Killing Effects of Lead or Alternative Ammo Materials in Hunting Rifle Bullets and Shotshells
Hans-Dieter Pfannenstiel
Article 20a
Basic Law for the Federal Republic of Germany
Protection of the natural foundations of life and animals

Mindful also of its responsibility toward future generations, the state shall protect the natural foundations of life and animals* by legislation and, in accordance with law and justice, by executive and judicial action, all within the framework of the constitutional order.

* - since 2006
Most important question after a hunt:

Have all animals been killed according to the laws of animal welfare and hunting ethics?
„Heart Shot“
As a rule, a heart or thorax shot produces lesions of vital blood vessels, of the heart or of the lung. Normally, the flight distance is very short after such a shot, and - most important - the animal is killed according to hunting ethics.
„Heart Shot“
If neither vital blood vessels nor the heart or the lung are hit, the flight distance may be rather long and the animal is not killed according to hunting ethics.

Most important:
Where did the bullet hit?
What damage caused the bullet?
According to hunting ethics this must not be the result after a hunt!
We are talking about 1.9 billion hoofed game killed in Germany during the hunting season 2013/14. This is not a side issue!

Hunting Bag (Hoofed Game) Germany
Hunting Season 2013/14

<table>
<thead>
<tr>
<th>Species</th>
<th>Killing Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wild Boar</td>
<td>474,287</td>
</tr>
<tr>
<td>Mouflon</td>
<td>7,228</td>
</tr>
<tr>
<td>Chamois</td>
<td>4,803</td>
</tr>
<tr>
<td>Roe Deer</td>
<td>115,135</td>
</tr>
<tr>
<td>Sika Deer</td>
<td>1,360</td>
</tr>
<tr>
<td>Fallow Deer</td>
<td>64,083</td>
</tr>
<tr>
<td>Red Deer</td>
<td>75,762</td>
</tr>
</tbody>
</table>

Source: DJV Handbuch Jagd
From the beginning there had been many reports from hunters that gave rise to doubts whether lead-free bullets are suitable to kill animals according to hunting ethic standards.

Full Metal Jacket Bullet
Final Report:
„Ergänzende Untersuchungen zur Tötungswirkung bleifreier Geschosse“
Supplementary examinations on the killing effect of lead-free bullets

December 2012

Significance and meaningfulness of the results of this study had been called in question since then.
**Abschussbericht**

**Name des Erlegers:**

**Stelle:**

**Wohnort:**

**Telefon:**

**Reg.-Nr.:**

**Fachhochschule Eberswalde**

**Fachgebiet Wildbiologie / Jagd**

**Prof. Dr. Siegfried Rieger**

**Carl Gremse, M.Sc.**

**Tel.: 03334 65 512**

**Mobil: 0170 581 88 24**

**Fax: 03334 65428 (Rücksendung)**

**e-mail: cgremse@fh-eberswalde.de**

**Datum:** ____________  **Uhrzeit:** ___ : ___

**Verhalten des Wildes vor dem Schuss:**

**Verhalten des Wildes nach dem Schuss:**

**Angaben zur Flucht u. Schweißfährte:**

**Sonstige Angaben 1:**

**Sonstige Angaben 2:**

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**beschossenes Wild** | **Aufbrechgewicht** | **Schusseinfüren** | **Fluchtstrecke**
---|---|---|---
Rehwild | 001 | bis 10kg | 007 | 013 | am Anschuss | 019
Rotwild | 002 | 11-20kg | 008 | 51-100m | 014 | bis 15m | 020
Schwarzwild | 003 | 21-45kg | 009 | 101-150m | 015 | 16-40m | 021
Dämmild | 004 | 46-75kg | 010 | 151-200m | 016 | 41-75m | 022
Sikwilde | 005 | 76-120kg | 011 | 201-250m | 017 | 76-150m | 023
Muffeld | 006 | >120 kg | 012 | 018 | >150m | 024

**Ausschussgröße (s. u.)** | **Schusszeichen (Anschuss)** | **Verletzte Organe** | **Organverletzungen**
---|---|---|---
ohne | 025 | Herzschweiß | 031 | Herz | 038 | normal | 044
bis 20mm | 026 | Lungenschweiß | 032 | Lunge | 039 | stark beschädigt | 045
21-35mm | 027 | Leberschweiß | 033 | Leber | 040 | nicht verwendbar | 046
36-60mm | 028 | Pansen/Gescheide | 034 | Niere | 041 | Wildbretzustand | 047
> 61-100mm | 029 | Schnitthaare | 035 | Gr. Gescheide | 042 | gut | 048
> 100mm | 030 | Knochensplitter | 036 | Kl. Gescheide | 043 | mangelhaft | 049

**Bitte Maßband mitführen!**

**Verhalten des Wildes vor dem Schuss**

**Verhalten des Wildes nach dem Schuss**

**Angaben zur Flucht u. Schweißfährte**

**Sonstige Angaben 1**

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**Bitte Maßband mitführen!**

**Verhalten des Wildes vor dem Schuss**: 050 nicht gezeichnet | 055 | kein Schweiß | 061 | Hämatome / Blutergüsse | 067
flüchtig | 051 | gezeichnet | 056 | wenig Schweiß | 062 | Rückgrat treffer | 068
läset / vertraut | 052 | nicht beobachtet | 057 | reichlich Schweiß | 063 | Rippen treffer | 069
alarmiert / gestreit | 053 | bleibt stehen | 058 | Schweiß regelmäßig | 064 | sonst. Knochentreffer | 070
vor dem Hund | 054 | laumet, bricht zusammen | 059 | Nachsuche erfolgreich | 065 | Schuss d. Hindernis | 071
Flucht | 060 | Nachsuche ohne Erfolg | 066 | Entfern. Hind. zum Ziel | (Art. d. Hind. unten angeb.) | m

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**11371 questionaires (Abschussbericht) had been evaluated**

**19.7% lead bullets, 80.3% lead-free bullets**

**12 different calibers, 64 different bullets**

**Flight distance was taken as measure of killing effect, because energy output in the hit animal was not known, and no vet. pathol. examinations were carried out**

**Shooting in ballistic soap was performed to analyze terminal ballistic properties of different bullet types**

**Definition „Grenzgeschwindigkeit Jagd“**
### Gremse & Rieger, 2012: Final Report

<table>
<thead>
<tr>
<th>Total number of animals killed</th>
<th>11278 – 100 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pb/Pb-free ratio</td>
<td>2222 – 19.7 % Pb</td>
</tr>
<tr>
<td></td>
<td>9056 – 80.3 % Pb-free</td>
</tr>
<tr>
<td>Average shot distance</td>
<td></td>
</tr>
<tr>
<td>State Forest Brandenburg</td>
<td>67 m</td>
</tr>
<tr>
<td>Federal Forest</td>
<td>84 m</td>
</tr>
<tr>
<td>Average shot distance</td>
<td>139 m Reed Deer</td>
</tr>
<tr>
<td>BDB (Professional Hunters Germany)</td>
<td>90 m Wild Boar</td>
</tr>
</tbody>
</table>
Gremse & Rieger, 2012: Final Report

<table>
<thead>
<tr>
<th>Weight</th>
<th>Total Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 75 kg</td>
<td>10985</td>
<td>97.4 %</td>
</tr>
<tr>
<td>75 – 120 kg</td>
<td>248</td>
<td>2.2 %</td>
</tr>
<tr>
<td>&gt; 120 kg</td>
<td>45</td>
<td>0.4 %</td>
</tr>
</tbody>
</table>

Gremse & Rieger did not publish average shot distances for different weight classes!
Dr. Beat Kneubuehl evaluated the Gremse & Rieger paper
„Grundlage dieses Abschlussberichts war eine umfangreiche Datenerhebung zur Tötungswirkung von Wild beim Abschuss. Der vorliegende Abschlussbericht wertet dieses Datenmaterial nur auszugsweise aus (Bewertung durch die Jäger wird nicht berücksichtigt, bedingte Analysen fehlen). Die Ergebnisse werden jedoch nicht zur Beantwortung der ursprünglichen Fragestellung verwendet, sondern es wird ein Wirksamkeitswert der Literatur entnommen, dessen Anwendung auf das vorliegende Problem der zuverlässigen Tötung von Wild unzulässig ist.

Mit Hilfe dieses Wirksamkeitswertes wird eine „Grenzleistung Zielballistik Jagd“ definiert, deren Wert wegen der in unzulässiger Weise verwendeten Grundlage sehr fraglich erscheint. Wegen dem fehlenden Nachweis der Richtigkeit dieser Grenzleistung gelten die berechneten zulässigen Einsatzentfernungen der verschiedenen Geschosse weder als nachgewiesen noch als widerlegt“.

Revisions of the Gremse & Rieger Paper have been criticised by Dr. Kneubuehl as well!!
Grundlage dieses Abschlussberichts war eine umfangreiche Datenerhebung zur Tötungswirkung von Wild beim Abschuss. Der vorliegende Abschlussbericht wertet dieses Datenmaterial nur auszugsweise aus (Bewertung durch die Jäger wird nicht berücksichtigt, bedingte Analysen fehlen). Die Ergebnisse werden jedoch nicht zur Beantwortung der ursprünglichen Fragestellung verwendet, sondern ein Wirksamkeitswert der Literatur entnommen, dessen Anwendung auf das vorliegende Problem der zuverlässigen Tötung von Wild unzulässig ist.

More comparative studies concerning the killing effect of rifle bullets are necessary!

**Best solution:**

Animals killed during a hunt are submitted to a veterinary pathologist to determine the primary cause of death!
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A veterinary pathological examination is the only way to determine which injuries caused by the shot led to the animal’s death and how long it took to die after the shot.
Best solution:

Animals killed during a hunt are submitted to a veterinary pathologist to determine the primary cause of death!

Apparently this is only a theoretical way because

1. a vet. pathol. institute would be busy for years even if only 1 % of the yearly hunting bag would be examined,

2. it would be impossible or at least extremely difficult to collect the animals for examination,

3. and the costs would exceed every reasonable measure!
Alternative:

Shooting in ballistic media under controlled conditions!
Killing Effects of Lead or Alternative Ammo Materials in Hunting Rifle Bullets and Shotshells
Alternative:

Shooting in ballistic media under controlled conditions!
We have to keep in mind:

Killing animals according to hunting ethics is demanded by the Basic Law for the Federal Republic of Germany!

The results of different studies and the experience of many hunters do not justify a ban of lead containing bullets at present!
Some notes regarding shot

In German States (Bundesländer) and also in member states of the EU it is no longer allowed to use lead shot along rivers, ponds, and in wetlands.

In Norway, the general ban on lead shot was lifted by the Parliament on Feb. 3, 2015 (79 votes pro, 16 votes contra).
Some notes regarding shot

The Norwegian Parliament justified the decision as follows: Lead was the most suitable element for hunting ammunition. No other material covered a similar broad range for hunting purposes and was as clean and efficient as lead. The lead free alternatives often caused harm and injury for game and were dangerous for hunters. On the other hand, danger for the environment and human health, which was suspected when using lead ammunition could not be substantiated in detail by present studies.
In Germany, **1,955,626** animals of the below listed species have been harvested during the hunting season 2013/14, at least **1.3 billion using shot**

**Hunting Bags Germany, Season 2013/14**

<table>
<thead>
<tr>
<th>Species</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raccoon</td>
<td>96162</td>
</tr>
<tr>
<td>Raccoon Dog</td>
<td>20140</td>
</tr>
<tr>
<td>Badger</td>
<td>62268</td>
</tr>
<tr>
<td>Fox</td>
<td>380494</td>
</tr>
<tr>
<td>Phaesant</td>
<td>577974</td>
</tr>
<tr>
<td>Ducks</td>
<td>363611</td>
</tr>
<tr>
<td>Rabbit</td>
<td>211592</td>
</tr>
<tr>
<td>Hare</td>
<td>243385</td>
</tr>
</tbody>
</table>

Source: DJV Handbuch Jagd
Ballistics

Range of different shot material

- Tungsten-based alloy
- Steel
- Lead

Source: RUAG
Energy at 40 m

Steel

Lead

Index:
Pb = 100

Source: RUAG
Killing Effects of Lead or Alternative Ammo Materials in Hunting Rifle Bullets and Shotshells

Lead was banned in 12-gauge shotguns in New Zealand a few years ago.

Now duck hunters frequently complain about the killing effect of steel shot which does not always kill immediately and birds may die over hours or days.

This is not at all in accordance with animal welfare and hunting ethics!

Covering the Shooting Business Globally

‘Bring back lead to save ducks’

As the duck shooting season begins in New Zealand, government advice is to use lead shot in 12-gauge shotguns to comply with a recent overturned ruling. The use of steel shot is banned, which has led to criticism of the killing effect. Steel shot is not always effective in killing birds, and it may take hours or days for the bird to die.

The new ruling has been greeted with mixed reactions. Some hunters welcome the ban on steel shot, while others argue that it is not a humane way to hunt. The government has been under pressure to find a solution that balances animal welfare and hunting ethics.

There has been concern that the ban on steel shot will harm hunters, and that it is not a fair solution. Some hunters argue that steel shot is not as effective as lead shot, and that it is not a humane way to hunt.

The ruling has been met with mixed reactions. Some hunters welcome the ban on steel shot, while others argue that it is not a humane way to hunt. The government has been under pressure to find a solution that balances animal welfare and hunting ethics.
Steel Shot (Fe) ↔ Lead Shot (Pb)

– Fe – lower Specific Weight (Pb 11,3; Fe 7,8)
– Fe – much harder

Significance for Fe:
• More pellets, when charge and and pellet diameter are identical;
• Deeper penetration;
• Higher loss of speed!
• Danger of rebounds higher!
• Loss of killing ability! Penetration of the hard steel pellets is better, but energy loss in the body is reduced because pellets do not deform readily.
• Coverage narrows;
• Range much shorter!
Danger of rebounding steel pellets much higher!

Steel pellets do not deform easily when touching a hard surface (even water) and consequently loss of speed in such cases is much smaller than in lead pellets.

Rebound angles of steel pellets are larger than those of lead pellets.
This may be the result if steel shot is used in shotguns which were constructed for lead shot.
Decisions should be based on knowledge and not on feelings!

A general ban on lead ammunition could be a dangerous cul de sac!