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EDITORIAL

Contemporary Methods for Studying Animal Sociality in the Wild

Striking pay dirt: Contemporary methods for studying animal sociality in the wild

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1 | STUDYING SOCIALITY IN THE WILD

From the early Lascaux painters to British naturalists and to modern scientists worldwide, throughout our history, our species has always watched other animals in their natural environment. In doing so, we were able to get a glimpse of the social life of animals from a wide variety of taxa, and to attempt to make sense of it, for all kinds of purposes, be it hunting or scientific knowledge. Often, those various purposes lead to the same outcomes: taking notice of their patterns and habits or recording their communicative displays and making use of them. Observing animals is not an easy task, and making sense of their sociality even less so. While observing wild animals has remained the major channel through which we can make sense of their social lives, humans are additionally aided by an ever-increasing tool set to do so, fuelled by our ever-improving technology as well as our reliance upon it (Henrich, 2017). Such technological advances can be seen both through the methods we use when collecting data in the field and the ones we use to analyse the product of our research. The latter can be as diverse as vocal or urine samples, records of distances or interactions between individuals, or choices in a field experiment, and the field is aided greatly by a constant effort in developing new technologies to analyse them.

Our Joint Special Feature in *Methods in Ecology and Evolution* and the *Journal of Animal Ecology* aims to showcase contemporary methods for studying sociality in the wild, from the renewed use of old methods (such as tagging or field experiments) to an increasing use of technology-assisted paradigms as well as increasingly large-scale laboratory methods. Overall, the present Feature demonstrates a current drive to introduce holistic approaches for making sense of the social world. Such approaches also require the use of combined integrative and statistical methods. Nevertheless, beyond introducing such methods by leading researchers in the field, we also believe this Special Feature is important in raising the ethical issues that can surround the use of these innovative methods in the field, and as such, will need to be taken into account in a human world that is increasingly aware of its impact on its surrounding wildlife.

2 | THE RENEWED USE OF FIELD EXPERIMENTS IN COMBINATION WITH REMOTE SENSING

Implementing field experiments has a long history in all sorts of taxa, and they have been used to study social behaviour in wild animals for several decades in some cases (Seyfarth et al., 1980). Yet, recent years have allowed the development of increasingly automated methods which minimize interaction between researchers and their study species. For example, in this Special Feature, Wild et al. (2022) show a fully automated two-option foraging device, which can adapt itself to the subject, in this case great tits *Parus major*. They also stress that a fundamental issue in current research is its cost, and therefore advocate for and demonstrate how to use freely available

software to implement such research. The use of remote cameras is also chosen by several other researchers in this Special Feature to limit their impact on animals. Mannion et al. (2022), for example, implement field experiments to study cultural propensities in wild chimpanzees *Pan troglodytes schweinfurthii*. Nevertheless, they also discuss how much behaviour is lost in the process of solely relying on remote cameras and advocate for a multidimensional approach using both ecological and physiological markers to complement the video data. Remote sensing is also one of several techniques that Sarabian and collaborators (2023) advocate for, to allow the study of disgust amongst an astonishingly large number of species. They combine methods from learning theory with new findings in machine learning to showcase how they can push the study of this highly adaptive emotion in animals. Finally, King and Jensen (2022), tasked with the far from easy challenge of conducting playback experiments with marine mammals, show that promising advances have been made by combining them with remote sensing, particularly the use of drones (see next section) to follow their focal animals. They also discuss the use of non-invasive tagging, which we address in the next paragraph, along with reporting articles from other authors in our Special Feature.

3 | THE DAWN OF TECHNOLOGY: FROM TAGS TO DRONES AND TOUCHSCREENS

Tagging animals has an equally long, if not longer history than field experiments for studying social behaviour in wild animals (McIntyre, 2014). Here also, while the technology itself is old, the miniaturization of tags, and what they can carry with them, has allowed gathering much more data on the animals besides their identification. Demartsev, Gersick, et al. (2022) show that the future may lie in multi-sensor tracking that can simultaneously record both movements and communication inside a social group. This unprecedented combination may allow understanding much of decision-making in animal groups, given the wealth of data accumulated. But just how much data should we meaningfully consider? He et al. (2022) provide detailed recommendations for implementing GPS-studies, highlighting the major issues regarding sampling, such as the number of animals to consider, how much time tracking has to last, and its frequency. They illustrate those recommendations using their work in vulturine guineafowl *Acryllium vulturinum*.

While tags and their development have been privileged for decades, new technology also offers much welcome new avenues of research. Echoing King and Jensen (2022), Schad and Fischer (2022) show how drones can be used to study a range of issues in individual and collective behaviour, particularly when paired with computer algorithms and automated detection software. Importantly, they also discuss the impact of drones in terms of animal disturbance, which we will come back to in our final paragraph. Introducing technology to animals can also be done by presenting touchscreens to animals, as demonstrated by Harrison et al. (2023). Crucially, the use of touchscreens is a tool of choice in captive studies, allowing one to implement similar paradigms as in captivity but with the beneficial ecological validity of wild subjects.

4 | HOW TO STAY IN THE DIRT?

The introduction of ever-increasing technology may however frighten some field researchers for whom reliance on human-built apparatuses may drive animals out of their natural behaviour. This would threaten the very use of wild subjects as 'ecologically valid' by producing artefactual behaviour, rather than the natural repertoire of the species. However, technology can be used differently. Firstly, it can be used to analyse with ever increasing precision the products of field research. Schneider et al. (2023) highlight how environmental DNA can be meaningfully used to test for the presence of intergroup variation in diet in neighbouring vervet monkey groups *Chlorocebus pygerythrus*. While their results do not allow them to make firm conclusions regarding this question in their study groups, they provide the tools to do so across species. Crucially, these tools may also allow investigation of how much of the diet of these wild animals is impacted by humans themselves: in a nutshell, the future might tell us how much our wild subjects have remained wild in their foods, despite being confronted with increasingly encroaching humans (Gruber et al., 2019; McLennan & Hockings, 2014). Gräßle et al. (2023) take a radically different approach and also tackle the 'ecological validity' of their wild subjects, but this time, by looking at their brains. Much of our knowledge regarding cognitive processes in animals comes from captive subjects, who have been argued by some to be impoverished versions of their wild counterparts (Boesch, 2007). The difficult but worthwhile task of extracting, preserving and studying the brains of wild animals will certainly provide answers regarding the differences between captive and wild animals, with consequences on their social lives.

5 | ANALYTICAL INTEGRATION & MACHINE LEARNING

Another way to make use of new technology to study social behaviour in animals without resorting to using that technology in their natural habitat is the extended use of video databases that can nowadays be computerized and studied with powerful machine learning algorithms. Both Wiltshire et al. (2023) and Schofield et al. (2023) illustrate how this can be done in wild chimpanzees. Schofield and colleagues look at the use of deep learning face recognition models to generate association networks between wild chimpanzees *P. t. verus* of the same community, Bossou, in New Guinea, over the course of 17 years. The use of such videos, often recorded within the settings of field experiments (Biro et al., 2003) is invaluable to track variations in the social habits of the same long-lived individuals. Wiltshire et al. (2023) also use machine learning approaches to study large corpuses of ape datasets but their goal is different, instead aiming to use machine learning to track movement. Movement tracking has

recently become particularly of interest in captive studies, with the development of software such as DeepLabCut (Mathis et al., 2018). The application of such software on wild data is highly relevant to both reduce the time taken to extract data but also to improve reliability by limiting human error.

Finally, one cannot analyse the large corpuses of data acquired without statistical methods that are themselves constantly evolving. Complex statistical models have allowed researchers to shed new light on social networks over the last decade (Allen et al., 2013; Hobaiter et al., 2014; Sosa et al., 2021), this being only one example of how statistical models can aid in the analysis of increasingly complex datasets. Both Barrett (2022) and Demartsev, Haddas-Sasson, et al. (2022) illustrate this in their articles. Barrett first tackles the question of having more than two options. Indeed, many famous social learning experiments, both in the wild and captivity, rely on two-choice tasks. But what happens when more than two choices are present? Demartsev, Haddas-Sasson, et al. (2022) tackle a different issue, which is combining various aspects of social life and the resulting data in statistical models. In particular, they investigate the connection between singing patterns in male rock hyraxes *Procavia capensis* and their reproductive success.

6 | ETHICAL CONSIDERATIONS

An important consideration for the future of the study of sociality in the wild is one of ethical practices. This is not to say that new technologies should be the sole drive for researchers to adopt ethical measures in the field. As exemplified by Gruber (2022) in this Feature, as well as Soulsbury et al. (2020) in a recent primer article, ethical issues arise as soon as we deal with wild animals. In particular, Gruber outlines the multiple ways that, similar to biomedical research, field research can be seen as invasive; he introduces the concepts of *body* invasiveness and *none-body* invasiveness to tackle these issues. Researchers already being in animals' natural habitat can constitute a stress, advantaging certain individuals over others. Similarly, wearing a tag can represent a burden that will affect an individual's fitness (Soulsbury et al., 2020). New technologies, in line with other older direct manipulations of the environment, are likely to elicit stress, fear, or be potential carriers of human diseases (Gruber, 2022). But this is not new and should not be a reason to forbid any reliance on such paradigms to study wild animals. Instead, ethical considerations should push researchers to develop their research protocols in view of limiting their impact on wild animals, while still extracting as much information as they can at one time, to avoid the need to re-expose animals indefinitely. Crucially, the methods presented in this Special Feature will all facilitate this, be it by automatizing feeders (Harrison et al., 2023; Wild et al., 2022), or by making extensive use of remote sensing (He et al., 2022; King & Jensen, 2022; Mannion et al., 2022; Sarabian et al., 2023) thus showing that the study of sociality in the wild is not incompatible with the use of contemporary methods. In fact, such methods should be tested to explore the limits of their use on different species and produce reasonable do-or-do not guidelines that can guide the design and implementation of future research.

7 | CONCLUDING REMARKS

As our editorial has shown, and echoing a recent Feature on social networks (Sosa et al., 2021), researchers have now developed methods that give them access to an unprecedented amount of data. They are also developing the tools to analyse them in concert. Contemporary methods used in the field echo the ones developed in captivity, fostering dialogue between domains that have been historically separated. Wild animals, becoming more and more subject to anthropogenetic pressures, also change their behaviour. Whether their social behaviour will also become more like captive individuals will clearly need to be investigated in the future, to assess how our own behaviour as a species modifies others' social structures. If the answer is yes, does this mean we can only helplessly witness such changes without acting? While observing animals has been a practice of all human societies through the ages, we now have the capacity to evaluate how much our own behaviour impacts others. This will allow us to reach outside the scientific community and to press for public actors to implement policies based on a wealth of newly accumulated data (Brakes et al., 2021). Ultimately, we can only gather such data in the most complete way, to understand and characterize animal societies, and to advocate for measures to be taken in place to conserve both species and habitats. The use of new technologies, for example producing high-quality footage using cameras mounted on drones, can broaden our audience, allowing publicly funded research to be directly observed, sometimes in real time, by the very people who pay for it. In doing so, new technologies can also shorten the distance between researchers and the lay audience, constituting a powerful tool for research and conservation. This Special Feature highlights a few of the tools that can be used so that this can be achieved.

AUTHOR CONTRIBUTIONS

Thibaud Gruber wrote the initial draft and both Thibaud Gruber & Erica van de Waal reviewed and contributed to the final version.

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