Writtle University College

Is there a wild animal welfare emergency facilitated by negative linguistic framing in wildlife population control studies?

Emma F. Randall and Nieky van Veggel

Introduction - context

- Associations between humans and wild non-human animals (hereafter animals) have been problematic since pre-history [1,2]
  - Transmit diseases to humans [3] and livestock [4]
  - Damage amenity land [5]
  - Raid and destroy crops [6] and damage native trees [7,8]
- Increases in human population (11 billion people by 2100 [9]) and mobility multiply opportunities for problematic interactions
  - Humans encroach on wild areas [2]
  - Species are introduced accidentally or deliberately by humans [1]
  - Climate change alters the range of some species [10]

IPBES identified 'invasive' species as a direct driver of biodiversity loss [11].

Introduction – animal suffering

- These are urgent problems that can't be ignored
- Approximately 38 million mammals and birdsare shot, snared, trapped or poisoned in the UK each year [12].
- A largely ignored welfare emergency.
- The Five Domains Model, originally devised to assess welfare in the laboratory can be applied to wild animals subject to control interventions [13]
- Some interventions cause severe suffering but the regulation of methods of control is less cognisant of welfare than for animals in other contexts
  - Time to insensibility of up to 300 seconds is considered acceptable [14].
  - Small ground vermin traps order 1956 exempts spring traps for rats, mice and moles from quality regulation.

Introduction – attitudes to animals

- Human cultures must manage contradictions in how animals are treated [15].
  - Animals as family (pets)
  - Animals as food (livestock)
  - Animals as nuisance (pests)
- Cognitive dissonance has been proposed as a phenomenon that enables the justification of behaviour that doesn't attune with a person's values [16].
- It has been proposed that language and labelling influences attitudes to wild animal species [17]
  - Blaming a species for an ill thought through human introduction of their ancestors [18].
  - Juxtaposing 'native' vs 'invasive' [19].

Introduction – linguistic framing

- Linguistic framing uses language to conceptualise a subject as a defined problem, with a particular cause and solution[20].
- It works by highlighting aspects of the subject which accentuate its salience and projects a moral judgement [20,21].
- It de-emphasises characteristics that would contradict the intended paradigm [20,21].
- Framing may be used intentionally as a tool of persuasion, for example the tax as 'theft' (Conservative) vs tax as 'payment for services' (Liberal) paradigm in U.S. politics [22].
- Or may unconsciously, reflect cultural bias, such as human exceptionalism [21] or passive femininity [23].
- Cultural context affects the way a framed concept is received, the effect may be different depending on the receiver's, education and experience [21,24,25].

Introduction – framing animals

- How animals are framed differently according to context is obvious in grey literature (figure 1) but is also apparent in scientific literature [26].
- Titles, abstracts and keywords distil the content of papers and have the furthest reach [27].
- An 'ends justify the means' philosophy can be more palatable where a target species is presented as a sufficient threat to a protected species or environment that has been framed as precious and vulnerable [28].
- The inference of threat can be amplified through framing the control measure, for example, using war imagery [29].
- Systematic reviews have been used for qualitative research [30], to investigate the influence of metaphor on attitudes [31] and can reveal how discourse frames issues to emphasise a perspective [32].

Pest

- Large
- 'Acute sense of hearing'
- 'Well developed' sense of touch and smell
- Produce up to 12 litters a year
- 'Inflict' damage
- Carry 'nasty diseases'
- Contaminate food
- Nimble climbers
- 'Adept at swimming in sewers'
- 'Eat almost anything'
- Smell bad
- Good at hiding

Pet

- Intelligent
- Highly social
- Active at night
- 'excellent sense of touch'
- 'wonderful sense of smell'
- 'have complex needs'
- Variety of coat colours
- Young are 'baby rats'
- 'Fond of titbits'
- Need exercise, entertainment and company

Figure 1 Comparison of rats framed as Pests vs Pets [33,34,35,36]

Research aims

- Systematically review scientific research papers reporting on studies into the control of wild mammal and bird populations in the UK.

- Investigate how language is used to frame target species.

- Determine whether there is a relationship between negative, positive or neutral framing and welfare impacts of interventions used.

Materials and methods – search strategy

- The scope of the investigation was defined using PICOS (Population, Intervention, Comparison, Outcome, Study design) (Table 1) [37,38].
- Literature was sourced from:
  - Scientific journals - Web of Science (WOS) and EBSCO databases
  - Government research – DEFRA Science and Research database (England, Wales and Scotland) [39] and the Northern Ireland (NI) Assembly Research and Information Service [40]
  - Unpublished theses - Open Grey [41].
- keywords, identified via a review of literature, formed the basis of search strings which were adapted for each database.
- Documents that could not be accessed via subscriptions, were obtained directly from authors or through inter library loans.

Inclusion and exclusion criteria

Table 1 Inclusion and exclusion criteria (PICOS)

PICOS	Inclusion and exclusion criteria
Population	Inclusion criteria: Bird or mammal species
	Exclusion criteria: Invertebrate species; species not subject to population control.
Intervention	Inclusion criteria: Any lethal or non-lethal method of controlling wild populations of animals
	Exclusion criteria: Interventions not used for wildlife population control
Comparison	N/A
Outcome	Inclusion criteria: Descriptive language and imagery used to describe species subject to control, the element to be protected and the aims of the study
	Exclusion criteria: descriptive language and imagery used to describe other factors
Study design	Inclusion criteria: All original field studies where the objective of the study is wildlife population control for pest control or conservation
	Exclusion criteria: Reviews. Studies that are not directly controlling a wildlife population; Laboratory trials of population control methods
Other restrictions	
Language	Inclusion criteria: English language
	Exclusion criteria: Any other language and translations into English
Publication date	Inclusion criteria: All
	Exclusion criteria: None
Region	Inclusion criteria: Geographical restriction to the UK
	Exclusion criteria: Studies outside the UK

Data extraction

- A data extraction template was designed, and all relevant information collected (full texts were searched at this stage) (Table 2) [42]
- Information was transferred to an Excel spreadsheet for analysis (Supplementary Materials 1: https://tinyurl.com/upbhs7o).
- Texts were searched for linguistic themes and descriptive and *in vivo* codes were recorded [43].
- A welfare assessment rating was assigned, guided by Sharp and Saunders' (2011) model [14].
- Quality assessment was performed after data extraction as it was not necessary to exclude poor quality papers from the data set [44].

Table 2 Data extraction template

Study ID	
Study title	
Author/s	
Journal	
Year of Publication	
Year/months research carried out	
Duration of project	
Research aims	
Study design	
Statistical Analysis	
Location/s	
Number of sites	
Target species	
Number of animals	
Species/environment being protected	
Target species linguistic frames/themes	
Intervention (control method/s used)	
Intervention welfare factors	
Comparison	
Outcome/results	

Welfare assessment

- Welfare was assessed for each study using Sharp and Saunders (2011) model
- Sharp and Saunders adapted the Five Domains Model as a tool to evaluate wildlife population control interventions.
- The model assigns two scores: (A) rates the overall suffering, by plotting duration against intensity (scores 0-8), and (B) rates the mode of death in terms of time to unconsciousness and level of suffering (A-G) (Figures 2 and 3).

Overall impact on welfare	Duration of impact				
	Immediate to Seconds	Minutes	Hours	Days	Weeks
EXTREME	5	6	7	8	8
SEVERE	4	5	6	7	8
MODERATE	3	4	5	6	7
MILD	2	3	4	5	6
NO IMPACT	1	1	1	1	1

Figure 2 Scoring Matrix for overall welfare impact (A) [13]

Level of suffering (after application of the method that causes death but before insensibility)	Time to insensibility (minus any lag time)				
	Immediate to Seconds	Minutes	Hours	Days	Weeks
EXTREME	E	F	G	H	H
SEVERE	D	E	F	G	H
MODERATE	C	D	E	F	G
MILD	B	C	D	E	F
NO IMPACT	A	A	A	A	A

Figure 3 Scoring matrix for mode of death (B) [13]

Data analysis

- Discourse analysis using a framework analysis approach was used, this allowed *a priori* themes to be identified (Table 3) but also allowed for an iterative element so new themes that emerged from the texts would not be overlooked [45].
- Once *a priori* frames and themes had been established, detailed analysis of titles, abstracts and keywords was carried out using the qualitative data analysis software Atlas.ti [43,46].

Table 3 A priori frames and themes [46–49]

Frames	Themes
Nativeness	Social
Naturalness	Family
Value	Human-like
War	Feeding and foraging
Threat	Protected
Victim	Death
	Conservation threat
	Crop damage
	Useful
	Resource
	Threat to livestock
	Human-animal conflict

Data analysis

- The Atlas.ti software enabled themes to be assigned to framing categories as code groups, the groups were found to have overlapping characteristics, so codes were assigned to one or several groups.
- Documents were organised by wildlife population control method, and the query tool was used to interrogate the frames and themes for each method.
- A “Full content” report was generated for each frame within each document group; this identified quotations, comments and themes.
- These themes were examined to confirm which were relevant to the frame and identify quotations that represented the prevailing attitudes and positive, negative or neutral tone of the relevant papers.
- Relationships between method of control, welfare and frames and themes could then be inferred.

Quality assessment

- Mupepele *et al.*, (2014)'s quality assessment format (designed for conservation studies) was adapted and used to assess the included papers.
- This method grades the Level of Evidence (LoE) on a hierarchy from weak to strong (Figure 4). An initial level was designated corresponding to study design, then a series of questions generated a score, and the LoE was adjusted (Table 4) accordingly (Supplementary Materials 2 https://tinyurl.com/tpwxy3k).

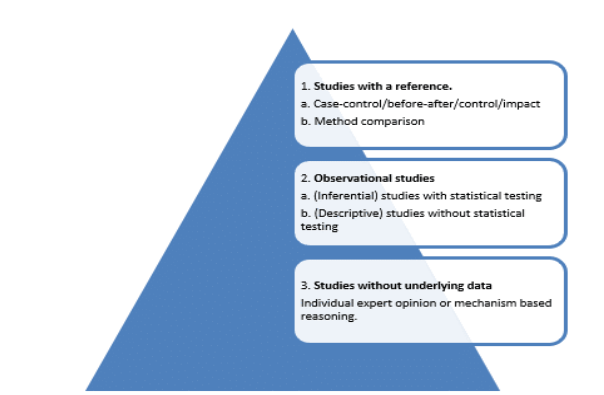

Figure 4: Hierarchy of study designs from stronger (top) to weaker (bottom) evidence, adapted from [47].

Table 4 Quality assessment adjustment guide adapted from Mupepele et al 2014 [47]

Score	Adjustment
80-100%	No adjustment
60-79%	Half level adjustment
40-59%	1 level adjustment
20-39%	1 ½ level adjustment
0-20%	Invalid study

Search results

- Searches were as follows:
- Web of Science: 07/07/2019, (1843 results);
- EBSCO: 07/07/2019 (430 results);
- Open Grey: 08/07/2019 (75 results);
- DEFRA 25/072019 (385 results);
- NI Assembly: 01/08/2019 (70 results) (Appendix iii).
- After duplicates were removed and titles, abstracts and finally full texts screened, 65 papers were available for analysis (Figure 5)

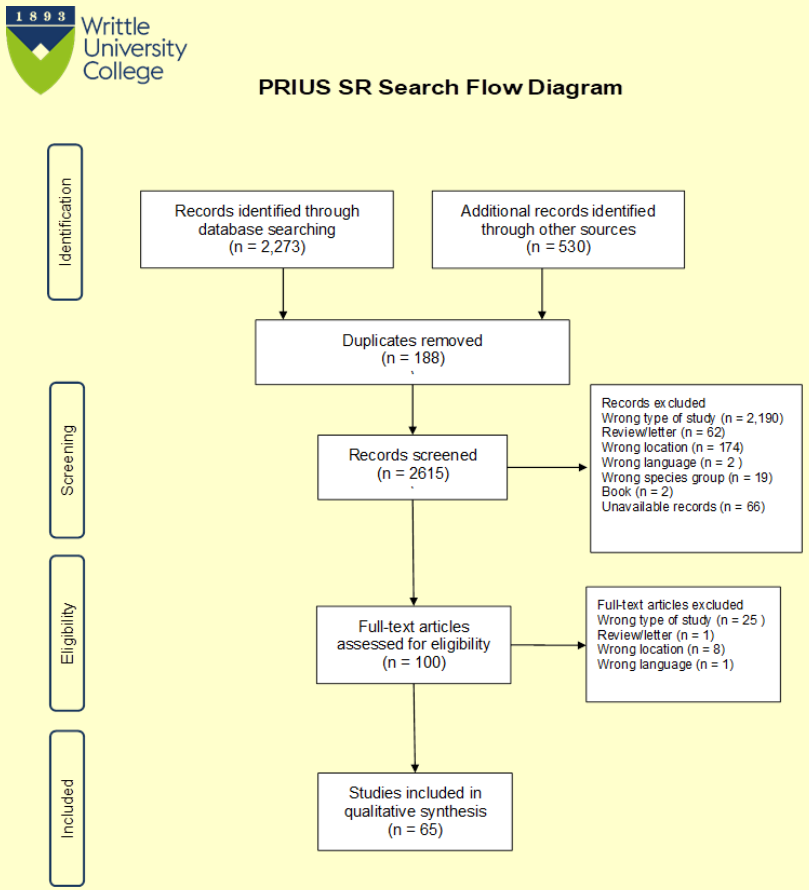

Figure 5 Search flow diagram, adapted from: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). *P*referred *R*eporting *I*tems for *S*ystematic Reviews and *M*eta-*A*nalyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

Database distribution

- 12 (19%) of the papers were sourced from the DEFRA Science and Research Database (Figure 6), these papers were clustered in the period 2001-2011, earlier papers were requested from the department but neither electronic nor paper copies were available. The remainder were from published journals (51) and one unpublished thesis.
- There was an uneven distribution of species, badgers, brown rats, rabbits and mink were the most popular to study (Figure 7).

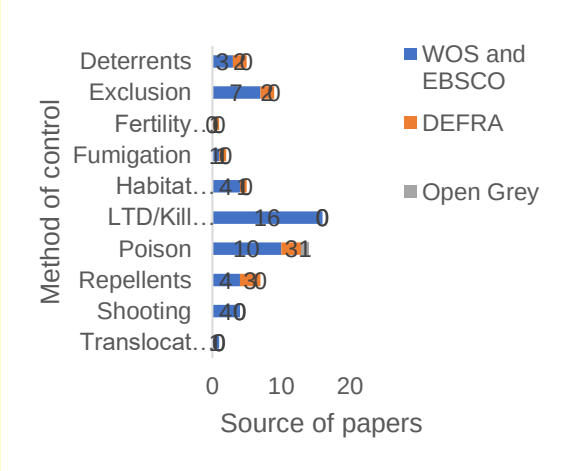

Figure 6 Sources of papers

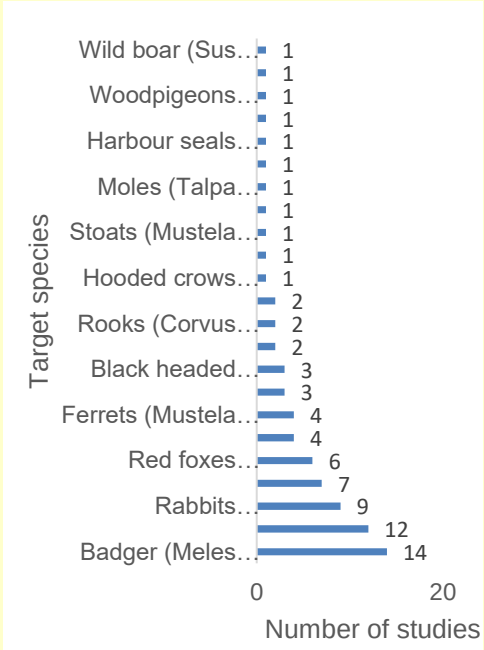

Figure 7 Number of papers species were targeted in (some studied multiple species)

Welfare assessment

- Welfare was assessed for each study and the range of potential welfare outcomes was visualised (Figure 8). Poison, kill traps and fumigation showed the greatest potential for suffering, whilst the mildest impact was from habitat modification.

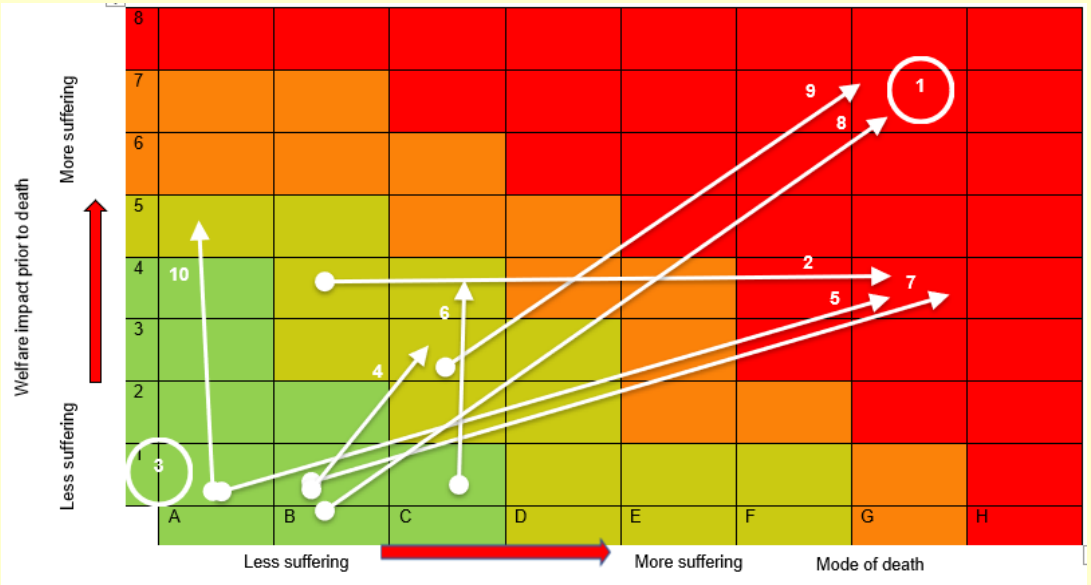

Figure 8 Welfare assessments for included studies by control method: Anticoagulant Rodenticide (1); Live trap and despatch (2); Exclusion (without lethal control), Repellents, Deterrents, and Habitat modification (3); Exclusion (with lethal control) (4);Repellents with fatality (Atkinson and Macdonald, 1994) (5); Deterrent (using falcons) (6);Shooting (7); Kill traps (8); Fumigation (9); Translocation and Immunocontraception (10). Arrows indicate the range of welfare outcomes, circles indicate a single outcome score. (adapted from Sharp and Saunders, 2011[13]).

Poison

- 14 studies (22%) used poison, 12 of which used anticoagulant rodenticide (AR) for rats (10) or mice (2), DEFRA or MAFF were involved in funding all the poison studies. The majority of the papers were of lower quality, LoE2b and were published between 1978 and 2007.
- Welfare was generally poor AR was rated 7:G, there was insufficient information regarding T3327 (carbamate).
- The tone of the papers was overwhelmingly negative.
- The animals were framed in many ways: **Threat**, **War**, **Place, Sentience** and **Victim** all appeared repeatedly.
- The theme of "infestation" was amplified by repetition and emphasis on size and seriousness; infestations were "heavy" and "substantial" [48] and populations were "abnormally large" [49].
- References to "rodenticide" added to the dark tone, "resistance" activated **War** as an image, this referred to physiological adaptations to AR, and actions that sabotaged the intervention.
- Rats "rejected bait" [50] and removed burrow blocking materials:
  - "…[rats] deliberately removed particles from the tunnel entrance and then left those they did not want to consume." [50]
  - "…[rats] invariably remove such [burrow blocking] material from an active burrow…" [50].

Poison

- Tone was neutralised where themes relating to **Place**, of "living in", being "resident" [51], or being "occupants" [50] counteracted the "infestation" paradigm. Additionally, themes of colonisation were countered by more domestic images of "home":
  - "…[rats] stayed within a small home range, two moved and stayed away from the trap site and only one moved into a farmyard [52].
- **Sentience** framing depicted rats' sociability and cognitive sophistication, which also diminished negative tone; this contrasted a passive lack of sentience in mice, whose rebounding populations were simply a "build-up".
  - "The removal initiated an information transfer system within each colony in which animals that had previously ignored plain blocks became familiar with this food type." [50].
  - "…effort is needed to prevent the build-up of *M. domesticus* numbers in farm buildings" [51].

Live trap and despatch (LTD) and kill traps

- 15 (24%) of the studies used LTD, Kill traps or both.
- The studies targeted a range of species; American mink were the most numerous (7 studies).
- Animals were caught using cage traps and shot (9 studies), killed with a lethal injection (3) or by cranial despatch (2). Spring traps were used in 3 studies.
- The majority were sourced from published journals and had predominantly government, but also charity and university funders.
- There was a range of quality and most were recent (published between 2000 and 2017).
- Welfare outcomes were mixed, dependant on trap inspection regime, handling and trap quality: LTD – 4:B-G; Spring traps – 0-7:B-G.
- Tone was negative (11 studies) or neutral (5); there was an apparent effect of species, all corvid studies had a neutral tone whereas all mink studies had a negative tone.

Live trap and despatch (LTD) and kill traps

- Tone was negative (11 studies) or neutral (5) with differences between species. All corvid studies had a neutral tone whereas all mink studies had a negative tone.
- There was strong **War** framing in 12 of the studies using a wide range of themes, traps were “deployed” and “armed”, the intervention was a “campaign”. This was particularly intense in studies that involved the public in lethal control [53,54].
- The power of **Threat** and **Place** was enhanced through repetition and integrating themes: “alien invasive” [55] and “harmful invasive” [53] and “abundance” [56] presented an overwhelming and escalating problem.
- Explicit reference to lethality emphasised **Threat**; the animals were unapologetically “killed” [54,57,58], “culled” [56,57,59] and “eradicated” [53]. This was further legitimised by citing legislative obligation to control [55].

Live trap and despatch (LTD) and kill traps

- Tone was neutralised where the justification focuses more on the protected species than the targeted one [63] or where there was an unsatisfactory outcome [59.61] or the control was ineffective [52].
- Grey squirrels are portrayed as a pathogenic and competitive **Threat** to native reds [62].
- "Grey squirrels carry an infection that causes epidemic pathogenic disease if spread to the native red squirrel" [62].
- The intensity of **War** and **Threat** was emphasised by the means of control, for example "Magnum 116 bodygrip traps" [63].
- Welfare outcomes for the squirrel studies varied, cage trapped animals had to be removed from the cage into a bag where cranial despatch involved a blow to the head, this requires expertise to ensure death occurs after a single blow. Additionally, spring traps can inflict near instant death, but 2 squirrels were found to be alive when traps were inspected [63].
- Corvids likely suffered the most harms, as they were caught in Larsen or Ladder traps but were presented in a neutral tone, still framed as a **Threat** but also as **Natural**, with fewer themes, mostly relating to predation [59,60,64].

Exclusion

- Nine studies (14%) used exclusion, two also used lethal control: fumigation [65] and shooting [66].
- Three species were targeted: Badgers (6 studies), rabbits (2) and foxes (2). 8 studies used electric fencing (one additionally used non-electrified barriers) and 1 study blocked rabbit burrows (after fumigation). Most studies (5) took place between 2000 and 2009 and three of the studies shared the same lead author (Poole). The majority received government funding.
- Welfare was rated as: Exclusion without lethal control – 1; exclusion with lethal control – 1-3:B-C.
- The quality of studies was good: LoE1a – LoE2a

Exclusion

- Tone was mixed with positive (3 studies), neutral (4) and negative (2) examples all represented.
- **War** themes (“recruitment”, “target”), and **Threat** (“crop damage”) were offset by multiple **Value** themes (“individuality”, “social animals”, “welfare”) and welfare impacts were mild [67].
- Those that were negatively framed in terms of **Place** (“Immigrant”) and causing economic costs had more severe welfare impacts [65].
- **Threat** was embedded in a wide range of themes; there were economic impacts of crop damage [7,68], conservation threat [66,69] particularly predation from “large mammalian predators” [69], and disease risk:
  - “…close direct contact with cattle and contamination of cattle feed” [70].
  - “…that badger activity in farm buildings may incur a significant risk of cross-infection.” [71]
- **Threat** integrated with **Natural** themes related to feeding and foraging:
  - “foxes preying on sandwich terns and eiders” [66]
  - “with most preferring to forage on pasture” [68].

Exclusion

- Positive tone related to **Value** and **Sentience**, animals were presented as “social”, “cognitively complex” with “individual” reactions to interventions, the agency to make decisions about whether or not to “visit” a protected area and as having preferences:
  - “visits by badgers to farm buildings” [70].
  - “…preferring to forage on pasture” [68].
  - “…for social reasons, rabbits seem reluctant to give up access to their burrow systems” [67].
- Although **War** framing was only used by 3 studies there were powerful images of conflict; badgers made “incursions” [71] into forbidden areas and rabbits were “recruited” [67]. Exclusion fencing was often “deployed”:
  - “remote surveillance and radio-tracking were used to monitor the effect of electric fencing manipulations on the frequency of badger incursions into feed stores” [71]
- **Place** was often framed in neutral terms of “home ranges”[72]:
  - “Badger home range and core activity areas tended to increase in size when the fencing was installed…” [72].

Repellents

- 7 (11%) studies used repellents and the target species were badgers (5 studies), rabbits (2), moles (1), grey squirrels (1) and foxes (1). 3 of the studies were sourced from the DEFRA database, the remainder were from published journals.
- Studies used conditioned taste aversion (badgers and squirrels), via additives to food bait; 1 study modified cereal crops to deter rabbit grazing and 1 applied odiferous repellents to mole tunnels. 3 of the papers had the same lead author (Baker).
- Most studies were of good quality (and most (6) took place during a 4 year period (2002-2006) (Figure 9).
- Welfare was good (1-3:B-C) for all but the mole study [76] where one displaced mole was found to have died.
- The tone of the papers was neutral, and all frames were represented; **Value** and **Sentience** dominated, with numerous themes relating to the animals' subjective experience, using themes of "sensing", "cognitive complexity" and "agency".

Repellents

- Success of this approach depended on the animals' abilities to make associations, discriminate and take decisions to avoid food or areas; they showed agency in their ability to choose:
  - "…the maximum treatment effect was seen when rabbits were presented with a simple choice..." [74]
- Sensing was depicted in their discrimination between treated and untreated conditions:
  - "Vertebrate herbivores actively discriminate between high and low silica grasses and preferentially feed on the latter" [75].
- Learning to connect aversive experiences with particular foods showed their cognitive complexity:
  - "conditioning badgers with the ziram–clove combination produced learned aversion towards untreated foods in the presence of the odour cue." [76].
- Animals were presented as legally protected (**Value**) and public opinion was important in the choice of "benign" control [76-78].
- **Natural** framing was also apparent:
  - "…[badgers were] a wild free-ranging population of mammals." [77].
- Themes related to **Threat** counteracted the positive representations, ensuring they are contextualised as pests [73-76], that have negative impacts though economic costs [75] and cause crop damage [74]

Deterrents

- 5 (8%) studies used deterrents against, gulls (2 studies), corvids, badgers, rabbits and seals (1 each).
- Each study used a different method; falcons (involving some lethality) (gulls), bamboo canes protecting ground nesting birds (gulls), an acoustic device (seals), visual and acoustic scarers (rabbits) and ultrasonic auditory deterrent and water squirters (badgers).
- 3 papers were sourced from journals and 2 from the DEFRA database and all were of high quality (Figure 9).
- Welfare was good for all studies, although Baxter and Allan (2006) used falcons to kill a small percentage of the target animals which accounts for the lower welfare score: non-lethal – 1; lethal 1-3:C).
- This group was diverse in tone (positive (1), neutral (3) and negative (1), frames and themes which reflects the variation in means of and reasons for control.

Deterrents

- The dominant frame was **Threat** which all studies utilised. Baxter and Allan (2006)'s negative framing, contrasted with Bootby *et al.* (2019) who promoted their control as a humane alternative to culling:
  - "Scavenging birds at landfill sites carry disease, cause nuisance, and may create a bird-strike hazard." [79]
  - "…an alternative method, using bamboo canes erected in four breeding sites …" [80].
- Although neutral studies highlighted **Threat** to crops [81], conservation [80] or infrastructure [82], **Threat** was muted by using **Victim**, **Value** and **Sentience** themes [81.82]. Badgers were in conflict (**War** and **Threat**) with humans but were sentient agents for whom resources were "important" [82]:
  - "…urban badger-human conflicts are particularly difficult to resolve, largely due to the pattern and concentration of resources that are important to badgers in urban areas." [82].
- Rabbits were vulnerable sensing animals, scared by the deterrent devices (**Victim**) and made choices between alternative feeding areas (**Sentience**):
  - "…[the research] established whether a visual-scaring device, based on a moving beam of light, could potentially deter rabbits from selected areas"
  - "Later the rabbits were provided with an alternative …" [81].
- Although, the conflict (**War**) between seals and fisheries was explicit [83], welfare was presented as a priority and the protected status of seals evoked a positive tone.

Other methods

Table 1 The relationship between the tone (positive, negative or neutral) and welfare outcomes for wildlife population control studies, showing number of studies (n), study quality and years of publication

Method (n)	Negative	Positve	Neutral	Welfare	Quality	Years
Poison (14)	✓			Poor	Low	1978-2007
LTD/kill traps (15)	✓		✓	Mixed	Mixed	2000-2017
Exclusion (9)	✓	✓	✓	Good	Good	2000-2009
Repellents (7)			✓	Good	Good	2002-2006
Deterrents (5)	✓	✓	✓	Good	Good	2001-2019
Shooting (4)	✓	✓	✓	Mixed	Mixed	1974-2018
Fumigation (2)			✓	Poor	Low	1986-2002
Habitat modification (5)	✓	✓		Good	Mixed	1987-2008
Translocation (1)	✓			Mixed	Good	1996
Immunocontraception (1)	✓			Mixed	Good	2011

Discussion

- The analysis identified seven framings: **War**, **Place**, **Victim**, **Value**, **Sentience**, **Threat** and **Natural**. This was consistent with framings reported in the literature [46,96,97] with an additional **Sentience** frame which proved integral to the tone in many of the studies.
- The frames were constructed around themes that defined the animals, often in relation to their problematic status (e.g. “invasive” or “pathogenic”) and emphasised salient characteristics whilst de-emphasising others [20,21].
- Frames were found to be interrelated and interacting, the balance of competing frames defining tone.
- Although the frames were pervasive across the literature, there were differences in which frames dominated between methods of control and species controlled, both within and between method groups.
- The effects were heavily influenced by tone and context; a frame could be positive, negative or neutral depending on the themes invoked, their density (number of different themes or repetition) within the text and how the species and control method were contextualised.

Negative framing and poor welfare

- Poison studies predominantly used AR to control rats, which is understood to cause potentially severe suffering [98-100]
- The overwhelmingly negative tone was evoked by framing the animals in terms of **Threat** and **War** with persistent and repetitive use of the “infestation” theme, combined with explicit reference to “rodenticide” and “resistance”
- Their intelligence and agency was shown to sabotage the control intervention; the rats “rejected bait” and removed materials blocking burrows.
- Rats have long held associations with negative human characteristics, are commonly objects of phobias and disgust [101], and are used as a metaphor to stigmatise other species, pigeons are denounced as “rats with wings” [102], squirrels as “tree rats” [103].

Mixed tone and welfare outcomes

- The **War** on wildlife was epitomized in mink studies which were the majority in this group and were exclusively negatively framed.
- There was a striking intensity of framing that integrated **War**, **Threat** and **Place**. The “alien”, “invasive”, “harmful” species were categorically defined using repetition to press home the effect, and juxtaposition with the “native” voles that projects were attempting to re-establish.
- This was clear in studies that had involved members of the public in carrying out lethal control [53].
- Exaggeration of **Threat** could be because the public tend not to favour lethal control even where it is presented as more effective and less costly than other means [93].
- The public are more likely to approve of lethal interventions when a problem species has been deliberately or negligently introduced by humans [94,95]. So this communication technique can both encourage public participation and dampen opposition [96].

Mixed tone and welfare outcomes

- Squirrel studies used negative **War**, **Threat** and **Place** framing, utilising the theme of “invasion”, but with less intensity than the mink studies.
- Invading greys competed with and infected the “native” reds with squirrelpox [62].
- Method of control added to the sense of **Threat -** the “Magnum 116 bodygrip trap” evoked images of firearms, and there were explicit descriptions of killing [63]
- Although the control of corvids was likely to cause extreme suffering for this group, the studies all had a neutral tone.
- These birds are traditionally disliked in the UK [99], there may be less need to justify the welfare harms.
- Additionally, the control actions for corvids was directed by the authors but carried out by professional gamekeepers for whom the interventions would have been routine.

Mixed tone and welfare outcomes

- Although there was a relationship between positive framing and mild welfare outcomes, both negative and neutral framing was associated with to poor and good welfare outcomes.
- Negative framing was associated with additional lethal control for rabbits [65] but not badgers [71].
- **Place** was the dominant frame defining rabbits as immigrants.
- Vivid **Threat** and **War** themes were applied to badgers which, were disease vectors, making “incursions” and were under “surveillance”.
- This reflects contradictory feelings these species evoke. Badgers are native animals but generate extreme oppositional opinions [46,101,102].
- Rabbits are an introduced species for which there is a legal obligation to control [103] but have not been characterised as “invasive”; this could be because they have a socially constructed benignity through their status as pets and food [89].

Culture

- There are conventions apparent in the literature that govern how species are described, rats and mice “infested”, mink and squirrels “invaded”, badgers were involved in “human-animal conflict”.
- This is consistent with Entman, (1993)’s explanation of how framing defines a problem and implies a solution.
- Language had to be contextualised to act as a frame thereby adding emotional valence and persuasive power [31].
- This was achieved by interaction of culturally established perceptions of the target animals and was either enhanced or diminished through intensification (repetition or multiple negative frames and themes) or counteracted by positive themes.
- Culture plays a crucial role is in this process,
- e.g. the status of the red squirrel in Scotland has travelled full circle from their reintroduction in the 19th century, to their eradication as pests in the early 20th century [110]

Welfare

- Mixed results were a reflection of two major deficits that became apparent during this study, the deficiency of current, high quality information regarding the welfare impacts of methods, and the variation in reporting welfare outcomes in the literature.
- In this study, welfare assessments were made using information reported by each study assessed in light of the available evidence regarding the impacts of the control method used
- However, these assessments cannot be considered to be robust, much of the literature regarding welfare of wildlife population control is based on older studies collating a mixture of information regarding impacts from diverse sources, including self-reported effects in humans [87.114].
- To overcome these problems accurate reporting of welfare outcomes for field studies could be demanded by both journals and government; this has already been proposed for laboratory research [115.116].
- Auditing of welfare where animals are killed for food is routine [117] and a similar approach could be taken for wildlife population control actions.

Conclusion

- There was a relationship between negative framing and poor welfare, but this was complex, particularly as there were cultural influences on how species were represented.
- Negative framing was most apparent in the poison and LTD and kill traps method group, but even within groups there was variation in tone and emphasis.
- Negative tone seemed particularly intense for mink, which were framed in terms of **War**, **Threat** and **Place** (“alien invasive species”).
- The loosest connection between framing and welfare was in the management of corvids, which were neutrally framed but subject to high welfare risks. In these studies authors were detached from the intervention by employing the gamekeepers to carry out the control.
- . Where considerable effort and expense had been taken, animals were more likely to be framed positively or neutrally.
- The analysis has shown that framing is a complex phenomenon and mere policing of language would likely have little influence on how animals are perceived or improve welfare outcomes.
- Additionally, the analysis was hindered by a lack of robust reporting of animal welfare in wildlife population control research, which could be improved if auditing and reporting of welfare impacts could be implemented in future.

1893 Writtle University College

Any questions?

References

- (1) Baker, S. J. Control and Eradication of Invasive Mammals in Great Britain The Neolithic Period to the 18th Century. *Rev. Sci. Tech. Int. Des Epizoot.* **2010**, *29* (2), 311–327.
- (2) Macdonald, D. W.; Fenn, M. P. G.; Gelling, M. The Natural History of Rodents: Preadaptations to Pestilence. In *Rodent pests and their control*; Buckle, A. P., Smith, R. H., Eds.; CAB INTERNATIONAL: Wallingford, 2015; pp 1–18.
- (3) Meerburg, B. G.; Singleton, G. R.; Kijlstra, A. *Rodent-Borne Diseases and Their Risks for Public Health Rodent-Borne Diseases and Their Risks for Public Health*; 2009; Vol. 35. https://doi.org/10.1080/10408410902989837.
- (4) Corner, L. A. L.; Ni Bhuachalla, D.; Gormley, E.; More, S. The Role of Badgers in the Epidemiology of Mycobacterium Bovis Infection (Tuberculosis) in Cattle in the United Kingdom and the Republic of Ireland: Current Perspectives on Control Strategies. *Vet. Med. Res. Reports* **2014**, No. default, 27. https://doi.org/10.2147/vmrr.s53643.
- (5) Baker, S.; Ellwood, S.; Johnson, P.; Macdonald, D. Moles and Mole Control on British Farms, Amenities and Gardens after Strychnine Withdrawal. *Animals* **2016**, *6* (6), 39. https://doi.org/10.3390/ani6060039.
- (6) Petrovan, S. O.; Barrio, I. C.; Ward, A. I.; Wheeler, P. M. Farming for Pests? Local and Landscape-Scale Effects of Grassland Management on Rabbit Densities. *Eur. J. Wildl. Res.* **2011**, *57* (1), 27–34. https://doi.org/10.1007/s10344-010-0394-9.
- (7) Kenward, R. E.; Dutton, J. C. F.; Parish, T.; Doyle, F. I. B. Damage by Grey Squirrels.1. Bark-Stripping Correlates and Treatment. *Q. J. For.* **1996**, *90* (February 2016), 135–142.
- (8) Crowley, S. L.; Hinchliffe, S.; McDonald, R. A. Killing Squirrels: Exploring Motivations and Practices of Lethal Wildlife Management. *Environ. Plan. E Nat. Sp.* **2018**, *1* (1–2), 120–143. https://doi.org/10.1177/2514848617747831.
- (9) Roser, M. Future Population Growth - Our World in Data https://ourworldindata.org/future-population-growth (accessed Jan 16, 2020).
- (10) Li, J.; Li, D.; Xue, Y.; Wu, B.; He, X.; Liu, F. Identifying Potential Refugia and Corridors under Climate Change: A Case Study of Endangered Sichuan Golden Monkey (Rhinopithecus Roxellana) in Qinling Mountains, China. *Am. J. Primatol.* **2018**, *80* (11), 1–11. https://doi.org/10.1002/ajp.22929.
- (11) Balvanera, P.; Pfaff, A.; Viña, A.; Frapolli, E. G.; Hussain, S. A.; Merino, L.; Minang, P. A.; Nagabhatla, N. *The IPBES Global Assessment on Biodiversity and Ecosystem Services. Chapter 2 . Status and Trends ; Indirect and Direct Drivers of Change*; 2019.
- (12) RSPCA. Wildlife https://science.rspca.org.uk/sciencegroup/wildlife (accessed Dec 3, 2019).
- (13) Sharp, T.; Saunders, G. *A Model for Assessing the Relative Humaneness of Pest Animal Control Methods*; 2011.
- (14) Iossa, G.; Soulsbury, C. D.; Harris, S. Mammal Trapping: A Review of Animal Welfare Standards of Killing and Restraining Traps. *Anim. Welf.* **2007**, *16* (3), 335–352.
- (15) Serpell, J. Killer with a Conscience. In *In the company of animals*; Serpell, J., Ed.; Cambridge University Press: Cambridge, 1996; pp 169–185.

References

- Bodenhausen, G. V.; Gawronski, B. Attitude Change. In *The Oxford Handbook of Cognitive Psychology*; Reisburg, D., Ed.; Oxford University Press: Oxford, UK, 2013; pp 957–969. https://doi.org/10.2307/2576362.
- (17) Dubois, S.; Fenwick, N.; Ryan, E. A.; Baker, L.; Baker, S. E.; Beausoleil, N. J.; Carter, S.; Cartwright, B.; Costa, F.; Draper, C.; Griffin, J.; Grogan, A.; Howald, G.; Jones, B.; Littin, K. E.; Lombard, A. T.; Mellor, D. J.; Ramp, D.; Schuppli, C. A.; Fraser, D. International Consensus Principles for Ethical Wildlife Control. *Conserv. Biol.* **2017**, *31* (4), 753–760. https://doi.org/10.1111/cobi.12896.
- (18) Macdonald, D. W.; King, C. M.; Strachan, R. Introduced Species and the Line between Biodiversity Conservation and Naturalistic Eugenics. In *Key Topics in Conservation Biology*; Macdonald, D. W., Service, K., Eds.; Blackwell Publishing Ltd: Oxford, 2007; pp 186-205.
- (19) Bremner, A.; Park, K. Public Attitudes to the Management of Invasive Non-Native Species in Scottland. *Biol. Conserv.* **2007**, *139*, 306–314.
- (20) Entman, R. M. Framing : Toward Clarification of A Fractured Paradigm. *J. Commun.* **1993**, *43* (4), 51–58. https://doi.org/10.1111/j.1460-2466.1993.tb01304.x.
- (21) Lakoff, G. Why It Matters How We Frame the Environment. *Environ. Commun.* **2010**, *4* (1), 70–81. https://doi.org/10.1080/17524030903529749.
- (22) Lakoff, G. *Moral Politics: How Liberals and Conservatives Think*, 3rd ed.; University of Chicago Press: Chicago, 2016.
- (23) Midgley, M. *Animals and Why They Matter*; University of Georgia Press: Georgia, 1983.
- (24) Steen, G. J.; Reijnierse, W. G.; Burgers, C. When Do Natural Language Metaphors Influence Reasoning? A Follow-up Study to Thibodeau and Boroditsky (2013). *PLoS One* **2014**, *9* (12), 1–25. https://doi.org/10.1371/journal.pone.0113536.
- (25) Burgers, C.; Konijn, E. A.; Steen, G. J. Figurative Framing: Shaping Public Discourse Through Metaphor, Hyperbole, and Irony. *Commun. Theory* **2016**, *26* (4), 410–430. https://doi.org/10.1111/comt.12096.
- (26) Peretti, J. H. Nativism and Nature: Rethinking Biological Invasions. In *Bioinvaders*; Johnson, S., Ed.; The White Horse Press: Cambridge, 2010; pp 28–36.
- (27) Stotesbury, H. Evaluation in Research Article Abstracts in the Narrative and Hard Sciences. *J. English Acad. Purp.* **2003**, *2* (4), 327–341. https://doi.org/10.1016/S1475-1585(03)00049-3.
- (28) Vucetich, J. A.; Nelson, M. P. The Infirm Ethical Foundations of Conservation. In *Ignoring nature no more: The case for compassionate conservation*; Bekoff, M., Ed.; University of Chicago Press: Chicago, 2013; pp 9–26.
- (29) Hodgetts, T. Geoforum Wildlife Conservation , Multiple Biopolitics and Animal Subjectification : Three Mammals ' Tales. *Geoforum* **2017**, *79*, 17–25. https://doi.org/10.1016/j.geoforum.2016.12.003.
- (30) Kannemeyer, R. L. A Systematic Literature Review of Attitudes to Pest Control Methods in New Zealand. *Manaaki Whenua Landcare Res.* **2017**, 1–49.

References

- (31) Boeynaems, A.; Burgers, C.; Konijn, E. A.; Steen, G. J. The Effects of Metaphorical Framing on Political Persuasion: A Systematic Literature Review. *Metaphor Symb.* **2017**, *32* (2), 118–134. https://doi.org/10.1080/10926488.2017.1297623.
- (32) Burgers, C.; Brugman, B. C.; Boeynaems, A. Systematic Literature Reviews: Four Applications for Interdisciplinary Research. *J. Pragmat.* **2019**, *145*, 102–109. https://doi.org/10.1016/j.pragma.2019.04.004.
- (33) BPCA. Pest advice for controlling Rats https://bpca.org.uk/a-z-of-pest-advice/rat-control-how-to-get-rid-of-and-prevent-rats-bpca-a-z-of-pests/188991 (accessed Jan 12, 2020).
- (34) Rentokil. Rat Control: Expert Treatment for Rat Infestations https://www.rentokil.co.uk/rats/ (accessed Jan 12, 2020).
- (35) Blue Cross. Caring for Your Pet Rat | Advice & Guidance | Blue Cross https://www.bluecross.org.uk/pet-advice/caring-your-rat (accessed Jan 12, 2020).
- (36) RSPCA. Guidance on caring for your rat & rodents https://www.rspca.org.uk/adviceandwelfare/pets/rodents/rats (accessed Jan 12, 2020).
- (37) Methley, A. M.; Campbell, S.; Chew-Graham, C.; McNally, R.; Cheraghi-Sohi, S. PICO, PICOS and SPIDER: A Comparison Study of Specificity and Sensitivity in Three Search Tools for Qualitative Systematic Reviews. *BMC Health Serv. Res.* **2014**, *14*, 579. https://doi.org/10.1186/s12913-014-0579-0.
- (38) Cherry, M. G.; Dickson, R. Defining My Review Question and Identifying Inclusion and Exclusion Criteria. In *Doing a systematic review: A student's guide*; Boland, A., Cherry, M. G., Dickson, R., Eds.; SAGE Publications: London, 2017; pp 43–60.
- (39) DEFRA. Science Search http://randd.defra.gov.uk/ (accessed Jan 27, 2020).
- (40) Northern Ireland Assembly. Research Publications http://www.niassembly.gov.uk/assembly-business/research-and-information-service-raise/research-publications/ (accessed Jan 27, 2020).
- (41) Open Grey. System for Information on Grey Literature in Europe http://www.opengrey.eu/ (accessed Jan 27, 2020).
- (42) Fleeman, N.; Dundar, Y. Data Extraction: Where Do I Begin? In *Doing a systematic review: A student's guide*; Boland, A., Cherry, M. G., Dickson, R., Eds.; SAGE Publications: London, 2017; pp 93–106.
- (43) Saldaña, J. *The Coding Manual for Qualitative Researchers (2nd Ed.)*; 2013. https://doi.org/10.1017/CBO9781107415324.004.
- (44) Greenhalgh, J.; Brown, T. Quality Assessment: Where Do I Begin? In *Doing a systematic review: A student's guide*; Boland, A., Cherry, G. M., Dickson, R., Eds.; SAGE Publications: London, 2017; pp 107–130.
- (45) Himsworth, C. G.; Parsons, K. L.; Jardine, C.; Patrick, D. M. Rats, Cities, People, and Pathogens: A Systematic Review and Narrative Synthesis of Literature Regarding the Ecology of Rat-Associated Zoonoses in Urban Centers. *Vector-Borne Zoonotic Dis.* **2013**, *13* (6), 349–359. https://doi.org/10.1089/vbz.2012.1195.

References

- (46) Cassidy, A. Vermin, Victims and Disease: UK Framings of Badgers In and Beyond the Bovine TB Controversy. *Sociol. Ruralis* **2012**, *52* (2), 192–214. https://doi.org/10.1111/j.1467-9523.2012.00562.x.
- (47) Mupepele, A.; Walsh, J. C.; Sutherland, W. J. An Evidence Assessment Tool for Ecosystem Services and Conservation Studies In a Nutshell • Human ' s Life Depends on Nature , Biodiversity and Their Related Ecosystem. **2014**, *26* (5), 1295–1301. https://doi.org/http://dx.doi.org/10.1101/010140;
- (48) Buckle, A. P.; Endepols, S.; Prescott, C. V. Relationship between Resistance Factors and Treatment Efficacy When Bromadiolone Was Used against Anticoagulant-Resistant Norway Rats (Rattus Norvegicus Berk.) in Wales. *Int. J. Pest Manag.* **2007**, *53* (4), 291–297. https://doi.org/10.1080/09670870701469872.
- (49) DEFRA. *PV1015 Efficacy Evaluation the Relationship between Bait Palatability, Efficacy and Anticoagulant Resistance.Pdf*; 2002.
- (50) DEFRA. *PV1016 Development of a Guidelines on Best Practice for Rodenticide Use*; 2002.
- (51) Rowe, F. P.; Swinney, T. The Efficacy of Two Permanent Baiting Stations. *EPPO Bull.* **1988**, *18* (2), 229–135.
- (52) Brown, M. Rats in an Agricultural Landscape: Population Size, Movement and Control, University of Leicester, 2007. https://doi.org/10.1017/CBO9781107415324.004.
- (53) Bryce, R.; Oliver, M. K.; Davies, L.; Gray, H.; Urquhart, J.; Lambin, X. Turning Back the Tide of American Mink Invasion at an Unprecedented Scale through Community Participation and Adaptive Management. *Biol. Conserv.* **2011**, *144* (1), 575–583. https://doi.org/10.1016/j.biocon.2010.10.013.
- (54) Porteus, T.; Short, M.; Richardson, S.; Reynolds, J. Empirical Development of Strategy for the Control of Invasive American Mink by Trapping. *Eur. J. Wildl. Res.* **2012**, *58* (2), 403–413. https://doi.org/10.1007/s10344-011-0589-8.
- (55) Harrington, L. A.; Harrington, A. L.; Moorhouse, T.; Gelling, M.; Bonesi, L.; Macdonald, D. W. American Mink Control on Inland Rivers in Southern England: An Experimental Test of a Model Strategy. *Biol. Conserv.* **2009**, *142* (4), 839–849. https://doi.org/10.1016/j.biocon.2008.12.012.
- (56) Schuchert, P.; Shuttleworth, C. M.; McInnes, C. J.; Everest, D. J.; Rushton, S. P. Landscape Scale Impacts of Culling upon a European Grey Squirrel Population: Can Trapping Reduce Population Size and Decrease the Threat of Squirrelpox Virus Infection for the Native Red Squirrel? *Biol. Invasions* **2014**, *16* (11), 2381–2391. https://doi.org/10.1007/s10530-014-0671-8.
- (57) Moore, N. P.; Roy, S. S.; Helyar, A. Mink (Mustela Vison) Eradication to Protect Ground-Nesting Birds in the Western Isles, Scotland, United Kingdom. *New Zeal. J. Zool.* **2003**, *30* (4), 443–452. https://doi.org/10.1080/03014223.2003.9518351.
- (58) Reynolds, J. C.; Richardson, S. M.; Rodgers, B. J. E.; Rodgers, O. R. K. Effective Control of Non-Native American Mink by Strategic Trapping in a River Catchment in Mainland Britain. *J. Wildl. Manage.* **2013**, *77* (3), 545–554. https://doi.org/10.1002/jwmg.500.
- (59) Bodey, T. W.; McDonald, R. A.; Bearhop, S. Mesopredators Constrain a Top Predator: Competitive Release of Ravens after Culling Crows. *Biol. Lett.* **2009**, *5* (5), 617–620. https://doi.org/10.1098/rsbl.2009.0373.
- (60) Bodey, T. W.; Mcdonald, R. A.; Sheldon, R. D.; Bearhop, S. Absence of Effects of Predator Control on Nesting Success of Northern Lapwings Vanellus Vanellus: Implications for Conservation. *Ibis (Lond. 1859).* **2011**, *153* (3), 543–555. https://doi.org/10.1111/j.1474-919X.2011.01132.x.

References

- (61) Bodey, T. W.; Bearhop, S.; McDonald, R. A. Localised Control of an Introduced Predator: Creating Problems for the Future? *Biol. Invasions* **2011**, *13* (12), 2817–2828. https://doi.org/10.1007/s10530-011-9965-2.
- (62) Schuchert, P.; Shuttleworth, C. M.; McInnes, C. J.; Everest, D. J.; Rushton, S. P. Landscape Scale Impacts of Culling upon a European Grey Squirrel Population: Can Trapping Reduce Population Size and Decrease the Threat of Squirrelpox Virus Infection for the Native Red Squirrel? *Biol. Invasions* **2014**, *16* (11), 2381–2391. https://doi.org/10.1007/s10530-014-0671-8.
- (63) Shuttleworth, C. M.; Mill, A.; Van Der Waal, Z. A Preliminary Comparison of Magnum 116 Bodygrip Traps with a Live Capture Trap Design during the Control of Grey Squirrels (Sciurus Carolinensis). *Int. J. Pest Manag.* **2017**, *63* (4), 316–321. https://doi.org/10.1080/09670874.2016.1260182.
- (64) Fletcher, K.; Aebischer, N. J.; Baines, D.; Foster, R.; Hoodless, A. N. Changes in Breeding Success and Abundance of Ground-Nesting Moorland Birds in Relation to the Experimental Deployment of Legal Predator Control. *J. Appl. Ecol.* **2010**, *47* (2), 263–272. https://doi.org/10.1111/j.1365-2664.2010.01793.x.
- (65) DEFRA. *VC0217 Developing a Method for Blocking Rabbit Burrows*; 2003.
- (66) Patterson, I. J. The Control of Fox Movement by Electric Fencing. *Biol. Conserv.* **1977**, *11* (4), 267–278.
- (67) MAFF. *VC0221 Rabbit Behaviour and Population Dynamics at Fenced Hot-Spots*; 2001.
- (68) Poole, D. W.; McKillop, I. G.; Western, G.; Hancocks, P. J.; Packer, J. J. Effectiveness of an Electric Fence to Reduce Badger (Meles Meles) Damage to Field Crops. *Crop Prot.* **2002**, *21* (5), 409–417. https://doi.org/10.1016/S0261-2194(01)00123-5.
- (69) Malpas, L. R.; Kennerley, R. J.; Hirons, G. J. M.; Sheldon, R. D.; Ausden, M.; Gilbert, J. C.; Smart, J. The Use of Predator-Exclusion Fencing as a Management Tool Improves the Breeding Success of Waders on Lowland Wet Grassland. *J. Nat. Conserv.* **2013**, *21* (1), 37–47. https://doi.org/10.1016/j.jnc.2012.09.002.
- (70) Judge, J.; McDonald, R. A.; Walker, N.; Delahay, R. J. Effectiveness of Biosecurity Measures in Preventing Badger Visits to Farm Buildings. *PLoS One* **2011**, *6* (12), 15–17. https://doi.org/10.1371/journal.pone.0028941.
- (71) Tolhurst, B. A.; Ward, A. I.; Delahay, R. J.; MacMaster, A. M.; Roper, T. J. The Behavioural Responses of Badgers (Meles Meles) to Exclusion from Farm Buildings Using an Electric Fence. *Appl. Anim. Behav. Sci.* **2008**, *113* (1–3), 224–235. https://doi.org/10.1016/j.applanim.2007.11.006.
- (72) Poole, D. W.; McKillop, I. G. Comparison of the Effectiveness of Two Types of Electric Fences to Exclude Badgers. *Crop Prot.* **1999**, *18* (1), 61–66. https://doi.org/10.1016/S0261-2194(98)00099-4.
- (73) Atkinson, R. P. D.; Macdonald, D. W. Can Repellents Function as a Non-Lethal Means of Controlling Moles (Talpa Europaea)? *J. Appl. Ecol.* **1994**, *31* (4), 731–736. https://doi.org/10.2307/2404163.
- (74) DEFRA. *Defra 2006 Field Application of Repellents for Wildlife Management*; 2006.
- (75) DEFRA. VC0414 Development of Repellents against Vertebrate Pests with Special Reference to Rabbits, Badgers and Grey Squirrels. 2002.

References

- (76) Baker, S. E.; Johnson, P. J.; Slater, D.; Watkins, R. W.; Macdonald, D. W. Learned Food Aversion with and without an Odour Cue for Protecting Untreated Baits from Wild Mammal Foraging. *Appl. Anim. Behav. Sci.* **2007**, *102* (3–4), 410–428. https://doi.org/10.1016/j.applanim.2006.05.039.
- (77) Baker, S. E.; Ellwood, S. A.; Watkins, R. W.; MacDonald, D. W. A Dose-Response Trial with Ziram-Treated Maize and Free-Ranging European Badgers Meles Meles. *Appl. Anim. Behav. Sci.* **2005**, *93* (3–4), 309–321. https://doi.org/10.1016/j.applanim.2004.11.022.
- (78) DEFRA. *WM0402 Modifying Problem Behaviour of Free-Living Badgers Using Conditioned Taste Aversion*; 2005.
- (79) Baxter, A. T.; Allan, J. R. Use of Raptors to Reduce Scavenging Bird Numbers at Landfill Sites. *Wildl. Soc. Bull.* **2006**, *34* (4), 1162–1168. https://doi.org/10.2193/0091-7648(2006)34[1162:uortrs]2.0.co;2.
- (80) Boothby, C.; Redfern, C.; Schroeder, J. An Evaluation of Canes as a Management Technique to Reduce Predation by Gulls of Ground-Nesting Seabirds. *Ibis (Lond. 1859).* **2019**, *161* (2), 453–458. https://doi.org/10.1111/ibi.12702.
- (81) MAFF. *VC0218 Developing a Visual Scaring Device to Deter Rabbits MAFF*; 2001.
- (82) DEFRA. *WM0304 Development of a Strategy for Resolving Urban Badger Damage Problems*; 2007.
- (83) Graham, I. M.; Harris, R. N.; Denny, B.; Fowden, D.; Pullan, D. Testing the Effectiveness of an Acoustic Deterrent Device for Excluding Seals from Atlantic Salmon Rivers in Scotland. *ICES J. Mar. Sci.* **2009**, *66* (5), 860–864. https://doi.org/10.1093/icesjms/fsp111.
- (84) Vitali, C. A Frame-Analytical Perspective on Conflict between People and an Expanding Wolf Canis Lupus Population in Central Italy. *Oryx* **2014**, *48* (4), 575–583. https://doi.org/10.1017/S0030605313000276.
- (85) Runhaar, H.; Runhaar, M.; Vink, H. Reports on Badgers Meles Meles in Dutch Newspapers 1900-2013: Same Animals, Different Framings? *Mamm. Rev.* **2015**, *45* (3), 133–145. https://doi.org/10.1111/mam.12040.
- (86) Littin, K. E.; Connor, C. E. O.; Eason, C. T. Comparative Effects of Brodifacoum on Rats and Possums. *New Zeal. Plant Prot. Soc.* **2000**, *53*, 310–315.
- (87) Mason, G.; Littin, K. E. The Humaneness of Rodent Pest Control. *Animal Welfare*. Animal Welfare 2003, pp 1–37.
- (88) Smit, F. J. L. Ethics in Rodent Control. In *Rodent pests and their control*; Buckle, A. P., Smith, R. H., Eds.; CABI: Wallingford, 2015; pp 315–329.
- (89) Sevillano, V.; Fiske, S. T. Animals as Social Objects: Groups, Stereotypes, and Intergroup Threats. *Eur. Psychol.* **2016**, *21*, 206–217.
- (90) Jerolmack, C. How Pigeons Became Rats: The Cultural-Spatial Logic of Problem Animals. *Soc. Probl.* **2008**, *55* (1), 72–94. https://doi.org/10.1525/sp.2008.55.1.72.

References

- (91) Rantzen, E. Damn these tree rats! https://www.dailymail.co.uk/news/article-390805/Damn-tree-rats.html (accessed Feb 13, 2020).
- (92) DEFRA. *SE0419 Biology and Control of Mammalian Vectors of Rabies and Rabies-Related Lyssaviruse*; 2006.
- (93) Lute, M. L.; Attari, S. Z. Public Preferences for Species Conservation: Choosing between Lethal Control, Habitat Protection and No Action. *Environ. Conserv.* **2017**, *44* (2), 139–147. https://doi.org/10.1017/S037689291600045X.
- (94) Selge, S.; Fischer, A.; van der Wal, R. Public and Professional Views on Invasive Non-Native Species - A Qualitative Social Scientific Investigation. *Biol. Conserv.* **2011**, *144* (12), 3089–3097. https://doi.org/10.1016/j.biocon.2011.09.014.
- (95) Martin, A. R.; Lea, V. J. A Mink-Free GB: Perspectives on Eradicating American Mink Neovison Vison from Great Britain and Its Islands. *Mamm. Rev.* **2020**, *Early Acce*. https://doi.org/10.1111/mam.12178.
- (96) van Eeden, L. M.; Dickman, C. R.; Ritchie, E. G.; Newsome, T. M. Shifting Public Values and What They Mean for Increasing Democracy in Wildlife Management Decisions. *Biodivers. Conserv.* **2017**, *26* (11), 2759–2763. https://doi.org/10.1007/s10531-017-1378-9.
- (97) BOU. BOU ethical policy https://www.bou.org.uk/about-the-bou/ethical-policy/ (accessed Feb 13, 2020).
- (98) Springer. Submission guidelines https://www.springer.com/journal/10530/submission-guidelines#Instructions for Authors_Ethical Responsibilities of Authors (accessed Feb 13, 2020).
- (99) Lovegrove, R. Birds - Individual Species Accounts. In *Silent Fields*; Lovegrove, R., Ed.; Oxford, 2007; pp 100–185.
- (100) DEFRA. *Use of General Licences for the Management of Certain Wild Birds: Government Response to the Call for Evidence*; 2019.
- (101) Cassidy, A.; Mills, B. "Fox Tots Attack Shock": Urban Foxes, Mass Media and Boundary-Breaching. *Environ. Commun.* **2012**, *6* (4), 494–511.
- (102) Enticott, G. Public Attitudes to Badger Culling to Control Bovine Tuberculosis in Rural Wales. *Eur. J. Wildl. Res.* **2015**, *61* (3), 387–398. https://doi.org/10.1007/s10344-015-0905-9.
- (103) HMSO. *Pests Act 1954*; Statute Law Database, 1954.
- (104) Hill, D.; Player, A. Behavioural Responses of Black-Headed Gulls and Avocets to Two Methods of Control of Gull Productivity. *Bird Study* **1992**, *39* (1), 34–42. https://doi.org/10.1080/00063659209477097.
- (105) Batavia, C.; Nelson, M. P. For Goodness Sake! What Is Intrinsic Value and Why Should We Care? *Biological Conservation*. May 2017, pp 366–376. https://doi.org/10.1016/j.biocon.2017.03.003.

References

- (106) Naylor, J. R. J.; Knott, J. G. A Pack of Dogs Is More Effective at Flushing Red Foxes to Guns than a Pair. *Wildl. Soc. Bull.* **2018**, *42* (2), 338–346. https://doi.org/10.1002/wsb.876.
- (107) Murton, R. K.; Westwood, N. J.; Isaacson, A. J. A Study of Wood-Pigeon Shooting: The Exploitation of a Natural Animal Population. *J. Appl. Ecol.* **1974**, *11* (1), 61–81. https://doi.org/10.2307/2402005.
- (108) Ross, J. Comparison of Fumigant Gases Used for Rabbit Control in Great Britain. In *Proceedings of the Twelfth Vertebrate Pest Conference (U.S.A)*; 1986; pp 153–157.
- (109) DEFRA. Efficacy of CO as a Rabbit Fumigant. 2002.
- (110) Holmes, M. William T. Stearn Prize 2014: The Perfect Pest: Natural History and the Red Squirrel in Nineteenth-Century Scotland. *Arch. Nat. Hist.* **2015**, *42* (1), 113–125. https://doi.org/10.3366/anh.2015.0284.
- (111) Russell, J. C.; Blackburn, T. M. Invasive Alien Species: Denialism, Disagreement, Definitions, and Dialogue. *Trends Ecol. Evol.* **2017**, *32* (5), 312–314. https://doi.org/10.1016/J.TREE.2017.02.005.
- (112) Larson, B. M. H. Thirteen Ways of Looking at Invasive Species. In *Invasive plants: Inventories, strategies and action*; Clements, D. R., Darbyshire, S. J., Eds.; 2007; pp 131–152.
- (113) Tassin, J.; Thompson, K.; Carroll, S. P.; Thomas, C. D. Determining Whether the Impacts of Introduced Species Are Negative Cannot Be Based Solely on Science: A Response to Russell and Blackburn. *Trends in Ecology and Evolution*. Elsevier Current Trends April 1, 2017, pp 230–231. https://doi.org/10.1016/j.tree.2017.02.001.
- (114) Pesticide Safety Division. *Assessment of the Humaneness of Vertebrate Pest Control Agents*; 1997.
- (115) Buck, V. Who Will Start the 3Rs Ball Rolling for Animal Welfare ? Why Do so Few Women Speak at Science Meetings ? *Nature* **2007**, *446*, 2007.
- (116) Osborne, N. J.; Payne, D.; Newman, M. L. Journal Editorial Policies, Animal Welfare, and the 3Rs. *Am. J. Bioeth.* **2009**, *9* (12), 55–59. https://doi.org/10.1080/15265160903318343.
- (117) Grandin, T. Auditing Animal Welfare at Slaughter Plants. *MESC* **2010**, *86*, 56–65. https://doi.org/10.1016/j.meatsci.2010.04.022.
- (118) Thayer, K. A.; Wolfe, M. S.; Rooney, A. A.; Boyles, A. L.; Bucher, J. R.; Birnbaum, L. S. Intersection of Systematic Review Methodology with the NIH Reproducibility Initiative. *Environ. Health Perspect.* **2014**, *122* (7), 176–177. https://doi.org/10.1289/ehp.1408671.
- (119) Dickson, R.; Cherry, M. G.; Boland, A. Carrying out a Systematic Review as a Master's Thesis. In *Doing a systematic review: A student's guide*; Boland, A., Cherry, M. G., Dickson, R., Eds.; SAGE Publications: London, 2017; pp 2–19.
- (120) Dundar, Y.; Fleeman, N. Developing My Search Strategy. In *Doing a systematic review: A student's guide*; Boland, A., Cherry, M. G., Dickson, R., Eds.; SAGE Publications: London, 2017; pp 21–42.
- (121) Rao, S. J.; Iason, G. R.; Hulbert, I. A. R.; Elston, D. A.; Racey, P. A. The Effect of Sapling Density, Heather Height and Season on Browsing by Mountain Hares on Birch. *J. Appl. Ecol.* **2003**, *40* (4), 626–638. https://doi.org/10.1046/j.1365-2664.2003.00838.x.
- (122) Boag, B. Reduction in Numbers of the Wild Rabbit (Oryctolagus Cuniculus) Due to Changes in Agricultural Practices and Land Use. *Crop Protection*. 1987, pp 347–351. https://doi.org/10.1016/0261-2194(87)90066-4.
- (123) DEFRA. *Development of a Decision Support System for Ecologically Sound Rabbit*; 2004.
- (124) DEFRA. *WM0408 Towards Practical Application of Emerging Fertility Control Technologies for Wildlife Management*; 2011.