

**RESULTS OF AN INVESTIGATION INTO THE INCIDENCE OF
INGESTED LEAD SHOT IN MALLARD/GREY DUCK POPULATIONS
FROM SIX FISH AND GAME REGIONS**

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March 2001

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Executive Summary

During the 1999 and 2000 game seasons, 1077 mallard/grey duck gizzards were obtained from hunters from six Fish and Game regions (Southland, Central South Island, North Canterbury, Nelson/Marlborough, Hawke's Bay and Auckland/Waikato). Gizzard contents were extracted and x-rayed for the presence of lead shot. Ingested lead shot was recorded in samples from all regions with incidences varying from a minimum of three percent to over ten percent. Combining these results with those of a similar investigation conducted in the Eastern Region of Fish and Game during the 1999 game season generates an average ingestion rate of 8.1% for the 1999 and 2000 seasons across these regions as a whole.

1. Introduction

In October 1998, at the request of the Minister of Conservation and Minister for the Environment, a working party was convened to advise on options which would reduce avoidable contamination of the environment by lead shot derived from shotgun use. One of the party's terms of reference was to encourage and co-ordinate any new research which might assist the education of hunters and managers about the effects of lead shot. An early outcome of the working party's deliberations was the identification of the need for investigations into the incidence of ingested lead shot and/or elevated lead levels in *New Zealand's* waterfowl populations. In 1999 a pilot study was undertaken within the Eastern Region of Fish and Game New Zealand which involved blood lead level analyses and/or the examination of gizzard contents of 620 mallards and grey ducks. The results of that investigation have been reported separately (see Garrick 2000). During the 1999 game season gizzards were also collected from hunter-killed mallards/grey ducks in the Southland Region. Further samples of gizzards were obtained from five other Fish and Game regions during the 2000 game season. This report presents a summary of results for the six regions most recently studied.

2. Methods

Gizzard collections were organised by regional Fish and Game staff. Subsequent processing of samples was undertaken in accordance with the methods described in Garrick (2000). Southland Region performed the first stage of extracting, drying and packaging its gizzard samples while initial processing of gizzards from the remaining five regions was undertaken by a wage worker contracted to and supervised by the Auckland/Waikato Region. X-raying of all samples, interpretation of x-rays and subsequent analyses were carried out by Eastern Region Fish and Game staff. No attempt was made to distinguish between mallards or grey ducks nor were details of age or sex recorded.

3. Results

The results for each region are presented as summary statistics and as such should be self-explanatory. Details of gizzard samples are given only for those found to contain shot. Some details such as location and/or date sample was obtained are unavailable.

1. Southland Region

1. A total of 226 gizzard samples were x-rayed.
2. Twenty-eight samples (12.4%) contained lead.
3. Seventeen of the samples (7.5%) contained lead deemed to have been ingested; seven of the samples (3.1%) contained lead considered to have been embedded, ie shot-in; and four of the samples (1.8%) contained lead fragments whose origin could not be decided, ie they might have been fragments of pellets that had been ingested, or they might have been shot-in.
4. Thirteen of the 17 gizzards (76.5%) containing ingested lead shot had one pellet present; two (11.8%) had two pellets; and two (11.8%) had three pellets present.

Southland Gizzard Samples 1999 Season				
Sample #	Location	Date	Origin of shot	Comments
A8			Ingested	one pellet
C18			Ingested	one pellet
C7			Ingested	one pellet
D7			Ingested	two eroded pellets
E14			Ingested	one pellet
E17			Ingested	one pellet
E2			Ingested	one eroded pellet
G102			Ingested	2 eroded pellets
G112			Ingested	one eroded pellet
G118			Ingested	one very eroded pellet
G120			Ingested	one very eroded pellet
G14			Ingested	one eroded pellet
G22			Ingested	one eroded pellet
G31			Ingested	one eroded pellet
G39			Ingested	3 very eroded pellets
G71			Ingested	3 very eroded pellets
G83			Ingested	one eroded pellet
A1			Embedded	one pellet
A18			Embedded	one pellet + fragments
				<i>continued over page</i>

Southland Gizzard Samples 1999 Season continued				
A21			Embedded	one pellet + fragment
D14			Embedded	one pellet
E22			Embedded	one pellet
G51			Embedded	one pellet
G62			Embedded	one pellet
B16			Don't know	fragment
B9			Don't know	fragment
G101			Don't know	fragments
G77			Don't know	3 fragments

2. Central South Island Region

1. A small sample, 32 gizzards only, was examined.
2. Five samples (15.6%) contained lead pellets and one other, a steel pellet.
3. Only one of the samples (3.1%) contained lead deemed to have been ingested; two of the samples (6.3%) contained lead considered to have been embedded, ie shot-in; and a further two (6.3%) contained lead pellets whose origin could not be decided.
4. The steel pellet was categorised as having been shot-in.
5. The gizzard with ingested lead shot contained one pellet only.

Central South Island Gizzard Samples 2000 Season				
Sample #	Location	Date	Origin of shot	Comments
775	Lake Waitaki	06-Jul-00	Ingested	1 pellet
762	Lake Waitaki	06-Jul-00	Embedded	1 steel pellet
780	Lake Waitaki	06-Jul-00	Embedded	1 pellet
781	Lake Waitaki	13-May-00	Embedded	1 pellet
756	Lake Waitaki	06-Jul-00	Don't know	1 pellet
765	Lake Waitaki	06-Jul-00	Don't know	1 pellet

3. North Canterbury Region

1. A total of 192 gizzard samples were x-rayed.
2. Twenty-six samples (13.5%) contained lead.
3. Sixteen of the samples (8.3%) contained lead deemed to have been ingested; nine of the samples (4.7%) contained lead considered to have been embedded, ie shot-in; and one of the samples (0.5%) contained lead fragments whose origin could not be decided, ie they might have been fragments of pellets that had been ingested, or they might have been shot-in.
4. Nine of the 16 gizzards (56.3%) containing ingested lead shot had one pellet present; two (12.5%) had two pellets; and five (31.3%) contained three or more pellets. Thirty-four pellets were recorded in one gizzard and nineteen in each of two others.

<u>North Canterbury Gizzard Samples 2000 Season</u>				
<i>Sample #</i>	<i>Location</i>	<i>Date</i>	<i>Origin of shot</i>	<i>Comments</i>
631	Cops.Ford	21-May-00	Ingested	2 pellets, 1 eroded
635	Cops.Ford	21-May-00	Ingested	34 pellets, many eroded
644	Cops.Ford	21-May-00	Ingested	4 pellets, 3 eroded
659	Cops.Ford	21-May-00	Ingested	3 eroded pellets
671	Cops.Ford	21-May-00	Ingested	1 pellet
675	Cops.Ford	21-May-00	Ingested	1 pellet
676	Cops.Ford	21-May-00	Ingested	1 pellet
682	Cops.Ford	21-May-00	Ingested	1 very eroded pellet
686	Cops.Ford	21-May-00	Ingested	1 eroded pellet
687	Cops.Ford	21-May-00	Ingested	1 eroded pellet
698	Cops.Ford	21-May-00	Ingested	2 pellets
80	Lake Ellesmere	16-May-00	Ingested	19 pellets
314	Lake Ellesmere	18-May-00	Ingested	1 eroded pellet
611	Nth Canterbury	18-May-00	Ingested	1 pellet
618	Nth Canterbury	18-May-00	Ingested	19 eroded pellets
619	Nth Canterbury	18-May-00	Ingested	1 pellet
681	Cops.Ford	21-May-00	Embedded	1 pellet
69	Gibby's Pass	08-May-00	Embedded	1 pellet
315	Lake Ellesmere	18-May-00	Embedded	1 pellet
319	Lake Ellesmere	03-Feb-00	Embedded	1 pellet
328	Lake Ellesmere	03-Feb-00	Embedded	1 pellet
581	Nth Canterbury	18-May-00	Embedded	1 pellet
602	Nth Canterbury	18-May-00	Embedded	1 pellet
				<i>continued over page</i>

North Canterbury Gizzard Samples 2000 Season continued				
609	Nth Canterbury	18-May-00	Embedded	1 pellet
621	Nth Canterbury	18-May-00	Embedded	1 pellet
312	Lake Ellesmere	18-May-00	Don't know	minute fragments

4. Nelson/Marlborough Region

1. A small sample, 66 gizzards only, was examined.
2. Three samples (4.5%) contained lead pellets and one other, a steel pellet.
3. Two of the samples (3.0%) contained lead deemed to have been ingested and one (1.5%) contained a lead pellet considered to have been embedded, ie shot-in.
4. One gizzard contained a small steel pellet whose origin was classified as unknown due to its eroded appearance.
5. One of the two gizzards (50%) containing ingested lead shot had one pellet present, the other two pellets.

Nelson/Marlborough Gizzard Samples 2000 Season				
Sample #	Location	Date	Origin of shot	Comments
792	Sutton Pond	?	Ingested	2 eroded pellets
794	Sutton Pond	?	Ingested	1 eroded pellet
840	Havelock Estuary	07-May-00	Embedded	1 pellet
824	Roses Overflow	09-May-00	Don't know	1 small/eroded? steel pellet

5. Hawke's Bay Region

1. A total of 176 gizzard samples were x-rayed.
2. Sixteen samples (9.1%) contained lead pellets.
3. Six of the samples (3.4%) contained lead deemed to have been ingested; nine of the samples (5.1%) contained lead considered to have been embedded, ie shot-in; and one of the samples (0.6%) contained two lead pellets whose origin could not be decided.
4. Five of the six gizzards (83.3%) containing ingested lead shot had one pellet present and one (16.7%) had two pellets.

Hawke's Bay Gizzard Samples 2000 Season				
Sample #	Location	Date	Origin of shot	Comments
505	?	?	Ingested	1 pellet
453	McKenzies Dartmoor	04-May-00	Ingested	1 pellet
476	Moteo	?	Ingested	1 pellet
358	Oingo	08-May-00	Ingested	1 pellet
359	Oingo	08-May-00	Ingested	2 eroded pellets
446	Parson Lake	11-May-00	Ingested	1 eroded pellet
404	?	?	Embedded	1 pellet
438	?	?	Embedded	1 pellet
347	Glengarry Rd	10-May-00	Embedded	1 pellet
367	Glengarry Rd	?	Embedded	1 copper coated? pellet
384	Glengarry Rd	?	Embedded	1 pellet
385	Glengarry Rd	?	Embedded	1 pellet
462	McKenzies Dartmoor	04-May-00	Embedded	1 pellet
428	Oingo	?	Embedded	1 pellet
363	Waihau Rd	?	Embedded	1 pellet
436	?	?	Don't know	2 pellets, so ingested?

6. Auckland/Waikato Region

1. A total of 385 gizzard samples were x-rayed.
2. Fifty-three samples (13.8%) contained lead.
3. Forty-one of the samples (10.6%) contained lead deemed to have been ingested; six of the samples (1.6%) contained lead considered to have been embedded, ie shot-in; and a further six (1.6%) contained lead pellets or fragments whose origin could not be decided.
4. Nineteen of the 41 gizzards (46.3%) containing ingested lead shot had one pellet present; seven (17.1%) had two pellets; and fifteen (36.6%) contained three or more pellets. Twenty-three pellets were recorded in one gizzard and nineteen in one other.

Auckland/Waikato Gizzard Samples 2000 Season				
Sample #	Location	Date	Origin of shot	Comments
138	Firth of Thames	06-May-00	Ingested	1 pellet
150	Firth of Thames	06-May-00	Ingested	1 pellet
304	Hunua	07-May-00	Ingested	1 very eroded pellet
308	Hunua	07-May-00	Ingested	4 eroded pellets
9	Kopuku	07-May-00	Ingested	1 pellet
10	Kopuku	07-May-00	Ingested	2 eroded pellets
23	Kopuku	07-May-00	Ingested	1 pellet
39	Kopuku	07-May-00	Ingested	1 pellet
44	Kopuku	07-May-00	Ingested	1 very eroded pellet
68	Kopuku	07-May-00	Ingested	1 pellet
512	Lake Waikare	06-May-00	Ingested	1 pellet
269	Morrinsville	06-May-00	Ingested	2 pellets
95	Patetonga	07-May-00	Ingested	1 very eroded pellet
96	Patetonga	07-May-00	Ingested	1 pellet
100	Patetonga	07-May-00	Ingested	3 pellets
531	Piako	?	Ingested	2 pellets
533	Piako	?	Ingested	1 pellet
556	Piako	?	Ingested	1 pellet
704	Rotokauri	?	Ingested	2 eroded pellets
155	Twin Willows	07-May-00	Ingested	3 eroded pellets
166	Twin Willows	07-May-00	Ingested	4 pellets
172	Twin Willows	07-May-00	Ingested	4 eroded pellets
176	Twin Willows	07-May-00	Ingested	4 eroded pellets
196	Twin Willows	07-May-00	Ingested	1 pellet
200	Twin Willows	07-May-00	Ingested	6 eroded pellets
				<i>continued over page</i>

Auckland/Waikato Gizzard Samples 2000 Season continued				
Sample #	Location	Date	Origin of shot	Comments
203	Twin Willows	07-May-00	Ingested	4 eroded pellets
213	Twin Willows	07-May-00	Ingested	2 eroded pellets
214	Twin Willows	07-May-00	Ingested	1 eroded pellet
215	Twin Willows	07-May-00	Ingested	8 eroded pellets
220	Twin Willows	07-May-00	Ingested	4 eroded pellets
223	Twin Willows	07-May-00	Ingested	1 eroded pellet
224	Twin Willows	07-May-00	Ingested	19 eroded pellets
231	Twin Willows	07-May-00	Ingested	23 very eroded pellets
233	Twin Willows	07-May-00	Ingested	5 eroded pellets
236	Twin Willows	07-May-00	Ingested	4 eroded pellets
237	Twin Willows	07-May-00	Ingested	1 eroded pellet
244	Twin Willows	07-May-00	Ingested	1 eroded pellet
246	Twin Willows	07-May-00	Ingested	1 very eroded pellet
247	Twin Willows	07-May-00	Ingested	11 eroded pellets
282	Waitakaruru Canal	06-May-00	Ingested	2 pellets
289	Waitakaruru Canal	06-May-00	Ingested	2 pellets
148	Firth of Thames	06-May-00	Embedded	1 pellet
293	Hunua	07-May-00	Embedded	1 pellet
14	Kopuku	07-May-00	Embedded	1 pellet
57	Kopuku	07-May-00	Embedded	1 pellet
65	Kopuku	07-May-00	Embedded	1 pellet
169	Twin Willows	07-May-00	Embedded	1 pellet
152	Firth of Thames	06-May-00	Don't know	1 pellet
27	Kopuku	07-May-00	Don't know	2 fragments
97	Patetonga	07-May-00	Don't know	1 pellet
518	Piako	?	Don't know	1 shiny coated? pellet
539	Piako	?	Don't know	1 shiny coated? pellet
163	Twin Willows	07-May-00	Don't know	1 pellet

4. Discussion

Ingestion of lead shot by mallards/grey ducks was recorded in each of the regions from which samples were obtained. Ingestion rates varied from 3.0% to 10.6%. Because each regional collection contained a number of samples with pellets whose origin could not be decided, actual rates may have been slightly higher in some instances. Furthermore, some pellets which were categorised as having been shot-in due to their angular and unpitted appearance, may instead have been freshly ingested pellets which had been deformed after contact with other pellets and/or a hard substrate. Determining the origin of pellets is not an exact science but the outcomes reported here are unlikely to be far from the mark.

The gizzard collections from two of the regions, Central South Island and Nelson/Marlborough, were of particularly limited size, and as to some extent with all of the samples, may not be representative of their regions as a whole, or less so than the others. Nevertheless this study, which is effectively no more than a snapshot in space and time, confirms i) that the ingestion of lead shot by mallards and grey ducks occurs on a national scale, and ii) that ingestion rates are of sufficient magnitude to warrant considerable cause for concern.

An independent investigation undertaken in the Eastern Region during the 1999 game season recorded lead shot in 8.95% of a sample of 458 mallard and grey duck gizzards. If this result is combined with those reported here, an average ingestion rate of 8.1% can be calculated for the regions concerned during the game seasons of 1999 and 2000.

5. Acknowledgements

Thanks are due to the numerous hunters who provided gizzard samples, to the regional Fish and Game officers who organised the collections, and to Phil Teal for co-ordinating the exercise. Zane Moss was responsible for initial processing of the Southland sample, and Phil arranged and supervised the processing of the others. I am again indebted to Ian McKenzie of the Rotorua Central Veterinary Clinic for allowing me to use his x-ray facilities, and to Rob Pitkethley for his assistance with determining whether shot had been ingested or shot-in. My time was provided by the Eastern Region of Fish and Game New Zealand while direct costs were met from Fish and Game's National Research Fund.

6. References

Garrick, AS. 2000. Results of an investigation into the incidence of ingested lead shot and elevated blood lead levels in mallard and grey duck populations in the Bay of Plenty and East Coast Regions of the North Island. *Unpublished Fish and Game New Zealand Technical Report, Eastern Region. 25pp.*