BASC Literature Review

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A literature update from BASC's research department

The research department monitors scientific journals for relevant papers related to our sport and the quarry we pursue, as well as others on wildlife in general and the wider countryside. This review includes titles of such papers published this month and the abstracts of the more interesting ones.

Most papers are available through the website Ingenta Connect. Acquiring full journal papers in this way may incur a charge.

Please note: We don't necessarily agree with the claims and findings of these papers, and take no responsibility for any errors in the titles and abstracts, as they are lifted from the online reference database.

Papers particularly worth noting:

- Lead-free, high-powered rifle bullets and their applicability in wildlife management.
- Lead exposure in large carnivores in the greater Yellowstone ecosystem.
- Selectivity and injury risk in an improved neck snare for live-capture of foxes.
- The status of tuberculosis in European wild mammals.

Waterfowl

Bloom, P. M., Clark, R.G., Howerter, D. W. & Armstrong, L. M. (2012). **Landscape-level correlates of mallard duckling survival: Implications for conservation programs.** *The Journal of Wildlife Management* 76(4): 813-823.
http://onlinelibrary.wiley.com/doi/10.1002/jwmg.297/abstract

Despite recent work, uncertainty remains concerning how abiotic and biotic factors affect duckling survival. Additionally, upland habitat characteristics may affect duckling survival rates but this potential relationship has largely been ignored. We evaluated several unresolved hypotheses about causes of mallard (*Anas platyrhynchos*) duckling survival variation, with an emphasis on assessing effects of managed and remnant natural upland habitats. During 1993–2000, 617 radio-marked females provided information about brood habitat use and duckling survival on 27 sites in prairie Canada. We contrasted a priori and exploratory models that incorporated effects of upland, wetland, weather, female, and brood-related variables on duckling survival rates. Survival was highest for ducklings when a greater proportion of their surrounding landscape (i.e., within a 500-m radius buffer around the brood) was comprised of wetlands characterized by a central expanse of open water and a peripheral ring of flooded emergent vegetation. Cold and wet weather in the first week of life resulted in lower duckling survival. In a post hoc analysis, duckling survival (of older ducklings) was negatively related to increasing proportions of managed hayland.

Deer

Lang, K. R. &. Blanchong J.A. (2012). **Population genetic structure of white-tailed deer: Understanding risk of chronic wasting disease spread**. *The Journal of Wildlife Management* 76(4): 832-840.
http://onlinelibrary.wiley.com/doi/10.1002/jwmg.292/abstract

Understanding factors that influence the spread of wildlife diseases can assist in designing effective surveillance programs and appropriate management strategies. Chronic wasting disease (CWD), a fatal prion disease of cervids, was detected in south-central Wisconsin in 2002 and over time has been identified increasingly farther west in the state leading to concerns about CWD spreading to Iowa. Our objective was to characterize genetic connectivity between white-tailed deer (*Odocoileus virginianus*) populations in eastern Iowa and western Wisconsin to assess the risk of CWD-infected deer dispersing to Iowa. We hypothesized that the Mississippi River, which separates the states, may restrict the movement of deer and thus disease. We genotyped hunter-harvested female deer collected from both states at 12 nuclear microsatellite loci (n=249) and sequenced a portion of the mitochondrial DNA (mtDNA) control region (n=173). Microsatellite data indicated there was low genetic differentiation (ΦPT=0.005) between states and weak spatial genetic structure across the study area as a whole. Verifying expectations that dispersal in deer is male-biased, maternally inherited mtDNA data showed stronger spatial structuring across the study area and greater genetic differentiation between the states (ΦPT=0.052) such that clustering analysis grouped the majority of deer from Iowa and Wisconsin into separate clusters. The low level of genetic differentiation between deer in northeast Iowa and southwest Wisconsin, primarily the result of dispersing males who have greater CWD prevalence than females, indicates that the Mississippi River is unlikely to prohibit the westward spread of CWD, and underscores the importance of continued CWD surveillance in Iowa.

Tobe, S. S., Bailey, S., Govan, J. & Welch, L.A. (2012). **Recovery of human DNA profiles from poached deer remains part 2: Improved recovery protocol without the need for LCN analysis**. *Science and Justice* - In Press, Corrected Proof
http://www.sciencedirect.com/science/article/pii/S1355030612000287
(This study has been part funded by BASC)

Although poaching is a common wildlife crime, the high and prohibitive cost of specialised animal testing means that many cases are left un-investigated. We previously described a novel approach to wildlife crime investigation that looked at the identification of humanDNA on poached animal remains (Tobe, Govan and Welch, 2011). HumanDNA was successfully isolated and amplified from simulated poaching incidents, however a low template protocol was required which made this method unsuitable for use in many laboratories. We now report on an optimised recovery and amplification protocol which removes the need for low template analysis.

Samples from 10 deer (40 samples total — one from each leg) analysed in the original study were re-analysed in the current study with an additional 11 deer samples. Four samples analysed using Chelex did not show any results and a new method was devised whereby the available DNA was concentrated. By combining the DNA extracts from all tapings of the same deer remains followed by concentration, the recovered quantity of humanDNA was found to be 29.5 pg ± 43.2 pg, 31 × greater than the previous study. The use of the Investigator Decaplex SE (QIAGEN) STR kit provided better results in the form of more complete profiles than did the AmpFℓSTR® SGM Plus® kit at 30 cycles (Applied Biosystems). Re-analysis of the samples from the initial study using the new, optimised protocol resulted in an average increase of 18% of recovered alleles. Over 17 samples, 71% of the samples analysed using the optimised protocol showed sufficient amplification for comparison to a reference profile and gave match probabilities ranging from 7.7690 × 10− 05 to 2.2706 × 10− 14.

The removal of low template analysis means this optimised method provides evidence of high probative value and is suitable for immediate use in forensic laboratories. All methods and techniques used are standard and are compatible with current SOPs. As no high cost non-human DNA analysis is required the overall process is no more expensive than the investigation of other volume crime samples. The technique is suitable for immediate use in poaching incidents.

Other Mammals

Gortazar, C., Delahay, R.J., McDonald, R. A., Boadella, M., Wilson, G. J., Gavier-Widen, D. & Acevedo, P. (2012). **The status of tuberculosis in European wild mammals**. *Mammal Review* 42(3): 193-206. http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2907.2011.00191.x/abstract

Tuberculosis (TB) is a chronic disease caused by *Mycobacterium bovis* and related members of the *Mycobacterium tuberculosis* complex. Infection affects not only cattle but also other livestock species, companion animals and wild mammals. Humans are also susceptible; hence, zoonotic infection is a driver for disease control in animal hosts. As bovine TB prevalence has been reduced in livestock, the relative epidemiological and socio-economic importance of wildlife reservoirs has increased, and there is a need for disease management strategies.
We review the current status of TB in European wild mammals, identifying epidemiological trends and areas for future research and management. TB has a complex epidemiology, which may involve multiple hosts, and is influenced by climate and habitat.
Consequently, the role of wild and domestic hosts in the epidemiology of TB varies among regions. In Europe, there are three regional examples of *M. bovis* maintenance hosts: the Eurasian badger *Meles meles* in Great Britain and Ireland, the Eurasian wild boar *Sus scrofa* in the Iberian Peninsula and deer belonging to the subfamily Cervinae in several European regions. In other parts of Europe, these species are currently regarded as spillover hosts, although in time their status may change depending on local or regional risk factors. Nevertheless, in most situations, the relative contribution of wild mammals to *M. bovis* infection in cattle is still a matter of debate. Also, the outcome of management interventions to control disease in wildlife populations may be complex and counter-intuitive.
As our knowledge of disease dynamics in wild mammals improves, options for disease control in wildlife reservoirs, such as vaccination, improved biosecurity and population management, are likely to broaden. In order to evaluate our existing control options, we must monitor the effects of interventions on TB occurrence in the affected regions of Europe and share our collective experiences.

Short, M. J., Weldon, A.W., Richardson, S. M. & Reynolds, J. C. (2012). **Selectivity and injury risk in an improved neck snare for live-capture of foxes.** *Wildlife Society Bulletin* - Early View (Online Version of Record published before inclusion in an issue).
http://onlinelibrary.wiley.com/doi/10.1002/wsb.133/abstract

Neck snares have been considered valuable for the control of canids and to catch canids for scientific purposes, but they have been criticized for perceived low target selectivity and poor animal-welfare. In 2006, we designed an experimental passive neck snare for live-capture of red fox (*Vulpes vulpes*), in which postcapture selectivity was addressed by means of a breakaway device and minimum loop size. In field trials during 2007–2009, performance was compared against snare types already in use (i.e., nonexperimental snares) by full-time game managers at 34 different sites in the United Kingdom (UK). Red fox, European badger (*Meles meles*), and brown hare (*Lepus europaeus*) made up 91% of 1,296 captures. Capture rate of red fox (n=359) was similar in experimental and nonexperimental snares (6.6 captures/1,000 snare-days). The percentage of European badgers that escaped after capture was 39% (n=76) in experimental and 14% (n=36) in nonexperimental snares. The percentage of brown hares that escaped after capture was 33% (n=384) in experimental snares compared with 18% (n=311) in nonexperimental snares, but it was further improved to 68% (n=192) in a second version of the experimental snare with increased minimum loop size. In experimental snares, 31% of captured badgers, 10% of captured brown hares, and 6% of captured foxes escaped by opening the breakaway device. The study showed that careful snare design can improve selectivity without sacrificing effectiveness. For restrained animals, however, condition was also strongly influenced by operating practices. Entanglement with nearby objects was the principal determinant of externally visible injury or death in restrained animals. Given a well-designed snare, entanglement can largely be avoided through choice of snare location as described in UK best practice guidelines.

Biodiversity

Larsen, F. W., Turner, W.R. & Brooks, T. M. (2012). **Conserving Critical Sites for Biodiversity Provides Disproportionate Benefits to People.** *PLoS ONE* 7(5): e36971.
http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0036971

Protecting natural habitats in priority areas is essential to halt the loss of biodiversity. Yet whether these benefits for biodiversity also yield benefits for human well-being remains controversial. Here we assess the potential human well-being benefits of safeguarding a global network of sites identified as top priorities for the conservation of threatened species. Conserving these sites would yield benefits a) climate change mitigation through avoidance of CO_2 emissions from deforestation; b) freshwater services to downstream human populations; c) retention of option value; and d) benefits to maintenance of human cultural diversity - significantly exceeding those anticipated from randomly selected sites within the same countries and ecoregions. Results suggest that safeguarding sites important for biodiversity conservation provides substantial benefits to human well-being.

Other

Caudell, J. N., Stopak, S.R. & Wolf, P.C. (2012). **Lead-free, high-powered rifle bullets and their applicability in wildlife management**. *Human–Wildlife Interactions* 6(1): 105-111.
http://www.aphis.usda.gov/wildlife_damage/nwdp/pdf/12pubs/caudell121.pdf

In recent years, concern over the use of lead-based ammunition for hunting has been growing, primarily due to consumption of discarded offal by scavengers and donated game meat for human consumption. While there are alternative bullet technologies on the market that are suitable for hunting, these alternatives have not been adequately researched and tested for use in professional wildlife damage management (WDM). Differences between hunting and WDM include an increased level of precision necessary for safe WDM work, potentially greater distances for shots fi red at targets, a need for instant incapacitation, and overall cost-effectiveness. To determine the applicability of lead-free bullets for WDM, we reviewed current lead-free bullet technologies and examined their limitations and benefits based on ballistic theory and available research. We found that there has not been sufficient research or experience with lead-free ammunition in the unique shooting scenarios used in WDM. Some of the issues identified by our review include a reduced theoretical precision of lead-free bullets due to a mismatch between bullet length and twist rate of the rifle barrel, lower performance of lead-free ammunition at greater ranges compared with lead-based bullets, and greater chance of bullets passing through targets and striking a nontarget object or animal. While some of these deficiencies may be overcome with new equipment and decreased target ranges, there are still situations where lead-based ammunition may be the safest and most practical option.

Cruz-Martinez, L., Redig, P.T. & Deen, J. (2012**). Lead from spent ammunition: a source of exposure and poisoning in bald eagles.** *Human–Wildlife Interactions* 6(1): 94-104.
http://www.berrymaninstitute.org/journal/spring2012/HWI_6.1_p94-104.pdf

Ongoing occurrence of elevated levels of lead in bald eagles (*Haliaeetus leucocephalus*) following the ban on lead shot for waterfowl hunting led us to hypothesize that spent lead from ammunition, which is present in field residues of white-tailed deer (*Odocoileus virginianus*), represented a source of lead exposure in eagles. We conducted a case-control study using data from 1,277 bald eagles admitted for rehabilitation from January 1996 through December 2009. A multivariate logistic regression model was used to predict the odds of elevated lead levels using admission date in relation to deer hunting season, recovery location in relation to deer hunting zones, and age as predictors. We also assessed mean liver copper concentrations from eagles with elevated lead levels and from eagles with background lead levels, because most high velocity rifle bullets that are used for deer hunting are jacketed in copper. We found 334 bald eagles with elevated lead levels out of 1,277 bald eagles we examined. We detected significantly increased odds for elevated lead levels based on season (late fall and early winter), deer hunting rifle zone, and age (adult birds). The mean liver copper concentration was higher ($P = 0.02$) in eagles with elevated lead levels. These combined results supported our hypothesis that eagles are acquiring lead from hunter-shot deer. Further research is needed to determine whether this exposure to lead is having a population-level impact.

Evangelou, M. W. H., Hockmann, K., Pokharel, R., Jakob, A. & Schulin, R. (2012). **Accumulation of Sb, Pb, Cu, Zn and Cd by various plants species on two different relocated military shooting range soils.** *Journal of Environmental Management* 108: 102-107.
http://www.sciencedirect.com/science/article/pii/S0301479712002411

Annually, more than 400 t Pb and 10 t Sb enter Swiss soils at some 2000 military shooting ranges. After the decommission of military shooting ranges, heavily contaminated soils (>2000 mg kg^{-1} Pb) are landfilled or processed by soil washing, whereas for soils with less contamination, alternate strategies are sought. Although the use of military shooting ranges for grazing in Switzerland is common practice, no assessment has been done about the uptake of Sb in plants and its subsequent potential intake by grazing animals. We determined the uptake of Sb, Pb, Cu, Zn and Cd in the aboveground biomass of nine plant species growing on a calcareous (Chur) and a weakly acidic (Losone) military shooting range soil in order to assess if grazing would be safe to employ on decommissioned military shooting ranges. The two soils did not differ in their total concentrations of Cu, Zn, Sb and Cd, they differed however in the total concentration of Pb. Additionally, their physical and chemical properties were significantly different. The accumulation of Zn, Cu, Cd and Pb in the shoots of all nine plant species remained below the Swiss tolerance values for fodder plants (150 mg kg^{-1} Zn, 15-35 mg kg^{-1} Cu, 40 mg kg^{-1} Pb, and 1 mg kg^{-1} Cd DW), with the only exception of Pb in Chenopodium album shoots which reached a concentration of 62 mg kg^{-1} DW. Antimony concentrations were 1.5-2.6-fold higher in plants growing on the calcareous soil than on the weakly acidic soil. Considering Cu, Zn, Pb, Sb and Cd, all plants, with the exception *C. album*, would be suitable for grazing on similar shooting range soils.

Finkelstein, M. E., Doak, D.F., George, D., Burnett, J., Brandt, J., Church, M., Grantham, J. & Smith, D. R. (2012). **Lead poisoning and the deceptive recovery of the critically endangered California condor.** *Proceedings of the National Academy of Sciences.*
http://media.independent.com/news/documents/2012/06/27/Finkelstein_et_al_2012_Early_Edition.pdf

Endangered species recovery programs seek to restore populations to self-sustaining levels. Nonetheless, many recovering species require continuing management to compensate for persistent threats in their environment. Judging true recovery in the face of this management is often difficult, impeding thorough analysis of the success of conservation programs. We illustrate these challenges with a multidisciplinary study of one of the world's rarest birds—the California condor (*Gymnogyps californianus*). California condors were brought to the brink of extinction, in part, because of lead poisoning, and lead poisoning remains a significant threat today. We evaluated individual lead-related health effects, the efficacy of current efforts to prevent lead-caused deaths, and the consequences of any reduction in currently intensive management actions. Our results show that condors in California remain chronically exposed to harmful levels of lead; 30% of the annual blood samples collected from condors indicate lead exposure (blood lead ≥ 200 ng/mL) that causes significant subclinical health effects, measured as >60% inhibition of the heme biosynthetic enzyme δ-aminolevulinic acid dehydratase. Furthermore, each year, 20% of free-flying birds have blood lead levels (≥450 ng/mL) that indicate the need for clinical intervention to avert morbidity and mortality. Lead isotopic analysis shows that lead-based ammunition is the principle source of lead poisoning in condors. Finally, population models based on condor demographic data show that the condor's apparent recovery is solely because of intensive ongoing management, with the only hope of achieving true recovery dependent on the elimination or substantial reduction of lead poisoning rates.

Rogers, T. A., Bedrosian, B., Graham, J. & Foresman, K. R. (2011). **Lead exposure in large carnivores in the greater Yellowstone ecosystem.** *The Journal of Wildlife Management* 76(3): 575-582.
http://etd.lib.umt.edu/theses/available/etd-05112010-102626/unrestricted/Rogers_Tom_Thesis_final.pdf

Ingestion of lead rifle bullet fragments found in discarded hunter-harvested ungulate gut piles negatively affects avian wildlife. Some large carnivores, such as grizzly bears, are also known to target these gut piles as a food source and are therefore potentially at risk of lead exposure. We investigated whether large carnivores in the greater Yellowstone ecosystem were exposed to lead, and if so, if ammunition ingested from gut piles was an apparent source of exposure. Grizzly bears (Ursus arctos, n=82) exhibited higher blood lead levels (median=4.4μg/dL, range 1.1–18.6μg/dL) than black bears (Ursus americanus, n=35, median=1.6, range 0.5–6.9μg/dL), but blood lead levels did not increase during the autumn hunting season when potentially lead-tainted gut piles are available. Wolves (Canis lupus, n=21) and cougars (Puma concolor, n=8) showed lead concentrations near or below the minimum level

of detection in both blood and tissue samples. Unlike findings in previous studies on avian scavengers, we did not find lead ammunition fragments to be a widespread source of lead exposure in large carnivores. Grizzly bears do, however, exhibit blood lead levels that are higher than what is considered safe in humans, but the source of this exposure remains unknown.

Wilson, M. W., O'Donoghue, B., O'Mahony, B., Cullen, C., O'Donoghue, T. I. M., Oliver, G., Ryan, B. Troake, P., Irwin, S., Kelly, T. C., Rotella, J. J. & O'Halloran, J. (2012). **Mismatches between breeding success and habitat preferences in Hen Harriers Circus cyaneus breeding in forested landscapes**. *Ibis* 154(3): 578-589.
http://onlinelibrary.wiley.com/doi/10.1111/j.1474-919X.2012.01236.x/abstract

During the past century, the upland breeding areas of Hen Harriers in Ireland have been extensively afforested. There is no evidence that this species avoids breeding in heavily forested landscapes and, indeed, young commercial forests in their second rotation are often selected as nest-sites. However, Hen Harriers have coexisted with these forested areas for only a few decades and it is possible that such landscapes are suboptimal. We examined the relationship between breeding success and habitat using a dataset spanning three years and four study areas in the south and west of Ireland. We assessed whether nest success and fledged brood size were related to habitat type, both at the nest-site and in the surrounding landscape. Neither measure of breeding productivity was related to total forest cover or to percentage cover of closed canopy forest in the landscape. However, in a subset of areas, high cover of second-rotation pre-thicket (young forests planted on land from which a first rotation has already been harvested) in the surrounding landscape was associated with low levels of breeding success. This may be due to factors related to predation, disturbance or prey availability. The fact that second-rotation pre-thicket is a preferred habitat for nesting in Ireland suggests that Hen Harriers may be making suboptimal decisions in the landscapes available to them.

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