The welfare and ethics of research involving wild animals: A primer

Prof. Carl Soulsbury

UNIVERSITY OF LINCOLN











Animal welfare: where does it come from?

- Animal experimentation laws (1876) – “pain”
- Animal cruelty laws ~ early 1900s, owner focused
- In UK – Animal (Scientific Procedures) Act 1986 landmark for animal experimentation – based on EU directive – updates 2010







- Annually, about <1% of animals are used in procedures outside the lab

What about wild animal welfare?

- Wild animals are caught between two worlds – utilitarian (wildlife management, recreation, exploitation)









- Scientific research on wild animals poorly covered by legislation

Wild animal research

- Most research on wild animals is sub-threshold, i.e. may operate below the legal definition of a procedure
- In fact, the number of animals that are part of wild animal “research” is equal to or greater than lab animals





“*I’m just setting some traps for mice. I don’t need ethical approval for that as it is not an experiment*.”





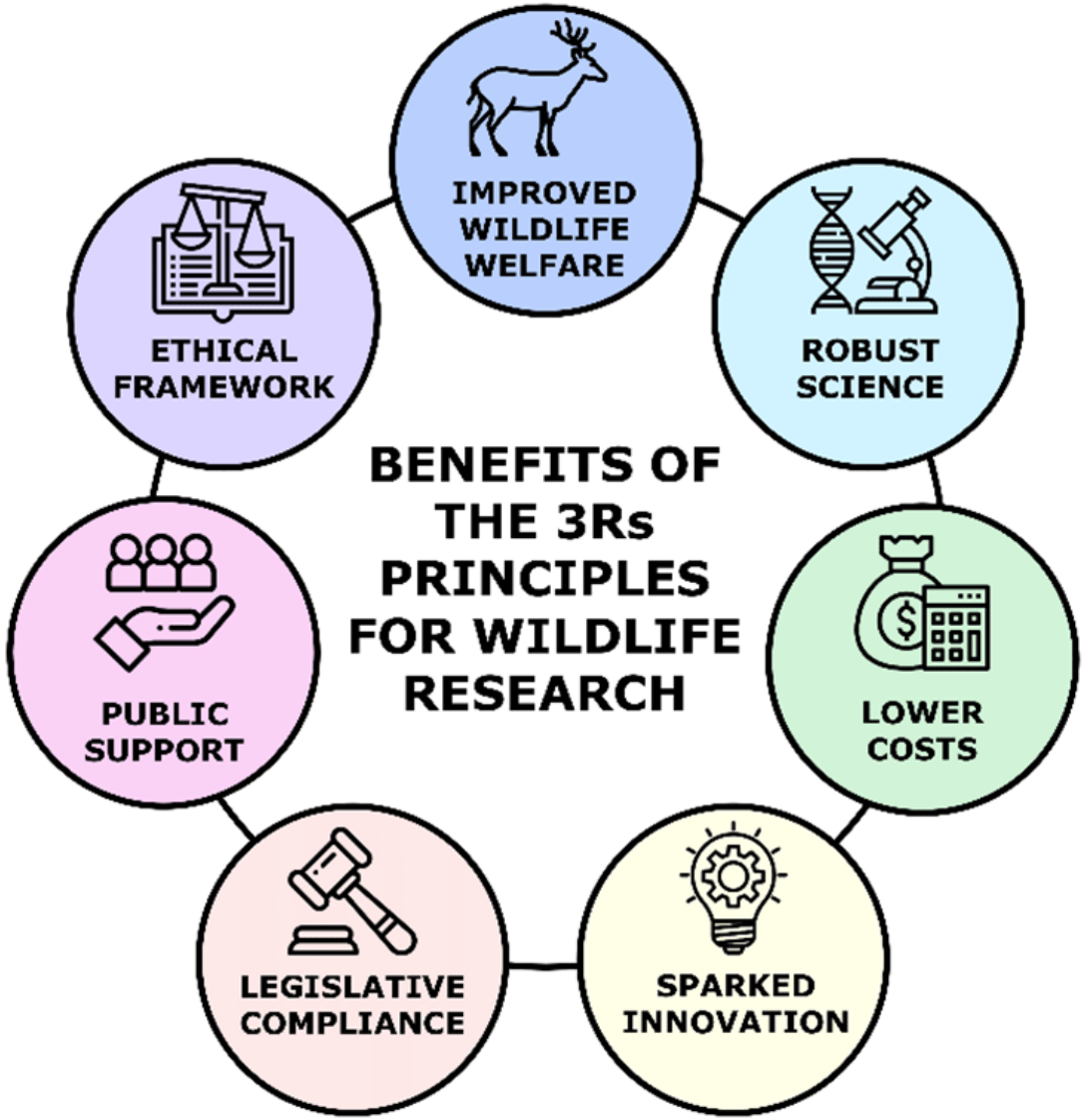
“*At my old place, I didn’t need to apply for ethics. I’m not collecting the samples, they are given to me.”*

“*We complied with all the regulations in the country we were working. They didn’t have a problem with it”*



Wild animal welfare: why does it matter?

- Study outcomes: interventions will change our results
- Animal's outside of human control, difficult to monitor or respond to problems
- Wild animal welfare is public-facing, strong public support



The 3Rs

	Basic	Updated
Replacement	Avoiding or replacing the use of animals in areas where they otherwise would have been used.	Accelerating the development and use of predictive and robust models and tools, based on the latest science and technologies, to replace the use of animals in addressing important research questions.
Reduction	Minimising the number of animals used consistent with scientific aims.	Appropriately designed and analysed animal experiments that are robust and reproducible, and add to the knowledge base.
Refinement	Minimising the pain, suffering, distress or lasting harm that research animals might experience.	Advancing laboratory animal welfare by exploiting the latest *in vivo* technologies to minimise pain, suffering and distress and improving understanding of the impact of welfare on scientific outcomes.

Replacement

- **Replacement**: The 3Rs principles promote the use of the lowest sentient forms where possible. In biomedical research, the typical targets are to move towards more *in vitro* and *in silico* research.
- In wild animal research, Replacement is often not possible as the study focus is often at the level of individual animals, and their interactions within the wider ecosystem. There are scenarios where a species considered less sentient or less protected could be used to test hypotheses.
- Existing data – large datasets already collected. AI, simulations…..

Reduction

Reduction: A key aim of the 3Rs is to minimize the number of animals used. It is challenging to translate Reduction into practice in wild animal research for several reasons:

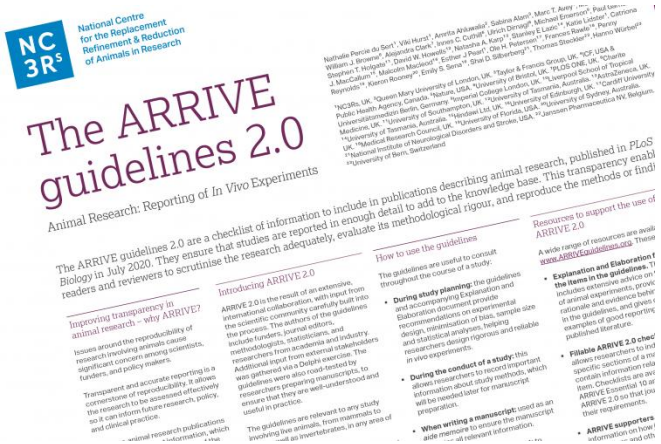
(a) **genetic variation** is generally greater in wild animals, meaning they respond more heterogeneously to a given set of conditions. This increased variation often necessitates larger sample sizes than captive populations;

(b) the **environmental variation** of animals is considerably greater than in controlled laboratory conditions, meaning larger sample sizes are required;

(c) in wild-based studies, **animals will be lost** due to natural mortality or other random events.

Reduction in practice

1) Do not start if you cannot achieve at meaningful sample size
2) Set a maximum sample size – consider meaningful effect sizes (pilot or previous studies are vital)
3) Build in loss and contingency for unexpected events



The ARRIVE guidelines 2.0

Animal Research: Reporting of *In Vivo* Experiments

Maximise the information gathered per animal to reduce the use of additional animals – **but balance with harm.**

STRANGE guidance

- **S**ocial background; **T**rappability and self-selection; **R**earing history; **A**cclimation and habituation; **N**atural changes in responsiveness; **G**enetic make-up; and **E**xperience
- STRANGE-related biases can affect both laboratory and field studies

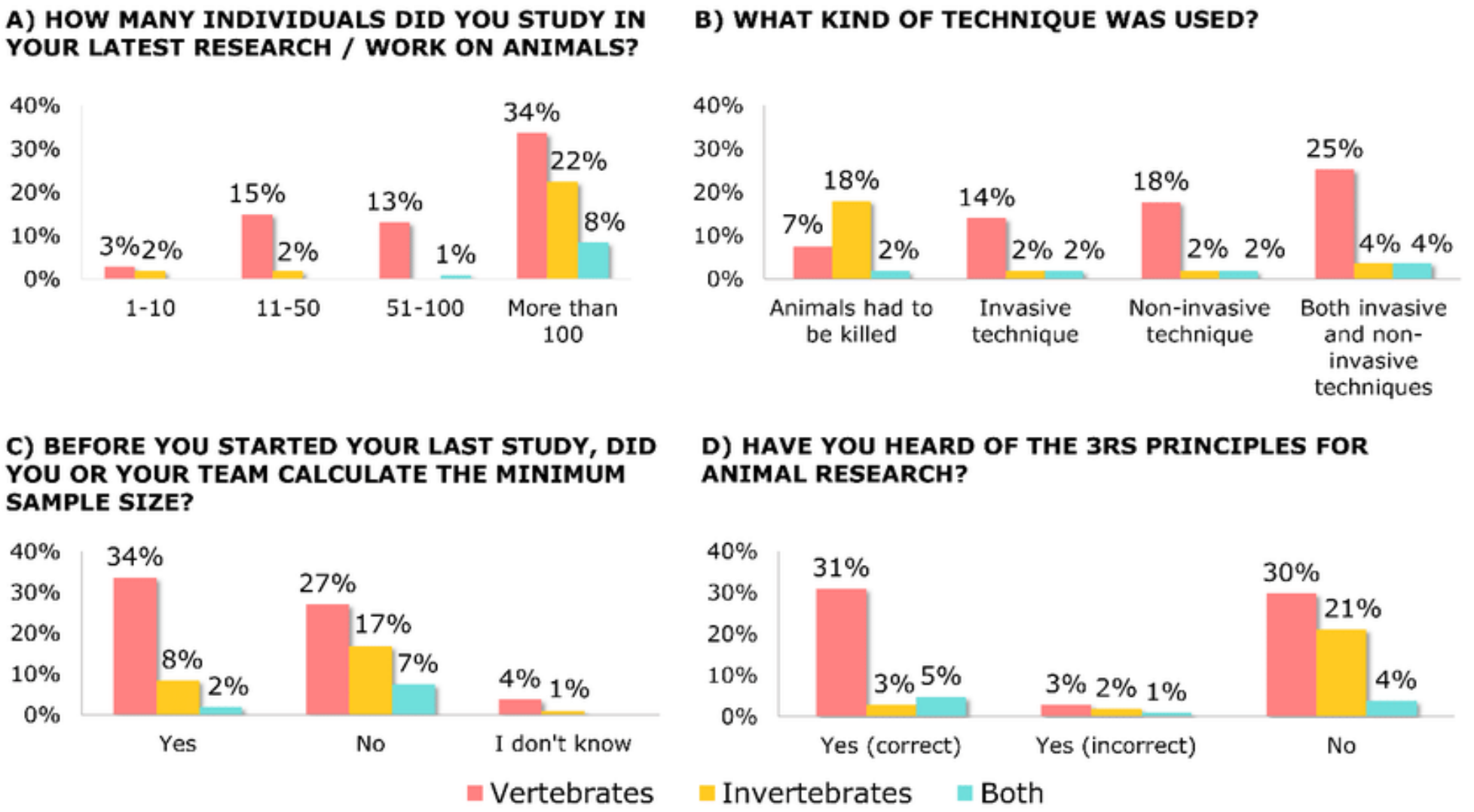
"We encourage animal-behaviour researchers to routinely ask how unusual their samples are."

Webster, M.M. & Rutz, C., 2020. *Nature*, *582*, 337-340.

Refinement

Refinement: A greater diversity of “non-invasive” methods has been devised in wild studies, compared to laboratory-based studies.

- One driver of this is the need to return animals to the wild as quickly as possible or because techniques may harm the species or population.
- The increase rise of “non-invasive" methods has been massively driven by wild animal research.
- Must remember, that non-invasive does not equal no impact
- Better use of new techniques even with “invasive sampling” e.g. microblood sampling



Zemanova 2021. *European Journal of Ecology*, 7.2, 18-39

Acceptable limits

- Acceptable limits of harm are often based arbitrarily
- Guidance of size/mass of transmitters
- Attachment – unexpected impacts

Watts et a. 2008. *Wader Study Group Bulletin*, *115*: 119-120. = 2.6%



Kelling et al. 2024 *Movement Ecology*, *12*: 38 = 14%

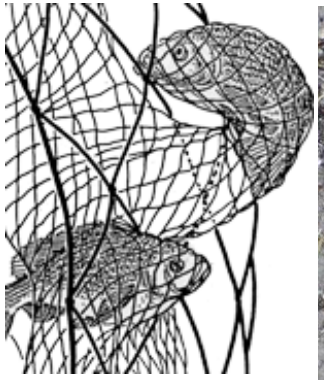


Brooks et al. 2008. *Journal of Wildlife Management*, *72*, 527-534.



Acceptable limits

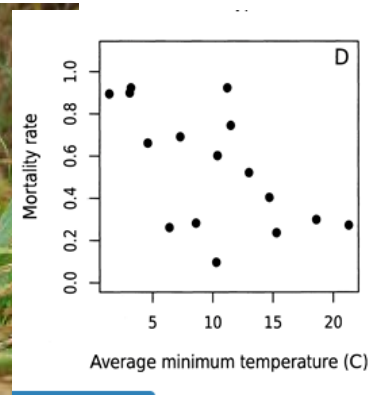
- There is a generally accepted threshold that methods of capture should cause <10% minor injuries and <2% mortality from total capture.
- Includes target and non-target species











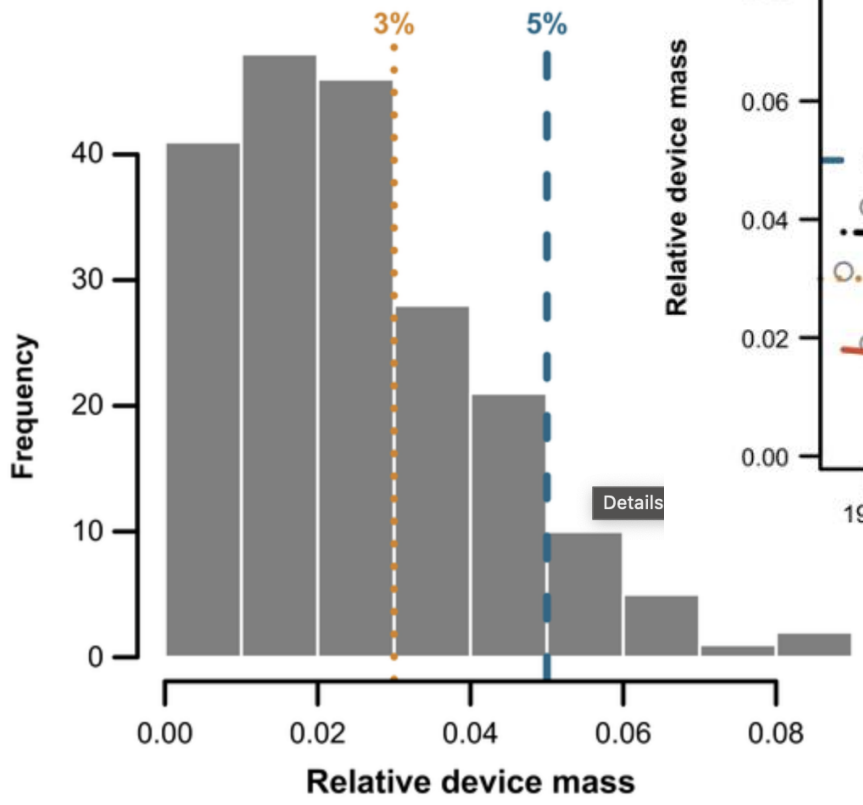
10-70% mortality

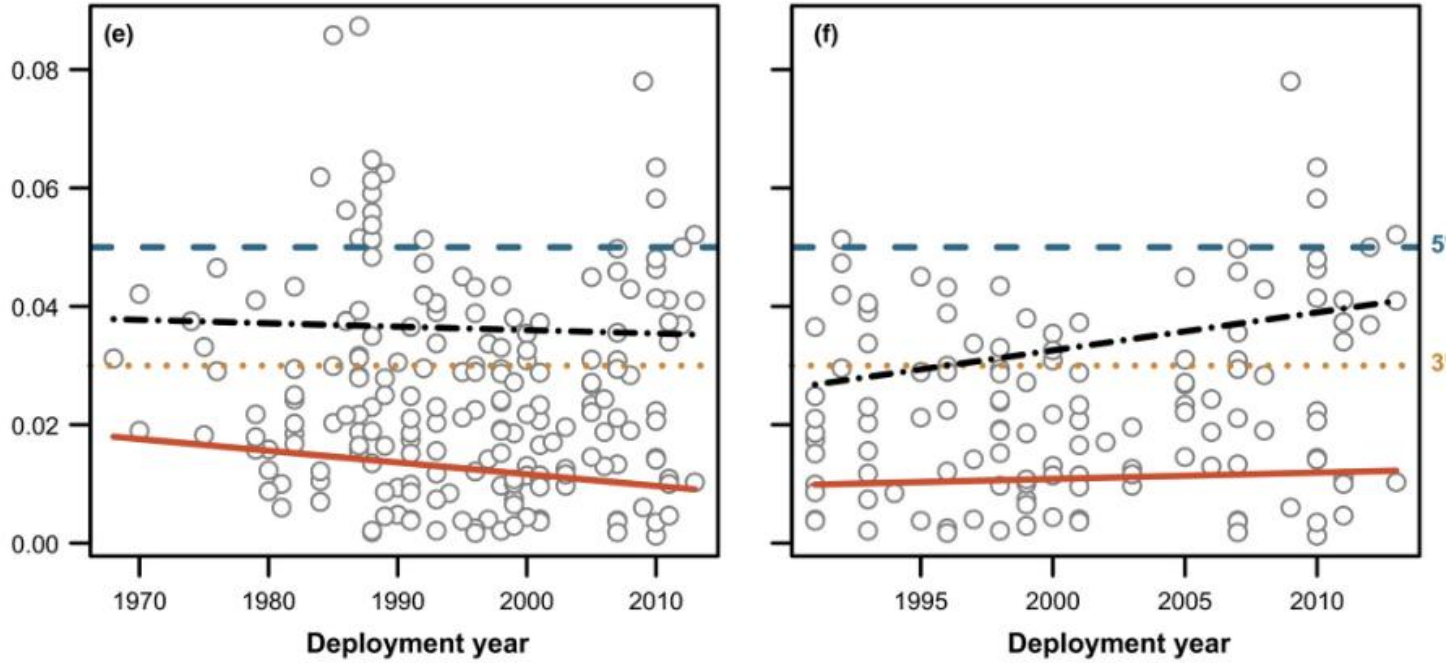
20% injury rates

<1% to 10% mortality (up to 80% in cold weather for some species)

- <u>What about dependent young?</u>

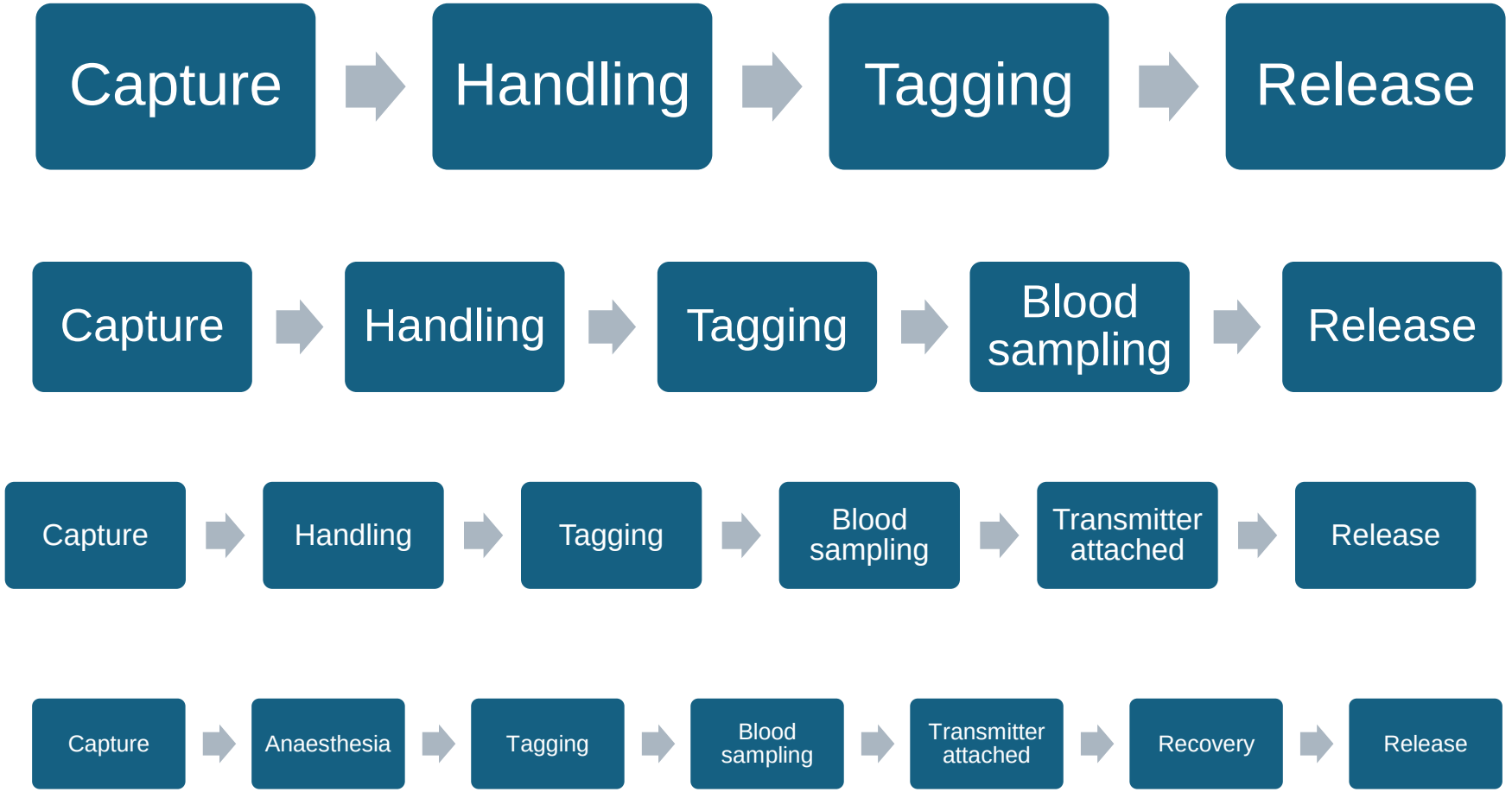
Choice of methodology: are we changing?





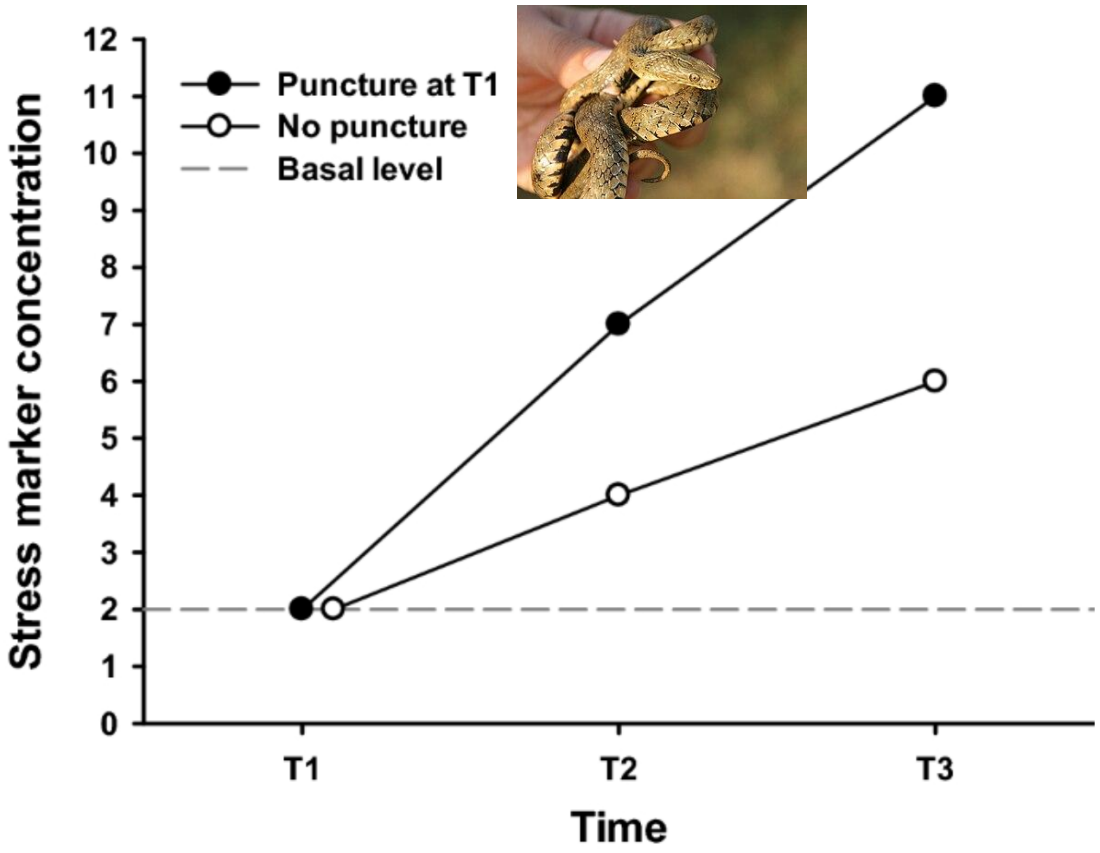


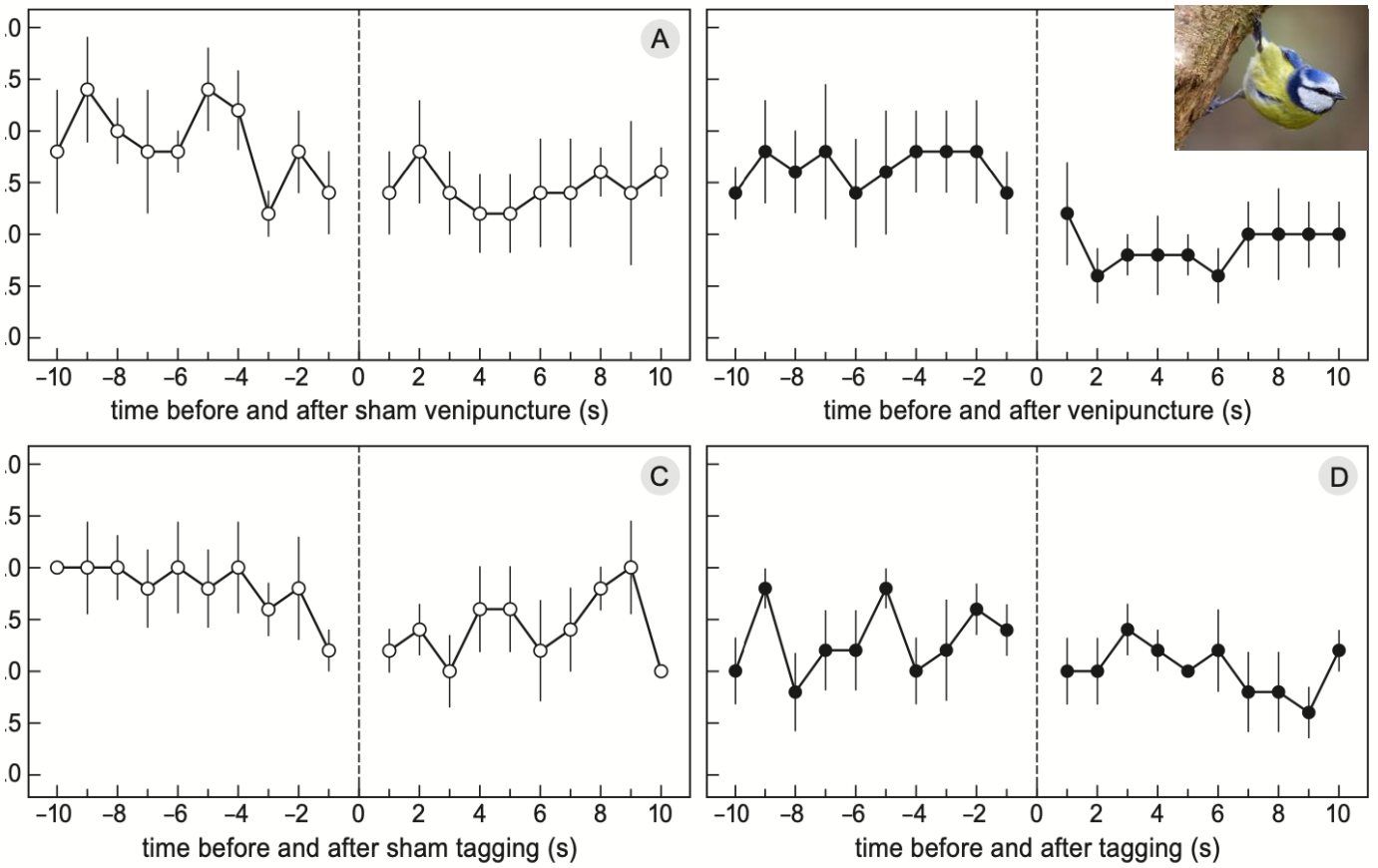
Cumulative affect



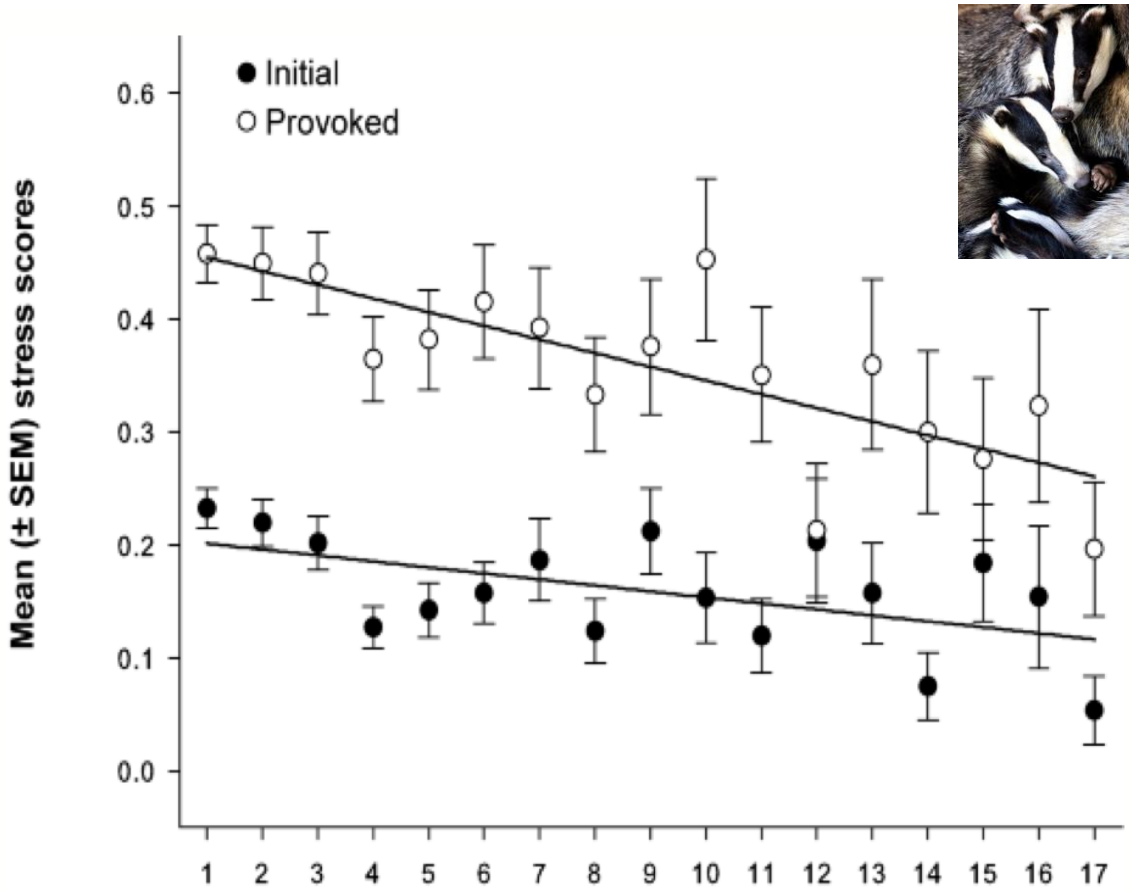
Cumulative effects (within event)

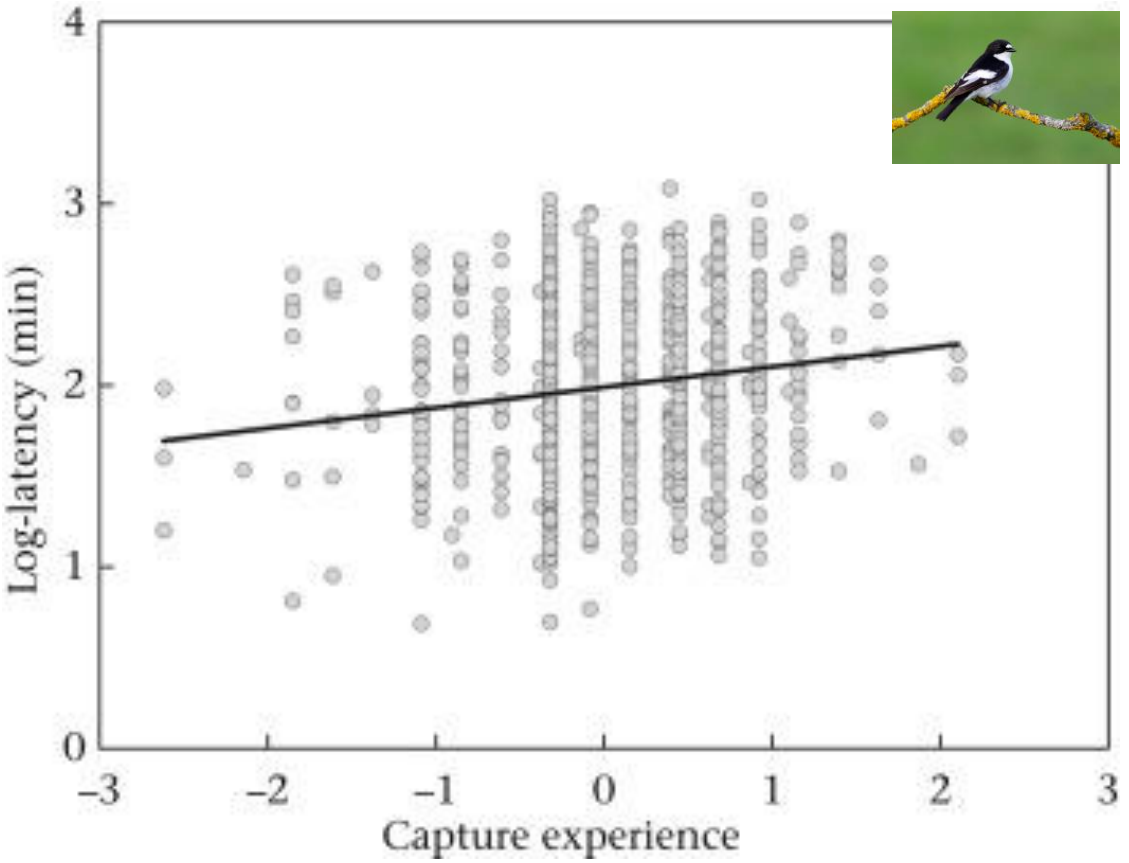
- The more you do and the longer you take, the bigger the impacts





Cumulative effects (many events)





Sun et al. 2015. *Animal Welfare*, *24*, 373-385.

Camacho et al. 2017 *Animal Behaviour*, *130*, 133-139.

Bird ringing

EURING
The European Union for Bird Ringing

- 4 million birds ringed annually – most by citizen scientists
- >6500 colour ringing projects
- Monitoring of welfare– scientific activity carried out by non-scientists
- Licensed, but self-regulation – license removal for illegal activities (using live birds as bait) or poor behaviour (leaving birds in harm). Some ringing groups collect no biometric data
- Data recording

Effects of capture, marking, and tracking on the welfare of wild birds

Katrine Eldegard, Marianne W. Furnes, Matthew J. Grainger, Børge Moe, Brett K. Sandercock, Geir A. Sonerud, Bjørnar Ytrehus, Eli Rueness, Amin Sayyari, Lawrence Kirkendal, Erik Granquist, Kyrre Kausrud

The alternatives: non-invasive work

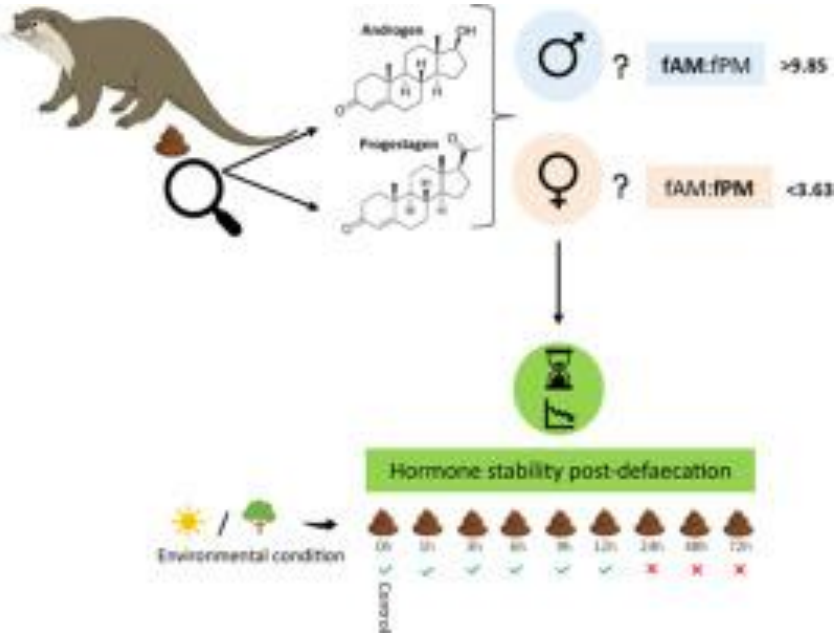
"many new methods are emerging that collect data without ***needing to disturb animals****."*

- The rise of non-invasive techniques including camera trapping, collecting of data from hair, footprints and faeces, eDNA……..

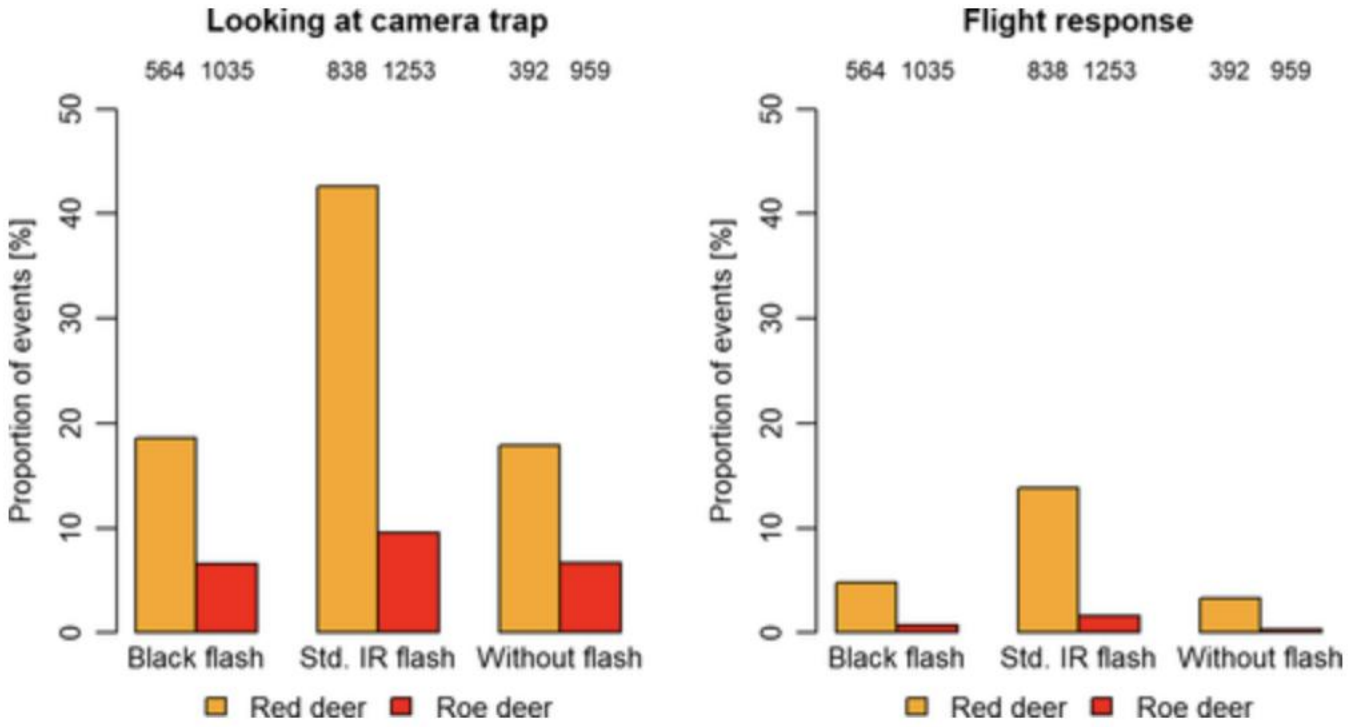


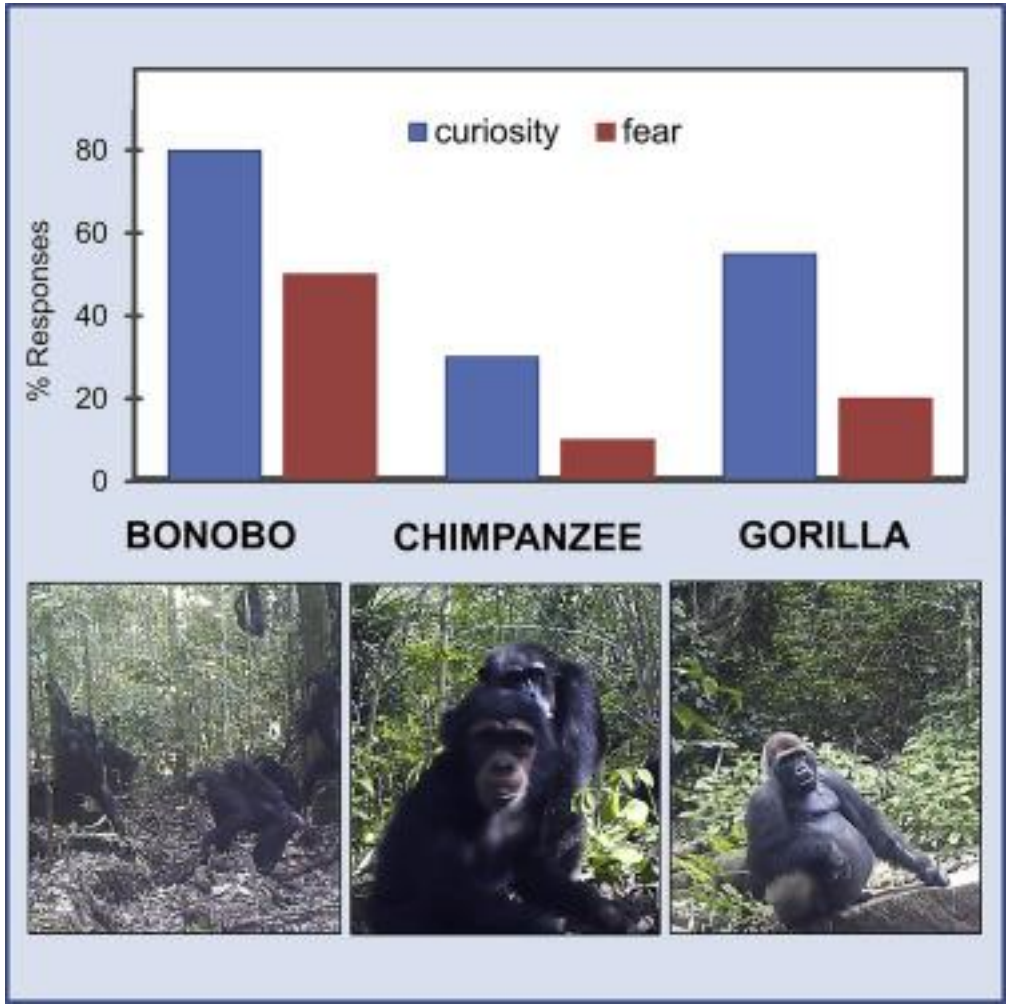






“Non-invasive” methods

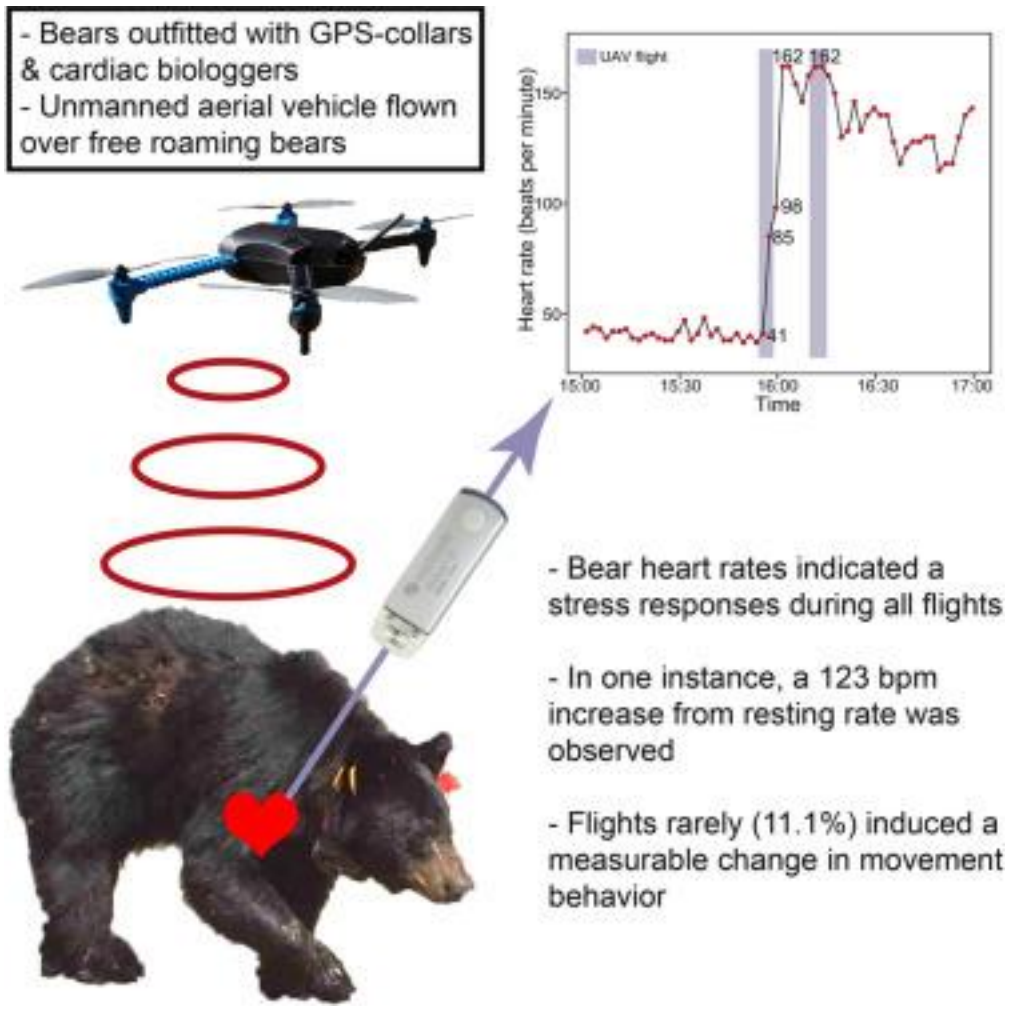




Reactive behaviours are common to remote devices – addition of food/feeding sites change behaviour

Placing devices cause disturbance – cameras are novel objects.

“Noninvasive” methods



- The majority of drone-based studies looked at behavioural responses to disturbance
- Yet, the bear study showed limited behavioural response
- Altitude, drone design, flight pattern, species……
- **Non-invasive – assumed not impacts. Studies have not tested.**

When something goes wrong

- Animal is in poor health
- Animal in injured/unwell during capture
- The bigger your N, the increased likelihood something goes wrong
- Do not forget the emotional impact on researchers





Table 1. Selected published studies reporting the frequency of adverse animal welfare events from operational activities (not research trials).

Animal species	Operational activity	Adverse event type	Number of adverse events	*n* (sample size)	Source
Domestic horse (*Equus caballus*)	Racing	Injury	2,358	222,993	[15]
Badger (*Meles meles*)	Trapping	Injury	3,015	18,596	[38]
Domestic cattle (*Bos taurus*)	Dairy calf transport	Weak or recumbent animals	27	7,169	[39]
White-tailed deer (*Odocoileus virginianus*)	Helicopter net gunning	Injury	281	3,350	[40]
Impala (*Aepyceros melampus*)	Night shooting	Non-immediate insensibility	54	856	[41]
Caribou (*Rangifer tarandus*)	Helicopter darting	Mortality	12	296	[42]
New Zealand fur seal (*Arctocephalus forsteri*)	Ground darting	Escape	16	120	[17]
White-tailed deer (*Odocoileus virginianus*)	Ground darting	Escape	11	23	[43]
Vicuña (*Vicugna vicugna*)	Mustering and transport	Laceration injury	2	19	[44]
Wild horse (*Equus caballus*)	Helicopter darting	Hyperthermia	2	11	[28]
Domestic chicken (*Gallus gallus domesticus*)	Captive bolt	Non-immediate insensibility	0	10	[45]
Green sea turtle (*Chelonia mydas*)	Euthanasia	Non-immediate insensibility	0	2	[46]

Animal species, point estimates of frequency, sample sizes and citations are listed. Studies are listed in descending order of sample size.

https://doi.org/10.1371/journal.pone.0211417.t002

When something goes wrong

- Mitigation (3Ps) – prepare, practice, predict
- Contingency – know where to get help
- Training – not just about practical skills, decision-making is a skill
- Reflect – Stop. Debrief and discuss. Be open. Change.

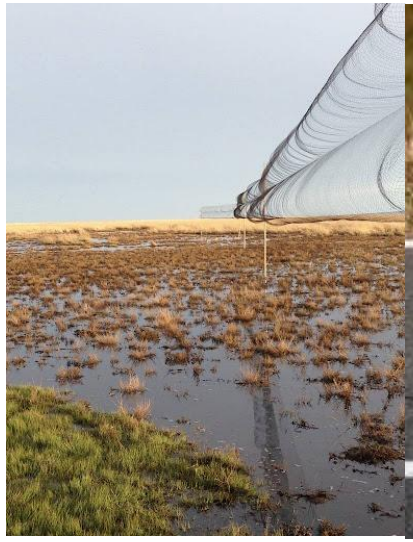




TABLE 5 Detailed description of eight capture-related mortalities reported from a total of 565 capture events of free-ranging mountain lions (*Puma concolor*) in California, USA, between 2001 and 2019. The year, estimated animal age, sex, capture method, drug combination, capture number and description of the event are shown.

Year	Estimated age (yrs.)	Sex	Method	Immobilization drug	Event
2001	3	Male	Hounds	TZ	Drowned after being darted and trying to escape
2002	0.5	Male	Hounds	TZ	Hyperthermia
2005	8	Male	Hounds	TZ	Drowned after being darted and trying to escape
2005	1.2	Male	Cage trap	TZ	Asphyxiated with the collar while still inside cage
2011	4	Female	Hounds	TZ	Drowned after being darted and trying to escape
2011	8	Male	Hounds	TZ	Drowned after being processed and waking up from anesthesia
2011	12	Female	Cable restraint	TZ	Capture related mortality, no details recorded but broke teeth in cable restraint
2018	6	Female	Hounds	TZ	Fell from tree after being immobilized and broke its spine

Welfare of non-target animals (and young)

- Welfare must consider any non-target species. Negative outcomes are not limited to focal species

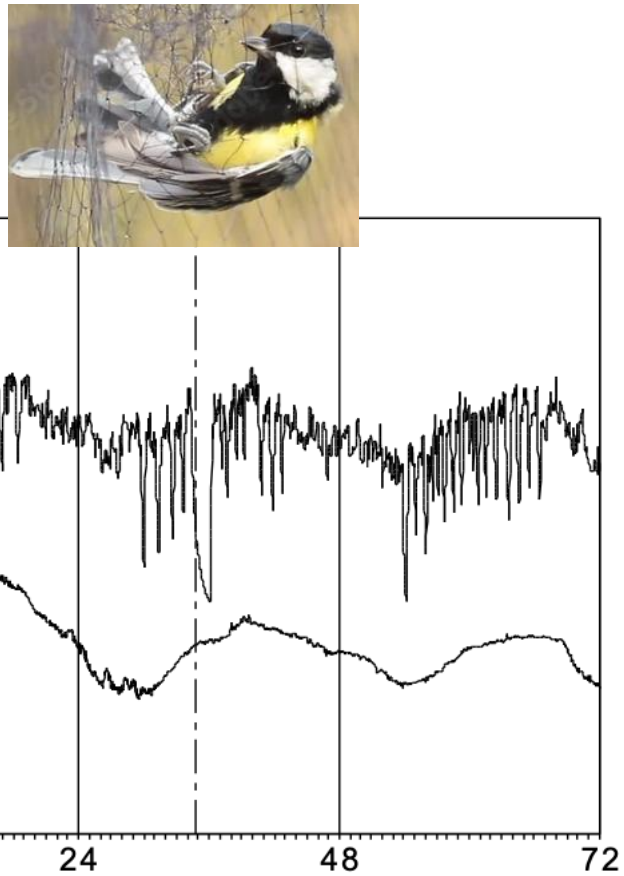
Restraining traps						
Box trap	*Felis silvestris, Lynx lynx*	*Meles meles, Ursus arctos*	64%	0%	0%	Potočnik *et al* 2002
Box trap	*Canis familiaris*	*Corvus brachyrhynchos, Felis catus, Procyon lotor, Mephitis mephitis*	93%	-	-	Way *et al* 2002
Box trap	*Martes pennanti*	*Martes americana, Gulo gulo, Vulpes vulpes*	94%	1%	-	Weir 1997
Leg-hold snare	*Panthera leo*	*Hyaena hyaena, Crocuta crocuta, Acinonyx jubatus*	32%	0%	17%	Frank *et al* 2003
Leg-hold snare	*Puma concolor*	*Odocoileus hemionus, Canis latrans, Bos taurus*	45%	17%	-	Logan *et al* 1999
Neck snare	*Vulpes vulpes*	*Canis familiaris, Felis catus, F. sylvestris, Meles meles, Martes martes, Lutra lutra, Lepus europaeus*	46%	-	-	Chadwick *et al* 1997

Welfare of non-target animals (and young)

1.

- The effect on dependent young is not taken into consideration with this assessment only the impact on the target animal. There is no practical way of addressing the problem of dependent young being left in burrows

The direct impact on offspring or dependent young are rarely considered



Working abroad and “outside” projects

“We complied with all the regulations in the country we were working. They didn’t have a problem with it”

- Legal versus moral framework
- Ethical considerations must not be overridden by weaker legal standards. “Appropriate permits for…..were provided”
- Working abroad is not an excuse to lower ethical standard

Outcry as UK scientist flies to Africa for experiments on monkeys that are banned here

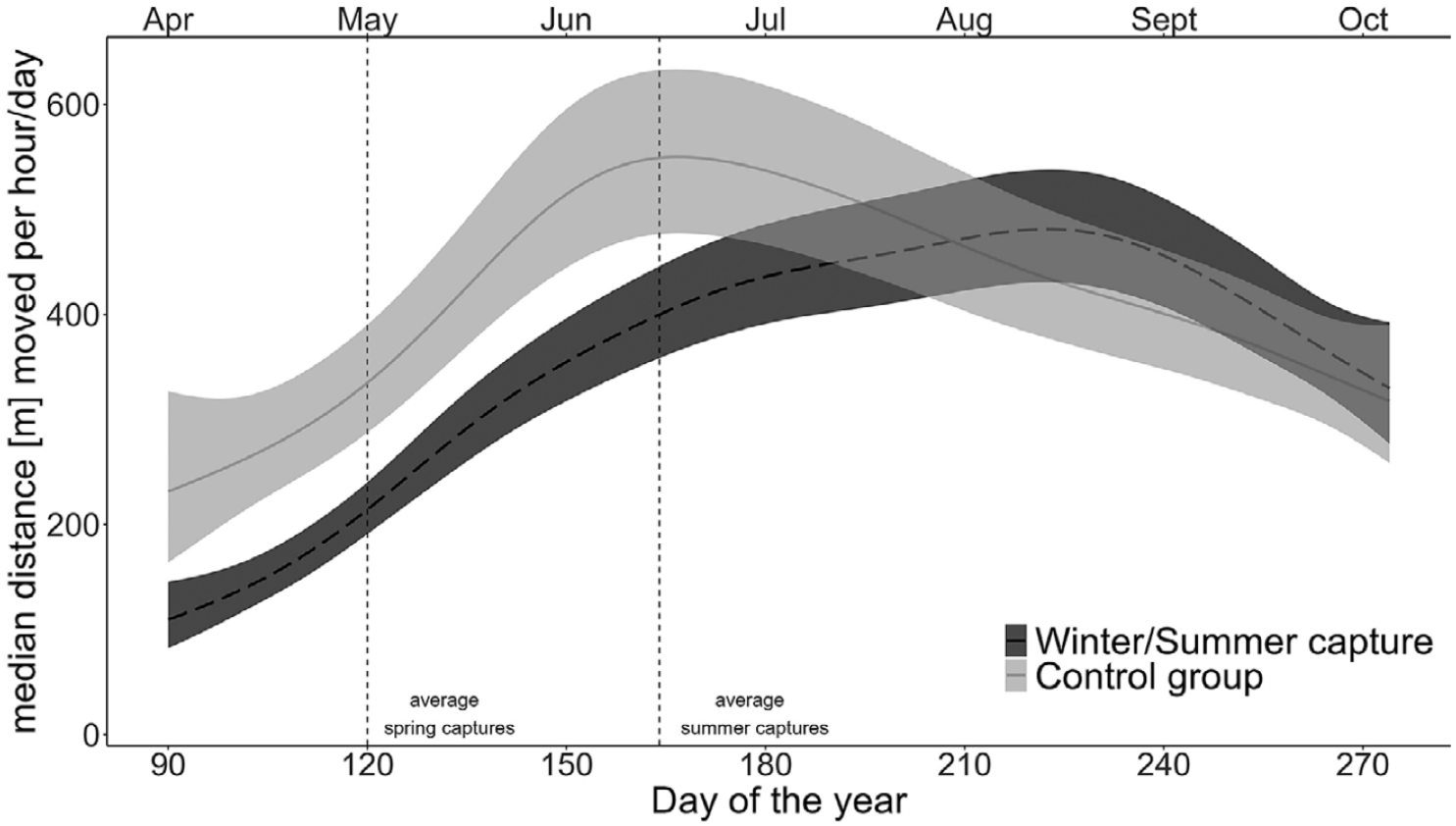
Wild animal welfare: how do we measure it

- Depends on your species
- Depends on what you can measure – measure something (>1), report it

1. Fitness metrics – survival, offspring production, offspring survival
2. Physical – changes to condition or health
3. Stress measures – hormonal/physiological
4. Behavioural – changes to movement, activity, responsiveness

Measuring welfare



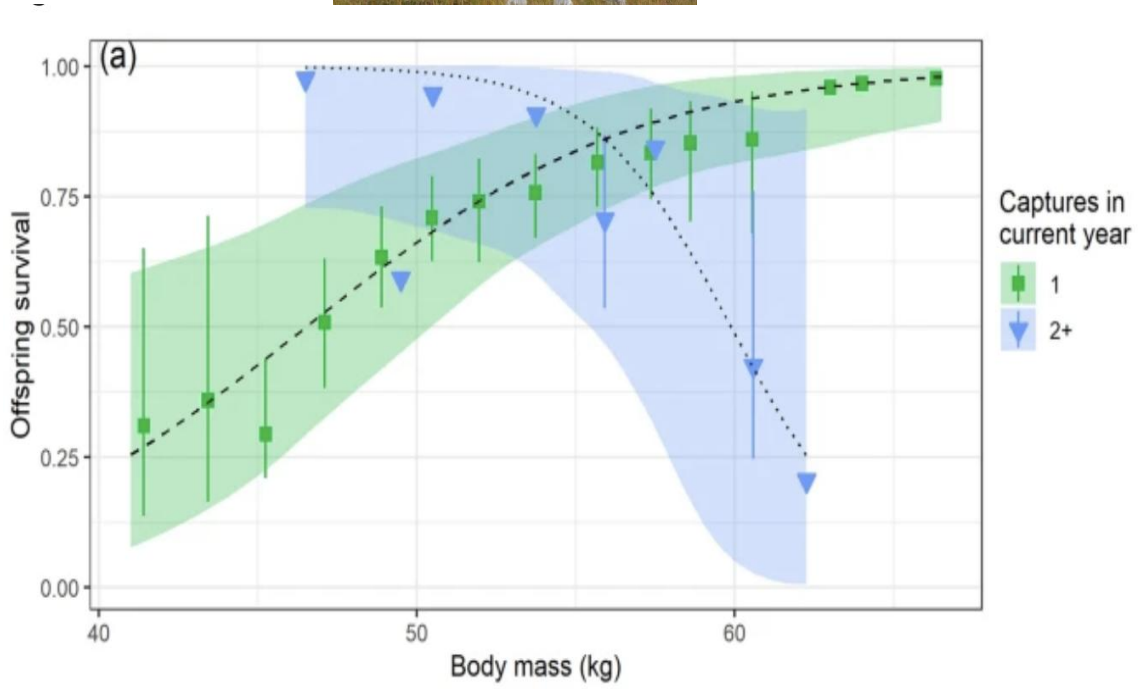


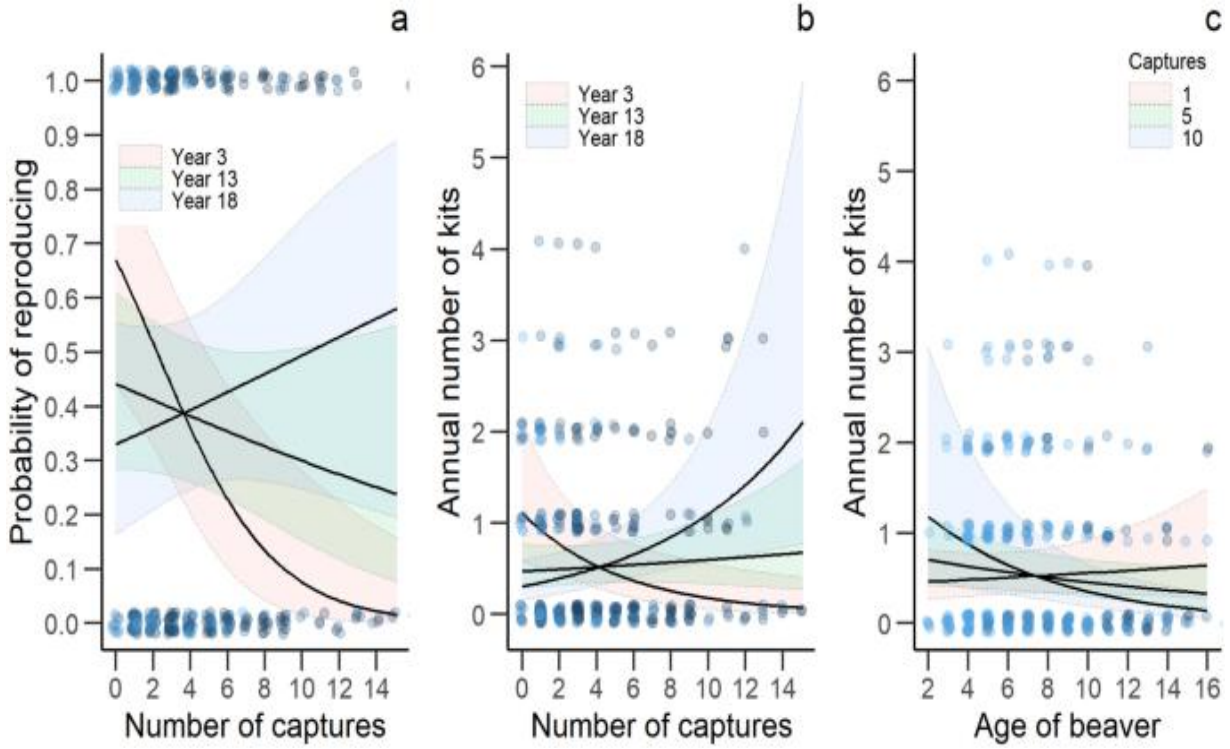
Thiel et al. 2023 *Animal Welfare*, *32*, e75.

Fitness metrics









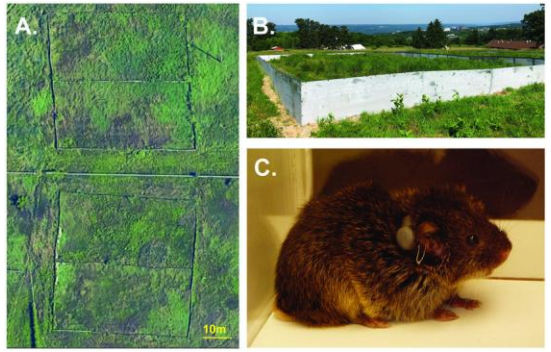
Trondrud et al. 2022. *Scientific Reports*, *12*, 16289.

Mortensen & Rosell, 2020. *Scientific Reports 10*, 17886

Wild animal ethics (hiding the truth)



Authors conducted a “removal experiment” – shotgun removal of 60 birds
Complied with all legislation and authors defended the decision robustly



Authors used snap traps to “remove last few voles” – not in methods
Complied with all legislations, alerted by a reviewer

Sillett, T.S., Rodenhouse, N.L. and Holmes, R.T., 2004. Experimentally reducing neighbor density affects reproduction and behavior of a migratory songbird. *Ecology*, *85*(9), pp.2467-2477.

Our responsibility

1) We should be better at reporting and building welfare outcomes into study designs
2) We need to consider the 3Rs more in our study design – remember our actions have consequences
3) Innovate the development of new research tools and new ways to measure welfare in the wild
4) Challenge accepted techniques and methods – including non-invasive techniques

Wild animal welfare: funding

- Wild animal welfare is poorly supported – unlikely to produce high impact publications
- Poorly supported by funding sources
- Out-of-sight out-of-mind attitude by many researchers

Wild Animal Initiative

Where do I go for more information?

- NC3Rs: https://nc3rs.org.uk/3rs-resources/wildlife-research
- Journal: *Methods in Ecology and Evolution* (papers on wild animal welfare, techniques, metanalyses, biologging, transmitters)
- Your local experts and colleagues around the world

