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Priorities for translating goodwill between movement ecologists and conservation practitioners into effective collaboration

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Abstract

Addressing ongoing biodiversity loss requires collaboration between conservation scientists and practitioners. However, such collaboration has proved challenging. Despite the potential importance of tracking animal movements for conservation, reviews of the tracking literature have identified a gap between the academic discipline of movement ecology and its application to biodiversity

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conservation. Through structured conversations with movement ecologists and conservation practitioners, we aimed to understand whether the identified gap is also perceived in practice, and if so, what factors hamper collaboration and how these factors can be remediated. We found that both groups are motivated and willing to collaborate. However, because their motivations differ, there is potential for misunderstandings and miscommunications. In addition, external factors such as funder requirements, academic metrics, and journal scopes may limit the applicability of scientific results in a conservation setting. Potential solutions we identified included improved communication and better presentation of results, acknowledging each other's motivations and desired outputs, and adjustment of funder priorities. Addressing gaps between science and implementation can enhance collaboration and support conservation action to address the global biodiversity crisis more effectively.

KEYWORDS
biodiversity crisis, biologging, GPS tracking, interdisciplinary collaboration, thematic analysis, wildlife management

1 | INTRODUCTION

The earth is currently experiencing rapid loss of biodiversity on a global scale (Pimm et al., 2014; Secretariat of the Convention on Biological Diversity, 2020). Many species have gone extinct or are on the brink of being lost forever (WWF, 2018), a process accelerated by the current rate of climate change (Bellard et al., 2012; IPBES, 2019; Urban, 2015). Even if losses are mitigated, it will take many years for ecological systems to be restored and recovered to a functional ecosystem (Davis et al., 2018; Moreno-Mateos et al., 2020). Recognizing this, conservation practitioners work to protect species from declining and extinction, maintain and restore habitats, lobby for more effective conservation laws and enforcement, and propose ecologically-informed political decisions locally and globally, often supported by rigorous scientific studies (Kareiva & Marvier, 2012).

Research projects that actively engage with stakeholders from other disciplines, either in- or outside of academia, have a higher probability of resulting in actions that benefit both people and biodiversity (LeFlore et al., 2021), however, how to measure the impact of scientific research outside academia is yet a topic for debate (Lavery et al., 2021). Effective collaboration between conservation scientists and practitioners, has proved challenging for a variety of reasons (Jarvis et al., 2015). This has been described as the research-implementation gap, also termed the "knowing-doing gap" (Bertuol-Garcia et al., 2018; Pfeffer & Sutton, 1999). This gap has been described in many disciplines, and various explanations and ways to bridge it have been proposed (see for example Cook et al., 2013). One of the most prominent explanations is that most researchers never plan for implementation (Knight et al., 2008). Suggested solutions range from open science (Roche et al., 2021) and more active participation in research by practitioners (Dubois et al., 2020), to building "evidence bridges" (Kadykalo et al., 2021) and engaging graduate students in the process (Courter, 2012). Here we look at the research-implementation gap from both the academic research and the conservation practice sides, focusing on the topic of tracking animal movement.

Tracking of animal movement is a rapidly growing field in ecology that has the potential to contribute to both science and practical conservation both in the terrestrial (Kays et al., 2015) and the marine realms (Hays et al., 2019). Cutting-edge technology has enabled individual animals to be tracked, providing new perspectives on animal movement and behavior and opening up new strands of scientific inquiry (McGowan et al., 2017; Smith et al., 2019). At first, questions answered with animal movement data revolved around where animals go when they are out-of-sight from human observers (Bridge et al., 2011). As technology improved, this quickly developed into questions including, but not limited to, individual decisions about where to go or when to move (Vansteelant et al., 2017), interactions with the environment (Dodge et al., 2013), energy and activity budgets (Dokter et al., 2018; Williams et al., 2014), mechanisms of resource acquisition (Bijleveld et al., 2016; Ranc et al., 2020, 2021), causes and locations of mortalities

(Byrne et al., 2017; Klaassen et al., 2014), and breeding success (Schreven et al., 2021). In addition, tracking data are increasingly used in modeling studies to predict future species distributions under different climatic conditions (Lameris et al., 2017).

For conservation, the tracking of individual animals has yielded an opportunity to collect vital information for the protection and management of species. Examples include monitoring individuals after reintroduction (Robins et al., 2019), tracking to protect animals from poaching (Kamminga et al., 2018), or collecting information on previously unknown important areas for feeding and breeding (Pedersen et al., 2019). Recent advances in real-time tracking have expanded these possibilities (see Wall et al., 2014). In addition, tracking individuals over longer time periods can provide information on the impact of disturbances (Voigt et al., 2020) or the effect of mitigation measures (Okita-Ouma et al., 2021; Pekarsky et al., 2021).

Despite the value of tracking animals for both academics and conservationists, reviews of the tracking literature suggest a substantial gap between the academic discipline of movement ecology, that uses animal tracking data, and the application of the knowledge gained from tracking to the conservation practice (Allen & Singh, 2016; Fraser et al., 2018; Katzner & Arlettaz, 2020). This gap is particularly acute in animal behavior research and management action (Greggor et al., 2021). In 2018, Fraser et al. concluded that only 1/3 (on average 35%) of scientific papers published in the field of movement ecology had explicit connections to conservation and/or management of species. In 2020, Katzner & Arlettaz concluded that only 14% of movement ecology papers described studies designed to address a specific conservation or management challenge. These low percentages suggest that knowledge gained from tracking research is far from always being implemented to aid in the conservation of species. The opposite is also likely true; that applied (research) questions from the field do not reach the academics planning or conducting research projects, despite the evident advantages of synergies.

In this study, we aimed to understand whether the gap between movement ecologists and conservation practitioners identified in the literature is also perceived in practice, and if so, what factors hamper effective collaboration and how these can be remediated. We began by exploring how a group of scientists and practitioners with experience of tracking projects perceived the scientific and conservation relevance of selected scientific papers. This exercise provided a starting point for a set of structured conversations to identify the groups' (dis)similarities in definitions, methodologies, and desired outputs. We then analyzed themes that were discussed in the conversations. Based on these analyses, we present potential ways forward to bridge the gap to the mutual benefit of both researchers and practitioners.

2 | METHODS

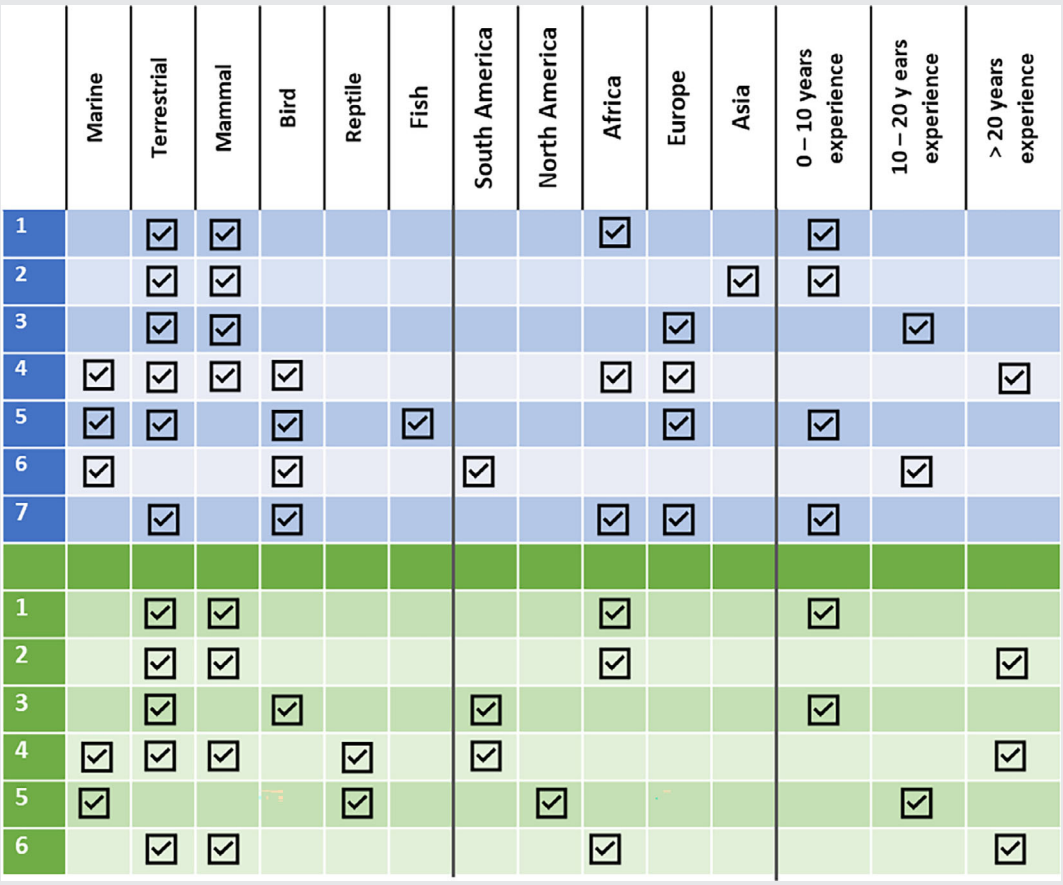
2.1 | Participant recruitment

Study participants were recruited from the primary authors' networks of contacts. We selected people who had experience with tracking data or devices, either from an academic movement ecology or an applied conservation perspective. Hereafter, we refer to these groups as "movement ecologists" (ME) or "conservation practitioners" (CP). Our aim was to ensure broad representation across a range of expertise with regard to system (marine or terrestrial), taxonomic group, geographic location, and years of experience (Table 1). Due to time-zone differences and field work obligations of some of the contacted candidate participants, we ended up with a set of participants somewhat biased in geographical area (i.e., excluding Asia and Oceania) and hemisphere (most participants from the northern hemisphere). Yet participants' perspectives, area of work, taxonomic focus, and level of experience were still diverse. At the start of the project, all participants agreed to the methodology, anonymization of the scores in the discussion, and inclusion as a co-author after approval of the manuscript.

2.2 | Scoring scientific papers

After agreeing to participate in the study, participants were sent a set of 10 peer-reviewed scientific papers that used animal tracking data, representing a broad range of taxa, locations, habitats, central questions, and research approaches (Appendix A). We asked participants to score each paper from low (1) to high (10) for (i) scientific, and (ii) conservation, relevance (details on scoring below). When explaining the exercise to participants, we defined scientific relevance as "*the impact of a study on scientific developments in a particular field or discipline (at the moment of publication), answering original and interesting questions for a species or in general*" and we defined conservation relevance as "*the impact of the study on the conservation and management of a species of concern, on a local or more general scale*". We purposefully kept the definitions of scientific and conservation relevance somewhat vague to ensure that participants would apply their own understanding of these terms. This allowed us subsequently to explore how understanding might differ within and between groups, while constraining participants enough that papers were assessed on a roughly

TABLE 1 Focal species, area(s) and expertise of the participants of this study. Movement ecologists (ME) are visualized in blue and numbered 1–7. Conservation practitioners (CP) are visualized in green and numbered 1–6. The numbers correspond to the quotes in the main text



level playing field. When scoring, participants were given the opportunity to explain their scores briefly or add notes, for example to state whether they were familiar with the authors or the study before reading the paper. To minimize bias, participants were given minimal prior information about the project, and scored the papers independently.

We anonymized the scoring data and plotted them for visual comparison during follow-up conversations with the participants. We assessed differences between the scores of the two groups of participants with a Student's *t*-test. Remarks made by the participants during the conversations were used to understand the rationale behind their scoring. The lead author did not participate in the scoring of the papers.

2.3 | Structured conversations

The next phase of the study consisted of three structured conversations, facilitated by the lead author. First, we had separate two-hour conversations with groups of movement ecologists and with conservationist practitioners. The results of the scoring exercise from their own group were shared and discussed with the participants, followed by a conversation about whether they perceived a gap with the other group, why they felt this was, and if and how it could be bridged. The discussion was deliberately unstructured, and participants were free to voice their opinion as they sought fit, to allow the conversation to flow according to participants' views.

In the third workshop, a three-hour session, members of both groups were present, as well as two of the lead authors of previous literature reviews on the topic (Allen & Singh, 2016; Katzner & Arlettaz, 2020). These authors did not participate in the prior scoring and workshops, as they had already thought deeply about the topic and may therefore have substantively influenced the groups' discussions. This time the participants discussed the combined results of the scoring exercise (from both groups), focusing on similarities and differences between scores by group. Participants were then asked about potential barriers to, opportunities for, and ways to promote, more fruitful collaboration between movement ecologists and conservationists.

Personal motivations for activities and challenges concerning specific aspects of careers came up frequently

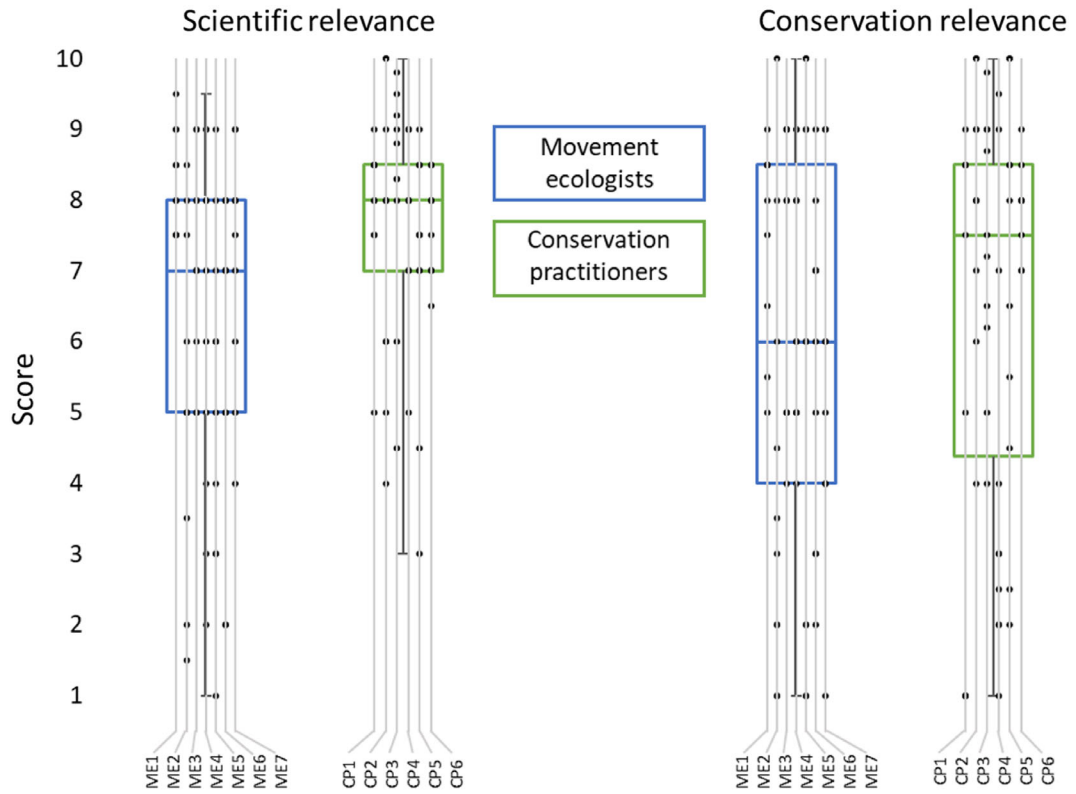


FIGURE 1 Scientific relevance and conservation relevance for 10 papers (appendix A: Buchholtz et al., 2019; Chambault et al., 2018; Efrat et al., 2019; Graham et al., 2012; Kays et al., 2011; Lameris et al., 2018; Nadŏ et al., 2019; Rio-Maior et al., 2019; Siegel et al., 2016; Ventura et al., 2019) scored by seven movement ecologists (ME1-7, in blue) and six conservation practitioners (CP1-6, in green). Scores for scientific relevance (left; black dots) or conservation relevance (right; black dots) range from 1–10 (*y*-axis) and are represented per individual participant (*x*-axis). Colored boxplots indicate the median and second and third quartiles, whiskers represent the first and fourth quartile respectively. Scores for the individual papers are given in Appendix B

in the first two meetings. To qualitatively assess any differences in challenges and motivations between the two groups, during the third conversation, all participants were asked to individually describe, in writing, their main motivations, and drivers for doing what they were doing professionally (i.e., either being a movement ecologist or a conservation practitioner), as well as the challenges and pressures they experienced in doing so.

2.4 | Thematic analysis

After the conversations, we conducted a high-level thematic analysis to identify the key themes that were discussed (c.f. Joffe, 2012). The themes were identified based on the directly observable topics of conversation in the recordings of the meetings. Since the conversations were structured in their set-up, some themes were deductive (i.e., drawn from the initial idea brought to the sessions by the convener) and others were inductive (i.e., those that came up during the conversation). Quotes from the conversations presented anonymously in the Results section refer to the 13 participants and three structured conversations and are coded as ME*i*-*x* or CP*i*-*x*, where *i* represents an individual movement ecologist (ME) or conservation practitioner (CP) (Table 1), and *x* represents structured conversation 1, 2 or 3.

3 | RESULTS

3.1 | Scores, and scoring systems, for scientific papers

Seven movement ecologists and six conservation practitioners contributed to scoring of the papers. The scores for scientific relevance of the 10 papers were statistically different ($t_{121.6} = -3.71$, $p < .005$) between movement ecologists ($\bar{x} = 5.9 \pm 2.2$ [SD]) and conservation practitioners (7.5 ± 1.5; Figure 1, Appendix B). The scores for conservation relevance did not differ between the groups ($t_{120.5} = -0.83$, $p = .408$; ME: 5.2 ± 2.7; CP: 5.5 ± 2.8). Overall, the applicability of the results was cited as a major factor behind the conservation relevance score

given, but how to judge this was differently perceived both within and between groups, leading to the widely divergent scoring in Figure 1.

In their conversation, the movement ecologists mentioned they found it more difficult to score the conservation relevance of a paper ("*It was easier to give sufficient or good scores for the scientific methods than the application*" [ME1-1]). The conservationists made the exact opposite remark, stating they had more difficulty assigning scores for scientific relevance ("*scientific side was definitely harder; to assess whether the methods and tests were the most applicable in the situation was difficult to judge*", CP1-2). When exploring potential explanations for this, it was mentioned that "*movement ecologists are perhaps more critical of the scientific process that led to the paper*" (ME2-3), and "*the conservationists are perhaps not looking as critically to the science as the movement ecologists are because they are often very species focused*" (CP2-3). This was confirmed by the statement: "*in general, most of the tracking studies for me were high in scientific relevance [just] because they were doing something new*" (CP3-3).

Some papers provoked more discussion than others, particularly when debating the definition and scoring of their conservation relevance. This was primarily because not all participants assessed conservation relevance the same way. Aspects considered by different participants when scoring conservation relevance included: the threatened status of the species, the direct value of the results for the conservation of the study species, the ability to use the results practically immediately, the presentation of new information, and the presentation of specific recommendations.

For example, for some participants the IUCN conservation status (IUCN, 2021) of a species was considered key, where for others it was not included in their assessment of conservation relevance of a paper. It was noted that "*even if [a paper] doesn't study a species of conservation concern, it can be a very replicable model for other study cases where there could be conservation concern*" (ME3-1). And "*looking at species that are not of conservation concern isn't a complete cut-off because it may well be that there are inferences that can be made from that work that would be equally applicable to species of conservation concern*" (CP4-2).

At the same time, it was mentioned that if a study does provide the methodology but results are not directly translatable, "*the conservationist is still left with having to perform that study on the species of interest or find a scientist and funding to do it*" (ME2-1). From this the question was raised: "*Is conservation relevance only [related to] the results which have some practical immediate use, or does it also apply to the results which you could use in modelling or additional work also, and only then it might provide a good conservation value?*" (ME4-3).

Some participants stated that presentation of new information was key to conservation relevance ("*sometimes for very obscure papers it took decades to be recognized as having very practical implications*" (ME4-3), "*when a work is robust and it does have some advances in understanding the process of what we observe in nature, this can become incredibly useful for conservation. It is just that maybe we don't see that immediately*" (ME3-1)).

Others felt conservation relevance required papers to describe specifically how the results could be used for conservation ("*the way things are in the world, in my mind everything has to be applied. There is hardly any time or funds left for non-applied research*" [CP2-2] and "*So many issues are that urgent, [therefore] we really need to be looking for fast responses, things that can be used in the near future rather than decades down the line*" [CP4-3]).

A third opinion that was voiced stated that a paper that has high conservation relevance must have research questions designed to address a conservation problem: "*I gave a higher score if the paper was aimed at conservation or if the authors directly had recommendations for conservation, but [still] if the paper would be able to yield some conservation impact for when conservationists would read the paper I would give it a few points for that.*" (ME2-1).

3.2 | Structured conversations and thematic analysis

All participants were keen to be involved in the project and the conversations, and they agreed with the notion that movement ecology and conservation have a lot to offer to each other, and that the full potential of collaboration between the two is currently not realized. In a collaborative effort to understand this gap, several themes came up in the conversations. Elaborating on these themes provides a starting point for understanding the research-implementation gap. The main themes we identified were: the definition of conservation relevance, drivers and motivations of individual practitioners, desired outcomes of tracking projects, and ways forward.

3.2.1 | Definition of conservation relevance

We detected within- and between-group differences in perceptions of the conservation relevance of particular papers. The papers that overall scored the highest on conservation relevance were either papers that used a conservation challenge or question as a basis for the study, or

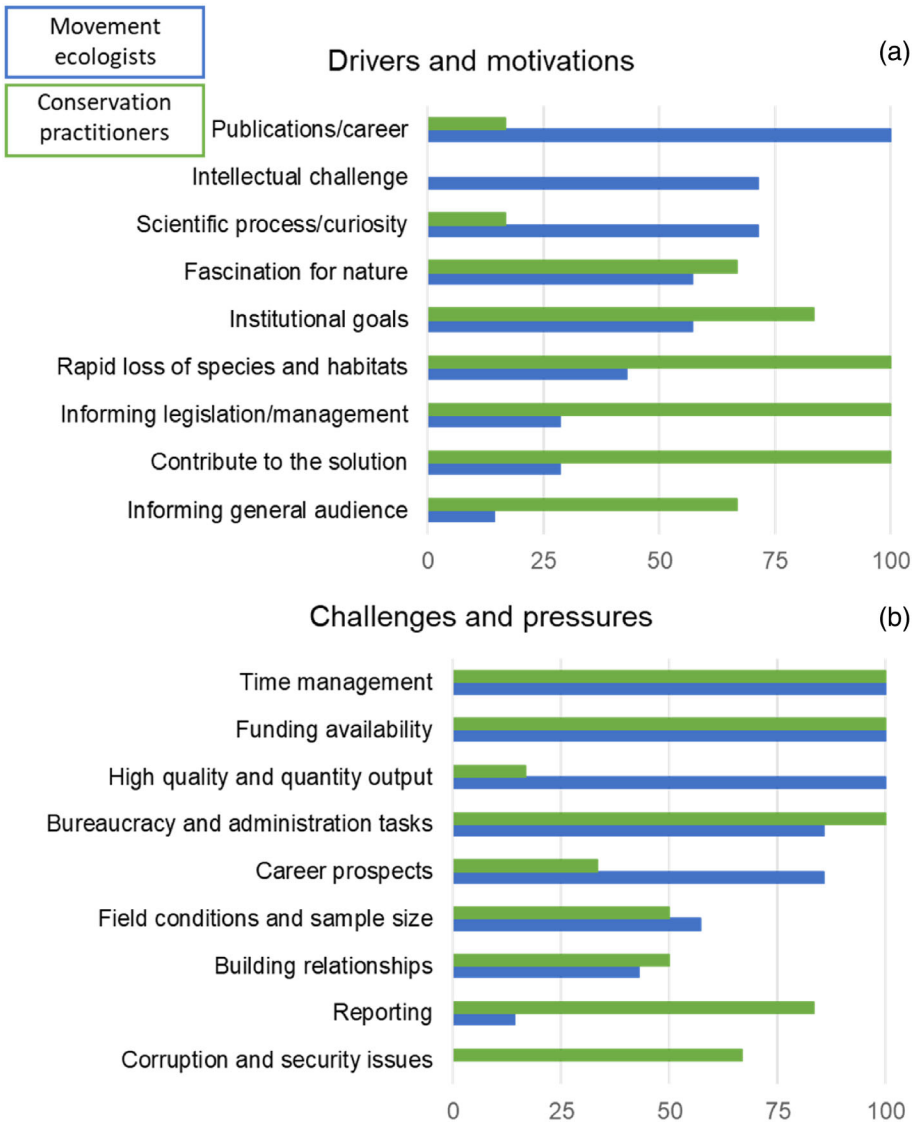


FIGURE 2 (a) Personal drivers and motivations; and (b) challenges and pressures, both as reported by movement ecologists (ME; $n = 7$, in blue) and conservation practitioners (CP; $n = 6$, in green). The x-axis shows percentages of the total of participants in a group that mentioned a particular topic. Topics are ordered based on movement ecologists' participant results

that presented their results in a way that linked to potential conservation action. Examples in this study were papers 8 and 10 (Appendix A). Both explicitly take a conservation challenge in a specific area as a basis for their research; either the co-existence of humans and wolves in Iberia, or the effectiveness of a designated conservation area for two species of endangered pinnipeds in the Galapagos. Apart from presenting the results of their studies, these papers also extensively describe why and how their results should be implemented at the management level to aid conservation initiatives.

Papers that spurred the most discussion were those that were not designed to address a specific conservation challenge, but did mention the potential relevance of the results for implementation. For example, papers 3 and 5 were considered purely ecological (presenting new information on pelican migration strategies or seed dispersal by toucans, respectively) but were scored highly relevant for conservation by some participants because this information might prove to be valuable in future conservation initiatives. Similarly, paper 7 presents new information on bat ecology and behavior. Text on the potential conservation relevance of these results is limited to a single sentence at the end of the abstract and the main text highlighting that "results are important for future conservation initiatives". Participants in our study disagreed as to whether this potential impact should count as conservation relevance.

Papers 6 and 9 created a different type of discussion. Paper 6 showed how migration and breeding success of Arctic geese respond to changing climatic conditions and consequences thereof for their breeding success (paper 6, Appendix A). One participant noted that "*understanding the climate change aspect is certainly of real value, but what can one do with that?*" (CP4-3). By contrast, another mentioned that "*anything that can have relevance on*

global climate change is quite important from a conservation perspective" (CP2-2). Paper 9 was also scored low because participants felt the small sample size affected both the scientific and conservation relevance.

3.2.2 | Drivers and motivations of individual practitioners

Our conversations highlighted differences and similarities in motivations, drivers, challenges, and pressures participants faced in their work. Movement ecologists were typically highly motivated by academic matters such as publications and career prospects, intellectual challenge, and scientific curiosity (Figure 2). Conservationists were motivated by collaborative progress toward a conservation goal, and were driven by the ability to inform the general public, as well as informing and influencing management and legislative decisions, and contributing to a solution to the rapid loss of species and habitats (Figure 2).

Despite these differences in perspective, both groups faced similar challenges and pressures, especially regarding the time and funding available to do their work (Figure 2). For the movement ecologists, producing a large quantity of outputs that were also high quality was another challenge, whereas conservation practitioners indicated that they were pressured by reporting burdens and corruption or security issues at their sites (Figure 2).

3.2.3 | Desired outcomes of tracking projects

For academic movement ecologists, desired outcomes of tracking projects were new insights into the species' ecology that could be presented in the form of a peer-reviewed publication. Thus, this group was concerned about sample sizes, data collection rates, and field circumstances that might interfere with data collection: "*aspects with very high conservation relevance might not have the potential to be published in these type of journals so academics cannot afford to do the work*" (ME5-3). For conservation practitioners, desired outcomes are data that reveal information on individuals, their habitat use and survival, for example in the case of reintroductions. The sample size was considered of less importance; information about a specific species, even if it is only collected from a small number of individuals, can prove useful in the further protection of that species. Although a scientific paper is not a key outcome for the conservationists, the value of published peer-reviewed results for conservation impact of a project was nonetheless perceived to be high: "*Conservation value can be limited if the science is weak*" (CP4-2). Conservationists often struggle with this: "*We were able to place three trackers on the species. The science relevance might therefore not be really high, but because we know very little about the species, the conservation relevance is really high. Now we have difficulties in trying to publish these results, because the science is maybe not meeting the expectations of the journal*" (CP3-3).

The peer-reviewed publication was seen by the participants as "the tip of the iceberg" of potential outputs of an animal tracking project. This final product is not only shaped by the initial project idea, the research questions, the methodology, and results. Other factors, such as the research interests of the principal investigator, lead author or research group and requirements of the funder or journal also have an influence: "*Some journals, if you insist too much on the practical conservation implications they would simply refer you to a different journal. This can be limiting*" (ME4-3). Together, these factors shape the "story" of the final paper and define the way the data are presented. This is however not always the actual story about how the study was designed and conducted, and in addition not always the full story. It was agreed upon by the participants that indeed there is often a "backstory" to tell about a paper, or additional results and conclusions not included in the output. Knowing this backstory made participants score either higher or lower on one of the axes in the scoring exercise (this happened for papers 1 and 3).

Conservation practitioners expressed frustration with the often slow pace of academic science: "*one of the weaknesses [of science] is the turnaround time. People want to act [for the conservation of a species] because they feel strongly about it. It doesn't help if you tell a bunch of really passionate people 'sorry you've got to wait three years because the journal is still reviewing my paper'*" (CP2-2). This can hamper their progress towards more applied goals, for example, if data are not available until after peer review, or usage of data (e.g., publication in reports) is restricted to allow for future publication in scientific journals.

3.3 | Ways forward—Potential solutions to bridge the gap

Part of the conversations revolved around potential ways to bridge the gap that participants experienced between their fields. This focused on three major areas: funder priorities, presentation of outcomes, and communication.

3.3.1 | Funder priorities

Participants from both groups indicated that obtaining funding was one of the main challenges of their

profession (Figure 2). This was primarily because of the time commitments involved, the uncertainty of outcomes, and, sometimes, the requirements of the grant once funded. Some funding agencies specifically fund research projects and are interested in scientific outputs of a project. This means that researchers can do less conservation and must make published papers a priority output: "*I have to publish a certain amount of papers in a certain type of journal as part of my contract"* (ME1-1). Other funders are less concerned about publications but still impose substantial reporting burdens (Figure 2). Finally, some conservationists felt that conservation funds were sometimes used to support research, as noted by one participant: "*This can be a real risk of abstract science trying to access conservation funding without a broader understanding of the conservation challenge. Researchers can be great academically and even if they think they understand conservation that tends to be limited to the ecology side of it, not to the broader aspect of policy development, applicability, social acceptance and everything else that constitutes conservation*" (CP4-2).

As a way forward it was proposed that funders and permitting bodies aimed at conservation work could benefit from more guidance on how research could best contribute to conservation: "*Not to say 'don't allow pure research', but if the researcher is looking to work on a species of concern or is justifying the work on a conservation basis then look to see what is the level of communication and what is the level of collaboration with in-country expertise*" (CP4-3).

3.3.2 | Presentation of outcomes

The way in which scientific results are often presented in peer-reviewed journals, with jargon, information-dense, and aligning to strict criteria for academic rigor, were seen as sometimes making them less applicable in a conservation setting. Several ways to improve communication of the conservation relevance of papers were suggested. To reach a broader audience of non-scientists and policy makers, a separate summary could be prepared: "*some kind of executive summary should also mention what a paper does not say might be quite relevant for policymakers*" (ME6-1), and "*maybe a general audience summary rather than a policy summary*" (CP1-2), because "*scientists are often trained to speak in an incomprehensible manner*" (CP2-2). The option of presenting additional summarizing documents with a paper, such as a summary for a general audience or policymakers, was also criticized: "*Politicians don't tend to go look at papers, we are looking at very short attention span people who want bullet points*" (CP4-3), and "*general audience summary should probably not be written by the academics themselves as they often don't know how to write this well*" (CP2-2).

3.3.3 | Communication

Movement ecologists and conservation practitioners are often already in dialogue, but this could be improved. Communication should ideally start as soon as possible in a project, even before framing the questions: "*First have a conversation and find out the burning needs*" (CP2-2), "*then do the science to fill those needs*" (CP4-2). At the same time, it was noted that it can be difficult to know the ideal time to start conversations. At the time of writing a project proposal, researchers do not know whether it will attract funding, so may not want to raise expectations. However, once funding is received there is sometimes little flexibility left in the project. In addition, it was mentioned that "*It [i.e. collaboration with practitioners in an early stage] might be slower in a sense, because it takes time to reconcile the views. Just starting with putting the data together and then seeing how we could use this for conservation purposes is faster*" (ME3-1). However, early communication "*is hard but it is by having different languages communicate that you can really make a leap [towards efficient collaboration]*" (ME3-1).

Ultimately, it was generally agreed among all participants that the key to effective collaboration was having "*shared and well-agreed goals and be[ing] patient and flexible*" (ME4-3). Likewise, collaborators should be "*willing to understand each other's pressures and backgrounds, and investments that are not necessarily seen very clearly when arriving at the collaboration, and respecting and acknowledging those*" (ME1-3).

4 | DISCUSSION

In terms of participants' ultimate goals (understanding and preserving nature) and willingness to collaborate, the gap between movement ecologists and conservation practitioners in our study was smaller than we had expected. However, in practice, substantial difficulties were mentioned that hamper effective collaboration, as is reflected by the relatively low percentages of movement ecology papers with relevance to conservation (Fraser et al., 2018; Katzner & Arlettaz, 2020). Most of the issues identified came from differences in motivations and drivers for individual professionals, as well as consequential differences in desired outcomes of tracking projects. Furthermore, even though these two groups do communicate, a lack of understanding of each other's starting point, lack of proper communication about each person's desired

outcomes and stakes (including those of external parties such as funders), and different paces of progress (immediate action or peer-reviewed publication) make collaborations between movement ecologists and conservationists prone to frustration or disappointment.

In this study, the scores for the peer-reviewed papers within a group varied almost as much as the scores between the groups. The movement ecologists tended to use a wider range of scores for scientific relevance, possibly because these academic professionals are more experienced with reviewing scientific papers and thus more likely to form strong opinions on the strength or weakness of a particular study. For the practitioners on the other hand, the fact that a paper had gone through peer review and was published was often considered sufficient to acknowledge its scientific relevance.

The definition of conservation relevance was a primary topic of debate in the conversations. Scientific publication is aimed at presenting new knowledge to unravel how the world around us works. In these publications, applications of that knowledge can be apparent or can be left to the imagination of the reader. All papers in the scoring exercise of this study were somewhere on that continuum. In some cases, results were tangible and ready to be implemented in a conservation setting, in others they were ready for use in further modeling or analysis (e.g., species distribution modeling) or eligible for translation to another study system (e.g., different species). Finally, in some of the papers we considered, the application was not apparent in the publication itself, but the new knowledge had the potential to become useful in the future. Participants valued these representations differently, resulting in the divergent ranges of scores for conservation relevance for most of the papers. Specific opinions were not confined to any one group. This suggests a broad range of definitions of conservation relevance might be found among other groups of people as well, including relevant stakeholders for research and conservation projects such as funders and journal editors. On a broader, overarching level, this could lead to biases and misunderstandings about the scope and decision-making of funding agencies and academic journals.

Many of the similarities and differences between the groups came down to differences in people's initial drivers and motivations, which most likely also led them to their current professional specializations. Although this might seem trivial, these different motivations and drivers define how collaborations take shape (Crewe et al., 2020), especially in the light of a research-implementation gap (Rycroft-Malone et al., 2016). For academic movement ecologists, especially early in their career, the pressure to publish and attract funding for future projects can create an attitude that is oblivious towards the (potential) conservation merit of the data or the conclusions. This can lead to them failing to properly share or communicate their results outside an academic audience. At the same time, passionate conservation practitioners fighting for the protection of a species that needs immediate action, are at risk of being short-sighted with respect to the value of peer-review, the time and effort it takes to conduct proper scientific analysis, and objective interpretation of the results.

Rewards in these two systems also probably influenced the perspectives of our participants. Although the system of ranking of papers, journals, and individual researchers by their academic impact is regularly criticized (see for example DORA, 2012), adhering to it still benefits academics' future careers and funding. In conservation, the name of the individual practitioner is, in theory, of less importance than collaborative progress towards a certain goal (the protection of a species or habitat). Despite this, over time conservationists might get well-known as individuals and this can have benefits in terms of funding, collaborations, and (political) influence as well. In this context, it was interesting to notice that whereas publication in high-ranking journals was important for the academics, the practitioners stated that they rarely look at journal impact factors or ranking when consulting scientific literature. Rather, they look at the subject and content to decide whether a paper is relevant to their project. This is in line with previous findings of similar exercises (Gossa et al., 2015).

The three main themes for solutions that were discussed in the conversations were funder priorities, presentation of outcomes, and communication. Broadly speaking, these topics are not surprising and have been put forward in other analyses assessing this topic (e.g., Gossa et al., 2015; Merkle et al., 2019; Walsh et al., 2019). However, operationalizing them requires systemic changes that go far beyond a single project, team or donor (Greggor et al., 2021). With respect to research funder priorities, requiring applicants to think in advance about how they will facilitate the flow of knowledge from research to implementation could be helpful. This happens in many cases in a general or abstract way (i.e., in the form of questions about the relevance of the research) but this could be made more concrete and specific (i.e., how is this relevance going to be realized). A specific suggestion from this study is that it may be beneficial to make an established connection with practitioners or local decision-makers in the area of the study mandatory in research funding applications.

The barrier between researchers and practitioners with respect to how research outcomes are presented has many facets. For example, the places where scientists are keen to publish their work (i.e., peer-reviewed academic

journals) are often inaccessible behind paywalls for practitioners. This can be addressed by open science initiatives (Roche et al., 2021), yet it remains to be seen whether researchers are incentivized to proactively engage with open science, whether funders will sufficiently support the higher fees often associated with open science, and whether practitioners will use the resulting platforms (Dubois et al., 2020). Sharing data would be a great start to supporting the aspirations both for scientific advances and for conservation applications (e.g., the Global Initiative of Ungulate Migration, GIUM, 2022; Kauffman et al., 2021). Another facet is the language (jargon) and abstract, conceptual, questions used in scientific papers that make the results difficult to interpret and less likely to be implemented in practice. A collaboration between researcher and practitioner from the start, in the phase when the questions are formed, can reduce this issue and lead to outputs that benefit both. This way, the results of the science can go on to form the evidence bridge suggested by Kadykalo et al. (2021).

This early start to collaborations touches upon the third suggested way forward in this study: early collaboration and trust-building by open communication (see Results). We mean not only communication about the practical agreements of a joint project, but also about people's motivations, drivers, investments, and preferred outputs from the project. Communication that engenders confidence that the project will indeed be able to serve both disciplines improves outcomes, and if the overlap is not complete, it highlights where the points of common ground and separate objectives are. Building the trust that is required involves starting this collaborative discussion at an early stage (Merkle et al., 2019). A potential way forward could be the drafting of a joint memorandum of understanding including motivations and desired outcomes of parties as well as commitments to engaging in open communication and involving relevant stakeholders. Similar recommendations were made by Pooley et al. (2014) with regard to collaborations between social and natural scientists.

Based on the results of this study, we now have a much fuller understanding of the gap between movement ecology and conservation practice and we have identified a suite of potential ways of bridging the gap. Next steps in this area should focus on how the potential solutions to bridge the gap can be implemented, and by whom this should be done. A priority would be to assess this topic in other, larger, and more diverse groups of scientists and particularly practitioners to ensure all views are considered (Luque-Lora et al., 2022; Nana et al., 2022). Our work suggests that there is goodwill, communication, and substantial overlap in the motivations of the movement ecologists and conservation practitioners. Building on shared aspirations and explicitly acknowledging and working through the implications of any divergences could lead to collaborations which are both effective for conservation and academically productive. In the end, both academic research and conservation practice can contribute to stemming the global loss of biodiversity; recognizing and enhancing synergies and breaking down barriers to effective collaboration can only help progress toward this shared goal.

AUTHOR CONTRIBUTIONS

RJMN designed the project, selected the literature, prepared and carried out the conversations, analyzed the data and wrote the manuscript. TEK and E-JMG co-designed the project and prepared and coordinated the conversations. AMA and IMAH contributed to the preparations of the third conversation. AIB, TB, LB, FC, TH, MAH, RMH, EMAK, BM, BN, DS, SMV, PW participated in the scoring exercise and in the conversations. All authors read and revised the manuscript, and agreed with this final version for publication.

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CONFLICT OF INTEREST

We have no conflict of interest to declare.

DATA AVAILABILITY STATEMENT

The data is presented in the text (quotes) and Appendix (scores). The conversation recordings cannot be distributed to third parties without contributors' permission.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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