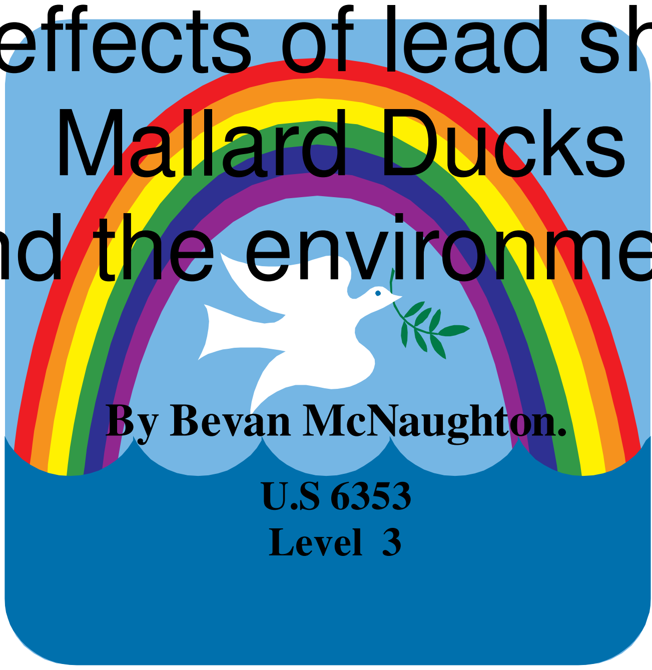

By Bevan McNaughton.

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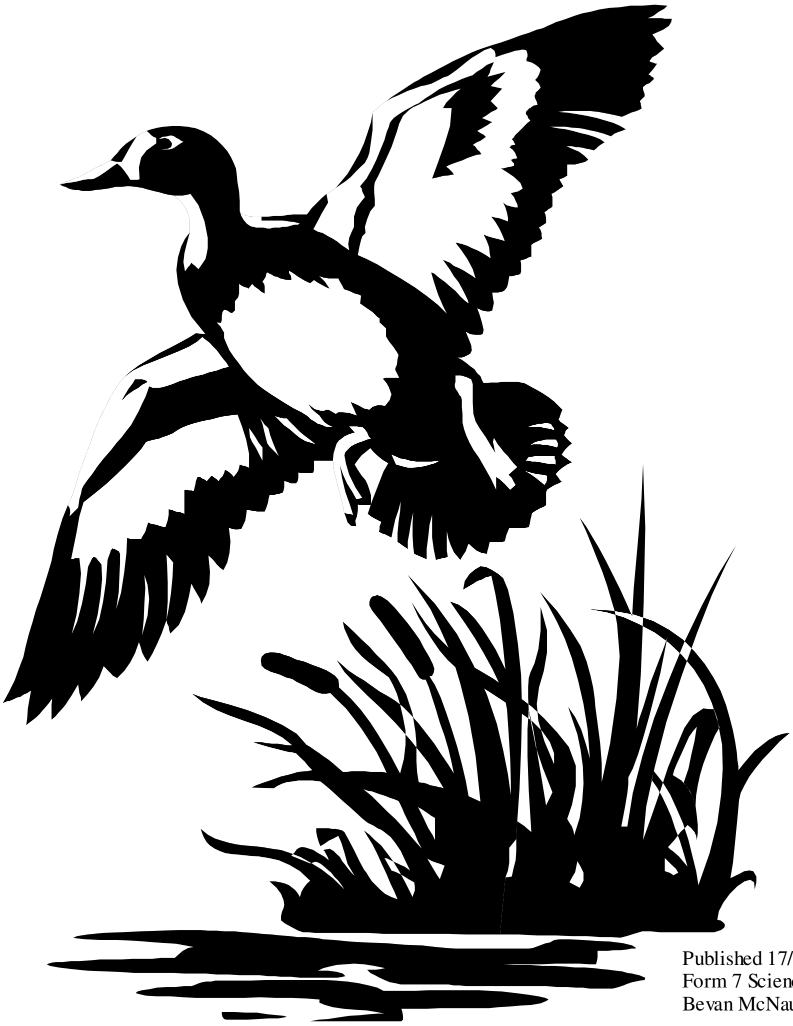

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The effects of lead shot on Mallard Ducks and the Environment.

By Bevan McNaughton.

Introduction:

This report was produced to bring attention to hunters and conservationists alike to the issue of the effect that spent lead shot pellets may have on waterfowl and its long lasting presence in the environment. The effects that lead shot has on Mallard Ducks (Anas platyrhynchos platyrhynchos) (the key species being investigated throughout this report) is being questioned and some organisations are pushing to have lead shot banned because of its impact on wading bird species and the environment.
(Waterfowl as defined by: [1] Swimming game birds, such as ducks and geese, considered as a group.)
One Number 5 Shotgun cartridge contains around 231 pellets (11/4 Oz) and can have an arc of travel of up to 100 metres.[2]
The issue is that Lead poisons and kills waterfowl. Lead shot is ingested whilst feeding and it poses a significant problem. "This problem differs from most environmental contamination's in that it is caused directly by the sport of individuals, the same people who espouse environmental protection and wildlife conservation." [3]
N.B. New Zealand Royal Forest and Bird Society are promoting a change away from lead shot yet there is very little information available in what the New Zealand situation is of lead poisoning. There is quite a lot of overseas information and many countries have moved to other shot alternatives besides Lead. The topic is often emotive with parties promoting their own views, often overestimated.

Aim:
To investigate the lead levels in a duck pond and see if the levels of lead shotgun pellets are enough to affect Mallard ducks.

Proposal:
Measure the density of spent lead pellets in a typical Southland "duck pond", using transect sampling techniques. Using radiographic techniques, examine the gizzards of a representative sample of Mallard ducks shot on the pond over "opening" weekend of the 1999 Duck Hunting Season.

Summary of the work:
The research investigates the amount of lead pellets that exist in a typical Southland duck pond and compare them to other researches done in New Zealand. To further the research gizzards of ducks shot on the pond and around Southland were analysed to give a picture of the amount of poisoning that resulted due to the spent lead pellets present in the waterway bottoms of which Mallard Ducks graze,

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[1] Houghton Mifflin Company. (1992). *The American Heritage® Dictionary of the English Language, Third Edition*

[2] Remington Arms Company, Inc. (1999). Steel vs: Lead. Differences You Should Know. http://www.remington.com/ammo/pages/shotshell/stlvsld.htm

[3] Thomas, V.G. (1995). Canada Aren't Adopting Nontoxic Shot/Sinkers. *Department of Zoology, University of Guelph. International Environmental Affairs (Page 375)[1]*

dive feed and dabble upon. The information is compared to other results and any correlations are listed.

Hypothesis:
That pellet density in a representative duck pond will be up to and/or exceed 50,000 pellets per hectare and consequently, more than 5% of the duck population will have ingested lead pellets present in their gizzards.

Method:
There are 2 areas to investigate the pond itself and the birds affected. (2 variables).

Soil Samples
The area sampled covered approximately a 90° spread from the front of the maimai *(shooting blind).*

History:
This area was used as this part of the pond of which the shooting area covers has been established for 9 years. The other more longer piece of the pond behind (to the south west of) the maimai is only 7 years old and has less representation to a 'typical' duck pond due to its shooting range from the maimai and age. Over the nine years there would be estimated 1080 shots fired over the pond. This would equate to 1080 shots at 1 1/4 Oz (35.4g) load to leave 38.27Kg (2dp) of lead shot (318932 pellets) total in the pond. The most commonly used shot on this pond is 5 shot, diameter 3.302mm and mass per pellet 0.12g. On an estimated average there are 40 birds shot per opening weekend of the season.)
The transect method consisted of six transect plots covering 90° spread total from the focal point on a 50m radius. The six transect plots were generated using a random numbers table generated between 0° and 90° = 22.5° - they will be spread at 22.5° either side of a random starting point. From the first transect 5 other transects either side within the area sampled were made. At every 10 metres ten soil samples will be taken, every 2 of these 10 samples will be placed in a plastic bag and marked (sample number) and then the five bags into a fertiliser type sack which will be marked with the transect letter (A-F) and meter increment reading (1-5). The soil samples will then be individually sifted to remove the soil and organic matter so as the lead pellets then can be counted from each sample. To extract each soil sample for use a pipe type soil sampler of depth 150mm and diameter 150mm will be used, each sample then will be pressed into the plastic bags by the plunger that is on the sampler. All samples within the first 10 metres was left out except Al-1 due to the fact that sampling in other transects of this distance would cause problems of over running the sample sites.
Each sample was later screen washed in a sieve of 1.5mm^2 from a bucket where the soil was washed down into smaller particles. This dramatically lowered the amount of soil for further sieving.
To sieve each soil sample, the sample was dried to remove water and make the soil hard. The dried soil lumps were then crushed (using a Mortar and Pestle,) sieved through a 3mm gauze plate to remove any large organic material and stones so as the sampling and removal of lead shot was easier to achieve and ran through a 2mm gauzed roller tumbler.
The amount of lead in each sample was recorded down on a data sheet to be put into a spreadsheet for mathematical and graphical analysis.

An example was something like this:

Soil sample Number (1-10)	Segment Number (l-5)(10m-50m)	Transect Letter (A-F)	Number of pellets Per sample
5	**2**	**B**	**11**

Fig. 1.0

(Note: The soil samples were already collected previous to this investigation plan due to the opening season starting in the first Saturday of May and the investigation time starting from the 25th of June 1999. At time of sample collection the pond held no water due to a dry summer, this made collection easier and the samples more solid to handle.)

Gizzard Samples

The gizzards were collected from ducks shot on the pond over Opening Weekend 1999. They were checked for entry wounds from shot in pellets and then sliced open. The contents were washed out to clear organic matter, dried, sealed in a plastic bag and then x-rayed in a spectrometer. The x-ray results were then assessed to find how much lead shot and/or lead particles/pieces (to 2ppm - the minimum reading the spectrometer can read to) was present. Lead metal (Pb) is easily distinguishable by the machine and prints out tables showing the concentrations of metals in the sample. (Gizzards had been collected due to date of opening weekend and were frozen until time of sampling. There were only 7 birds shot during the 1999 opening weekend of the season due to a lack of water in the pond. Last year (1998) 51 ducks were harvested for opening weekend.)

Most of the variables in this investigation were almost gone as there were numerous multiple samples, which offered a wide range of data that can be appropriately sorted to drop out invalid results (by means of ranges and averaging out data). There was some loss of validity in the Gizzard samples as mallards may have come to the pond from other areas and have been previously poisoned. This likeliness is low as most of the local birds have been at this duck pond for some time and were most likely to be fired upon first.

Equipment used:

Soil Sampler (150mm dia. x 150mm depth)
Gauzed Sieves (15mm^2 to 1.5mm^2)
Vivid Pen
Pegs or sticks to mark points
15L buckets
Steel trays
150 plastic supermarket type bags
30 Fertiliser type bags
Bailing Twine
Measuring tape (75m)
Mortar & Pestle
9KW Drier at constant 60°C

The pond chosen was marked out as such:

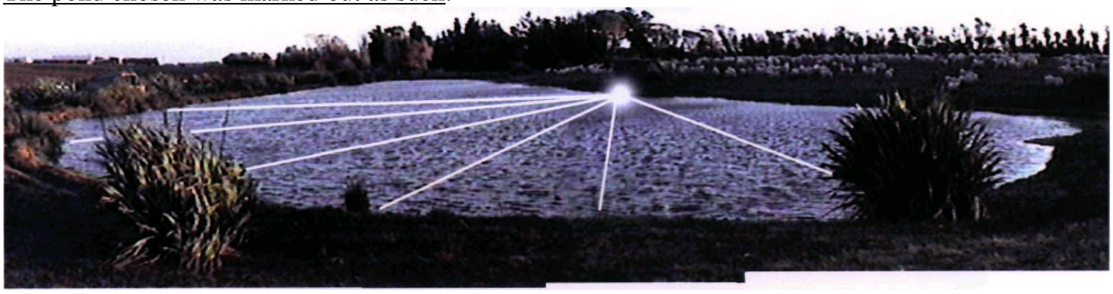


Fig 1.1: View of surveying and transect lines opposite the maimai. (90-120° view from opposite the maimai.)

Fig 1.2: View of surveying and transect lines from within the maimai. (180° view from within the maimai.)

<u>The Data Gathering Process:</u>

A) Soil samples:

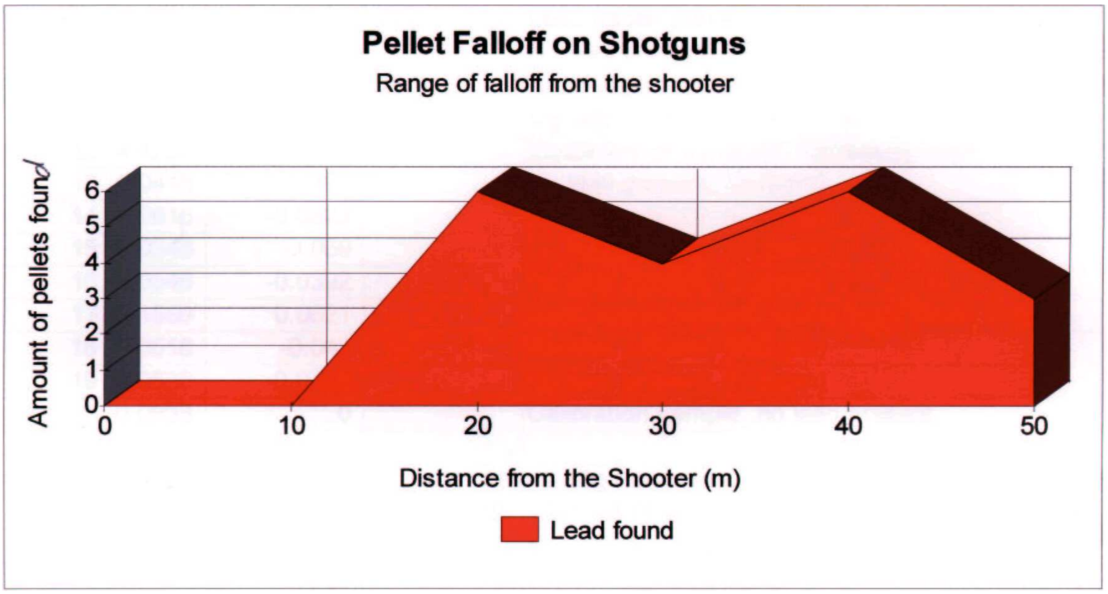
The most time consuming and labour intensive part of the research was the soil sampling. Through the process there were constant modifications on the method to reduce time and effort. None of these affected the results as certain standards (controls) were held to conserve the readings needed. The actual sieving deemed to provide the most effort apart from the needs of drying, sorting, crumbling, extraction of large matter (sticks, stones) and roller sieving.

To reduce the size of the sample from 150mm depth x 150mm diameter the samples were after the first transect segment screen washed using a 1.5mm gauzed sieve and buckets. Each sample was placed in a bucket and crushed up, the bucket then had water constantly running into it and was stirred so as any soil was easily spilled out then the sample and water spilled through the sieve, dramatically reducing the size of the sample up to l/10th the size, the samples were then re-bagged. This greatly reduced the size of the sample cutting down the time and amount of samples to be dried at one time in the drier.

See end tables for results of soil sampling.

The lead present works out to be in this duck pond at 3358 (0 d.p) pellets per hectare. In contrast to other areas such as the Kaikorai Lagoon (Otago) with Adrian Evans' (1992)[44] density of 387,500 pellets/ha and Belford's (1975) results of between 40,475 to 48,500 pellets/ha this seems to be VERY low in consideration. Adrian Evans' results may be overestimated, as his sampling techniques were limited to only a very small sample size and a small limit of samples (1.13cm^2 (2d.p) and around 4 cores per transect). The main reason that 300 samples of each a top area of 176.724cm^2 (2d.p) and a volume of 2650.72cm^3 (2d.p) was taken was to lower any variables of the result and give a much more accurate picture of the amount of lead in the soil of the pond.

There are specific exemptions to this fact as there was only one shooting position for only one party and the sampling was unaffected by a water presence as the pond sampled was dry at the time of sampling due to a dry summer.



10,000m^2 =1 ha
Sample = 0.017671458m^2
Pellets per ha = 3357.577149
Sample Vol. = 2650.718801cm^3 / 2.650718801m^3

19 pellets found
19 samples - 0.335757714m^2
top area of 176.7145868cm^2 / 0.1767145868m^2[4]

[4] Evans, Adrian. (October 1992). The density and fate of spent lead gunshot in Otago Wetlands. *University of Otago Wildlife Management research report, Report Number 30.*

A non-related graph was produced from the pellet data resembling a shooting falloff range of pellets from the maimai shot, this showed that most spent lead shot settled from a distance of 20 and 40 metres from the shooter and where most concentrations of lead would lie. There is no direct pattern available in comparison to other results but gives the results of where ducks may settle on a pond or where lead usually settles away from the firing distance of the hunter. For example Fredrickson, L.H.[55] found the best area for lead settlement was between 100-200m from the maimai. This seems incorrect as lead pellets only really have a good travelling power of up to 100m. Fredrickson may have had overruns from other transects interfering with these results

B) Gizzard Samples:

The gizzards deemed to be a lot less work and each gizzard were able to be dissected and washed in about 2 minutes each. The samples were then laid in a pitri dish to dry and then bagged for processing in an 'X-Ray Spectrometer'. The x-ray spectrometer emits x-rays onto the sample and measures the amount of diffraction off the sample. This process is extremely accurate and can measure metals in a sample up to 2ppm (parts per million). The main metal to be measured was lead.

There were 20 gizzard samples to be analysed, below are the results, these are instead measured in Thousands of counts per second of Pb (lead) due to the fact that sample crushing was costly and time consuming:

Sample	Kcps	Mod'd Kcps	Kcps/gm Pb	Notes:
1	0.3281	0.2343		Equivalent of 1 Pellet present
2	0.1697	0.0759		Lead traces present, in too lower levels to harm.
3	0.0992	0.0054		Lead traces present, in too lower levels to harm.
4	2.4591	2.3653		Equivalent of 4 Pellets present
5	0.1007	0.0069		Lead traces present, in too lower levels to harm.
6	0.1013	0.0075		Lead traces present, in too lower levels to harm.
7	0.0664	-0.0274		No lead present. (0-2ppm)
8	0.1178	0.024		Lead traces present, in too lower levels to harm.
9	-0.0028	-0.0966		No lead present. (0-2ppm)
10	0.0733	-0.0205		No lead present. (0-2ppm)
11	0.364	0.2702		Equivalent of 1.5 Pellets present
12	4.4288	4.335		Equivalent of 8 Pellets, Extremely High
13	0.0445	-0.0493		No lead present. (0-2ppm)
14	0.0616	-0.0322		No lead present. (0-2ppm)
15	0.0348	-0.059		No lead present. (0-2ppm)
16	0.0546	-0.0392		No lead present. (0-2ppm)
17	0.1559	0.0621		Lead traces present, in too lower levels to harm.
18	0.0518	-0.042		No lead present. (0-2ppm)
19	0.0536	-0.0402		No lead present. (0-2ppm)
20	0.0938	0		Calibration sample, no lead present.
21	0.3281	0.2343	1.95	+0,12g Pb metal (comparison: 1 #5 shot pellet)
22	0.6932	0.5994	2.495	+2x0.12 Pb metal (comparison: 2 #5 shot pellets)
23	1.1565	1.0627	2.953	+3x0.12 Pb metal (comparison: 3 #5 shot pellets)

<u>Fig 3.0:</u> Gizzard sample spectrometer results.

(No lead pellets were identified in samples 1 -20.)
(Samples 21-23 are for comparison of lead masses Vs. Kcps readings.)

5 Fredrickson, L.H. Baskett, T.S. Brakhage, G.K. Cravens, V.C. (1977) *Evaluating cultivation near duck blinds to reduce lead poisoning hazard.* J. Wildl. Manage, 41:4, 624-631

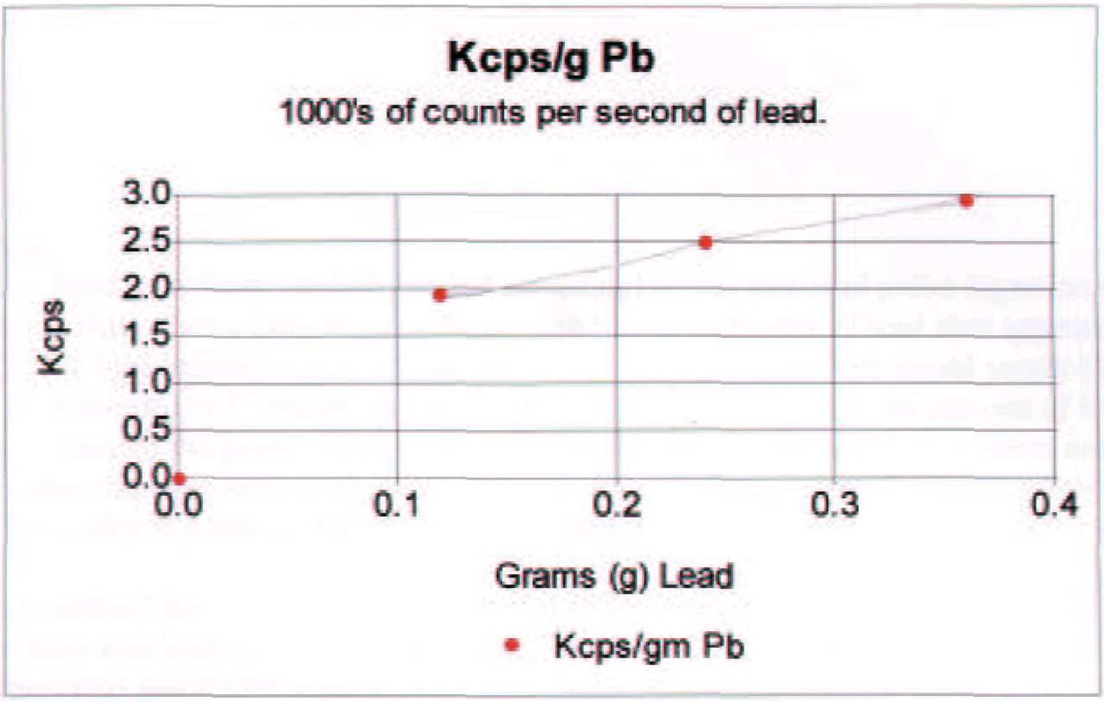


Fig 3.1: Graph of samples 21-23, non-linear line (curved)

As you can see above 2 ducks had up to 4.5 Kcps of lead present in their gizzards. At levels of 0.25+ Kcps this is enough to kill or brain damage a mature Mallard duck. At t .5 pellets this would quickly kill a duck within days. At the point where samples contain 4 & 8 pellets this raises some very serious questions about the duck and area shot. These levels are extremely high and would kill a mature Mallard very quickly. It is unknown if these gizzards did indeed contain pellets that were ingested or if there were high amounts of lead levels in its environment There are presences of lead in 50% of the gizzards, this may be from particles picked up from the likes of road dust or remained present from other feeding areas (near factories or waste tips). This comes to resolve that some ducks may not have been poisoned primarily from lead pellets. The Kcps/gm column was used to evaluate the idea of a graph to estimate the amount of shot in comparison to the modified (to the calibration sample analysis) Kcps count. Continuing the graph produces a non-linear (due to the fact that that it is analysing lead particles in a 3D matrix) graph on a more exponential curve.
The above table is of spread Southland gizzard samples (other Southland ponds, waterways) donated by the Southland Fish & Game Council to give an overall picture of the results of lead poisoning in Southland. The method of dissection is the same as followed below.
Seven Mallards shot on the pond were local ducks to the pond as they contained feed the same as what was fed out for a week before opening weekend (whole oats and peas (Duck mix)). The ducks gizzards were split open and washed out tipping the contents into a bowl. The contents were then gold panned' at to remove any such feed and leave heavier materials such as stones, sand and lead. If whole lead pellets were found (as there was in 2 cases) the gizzard was checked for entry points which may have occurred from shooting. Both had resulted in such an instance, in fact one gizzard contained a pellet in the actual gizzard muscle with a down feather around it. The heavier contents were then laid in a pitri dish to dry out The samples to be analysed were bagged then X-Rayed in a Spectrometer. The gizzards from the pond were not analysed in the spectrometer due to time restraints.
The results as shown above provide information that there were cases of lead poisoning present, at a 20% incidence rate. In relation to other such researches carried out this provides a higher result of lead poisoning from ingestion than that in comparison in other such as Bellford (1975) a 6.0% incidence rate in Otago and in an Auckland/Waikato Fish & Game survey by Dyer (1992) a 13.9% incidence rate. With the 20 samples done, no pellets were found yet when the gizzards were x-rayed an alarming amount of lead was found to be present in the gizzard contents. As the particles must have been very fine (smaller than a shot pellet) it is not clear where the lead contamination came from.

Conclusion:

The results from both fields (soil & gizzard sampling) reveal that lead pellet ingestion may be taking place and that this poses a long-term problem with newer additions of lead shot appearing in waterways per year (game bird season) and increases constantly. The pond studied would yearly (on median average) have about 35437 pellets added to the pond increasing yearly the amount of lead present for poisoning. Many of the pellets fired each year can also fall beyond the ponds water area. In a contrast to a larger shooting area such as Pukepuke (Caithness, 1974) he found that lead pellets were being deposited annually at a rate of 23,000-50,000 pellets per hectare. This is much more than an average pond.

The seven mallard ducks taken within the pond showed no signs of lead ingestion (all seemed healthy birds) yet there was lead shot present in the soil samples. These were still present after almost a year since the previous game bird season. The other twenty gizzards sampled are of concern due to no pellets being visually found yet when x-rayed showed presence in some of the samples (e.g. gizzard sample 12).

While the results are not conclusive it does show that little is known in New Zealand about the effects of lead poisoning by birds which ingest pellets. With certainty the results do show the cause may be there.

In relation to other - more open waterways such as the Kaikorai Lagoon it shows that over time lead can accumulate in higher densities annually therefore increasing the chance and incidence rate of lead poisoning by ingestion.

Although ingestion of spent lead pellet poisoning is a threat there are other causes to the fact of lead poisoning in Mallard ducks, of which are unknown (i.e. the equivalency of 8 pellets in a gizzard.) Therefore it is not only a problem with lead pellet ingestion that is causing the poisoning of Mallard ducks.

The hypothesis was proved incorrect in the instance of there being more than 50,000 pellets per hectare but did indeed prove true with a more than 5% incidence rate of lead pellet ingestion.

Investigation evaluation:

To keep sources valid and reliable all sources were checked for linking to scientific research, results and known organisations, there were a few papers found which had a total biast view on the lead shot issue. All statements were noted down from the material and any references to statements were checked along with data. This concluded valid sources of information so as not to add incorrect data to my research.

The actual investigation was followed along the same lines as other research papers studied to gain information on how to carry out the experiment, none had tried such large sampling techniques nor the use of an x-ray spectrometer. To do this type of sampling I discussed with organisations who work in this field and asked them for their views and assistance on the matter. The organisations involved kindly helped me get started and linked their techniques back to similar techniques on different jobs. In effect it made the data collected reliable to work upon.

Acknowledgements:
I would first like to thank Alan Munro for his support and guidance throughout the research, without him this paper would not be off the ground floor.
Next I would like to thank Zane Moss of the Southland Fish & Game Council, N.Z for providing the research information and for helping out in the method of collecting the soil samples as well as helping to process the gizzards ready for the Spectrometer.
Roger McNaughton for his help on collecting the soil samples along with his support in writing this paper and getting the screen showering organised for me to start on.
A thank you to Pack "N Save, Invercargill for their very kind donation of 150 supermarket bags for me to place the soil samples in. I apologise but all the bags are not fit for reuse!
I would last but not least like to humbly thank Stan Winter of Southern Chemical Consultants for the use of the laboratory and equipment, as well as his very kind guidance in getting me started in processing the numerous samples. I also wish to kindly thank him for his extremely generous offer in processing the gizzard samples in the X-Ray Spectrometer free of charge which was entirely unexpected! Stan, your help and use of your facilities got me through that large amount of dirt and labour intensive hours!

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Sample Data Results:

Sample No.	Segment No.	Transect	Pellets	Sample No.	Segment No.	Transect	Pellets
1	1	A	0	1	2	A	0
2	1	A	0	2	2	A	0
3	1	A	0	3	2	A	2
4	1	A	0	4	2	A	0
5	1	A	0	5	2	A	0
6	1	A	0	6	2	A	0
7	1	A	0	7	2	A	0
8	1	A	0	8	2	A	0
9	1	A	0	9	2	A	0
10	1	A	0	10	2	A	0

Sample No.	Segment No.	Transect	Pellets	Sample No.	Segment No.	Transect	Pellets
1	3	A	0	1	4	A	0
2	3	A	0	2	4	A	1
3	3	A	1	3	4	A	0
4	3	A	0	4	4	A	0
5	3	A	0	5	4	A	1
6	3	A	0	6	4	A	0
7	3	A	0	7	4	A	0
8	3	A	0	8	4	A	0
9	3	A	0	9	4	A	0
10	3	A	0	10	4	A	0

Sample No.	Segment No.	Transect	Pellets
1	5	A	0
2	5	A	0
3	5	A	0
4	5	A	0
5	5	A	0
6	5	A	0
7	5	A	0
8	5	A	0
9	5	A	0
10	5	A	1

Sample No.	Segment No.	Transect	Pellets	Sample No.	Segment No.	Transect	Pellets
1	1	B	0	1	2	B	0
2	1	B	0	2	2	B	0
3	1	B	0	3	2	B	0
4	1	B	0	4	2	B	0
5	1	B	0	5	2	B	0
6	1	B	0	6	2	B	0
7	1	B	0	7	2	B	0
8	1	B	0	8	2	B	0
9	1	B	0	9	2	B	0
10	1	B	0	10	2	B	0

Sample No.	Segment No.	Transect	Pellets	Sample No.	Segment No.	Transect	Pellets
	1	3 B	1	1		4 B	0
	2	3 B	0	2		4 B	0
	3	3 B	0	3		4 B	0
	4	3 B	0	4		4 B	1
	5	3 B	0	5		4 B	0
	6	3 B	0	6		4 B	0
	7	3 B	0	7		4 B	0
	8	3 B	0	8		4 B	0
	9	3 B	0	9		4 B	0
	10	3 B	0	10		4 B	0

Sample No.	Segment No.	Transect	Pellets
	1	5 B	0
	2	5 B	0
	3	5 B	0
	4	5 B	0
	5	5 B	0
	6	5 B	0
	7	5 B	0
	8	5 B	0
	9	5 B	0
	10	5 B	0

Sample No.	Segment No.	Transect	Pellets	Sample No.	Segment No.	Transect	Pellets
	1	1 C	0	1		2 C	0
	2	1 C	0	2		2 C	0
	3	1 C	0	3		2 C	0
	4	1 C	0	4		2 C	0
	5	1 C	0	5		2 C	0
	6	1 C	0	6		2 C	0
	7	1 C	0	7		2 C	0
	8	1 C	0	8		2 C	0
	9	1 C	0	9		2 C	0
	10	1 C	0	10		2 C	0

Sample No.	Segment No.	Transect	Pellets	Sample No.	Segment No.	Transect	Pellets
	1	3 C	0	1		4 C	0
	2	3 C	0	2		4 C	0
	3	3 C	0	3		4 C	0
	4	3 C	0	4		4 C	0
	5	3 C	0	5		4 C	0
	6	3 C	0	6		4 C	0
	7	3 C	0	7		4 C	0
	8	3 C	0	8		4 C	0
	9	3 C	0	9		4 C	0
	10	3 C	0	10		4 C	0

Sample No.	Segment No.	Transect	Pellets
1	5	C	0
2	5	C	0
3	5	C	0
4	5	C	0
5	5	C	2
6	5	C	0
7	5	C	0
8	5	C	0
9	5	C	0
10	5	C	0

Sample No.	Segment No.	Transect	Pellets	Sample No.	Segment No.	Transect	Pellets
1	1	D	0	1	2	D	0
2	1	D	0	2	2	D	1
3	1	D	0	3	2	D	0
4	1	D	0	4	2	D	0
5	1	D	0	5	2	D	0
6	1	D	0	6	2	D	0
7	1	D	0	7	2	D	1
8	1	D	0	8	2	D	0
9	1	D	0	9	2	D	0
10	1	D	0	10	2	D	0

Sample No.	Segment No.	Transect	Pellets	Sample No.	Segment No.	Transect	Pellets
1	3	D	0	1	4	D	0
2	3	D	0	2	4	D	0
3	3	D	1	3	4	D	0
4	3	D	0	4	4	D	0
5	3	D	0	5	4	D	0
6	3	D	0	6	4	D	1
7	3	D	0	7	4	D	0
8	3	D	1	8	4	D	0
9	3	D	0	9	4	D	0
10	3	D	0	10	4	D	0

Sample No.	Segment No.	Transect	Pellets
1	5	D	0
2	5	D	0
3	5	D	0
4	5	D	0
5	5	D	0
6	5	D	0
7	5	D	0
8	5	D	0
9	5	D	0
10	5	D	0

Sample No.	Segment No.	Transect	Pellets	Sample No.	Segment No.	Transect	Pellets
1	1	E	0	1	2	E	0
2	1	E	0	2	2	E	1
3	1	E	0	3	2	E	0
4	1	E	0	4	2	E	0
5	1	E	0	5	2	E	0
6	1	E	0	6	2	E	0
7	1	E	0	7	2	E	0
8	1	E	0	8	2	E	0
9	1	E	0	9	2	E	0
10	1	E	0	10	2	E	0

Sample No.	Segment No.	Transect	Pellets	Sample No.	Segment No.	Transect	Pellets
1	3	E	0	1	4	E	0
2	3	E	0	2	4	E	1
3	3	E	0	3	4	E	0
4	3	E	0	4	4	E	0
5	3	E	0	5	4	E	0
6	3	E	0	6	4	E	0
7	3	E	0	7	4	E	0
8	3	E	0	8	4	E	0
9	3	E	0	9	4	E	0
10	3	E	0	10	4	E	0

Sample No.	Segment No.	Transect	Pellets
1	5	E	0
2	5	E	0
3	5	E	0
4	5	E	0
5	5	E	0
6	5	E	0
7	5	E	0
8	5	E	0
9	5	E	0
10	5	E	0

Sample No.	Segment No.	Transect	Pellets	Sample No.	Segment No.	Transect	Pellets
1	1	F	0	1	2	F	0
2	1	F	0	2	2	F	1
3	1	F	0	3	2	F	0
4	1	F	0	4	2	F	0
5	1	F	0	5	2	F	0
6	1	F	0	6	2	F	0
7	1	F	0	7	2	F	0
8	1	F	0	8	2	F	0
9	1	F	0	9	2	F	0
10	1	F	0	10	2	F	0

Sample No.	Segment No.	Transect	Pellets	Sample No.	Segment No.	Transect	Pellets
1	3	F	0	1	4	F	0
2	3	F	0	2	4	F	0
3	3	F	0	3	4	F	1
4	3	F	0	4	4	F	0
5	3	F	0	5	4	F	0
6	3	F	0	6	4	F	0
7	3	F	0	7	4	F	0
8	3	F	0	8	4	F	0
9	3	F	0	9	4	F	0
10	3	F	0	10	4	F	0

Sample No.	Segment No.	Transect	Pellets
1	5	F	0
2	5	F	0
3	5	F	0
4	5	F	0
5	5	F	0
6	5	F	0
7	5	F	0
8	5	F	0
9	5	F	0
10	5	F	0

Distance (m)	Lead found	Transect & sample
20	2	A2-2
30	1	A3-3
40	1	A4-2
40	1	A4-5
50	1	A5-10
30	1	B3-1
40	1	B4-4
50	2	C5-5
20	1	D2-2
20	1	D2-7
30	1	D3-3
30	1	D3-8
40	1	D4-6
20	1	E2-2
40	1	E4-2
20	1	F2-2
40	1	F4-3

	Lead found
0	
10	0
20	6
30	4
40	6
50	3