

Lead Ammunition Group

Primary Evidence and Risk Assessment Subgroup

A list of publications and reports being considered as primary evidence.

(1) Risks to wildlife from ingested lead from ammunition

1 (a) Risks to non-wildfowl species

Reviews and collected volumes

Mateo, R. 2009. Lead poisoning in wild birds in Europe and the regulations adopted by different countries, *In* Watson, RTM, Fuller, M, Pokras, M and Hunt WG (Eds.) *Ingestion of Spent Lead Ammunition: Implications for Wildlife and Humans*, The Peregrine Fund, Boise, Idaho. (2, UK, EU)

Pain DJ, Fisher IJ, Thomas, VG (2009) A global update of lead poisoning in terrestrial birds from ammunition sources. In: Watson RT, Fuller M, Pokras M, Hunt G editors. *Ingestion of Lead from Spent Ammunition: Implications for Wildlife and Humans*. The Peregrine Fund, Boise, Idaho. pp. 99-118. (2, UK, EU, INT)

Quy, R. 2010. Review of evidence concerning the contamination of wildlife and the environment arising from the use of lead ammunition. FERA report to Defra. (3, UK)

Royal Commission on Environmental Pollution, 9th report Lead in the Environment, HMSO 1983 (2, UK) Royal Commission on Environmental Pollution, 9th report Lead in the Environment <http://www.rcep.org.uk/reports/09-lead/1983-09lead.pdf> (2, UK)

Papers

Butler, DA (2005) Incidence of lead shot ingestion in red-legged partridges (*Alectoris rufa*) in Great Britain. *Veterinary Record* 157: 661-662 (1, UK)

Butler, DA, Sage, RB, Draycott, RAH, Carroll, JP, & Potts, D (2005) Lead exposure in ring-necked pheasants on shooting estates in Great Britain. *Wildlife Society Bulletin* 33: 583-589. (1, UK)

Hunt WG, Burnham W, Parish CN, Burnham KK, Mutch B, et al. (2006) Bullet fragments in deer remains: Implications for lead exposure in avian scavengers. *Wildl Soc B* 34: 167-170. (1, UK, EU, INT)

Kendall, R. J., Lacher Jr, T. E., Bunck, C., Daniel, B., Driver, C., Grue, C. E., Leighton, F., Stansley, W., Watanabe, P. G., & Whitworth, M. (1996). An ecological risk assessment of lead shot exposure in non-waterfowl avian species: upland game birds and raptors. *Environmental Toxicology and Chemistry* 15: 4-20. (1, INT)

Krone, O., N. Kenntner, A. Trinogga, M. Nadjafzadeh, F. Scholz, J. Sulawa, K. Totschek, P. Schuck-Wersig, And R. Zieschank. 2009. Lead poisoning in White-tailed Sea Eagles: Causes and approaches to solutions in Germany. *In* R.T. Watson, M.

Fuller, M. Pokras, and W.G. Hunt (Eds.). Ingestion of Lead from Spent Ammunition: Implications for Wildlife and Humans. The Peregrine Fund, Boise, Idaho, USA. DOI 10.4080/ilsa.2009.0207 (2, EU)

Pain, D.J., Sears, J., & Newton, I. 1995. Lead concentrations in birds of prey in Britain. *Environ. Pollut.* 87(2):173-180. (1, UK)

Pain, D.J., Carter, I., Sainsbury, A. W., Shore, R.F., Eden, P, Taggart, M.A., Konstantinos, S., Walker, L.A, Meharg, A.A. and Raab, A. 2007 Lead contamination and associated disease in captive and reintroduced red kites *Milvus milvus* in England. *Sci. Total Environ.* 376:116-127. (1, UK)

Potts, G.R. 2005. Incidence of ingested lead gunshot in wild grey partridges (*Perdix perdix*) from the UK. *European J Wildlife. Res.* 51:31-34. (1, UK)

Sainsbury, A.W., Bennett, P.M. and Kirkwood, J.K. (1995) The welfare of free-living wild animals in Europe: harm caused by human activities. *Animal Welfare* 4,183-206. (1, UK, EU)

Thomas, VG, Scheuhammer, AM, Bond, DE (2009) Bone lead levels and lead isotope ratios in red grouse from Scottish and Yorkshire moors. *Science of the Total Environment* 407. 3494- 3502 (1, UK)

Vyas, NB; Spann, JW; Heinz, GH, et al. 2000. Lead poisoning of passerines at a trap and skeet range. *Environmental Pollution* 107: 159-166. (1, INT)

1 (b) Risks to wildfowl

We have not included the extensive literature covering the long-established risks to wildfowl from ingesting spent lead gunshot and in the UK (and many other countries) legislation has been introduced restricting the use of lead gunshot over wetlands and/or for shooting wildfowl in all UK countries (in 1999 in England). A recent review for Europe is provided in Mateo (2009), cited above.

Assessments of compliance with the regulations in England have been undertaken including a recent assessment commissioned by Defra. The report is available on the Defra website and will need to be included in the evaluation of ongoing risks to wildfowl:

<http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=16075>

O'Connell, M.M., Rees, E.C., Einarsson, Ó., Spray, C.J., Thorstensen, S. & O'Halloran, J. 2008. Blood lead levels in wintering and moulting Icelandic Whooper Swans over two decades. *Journal of Zoology* 276: 21-27. (1, UK)

(2) Risks to human health from ingesting lead from ammunition

Reviews

EFSA Panel on Contaminants in the Food Chain (CONTAM); Scientific Opinion on Lead in Food. EFSA Journal 2010; 8(4):1570. [147 pp.].

doi:10.2903/j.efsa.2010.1570. Available online: www.efsa.europa.eu (2, UK, EU)

FAO/WHO 2010. Joint FAO/WHO expert committee on food additives Seventy-third meeting Summary Report. Geneva 24th June 2010. JECFA/73/SC. Page 13. (2, UK, EU, INT)

Papers relating to lead ammunition

Bjerregaard P, Johansen O, Mulvad G, Pedersen HS, Hansen JC (2004) Lead Sources in Human Diet in Greenland Source. *Environ Health Persp* 112: 1496-1498. (1, INT)

Coburn, Snary & Wooldridge (2003) Hazards and Risks from Wild Game: A qualitative risk assessment. Veterinary Laboratories Agency, Weybridge. 155pp (3, UK).

Dewailly E, Ayotte P, Bruneau S, Lebel G, Levallois P, et al. (2001) Exposure of the Inuit population of Nunavik (Arctic Quebec) to lead and mercury. *Arch Environ Health* 56: 350-357. (1, INT)

Dobrowolska A, Melosik M (2008) Bullet-derived lead in tissues of the wild boar (*Sus scrofa*) and red deer (*Cervus elaphus*). *Eur J Wildl Res* 54: 231-235. (1, EU)

FSA (2007) Survey of Metals in a Variety of Foods. Food survey Information Sheets on: <http://www.food.gov.uk/science/surveillance> (3, UK)

Green P (2010). "Heavy metal" - recent (veterinary) review of implications for human health from lead bullets in shot deer. (*Deer magazine (BDS house mag)*) (4, UK)

Guitart, R; Serratosa, J; Thomas, VG 2002. Lead-poisoned wildfowl in Spain: a significant threat for human consumers. *International Journal of Environmental Health Research* 12: 301-309 (1, UK)

Gustavsson P and Gerhardsson L (2005). Intoxication from an accidentally ingested lead shot retained in the gastrointestinal tract. *Environmental Health Perspectives*, 113, no. 4, 491-493. (1, INT)

Haldimann, M., Baumgartner, A., & Zimmerli, B. (2002). Intake of lead from game meat - a risk to consumers' health. *European Food Research & Technology* 215: 375-379. (1, EU)

Hunt WG, Watson RT, Oaks JL, Parish CN, Burnham KK, et al. (2009) Lead bullet fragments in venison from rifle-killed deer: Potential for human dietary exposure. *PLoS ONE* DOI:10.1371/journal.pone.0005330. (1, INT)

Iqbal S, Blumenthal W, Kennedy C, Yip FY, Pickard S, et al. (2009) Hunting with lead: Association between blood lead levels and wild game consumption. *Environ Res* 109: 952-959. (1, INT)

Jaffer, A. 2009. A scientific review of the risk to the consumer from lead shot in game meat. A report commissioned by the Food Standards Agency Game Group. March 2009 GG/12/03/4. Abrar Jaffer, Veterinary Public Health Team, Hygiene and Microbiology Division

Johansen, P; Pedersen, HS; Asmund, G; Riget, F (2004). Lead shot from hunting as a source of lead in human blood. *Environmental Pollution* 142:93-97 (1, INT)

Johansen P, Asmund G, Riget, F (2004) High human exposure to lead through consumption of birds hunted with lead shot. *Environ Pollut* 127: 125-129. (1, INT)

Knott, J., Gilbert, J., Hoccom, D.G. & Green, R.E. (in press) Implications for wildlife and humans of dietary exposure to lead from fragments of lead rifle bullets in deer shot in the UK. *Science of the Total Environment* (1, UK)

Kosnett M J (2009) Health effects of low dose lead exposure in adults and children, and preventable risk posed by consumption of game meat harvested with lead ammunition. In: Watson RT, Fuller M, Pokras M, Hunt G editors. *Ingestion of Lead from Spent Ammunition: Implications for Wildlife and Humans*. The Peregrine Fund, Boise, Idaho. pp. 24-33. (1, INT)

Madsen, H. H. T., Skjødt, T., Jørgensen, P. J., & Grandjean, P. (1988). Blood lead levels in patients with lead shot retained in the appendix. *Acta Radiologica* 29: 745-746. (1, INT)

Mateo R, Rodriguez-de la Cruz M, Vidal D, Reglero M, Camero P (2006) Transfer of lead from shot pellets to game meat during cooking. *Sci Total Environ* 372: 480-485. (1, EU)

Monkiewicz J; Jaczewski S. 1990. Distribution of lead in the wild boars' carcasses is dependent upon the distance from a rifle-shot wound *Medycyna Weterynaryjna* 46:187-188. (1, EU)

Pain DJ, Cromie RL, Newth J, Brown MJ, Crutcher E, et al. (2010) Potential Hazard to Human Health from Exposure to Fragments of Lead Bullets and Shot in the Tissues of Game Animals. *PLoS ONE* 5(4): e10315. doi:10.1371/journal.pone.0010311 (1, UK)

Peddicord R K and LaKind J S (2000). Ecological and human health risks at an outdoor firing range. *Environ. Toxicol. & Chem.*, 19, no.10. (1, INT)

Scheuhammer AM, Perrault JA, Routhier E, Braune BM, Campbell GD (1998) Elevated lead concentrations in edible portions of game birds harvested with lead shot. *Environ Pollut* 102: 251-257. (1, INT)

Tsuji, L. J. S., Nieboer, E., Karagatzides, J. D., Hanning, R. M., & Katapatuk, B. (1999). Lead shot contamination in edible portions of game birds and its dietary implications. *Ecosystem Health* 5: 183-192. (1, INT)

Tsuji, L.J.S., Wainman, B.C., Martin, I.D., Sutherland, C., Weber, J-P., Dumas, P. & Nieboer, E. 2008. Lead shot contribution to blood lead of First Nations people: The use of lead isotopes to identify the source of exposure. *Sci. Total Environ.* 405: 180-185 (1, INT)

Tsuji, L.J.S., Wainman, B.C., Jayasinghe, R.K., VanSpronsen, E.P., Liberda, E.N. 2009. Determining Tissue-Lead Levels in Large Game Mammals Harvested with Lead Bullets: Human Health Concerns *Bull Environ Contam Toxicol* 82:435-439 (1, INT)

Tsuji, L.J.S., Wainman, B.C., Martin, I.D., Sutherland, C., Weber, J-P., Dumas, P. & Nieboer, E. 2008. The identification of lead ammunition as a source of lead exposure in First Nations: The use of lead isotope ratios. *Sci. Total Environ* 393: 291-298. (1, INT)

Verbrugge, L. A., S. G. Wenzel, J. E. Berner, A. C. Matz. 2009. Human exposure to lead from ammunition in the circumpolar north. *In* R.T. Watson, M. Fuller, M. Pokras, and W.G. Hunt (Eds.). *Ingestion of Lead from Spent Ammunition: Implications for Wildlife and Humans*. The Peregrine Fund, Boise, Idaho, USA. DOI 10.4080/ilsa.2009.0110 (2, INT)

Zmudzki J; Michalska K. 1992. Distance from rifle-shot wound and lead concentrations in wild pig roe and deer tissues *Medycyna Weterynaryjna* 48:127-129 1992 (1, EU)

Veterinary Medicines Directorate, Veterinary Residues Committee Annual Reports & Full Statutory & Non-Statutory Results
<http://www.vmd.gov.uk/Publications/AnnReps/AnnReps.htm> (3, UK)

Papers setting the context for the effects of low level lead exposure on human health (1, UK, EU, INT)

Borja-Aburto, VH; Hertz-Picciotto, I; Lopez, MR, et al. 1999. Blood lead levels measured prospectively and risk of spontaneous abortion. *Am J. Epidemiol* 150: 590-597

Canfield RL, Henderson CR, Cory-Slechta DA, Cox C, Jusko TA, et al. (2003) Intellectual impairment in children with blood lead concentrations below 10 μg per deciliter. *New Engl J Med* 348: 1517-1526.

Chandramouli L, Steer CD, Ellis M, Emond AM (2009) Effects of early childhood lead exposure on academic performance and behaviour of school age children. *Arch Dis Child.* 94: 844-848.

Jusko, T.A., Henderson Jr., C.R., Lanphear, B.P., Cory-Slechta, D.A., Parsons, P.J. and Canfield, R.L. 2008. Blood Lead Concentrations < 10 µg/dL and Child Intelligence at 6 Years of Age. *Environmental Health Perspectives* 116 (2): 243-248

Landrigan P, Nordberg M; Lucchini R, Nordberg G, Grandjean P; et al. (2006) The Declaration of Brescia on Prevention of the Neurotoxicity of Metals Brescia, Italia 17-18 June 2006. *La Medicina del Lavoro* 97: 811-4.

Lanphear BP, Hornung R, Khoury J, Yolton K, Baghurst P, et al. (2005) Low-level lead exposure and children's intellectual function: an international pooled analysis. *Environ Health Persp* 113:894-899.

Koller K, Brown T, Spurgeon A, Levy L. (2004) Recent developments in low-level lead exposure and intellectual impairment in children. *Environ Health Perspect* 112:987-94.

Télliez-Rojo MM, Bellinger DC, Arroyo-Quiroz C, Lamadrid-Figueroa H, Mercado-Garcia A, et al. (2006) Longitudinal associations between blood lead concentrations lower than 10 microg/dL and neurobehavioral development in environmentally exposed children in Mexico City. *Pediatrics* 118:e323-30.

(3) Risks to human health through livestock feeding in areas of lead gunshot deposition

Clements R (1997). The effect of clay pigeon shooting and pellet deposition on lead levels in soil, vegetation and milk. BSc (Hons) Thesis, Plymouth University. (2, UK)

EFSA 2004. Opinion of the Scientific Panel on Contaminants in the Food Chain on a request from the Commission related to lead as undesirable substance in animal feed *The EFSA Journal* (2004) 71, 1-20.

<http://www.efsa.europa.eu/en/scdocs/scdoc/71.htm> (2, UK, EU).

http://www.defra.gov.uk/vla/reports/rep_food.htm

Frape, D. L. & Pringle, J. D. (1984). Toxic manifestations in a dairy herd consuming haylage contaminated by lead. *Veterinary Record* 114: 615-616. (1, UK)

Mellor, A. & McCartney, C. (1994). The effects of lead shot deposition on soils and crops at a clay pigeon shooting site in northern England. *Soil Use and Management* 10: 124-129. (1, UK)

Rantalainen M-L et al (2006). Lead contamination of an old shooting range affecting the local ecosystem - a case study with a holistic approach. *Science of the Total Environment*, 369, 99-108. (1, INT)

Rice, D. A., McLoughlin, M. F., Blanchflower, W. J., & Thompson, T. R. (1987). Chronic lead poisoning in steers eating silage contaminated with lead shot - diagnostic criteria. *Bulletin of Environmental Contamination and Toxicology* 39: 622-629. (1, INT)

Sneddon, J., Rafael Clemente, Philip Riby and Nicholas W. Lepp 2009. Source-pathway-receptor investigation of the fate of trace elements derived from shotgun pellets discharged in terrestrial ecosystems managed for game shooting. *Environmental Pollution* 157: 2663-2669 (1, UK, EU, INT)

Stansley, W. & Roscoe, D. E. (1996). The uptake and effects of lead in small mammals and frogs at a trap and skeet range. *Archives of Environmental Contamination and Toxicology* 30: 220-226. (1, INT)

Stansley, W., Widjeskog, L., & Roscoe, D. E. (1992). Lead contamination and mobility in surface water at trap and skeet ranges. *Bulletin of Environmental Contamination and Toxicology* 49: 640-647. (1, INT)