

# **On the need for rigorous welfare and methodological reporting for the live capture of large carnivores: A response to de Araujo et al.**

Anthony Caravaggi, Talita F. Amado, Ryan K. Brook, Simone Ciuti, Chris T. Darimont, Marine Drouilly, Holly M. English, Kate A. Field, Graziella Iossa, Jessica E. Martin, Alan G. McElligott, Alireza Mohammadi, Danial Nayeri, Helen M. K. O'Neill, Paul C. Paquet, Stéphanie Périquet, Gilbert Proulx, Daniella Rabaiotti, Mariano R. Recio, Carl D. Soulsbury, Tamara Tadich & Rae Wynn-Grant

2021

Faculty of Social Sciences

Faculty Publications

© 2021 Caravaggi et al. This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 License: <https://creativecommons.org/licenses/by-nc-nd/4.0/>

Original citation:

Caravaggi, A., Amado, T. F., Brook, R. K., Ciuti, S., Darimont, C. T., Drouilly, M., English, H. M., Field, K. A., Iossa, G., Martin, J. E., McElligott, A. G., Mohammadi, A., Nayeri, D., O'Neill, H. M. K., Paquet, P. C., Périquet, S., Proulx, G., Rabaiotti, D., Recio, M. R., . . . Wynn-Grant, R. (2021). On the need for rigorous welfare and methodological reporting for the live capture of large carnivores: A response to de Araujo et al. (2021). *Methods in Ecology and Evolution*, 12(10), 1793–1799. <https://doi.org/10.1111/2041-210x.13664>

---

Downloaded from UVicSpace Research & Learning Repository


dspace.library.uvic.ca



**University  
of Victoria**

Libraries

# On the need for rigorous welfare and methodological reporting for the live capture of large carnivores: A response to de Araujo et al. (2021)

Anthony Caravaggi<sup>1</sup>  | Talita F. Amado<sup>2</sup>  | Ryan K. Brook<sup>3</sup>  | Simone Ciuti<sup>4</sup>  |  
 Chris T. Darimont<sup>5,6</sup>  | Marine Drouilly<sup>7,8</sup>  | Holly M. English<sup>4</sup>  |  
 Kate A. Field<sup>5,6</sup>  | Graziella Iossa<sup>9</sup>  | Jessica E. Martin<sup>10</sup>  | Alan G. McElligott<sup>11</sup>  |  
 Alireza Mohammadi<sup>12</sup>  | Danial Nayeri<sup>13</sup> | Helen M. K. O'Neill<sup>14</sup>  | Paul C. Paquet<sup>5,6</sup>  |  
 Stéphanie Périquet<sup>15</sup>  | Gilbert Proulx<sup>16</sup>  | Daniella Rabaiotti<sup>17</sup>  | Mariano  
 R. Recio<sup>2,18</sup> | Carl D. Soulsbury<sup>9</sup>  | Tamara Tadich<sup>19</sup>  | Rae Wynn-Grant<sup>20</sup> 

<sup>1</sup>Wildlife Ecology Group, School of Applied Sciences, University of South Wales, Glyntaff, UK; <sup>2</sup>Biology Department, King Juan Carlos University, Madrid, Spain; <sup>3</sup>College of Agriculture and Bioresources, University of Saskatchewan, Saskatoon, SK, Canada; <sup>4</sup>Laboratory of Wildlife Ecology and Behaviour, School of Biology and Environmental Science, University College Dublin, Dublin, Ireland; <sup>5</sup>Department of Geography, University of Victoria, Victoria, BC, Canada; <sup>6</sup>Raincoast Conservation Foundation, Sydney, BC, Canada; <sup>7</sup>Panthera, NY, USA; <sup>8</sup>ICWild, Department of Biological Sciences, University of Cape Town, Cape Town, South Africa; <sup>9</sup>School of Life Sciences, University of Lincoln, Lincoln, UK; <sup>10</sup>The Royal (Dick) School of Veterinary Studies and The Roslin Institute, University of Edinburgh, Edinburgh, UK; <sup>11</sup>Jockey Club College of Veterinary Medicine and Life Sciences, City University of Hong Kong, Kowloon, China; <sup>12</sup>Department of Environmental Science and Engineering, Faculty of Natural Resources, University of Jiroft, Jiroft, Iran; <sup>13</sup>Department of Environmental Sciences, Faculty of Natural Resources, University of Tehran, Karaj, Iran; <sup>14</sup>Durrell Institute of Conservation and Ecology, School of Anthropology and Conservation, University of Kent, Canterbury, UK; <sup>15</sup>Ongava Research Centre, Windhoek, Namibia; <sup>16</sup>Alpha Wildlife Research & Management Ltd., Sherwood Park, AB, Canada; <sup>17</sup>Institute of Zoology, Zoological Society of London, London, UK; <sup>18</sup>Department of Ecology, Swedish University of Agricultural Sciences, Uppsala, Sweden; <sup>19</sup>Programa de Bienestar Animal, Facultad de Ciencias Veterinarias, Universidad Austral de Chile, Valdivia, Chile and <sup>20</sup>Bren School of Environmental Science and Management, University of California at Santa Barbara, Santa Barbara, CA, USA

## Correspondence

Anthony Caravaggi  
 Email: ar.caravaggi@gmail.com

Handling Editor: Aaron Ellison

## Abstract

1. De Araujo et al. (*Methods in Ecology and Evolution*, 2021, <https://doi.org/10.1111/2041-210X.13516>) described the development and application of a wire foot snare trap for the capture of jaguars *Panthera onca* and cougars *Puma concolor*. Snares are a commonly used and effective means of studying large carnivores. However, the article presented insufficient information to replicate the work and inadequate consideration and description of animal welfare considerations, thereby risking the perpetuation of poor standards of reporting.
2. Appropriate animal welfare assessments are essential in studies that collect data from animals, especially those that use invasive techniques, and are key in assisting researchers to choose the most appropriate capture method. It is critical that authors detail all possible associated harms and benefits to support thorough review, including equipment composition, intervention processes, general body assessments, injuries (i.e. cause, type, severity) and post-release behaviour. We offer a detailed discussion of these shortcomings.

This is an open access article under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

© 2021 The Authors. *Methods in Ecology and Evolution* published by John Wiley & Sons Ltd on behalf of British Ecological Society

3. We also discuss broader but highly relevant issues, including the capture of non-target animals and the omission of key methodological details. The level of detail provided by authors should allow the method to be properly assessed and replicated, including those that improve trap selectivity and minimize or eliminate the capture of non-target animals.
4. Finally, we discuss the central role that journals must play in ensuring that published research conforms to ethical, animal welfare and reporting standards. Scientific studies are subject to ever-increasing scrutiny by peers and the public, making it more important than ever that standards are upheld and reviewed.
5. We conclude that the proposal of a new or refined method must be supported by substantial contextual discussion, a robust rationale and analyses and comprehensive documentation.

#### KEYWORDS

analysis, animal welfare, large carnivores, live capture, methods, peer-review

## 1 | INTRODUCTION

Considerations on the impacts of field research of animals underpins good research practice and study optimization (Osborne et al., 2009), with implications for data quality (Jewell, 2013). Recent articles have called for journals to play an active role as 'critical control points' in protecting animal welfare in field (Brook et al. 2015; Field et al., 2019; Soulsbury et al., 2020), clinical (Ashall et al., 2018; Fordyce & Mullan, 2016; Page et al., 2016) and laboratory settings (DeGrazia & Sebo, 2015; Pritt & Hammer, 2017; Rollin, 2006).

Foot snares are a widely used capture technique for many large and medium-sized carnivore species (e.g. Balme et al., 2007; Boitani & Powell, 2012; Mohammadi et al., 2019). Foot snares are generally used where handling an animal is essential, for example, the fitting of satellite collars (e.g. Cardoso et al., 2020; Jędrzejewski et al., 2002), or for research into vectors of disease (e.g. Doi et al., 2020). Other methods for live-trapping wildlife include cage traps (Casas-Díaz et al., 2015) and free darting (Olson et al., 2015). Foot snares can pose a greater risk of injury to animals than cage traps, particularly to non-target species (McCarthy et al. 2013), but offer key advantages including being more effective at capturing trap-shy species (Michalski et al. 2007; Mowat et al. 1994). Studies using invasive capture methods typically report the total number of captures of target and non-target species, means of immobilization (i.e. anaesthetics used and dosages), a detailed description of welfare assessments, (e.g. total number of injuries sustained by captured animals and their severity), trap selectivity, mortality, humane endpoints and euthanasia protocols identified a-priori. They also include an overview and discussion of the method, placing it in the appropriate context and examining caveats, concerns and possible future refinements.

Such details represent a minimum baseline for studies using existing foot snare techniques; those that offer developments on the method must have even higher levels of detail. Despite the critical

importance of these data, and information in both selecting and successfully deploying capture methods for wildlife, a recent paper by de Araujo et al. (2021), published in *Methods in Ecology and Evolution*, failed to provide many of these critical details. The authors described the development and application of a new design of foot snare trap to capture wild jaguars *Panthera onca* and cougars *Puma concolor* across three biomes in Brazil. Based on their findings, the authors suggested that '*Snares are a safe and efficient method to capture jaguars and cougars and can be adapted for capturing other large felid species.*'

Here, we offer a critical discussion of that paper: (a) highlighting key oversights and weaknesses on welfare protocols; (b) providing essential context on non-target animals; (c) a discussion of broader implications missing from the focal paper; and (d) emphasising the need for accurate and comprehensive reporting and rigorous peer-review of all animal studies. In doing so, this case study provides an important opportunity to emphasize the essential role journals, associated organizations and societies serve in actively promoting better animal welfare considerations in wild animal research.

## 2 | ANIMAL WELFARE CONSIDERATIONS

Ethical and animal welfare considerations are interwoven with the use of animals for research purposes, whether in the wild or the laboratory. Ethical considerations in animal research focus on the moral justification of our actions on animals and the cost-benefit analysis of potential benefits and associated harms (Bekoff & Jamieson, 2019; Fox & Bekoff, 2011). Animal welfare is a state within an animal (Mellor et al., 2020) and its; the consideration thereof provides the strategies to mitigate the identified harms and promote good animal welfare. Any activity involving research on animals can

generate animal welfare concerns that require objective consideration (Reed et al., 2017). In wildlife research, live capture is one of the critical points for animal welfare; any action that impacts the animals or their environment has the potential to directly or indirectly affect their welfare state (Soulsbury et al., 2020). The potential for captured animals to experience pain, distress or suffering must be considered (Sikes & Gannon, 2011). Indeed, many countries require an evaluation of the severity of the procedures via bioethical assessments (see European Directive 2010/63/EU) and specific guidelines have been developed for this purpose (Smith et al., 2018). Such assessments often involve combining methods, including the quantification of injuries and their severity via injury scores (e.g. Iossa et al., 2007; Proulx, 1999; Tullar Jr., 1984), the collection of behavioural, physiological and psychological measures (e.g. Brivio et al., 2015; Burn, 2017; Cattet et al., 2003), and long-term follow-up monitoring (e.g. Cattet, Boulanger, et al., 2008; Cattet, Stenhouse, et al., 2008). These steps allow researchers to mitigate potential negative effects of trapping and restraint. Subsequent publications that arise from studies with welfare implications should provide explicit information on the types of welfare assessments used and their outcomes.

In the case of de Araujo et al. (2021), the authors described a modified foot snare trap for the capture of jaguars and cougars. Specific details on animal welfare considerations and methodological impacts, that are conspicuously absent in the present form of the article, are required. Hence, it is difficult to ascertain whether any of these aspects were considered and/or whether steps were taken to minimize negative effects on captured animals. For example, one animal was noted as requiring veterinary treatment for a paw injury but the authors did not detail the type, severity or cause of the injury. Additionally, de Araujo et al. (2021) did not provide details of the criteria used to determine the point of intervention and whether any other injuries were sustained by other individuals and assessed as not requiring clinical care. A general body condition assessment, including observations of other limbs and teeth, should be undertaken when assessing leg-holding traps. Many injuries may not appear immediately problematic (e.g. abrasions, oedemas), but they can have long-term, sub-lethal effects (e.g. Cattet, Boulanger, et al., 2008; Mortensen & Rosell, 2020; Seddon et al., 1999) and impact biological interactions (e.g. competition, predation) by reducing the ability to capture prey, flee or fight (Virgós & Travaini, 2005).

The authors indicated that they removed debris from trapping sites but failed to mention whether sites were beneath a canopy that could provide some protection from environmental conditions or be a source of additional debris. Exposure can be stressful and sometimes lethal for captured animals (Del Guidice et al., 2001; Rutter et al., 2020). With regards to the snaring system, no information was given regarding the potential use of leather or rubber sheaths to mitigate abrasion from the steel cable (e.g. Frame & Meier, 2007; Lemieux & Czetwertynski, 2006). Further, the authors claim that 'the use of a spring limited injuries', but do not provide evidence to support this statement.

The authors stated that live bait was used during the study—a method that has inherent welfare implications for the bait animal(s). Certainly, live bait can be an effective and efficient method of attracting carnivores (Goodrich et al., 2001; Michalski et al., 2007; Rajaratnam et al., 2007). However, authors using this method should explicitly describe the associated components and conditions, thereby addressing welfare concerns and supporting replication. Hence, studies using live bait should describe the species used, the means of restraint, resource (i.e. food, water) provisioning and maintenance schedule, measures taken to minimize distress and prevent harm, pre-study screening for disease and post-study monitoring. de Araujo et al. (2021) do not provide any such details, hence the study can neither be properly assessed on the grounds of bait animal welfare, nor replicated. While live bait may be authorized by some ethical review committees, we strongly suggest that researchers only use live bait as a last resort and following robust methodological refinement.

de Araujo et al. (2021) did not indicate whether all the jaguars and cougars captured during their study were fully grown adults, whether any of the 16 females had dependent cubs at the time of capture, nor how they reduced the probability of capture of non-target individuals. The authors noted, however, that several non-target species were captured during their study. While snare traps can be calibrated to minimize the potential for capture of non-target species, the possibility of bycatch still remains as long as there is overlap in body mass of species within the ecological community. The welfare implications for captured non-target animals are often more severe than for target species (e.g. Brook et al., 2015; Goodrich et al., 2001; Logan et al., 1999). de Araujo et al. (2021) did not provide any information as to the state in which non-target animals were found or how they were handled (e.g. were they chemically or physically immobilized and released after capture?). The authors further noted that they 'sometimes used two snares mounted close to each other' to increase capture probability, but neither distance between paired traps nor simultaneous captures (and associated welfare implications) were reported.

Monitoring study animals for the duration of their restraint can inform our understanding of potential welfare implications associated with a capture method (e.g. Fahlman et al., 2020; Proulx, 2018). de Araujo et al. (2021) deployed camera traps to assess the likelihood of the focal species using a given area, yet did not report whether they monitored animal behaviour during and post-capture. Injuries often occur in the first moments after a trap has closed (Proulx et al., 1993). Further, the length of time an animal is in a trap before being chemically or physically restrained is a key consideration (Soulsbury et al., 2020). In their study, de Araujo et al. (2021) used a VHF transmitter to improve survey team response times and reduce the period during which the animals were restrained. Such efforts can minimize the time the animal spends in the trap unsupervised and is successfully used elsewhere (e.g. Darrow & Shivik, 2008; Notz et al., 2017). However, the authors did not provide any empirical data on restraint duration, hence, potential positive welfare implications cannot be reliably ascertained.

### 3 | THE NEED FOR DETAIL

When describing new methods or equipment, researchers should provide a thorough comparative analysis, placing the capture efficacy, selectivity and welfare considerations against those of differing capture techniques. Situating new methods in this broader context will strengthen claims to why their use is warranted by contrasting them against alternative approaches. More broadly, if researchers are proposing an invasive technique, they should offer a thorough and robust explanation of why it was chosen over alternative methods.

Within-study methodological variations should additionally be explained appropriately. This is essential information for researchers considering using these methods in their own work. Many of these details were missing from de Araujo et al. (2021). For example, de Araujo et al. (2021) stated that different baits were used intermittently and deployed at different times, but no justification was given for such changes nor the impact that they had on capture rate (section 2.4.3, de Araujo et al., 2021). There was also no consistency in the number of snares used at each trap site (section 2.4, de Araujo et al., 2021) and the total number of traps set is unknown. No information was provided on the number of corresponding sample sizes, temporal schedule, spatial variance, catch ratios, carcass/fish size, type and composition (where appropriate), nor any other fundamental information that is required to properly support replication of the study. Further, the authors stated 'As soon as the animal is safely under the effect of anaesthesia, the procedures could be performed.' The nature of these procedures and, indeed, the ultimate purpose for live capture in this study, remains unknown. As such it is unclear whether minimally invasive alternatives may have been more appropriate (e.g. Palomares, 2018), and where, when and how the authors recommend this method be implemented or, indeed, which variant should be used. Articles recommending a modified technique should explain why invasive methods are required, before providing a clear description of the recommended variant.

de Araujo et al. (2021) described their modified foot snare design in extensive detail but did not use multi-method comparisons or any discussion of preceding iterations of the technique. Without information on trapping effort (i.e. trap hours/days), it is not possible to evaluate the efficiency of their trapping method. Criteria for assessing trap efficiency and safety have been proposed and reviewed elsewhere (e.g. Powell & Proulx, 2003; Proulx, 1999; Proulx et al., 2020). Further, without internal or external comparators, it is impossible to compare the performance of the proposed method relative to other variants. Moreover, the context of and evidence for 'safety' was lacking, hence the authors' conclusion that the capture method is safe, effective and can be applied to other large felids therefore lacks an evidential basis.

We acknowledge that it may not be possible to address all of the issues we highlight in the *Practical Tools* format, given the inherent limitations associated with a short word count. However, we suggest that the correct solution is not to omit crucial details that support thorough evaluation of the efficacy and efficiency of the proposed

method, but for the Editor to recommend resubmission as a longer Research Article that would support critical detail. Alternatively, supplementary files should be requested.

### 4 | THE REVIEW PROCESS

Journal editorial policies provide a minimum benchmark of scientific and ethical standards the journal upholds. However, many journals do not provide specific guidance on animal welfare concerns (Festing et al., 1997; Osborne et al., 2009) other than stating adherence to generic published guidelines for planning studies that involve animals and for reporting studies that involve animals, such as the PREPARE (Smith et al., 2018) and ARRIVE 2.0 (Percie du Sert et al., 2020) guidelines. The manuscript submission process is frequently reliant on the authors simply declaring compliance with editorial policies, with little post hoc validation (Kilkenny et al., 2010; MacCallum, 2010). Journals should play leading roles in ensuring that the research they publish includes information related to animal welfare. Doing so would demonstrate good practice and encourage similar oversight among other authors and journals (Osborne et al., 2009). Failure to consider the welfare of study species can harm individual animals and the scientific process.

With the rise of open access publications, public access to and scrutiny of scientific studies is greater than ever. It is essential, therefore, that journals as a minimum, ensure that published studies comply with their own reporting requirements and emphasize animal welfare considerations as a priority. The editorial policies of *Methods in Ecology and Evolution* state that '*Researchers must have proper regard for conservation and animal welfare considerations*' and reference adherence to guidelines such as ARRIVE 2.0 (Percie du Sert et al., 2020), which explicitly states inclusion of '*the nature of the ethical review permissions, relevant licences, and national or institutional guideline for the care and use of animals*'. Additionally, the author guidelines for the journal state that permit numbers, including institutional animal use permits, should be included in the acknowledgements section. We note that the original editorial and review process failed to detect the omission of a welfare statement and permit details from de Araujo et al. (2021) (see [publons.com/p/33313648/](https://publons.com/p/33313648/)) and the paper was subsequently published, *First Online*, without that information. Following our communications on social media about these oversights, these details were subsequently added to the Acknowledgments section when the paper was assigned to an issue. This approach risks unintentionally obfuscating relevant issues and limiting the potential for review and the improvement of associated processes. We suggest, therefore that an *errata* would have been contextually appropriate.

This paper benefited from the Open Peer-Review system that allows interested parties to read reviewers' comments and subsequently revealed gaps in the peer-review process. We note that some important issues were raised during the review process ([publons.com/p/33313648/](https://publons.com/p/33313648/)) were not addressed in subsequent drafts. Journals have a critical role in ensuring high standards of animal welfare in laboratory or field research (Field et al., 2019; Soulsbury et al., 2020). We

therefore call upon journals to place an onus on Editors and reviewers to explicitly confirm that the submitted work complies with the journal's animal care policies. This is particularly important in the case of papers detailing capture methods, as these serve as a template for researchers considering those methods in their own research. We believe that this should be an integral part of the review process for any journal publishing research involving animals—whether wild, captive, domesticated or in the laboratory. We recommend that manuscripts that do not provide the required permit numbers on submission be rejected without review and the authors encouraged to provide the required documentation should they decide to resubmit.

Finally, we encourage journals without animal care policies to consider adopting a straightforward, bare-minimum template of requirements for animal care policies for wildlife studies upon which they can build (see 'ARROW guidelines', Field et al., 2019).

## 5 | CONCLUSIONS AND RECOMMENDATIONS

The accurate, appropriate and thorough reporting of studies that use live capture techniques for wild animals is essential, from both scientific and welfare perspectives, especially when new or refined methods are presented. In their recent paper, de Araujo et al. (2021) presented a study with multiple issues that resulted in their conclusion—that the proposed method is 'safe and efficient'—having no reliable evidential basis. We acknowledge that foot snares represent a potentially useful tool in the study of large carnivores. However, studies using invasive methods should offer a thorough justification for the use of a specific technique, including an explanation of why less invasive alternatives were not selected. Moreover, the proposal of a new or refined method requires substantial contextual discussion, robust analyses and comprehensive documentation, all of which were absent from the focal study.

More broadly, this *Forum* article also presents an important opportunity to use evidence and best practise principles to advocate for higher standards of welfare reporting in wildlife studies. At minimum, these should include (a) an explanation of the necessity for live capture, including how data obtained via live capture contributed to the main objective of the study; (b) the provision of full details of methodological reviews, welfare considerations and permits in the paper or supplementary materials; (c) comprehensive details on assessments of welfare of target and non-target animals, with suitable comparable measures; (d) quantitative information on impacts to target and non-target animals; and (e) selectivity of methods. We encourage researchers to adopt and adhere to strict ethical guidelines and emphasize the importance of the 3Rs and harm-benefit analysis frameworks in assessing the suitability of proposed methods. From the perspective of the Journal, we recommend that the specific assessment of the welfare implications of animal-studies becomes the norm, including consideration of ARROW guidelines (Field et al., 2019) and the requirement that reviewers and Editors explicitly confirm adherence to journal guidelines and standards.

## ACKNOWLEDGEMENTS

The authors thank the journal and Editors for encouraging the submission of this Forum article. We also thank the handling Editor and five reviewers for their feedback, and providing us with the opportunity to improve the manuscript.

## CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

## AUTHORS' CONTRIBUTIONS

A.C. organized and edited the article and contributed to the text; T.F.A., R.K.B., S.C., C.T.D., M.D., H.M.E., K.A.F., G.I., J.E.M., A.G.M., A.M., D.N., H.M.K.O., P.C.P., S.P., G.P., D.R., M.R.R., C.D.S., T.T. and R.W.-G. contributed to the text and edited the article.

## PEER REVIEW

The peer review history for this article is available at <https://publons.com/publon/10.1111/2041-210X.13664>.

## ORCID

Anthony Caravaggi  <https://orcid.org/0000-0002-1763-8970>  
 Talita F. Amado  <https://orcid.org/0000-0001-7503-3753>  
 Ryan K. Brook  <https://orcid.org/0000-0003-1658-1607>  
 Simone Ciuti  <https://orcid.org/0000-0003-1052-9509>  
 Chris T. Darimont  <https://orcid.org/0000-0002-2799-6894>  
 Marine Drouilly  <https://orcid.org/0000-0003-2793-4527>  
 Holly M. English  <https://orcid.org/0000-0002-8854-6707>  
 Kate A. Field  <https://orcid.org/0000-0002-1646-9474>  
 Graziella Iossa  <https://orcid.org/0000-0001-6813-4361>  
 Jessica E. Martin  <https://orcid.org/0000-0003-0294-8770>  
 Alan G. McElligott  <https://orcid.org/0000-0001-5770-4568>  
 Alireza Mohammadi  <https://orcid.org/0000-0001-5958-1530>  
 Helen M. K. O'Neill  <https://orcid.org/0000-0002-9458-4494>  
 Paul C. Paquet  <https://orcid.org/0000-0002-4844-2559>  
 Stéphanie Périquet  <https://orcid.org/0000-0001-8901-3729>  
 Gilbert Proulx  <https://orcid.org/0000-0002-6980-8927>  
 Daniella Rabaïotti  <https://orcid.org/0000-0003-4123-2492>  
 Carl D. Soulsbury  <https://orcid.org/0000-0001-8808-5210>  
 Tamara Tadich  <https://orcid.org/0000-0003-1620-7770>  
 Rae Wynn-Grant  <https://orcid.org/0000-0002-9757-0514>

## REFERENCES

- Araujo, G. R., Deco-Souza, T., Morato, R. G., Crawshaw, P. G., Silva, L. C., Jorge-Neto, P. N., Csermak-Jr, A. C., Bergo, L. C. F., Kantek, D. L. Z., Miyazaki, S. S., Beisiegel, B. D. M., Tortato, F. R., May-Junior, J. A., Silva, M. C. C., Leuzinger, L., Salomão-Jr, J. A., & Paula, T. A. R. (2021). Use of foot snares to capture large felids. *Methods in Ecology and Evolution*, 12, 322–327. <https://doi.org/10.1111/2041-210X.13516>
- Ashall, V., Millar, K. M., & Hobson-West, P. (2018). Informed consent in veterinary medicine: Ethical implications for the profession and the animal 'patient'. *Food Ethics*, 1, 247–258. <https://doi.org/10.1007/s41055-017-0016-2>
- Balme, G., Hunter, L., & Slotow, R. O. B. (2007). Feeding habitat selection by hunting leopards *Panthera pardus* in a woodland savanna:

- Prey catchability versus abundance. *Animal Behaviour*, 74, 589–598. <https://doi.org/10.1016/j.anbehav.2006.12.014>
- Bekoff, M., & Jamieson, D. (2019). 1. Ethics and the Study of Carnivores: Doing science while respecting animals. In J. L. Gittleman (Ed.), *Carnivore Behavior, Ecology, and Evolution* (pp. 15–45). Cornell University Press.
- Boitani, L., & Powell, R. A. (2012). *Carnivore ecology and conservation: A handbook of techniques*. Oxford University Press.
- Brivio, F., Grignolio, S., Sica, N., Cerise, S., & Bassano, B. (2015). Assessing the impact of capture on wild animals: The case study of chemical immobilisation on alpine ibex. *PLoS ONE*, 10, e0130957. <https://doi.org/10.1371/journal.pone.0130957>
- Brook, R. K., Cattet, M., Darimont, C. T., Paquet, P. C., & Proulx, G. (2015). Maintaining ethical standards during conservation crises. *Canadian Wildlife Biology and Management*, 4, 72–79.
- Burn, C. C. (2017). Bestial boredom: A biological perspective on animal boredom and suggestions for its scientific investigation. *Animal Behaviour*, 130, 141–151. <https://doi.org/10.1016/j.anbehav.2017.06.006>
- Cardoso, H. M., Morato, R. G., Miyazaki, S. S., Pereira, T. D. C., Araújo, G. R. D., & Kantek, D. L. Z. (2020). Effectiveness of protected areas for jaguars: The case of the Taiaimã Ecological Station in Brazil. *Papéis Avulsos de Zoologia*, 60, e20206048. <https://doi.org/10.11606/1807-0205/2020.60.48>
- Casas-Díaz, E., Closa-Sebastià, F., Marco, I., Lavín, S., Bach-Raich, E., & Cuenca, R. (2015). Hematologic and biochemical reference intervals for Wild Boar (*Sus scrofa*) captured by cage trap. *Veterinary Clinical Pathology*, 44, 215–222.
- Cattet, M. R., Boulanger, J., Stenhouse, G., Powell, R. A., & Reynolds-Hogland, M. J. (2008). An evaluation of long-term capture effects in ursids: Implications for wildlife welfare and research. *Journal of Mammalogy*, 89, 973–990. <https://doi.org/10.1644/08-MAMM-A-095.1>
- Cattet, M. R., Christison, K., Caulkett, N. A., & Stenhouse, G. B. (2003). Physiologic responses of grizzly bears to different methods of capture. *Journal of Wildlife Diseases*, 39, 649–654. <https://doi.org/10.7589/0090-3558-39.3.649>
- Cattet, M., Stenhouse, G., & Bollinger, T. (2008). Exertional myopathy in a grizzly bear (*Ursus arctos*) captured by leghold snare. *Journal of Wildlife Diseases*, 44, 973–978. <https://doi.org/10.7589/0090-3558-44.4.973>
- Darrow, P. A., & Shivik, J. A. (2008). A pilot evaluation of trap monitors by the USDA Wildlife Services Operational Program. In *Proceedings of the Vertebrate Pest Conference* (Vol. 23). UC Agriculture & Natural Resources. Retrieved from <https://escholarship.org/uc/item/2dq893v8#author>
- DeGrazia, D., & Sebo, J. (2015). Necessary conditions for morally responsible animal research. *Cambridge Quarterly of Healthcare Ethics*, 24, 420–430. <https://doi.org/10.1017/S0963180115000080>
- Del Giudice, G. D., Mangipane, B. A., Sampson, B. A., & Kochanny, C. O. (2001). Chemical immobilization, body temperature, and post-release mortality of white-tailed deer captured by clover trap and net-gun. *Wildlife Society Bulletin*, 29, 1147–1157.
- Doi, K., Nishida, K., Kato, T., & Hayama, S. I. (2020). Effects of introduced sika deer (*Cervus nippon*) and population control activity on the distribution of *Haemaphysalis* ticks in an island environment. *International Journal for Parasitology: Parasites and Wildlife*, 11, 302–307.
- Fahlman, Å., Lindsjö, J., Norling, T. A., Kjellander, P., Ågren, E. O., & Bergvall, U. A. (2020). Wild boar behaviour during live-trap capture in a corral-style trap: Implications for animal welfare. *Acta Veterinaria Scandinavica*, 62, 1–11. <https://doi.org/10.1186/s13028-020-00557-9>
- Festing, M. F. W., Van Zutphen, L. F. M., & Balls, M. (1997). Guidelines for reviewing manuscripts on studies involving live animals. Synopsis of the workshop. In L. F. M. van Zutphen & M. Balls (Eds.), *Animal alternatives, welfare and ethics* (pp. 405–410). Elsevier.
- Field, K. A., Paquet, P. C., Artelle, K., Proulx, G., Brook, R. K., & Darimont, C. T. (2019). Publication reform to safeguard wildlife from researcher harm. *PLoS Biology*, 17, e3000193. <https://doi.org/10.1371/journal.pbio.3000193>
- Fordyce, P., & Mullan, S. (2016). Nature and governance of veterinary clinical research conducted in the UK. *Veterinary Record*, 180, 69.
- Fox, C. H., & Bekoff, M. (2011). Integrating values and ethics into wildlife policy and management—lessons from North America. *Animals*, 1, 126–143. <https://doi.org/10.3390/ani1010126>
- Frame, P. F., & Meier, T. J. (2007). Field-assessed injury to wolves captured in rubber-padded traps. *The Journal of Wildlife Management*, 71, 2074–2076. <https://doi.org/10.2193/2006-537>
- Goodrich, J. M., Kerley, L. L., Schleyer, B. O., Miquelle, D. G., Quigley, K. S., Smirnov, Y. N., Nikolaev, I. G., Quigley, H. B., & Hornocker, M. G. (2001). Animal capture and handling capture and chemical anesthesia of Amur (Siberian) tigers. *Wildlife Society Bulletin*, 29, 533–542.
- Iossa, G., Soulsbury, C. D., & Harris, S. (2007). Mammal trapping: A review of animal welfare standards of killing and restraining traps. *Animal Welfare*, 16, 335–352.
- Jędrzejewski, W., Schmidt, K., Theuerkauf, J., Jędrzejewska, B., Selva, N., Zub, K., & Szymura, L. (2002). Kill rates and predation by wolves on ungulate populations in Białowieża Primeval Forest (Poland). *Ecology*, 83, 1341–1356.
- Jewell, Z. C. (2013). Effect of monitoring technique on quality of conservation science. *Conservation Biology*, 27, 501–508. <https://doi.org/10.1111/cobi.12066>
- Kilkenny, C., Browne, W. J., Cuthill, I. C., Emerson, M., & Altman, D. G. (2010). Improving bioscience research reporting: The ARRIVE guidelines for reporting animal research. *PLoS Biology*, 8, e1000412. <https://doi.org/10.1371/journal.pbio.1000412>
- Lemieux, R., & Czetwertynski, S. (2006). Tube traps and rubber padded snares for capturing American black bears. *Ursus*, 17, 81–91.
- Logan, K. A., Sweaner, L. L., Smith, J. F., & Hornocker, M. G. (1999). Capturing pumas with foot-hold snares. *Wildlife Society Bulletin*, 27, 201–208.
- MacCallum, C. J. (2010). Reporting animal studies: Good science and a duty of care. *PLoS Biology*, 8, e1000413. <https://doi.org/10.1371/journal.pbio.1000413>
- McCarthy, J. L., Belant, J. L., Breitenmoser-Würsten, C., Hearn, A. J., & Ross, J. (2013). Live trapping carnivores in tropical forests: Tools and techniques to maximise efficacy. *Raffles Bulletin of Zoology*, 28, 55–66.
- Mellor, D. J., Beausoleil, N. J., Littlewood, K. E., McLean, A. N., McGreevy, P. D., Jones, B., & Wilkins, C. (2020). The 2020 Five Domains Model: Including human–animal interactions in assessments of animal welfare. *Animals*, 10, 1870. <https://doi.org/10.3390/ani10101870>
- Michalski, F., Cranshaw, P. G., Oliveira, T. G. D., & Fabian, M. E. (2007). Efficiency of box-traps and leg-hold traps with several bait types for capturing small carnivores (Mammalia) in a disturbed area of Southeastern Brazil. *Revista de Biologia Tropical*, 55, 315–320.
- Mohammadi, A., Kaboli, M., Sazatornil, V., & López-Bao, J. V. (2019). Anthropogenic food resources sustain wolves in conflict scenarios of Western Iran. *PLoS ONE*, 14, e0218345. <https://doi.org/10.1371/journal.pone.0218345>
- Mortensen, R. M., & Rosell, F. (2020). Long-term capture and handling effects on body condition, reproduction and survival in a semi-aquatic mammal. *Scientific Reports*, 10, 17886. <https://doi.org/10.1038/s41598-020-74933-w>
- Mowat, G., Slough, B. G., & Rivard, R. E. (1994). A comparison of three live capturing devices for lynx: Capture efficiency and injuries. *Wildlife Society Bulletin*, 22, 644–650.
- Notz, E., Imholt, C., Reil, D., & Jacob, J. (2017). Testing automated sensor traps for mammal field studies. *Wildlife Research*, 44, 72–77. <https://doi.org/10.1071/WR16192>
- Olson, A. K., Gulsby, W. D., Cohen, B. S., Byrne, M. E., Osborn, D. A., & Miller, K. V. (2015). Spring excursions of mature male white-tailed deer (*Odocoileus virginianus*) in north central Pennsylvania.

- The American Midland Naturalist*, 174, 96–104. <https://doi.org/10.1674/0003-0031-174.1.96>
- Osborne, N. J., Payne, D., & Newman, M. L. (2009). Journal editorial policies, animal welfare, and the 3Rs. *The American Journal of Bioethics*, 9, 55–59. <https://doi.org/10.1080/15265160903318343>
- Page, R., Baneux, P., Vail, D., Duda, L., Olson, P., Anestidou, L., Dybal, N., Golab, G., Shelton, W., Salgaller, M., & Hardy, C. (2016). Conduct, oversight, and ethical considerations of clinical trials in companion animals with cancer: Report of a workshop on best practice recommendations. *Journal of Veterinary Internal Medicine*, 30, 527–535. <https://doi.org/10.1111/jvim.13916>
- Palomares, F. (2018). A minimally invasive capture system for the safe and compassionate live trapping of jaguar and puma. *Galemys*, 30, 49–59. <https://doi.org/10.7325/Galemys.2018.A5>
- Percie du Sert, N., Hurst, V., Ahluwalia, A., Alam, S., Avey, M. T., Baker, M., Browne, W. J., Clark, A., Cuthill, I. C., Dirnagl, U., Emerson, M., Garner, P., Holgate, S. T., Howells, D. W., Karp, N. A., Latic, S. E., Lidster, K., MacCallum, C. J., Macleod, M., ... Würbel, H. (2020). The ARRIVE guidelines 2.0: Updated guidelines for reporting animal research. *PLoS Biology*, 18, e3000410.
- Powell, R. A., & Proulx, G. (2003). Trapping and marking terrestrial mammals for research: Integrating ethics, performance criteria, techniques, and common sense. *ILAR Journal*, 44, 259–276. <https://doi.org/10.1093/ilar.44.4.259>
- Pritt, S. L., & Hammer, R. E. (2017). The interplay of ethics, animal welfare, and IACUC oversight on the reproducibility of animal studies. *Comparative Medicine*, 67, 101–105.
- Proulx, G. (1999). Review of current mammal trap technology in North America. In G. Proulx (Ed.), *Mammal Trapping* (pp. 1–46). Alpha Wildlife Research and Management Ltd.
- Proulx, G. (2018). *Intolerable cruelty - The truth behind killing neck snares and strychnine*. Alpha Wildlife Publications.
- Proulx, G., Cattet, M., Serfass, T. L., & Baker, S. E. (2020). Updating the AIHTS trapping standards to improve animal welfare and capture efficiency and selectivity. *Animals*, 10, 1262.
- Proulx, G., Onderka, D. K., Kolenosky, A. J., Cole, P. J., Drescher, R. K., & Badry, M. J. (1993). Injuries and behavior of raccoons (*Procyon lotor*) captured in the Soft Catch™ and the EGG™ traps in simulated natural environments. *Journal of Wildlife Diseases*, 29, 447–452.
- Rajaratnam, R., Sunquist, M., Rajaratnam, L., & Ambu, L. (2007). Diet and habitat selection of the leopard cat (*Prionailurus bengalensis*) in an agricultural landscape in Sabah, Malaysian Borneo. *Journal of Tropical Ecology*, 23, 209–217.
- Reed, B., Beatham, S., Carter, S., Clubb, R., Garrod, K., Gale, M., Gomm, M., Knight, K., Lane, J., Mathews, F., Pimlott, P., Smith, A., Wilson, R., Weyer, U., & Hawkins, P. (2017). Report of a RSPCA/APHA meeting on the welfare of wild animals used in research. *Animal Technology and Welfare*, 16, 13–25.
- Rollin, B. E. (2006). The regulation of animal research and the emergence of animal ethics: A conceptual history. *Theoretical Medicine and Bioethics*, 27, 285–304. <https://doi.org/10.1007/s11017-006-9007-8>
- Rutter, A. U., Hanrahan, A. T., Nielsen, C. K., & Schaubert, E. M. (2020). Functionality of a new live-capture device for river otters. *Journal of Fish and Wildlife Management*, 11, 238–244. <https://doi.org/10.3996/092018-JFWM-083>
- Seddon, P. J., VanHeezik, Y., & Maloney, R. F. (1999). Short- and medium-term evaluation of foothold trap injuries in two species of fox in Saudi Arabia. In G. Proulx (Ed.), *Mammal trapping* (pp. 67–78). Alpha Wildlife Research & Management Ltd.
- Sikes, R. S., & Gannon, W. L. (2011). Animal care and use committee of the American Society of Mammalogists. *Journal of Mammalogy*, 92, 235–253.
- Smith, A. J., Clutton, R. E., Lilley, E., Hansen, K. E. A., & Brattelid, T. (2018). PREPARE: Guidelines for planning animal research and testing. *Laboratory Animals*, 52, 135–141. <https://doi.org/10.1177/0023677217724823>
- Soulsbury, C. D., Gray, H. E., Smith, L. M., Braithwaite, V., Cotter, S. C., Elwood, R. W., Wilkinson, A., & Collins, L. M. (2020). The welfare and ethics of research involving wild animals: A primer. *Methods in Ecology and Evolution*, 11, 1164–1181. <https://doi.org/10.1111/2041-210X.13435>
- Tullar Jr., B. F. (1984). Evaluation of a padded leg-hold trap for capturing foxes and raccoons. *New York Fish and Game Journal*, 31, 97–103.
- Virgós, E., & Travaini, A. (2005). Relationship between small-game hunting and carnivore diversity in central Spain. *Biodiversity & Conservation*, 14, 3475–3486. <https://doi.org/10.1007/s10531-004-0823-8>

**How to cite this article:** Caravaggi, A., Amado, T. F., Brook, R. K., Ciuti, S., Darimont, C. T., Drouilly, M., English, H. M., Field, K. A., Iossa, G., Martin, J. E., McElligott, A. G., Mohammadi, A., Nayeri, D., O'Neill, H. M. K., Paquet, P. C., Périquet, S., Proulx, G., Rabaiotti, D., Recio, M. R., ... Wynn-Grant, R. (2021). On the need for rigorous welfare and methodological reporting for the live capture of large carnivores: A response to de Araujo et al. (2021). *Methods in Ecology and Evolution*, 12, 1793–1799. <https://doi.org/10.1111/2041-210X.13664>