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PRACTICE INSIGHTS

Co-Designed Projects in Ecological Research and Practice

Building spaces of interactions between researchers and managers: Case studies with wildlife monitoring and conservation in France

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Abstract

1. To document and halt biodiversity loss, monitoring, quantifying trends and assessing management and conservation strategies on wildlife populations and communities are crucial steps.
2. With increasing technological innovations, more and more data are collected and new quantitative methods are constantly developed. These rapid developments come with an increasing need for analytical skills, which are hardly accessible to managers. On the other hand, researchers spend more and more time on research grant applications and administrative tasks, which leaves fewer opportunities for knowledge transfer. This situation tends to increase the gap between researchers and managers. Here, we illustrate how to fill this gap by presenting two long-term collaborations between a research unit—Centre for Functional and Evolutionary Ecology; CEFE—and a national agency—French Biodiversity Agency; OFB.
3. The first example is a collaboration providing statistical support to national parks for the design and implementation of scientific monitoring protocols. It relies on the recruitment of a research engineer funded by OFB and physically based at CEFE, who works closely with OFB and managers. The second example is a collaboration on the management of large carnivores. For more than 10 years, it has involved several PhD students and post-doctoral fellows co-supervised by CEFE and OFB, and has recently resulted in the recruitment of a permanent OFB researcher who works half-time at CEFE and half-time at OFB. These case studies

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illustrate the modalities of collaborative work between public institutions acting at different levels of biodiversity conservation for the co-construction of research agendas and the exchange of knowledge.

4. These collaborations also bring out some challenges. Inter-knowledge and mutual learning remain difficult at scales larger than that of the teams concerned. The staff working at this interface needs to possess good listening skills, respect all partners' needs and demonstrate flexibility. Knowledge exchanges require time, thus reducing productivity according to quantitative metrics such as scientific publications or institutional reports. These collaborations can therefore be difficult to assume socially, and remain tenuous because they rely on a good understanding of the differences in governance of the various partners.
5. Based on our experience, success is favoured by long-term and close relationships, and by co-construction of projects at early stage. Sharing a space (i.e. office or building) facilitates face-to-face interactions during planned work sessions and casual meetings that build up a shared scientific culture and mutual trust.

KEYWORDS
boundary science, environmental management, research–implementation gap, science-conservation interface

1 | INTRODUCTION

To document and halt the biodiversity loss, essential steps consist of monitoring, quantifying trends and assessing management and conservation strategies on animal and plant populations and communities (Nichols & Williams, 2006).

With increasing technological innovations for biodiversity monitoring, more data become available to process, in large volume and high heterogeneity (Lahoz-Monfort & Magrath, 2021). Consequently, new analytical methods are constantly developed (Gimenez et al., 2014) fuelled by the democratization of remote sensors (e.g. camera-traps, drones) and genetic tools (e.g. eDNA). The development of methods comes with a need for new quantitative skills, which makes the gap between research and implementation even bigger (Cook et al., 2013), and more difficult to fill.

For managers: How to decipher the scientific methodological literature (Fabian et al., 2019)? How to navigate and keep up in the jungle of methodological options and decide which methods to apply and when? How to expand professional growth and learn to apply these methods?

For academics: How to keep up to date with manager's needs and questions when pushed to produce scientific knowledge over large spatial and/or temporal scales? How to focus the research on pressing questions with clear management applications? How to evaluate the efficiency of these methods, and whether they fill the needs?

Moreover, the time period dedicated to a project may differ between managers and academics. Managers who mostly answer to politic decisions usually have a shorter time period to complete their project with a fixed deadline compared to academics who usually have a longer time period to do their research with more relaxed deadlines.

To address these issues, we build on two recent proposals in the literature on the research–implementation gap. First, we adopt the re-formulation of the research–implementation gap not only as spaces between research and implementation (Toomey et al., 2017) but also as opportunities for interactions between academics and managers with shared interests but possibly different values. Second, we embrace the concept of boundary science (Cook et al., 2013) that favours a bilateral knowledge transfer, with science informing management actions and decision making on one side, and management needs motivating research questions on the other side.

In this paper, we illustrate how to build spaces of interactions between research and management. We present two case studies we conducted through a long-term collaboration between the Centre for Functional and Evolutionary Ecology (CEFE; academic/science—a public research laboratory mostly focused on basic ecological questions) and the French Biodiversity Agency (OFB; non-academic/management—a public institute dedicated to biodiversity protection and restauration, under administrative supervision of ecology and agriculture ministries) with biodiversity monitoring in national parks and management of large carnivores in France. These two specific examples highlight different ways of co-constructing monitoring programs. Note that the term 'managers' we use to refer to OFB employees encompasses several different profiles: field technicians, engineers as well as researchers working on applied management projects.

For each case study, we address the questions posed above, and underline the benefits for both managers and academics. We

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also emphasize the training of the new generation of early career researchers, and reiterate the need to incorporate social sciences in conservation biology (Mathevet & Marty, 2020). We also describe the difficulties and challenges we encountered. We close the paper by providing a list of recommendations to help build spaces and bridge gaps between research and implementation.

2 | CASE STUDY 1: BIODIVERSITY MONITORING IN NATIONAL PARKS

Eleven national parks exist in mainland France (Figure 1). Several threats such as agricultural mutations, pollution, invasive species and global warming affect the biodiversity occurring in these protected areas. It is thus crucial for national park managers to monitor abundance or distribution of some indicator species and to assess the efficiency of management (in)actions. The monitoring protocols they implement must be optimized by providing accurate and reasonably precise estimates of abundance or distribution while minimizing logistical and financial requirements (Yoccoz et al., 2001). They also require methods dealing with specific issues such as imperfect detection of individuals or species (MacKenzie, 2006; Williams et al., 2002) and rigorous sampling designs (Yoccoz et al., 2001). However, these methods are rarely transferred to national parks as highlighted by a study conducted back in 2009 in which we showed that among more than 500 scientific protocols implemented in French national parks between 1963 and 2012, 86% used sampling designs based on arbitrarily selections of sampling units, and none accounted for detection issues (Jailloux, 2010).

To deal with this issue, OFB and CEFE initiated a collaboration in 2018 aiming at: (i) providing methodological and statistical support to the national parks for the design and implementation of scientific protocols; and (ii) enabling a continuous transfer of skills, knowledge and methods to all managers of protected areas (Couturier et al., 2022). To achieve these goals, OFB has funded for the past 5 years a research engineer position physically based at CEFE to work closely with OFB and managers. His missions are:

- Helping managers to define precisely the scientific question or management objectives to be answered by the protocol.
- Carrying out bibliographic research on taxonomic groups and on existing methods to address the potential issues in the scientific and grey literature.
- Discussing with experts of taxonomic groups, mostly in the case of little-known taxa (e.g. carabids, earthworms, lichens).
- Discussing with technical staff in charge of data collection in the field to be aware of potential constraints and biases, with field trips systematically scheduled.
- Analysing existing data, or setting up a pilot study in case of no data. These pilot studies allow for collecting information on technical and logistical constraints, and on the detection of species. They also provide initial data sets to be analysed and to perform statistical power analyses.
- Writing a detailed methodological report for each protocol, as well as scientific papers.
- Communicating through web pages <https://professionnels.ofb.fr/fr/node/400> of the OFB website to provide information about the protocols implemented and to make the methodological reports produced publicly available.

A committee led by OFB has been set up to accompany the research engineer. After a support focused solely on national parks, this OFB-CEFE collaboration has been going on since 2020 to other networks of French protected areas such as regional natural parks, natural reserves, etc. Since 2018, nearly 30 protocols have been set up within the framework (Couturier et al., 2022).

One of the designed protocols aimed at studying the effects of climate change on orthopteran communities within the Mercantour and Ecrins National Parks, in the Southern French Alps. Several meetings between national parks' managers, CEFE and an orthopteran expert made it possible to define the scientific questions and the associated methods (e.g. sampling strategy, field data collection). The National Parks managers provided orthopteran historical data, knowledge of the field and logistical constraints. The CEFE research engineer provided methodological and statistical skills and the orthopteran expert provided naturalist knowledge and technical skills for data collection in the field. The data collected were analysed by a Master degree intern, contributing to his training. This collaboration thus enabled everyone to increase their skills, and resulted in the publication of a report (Couturier et al., 2020) and methodological scientific papers (Mourguiart et al., 2020, 2023).

The collaboration between OFB and CEFE also focused on the network of marine protected areas (MPAs) of the French Mediterranean Sea. A PhD student hosted at CEFE adopted a social sciences approach to identify the main constraints of monitoring

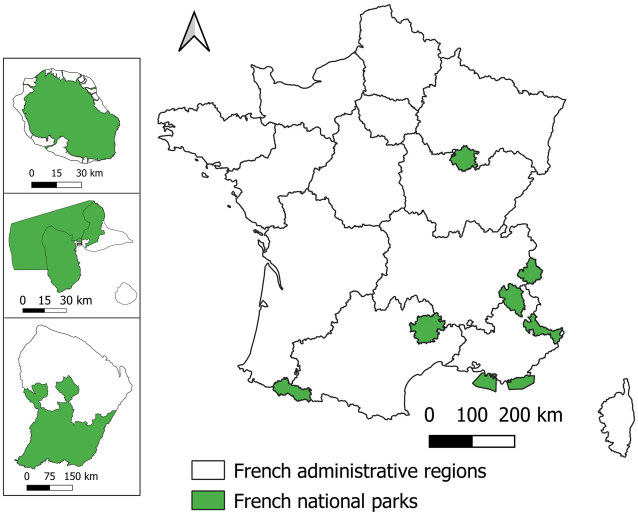

FIGURE 1 Location of the French national parks, where the OFB-CEFE collaboration has provided support for the implementation of biodiversity monitoring protocols. In the left column are three overseas department: Réunion (top square), Guadeloupe (center square) and French Guiana (bottom square).

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marine species within a network of MPAs (Lauret et al., 2022), and developed statistical tools to make the most of ecological data collected at the scale of the Mediterranean Sea by the multiple MPAs coordinated by OFB (Lauret et al., 2023, 2021).

3 | CASE STUDY 2: LARGE CARNIVORE MANAGEMENT

Today, three large carnivore species are present in mainland France (Figure 2): the grey wolf *Canis lupus*, the Eurasian lynx *Lynx lynx* and the brown bear *Ursus arctos* (Chapron et al., 2014). They are all protected at the European and French national levels. OFB monitors these species and defines and implements management actions following government policies, both regarding the conservation of the species, as well as the management of their conflicts with human activities, mainly related to pastoralism.

Analysing monitoring data to evaluate conservation status and developing conservation or mitigation measures require quantitative approaches. In this context, a long-term collaboration has taken place between OFB and CEFE since the 2000s. Importantly, OFB does not act as a mere data provider nor CEFE as a mere data analyst, there is collaborative work between the two institutions, with multiple interactions between OFB and CEFE staff, which results in benefits to both parties. Research questions, hypotheses and deliverables are jointly defined. Data analyses are performed with regular meetings to ensure the proper use of data in relation to the analyses.

An example of such collaborative projects is the study of lynx road mortality and the development of management actions to avoid, reduce or compensate this source of mortality. The objective of this project initiated in 2018 was to provide a predictive tool to evaluate the impact on lynx viability of different road and landscape management actions. The tool includes a simulation model projecting lynx viability regarding road and landscape characteristics, coupled with a user-friendly interface to allow users to create and test management scenarios. In this project, CEFE provided expertise in statistical analysis and modelling, while OFB provided data on lynx presence and mortality, and its expertise on the species biology. The project benefited from this diverse team with complementary skills. One institution alone would have struggled to complete the project and the different skills and knowledge of every partner proved to be valuable at the end. Moreover, to develop a tool that would be as useful as possible for local stakeholders, we organized several workshops. The team project presented the models and interface to local stakeholders and considered their knowledge and comments to improve the model structure and the interface user-friendliness. These workshops proved to be valuable to build a reliable and useful tool, highlighting the necessity of complementary knowledge.

Aside from this project and regular collaborations, there have been many PhD students, post-docs and interns with research subject on large carnivores co-supervised by CEFE and OFB, which has led to scientific publications with the application or development of quantitative tools to assess population dynamics (Marescot et al., 2012) or connectivity (Kervellec et al., 2023), estimate population size (Blanc et al., 2013; 2014; Cubaynes et al., 2010; Vanpé et al., 2022), growth rate (Marescot et al., 2011) and distribution (Louvrier et al., 2018; Piédallu et al., 2019) and refine management strategies (Grente et al., 2022; Marescot et al., 2013). This work has influenced the management of large carnivores in France, and has provided sound population monitoring tools and robust statistical methods to estimate abundance and trends in large carnivore populations, which can be particularly prone to political influence (Darimont et al., 2018) and stakeholder scepticism.

Recently, the collaboration between CEFE and OFB on large carnivore management got even stronger with a researcher hired by OFB and hosted at CEFE once every 2 weeks, therefore working closely with both institutions. This permanent position will insure the sustainability of the collaboration in the long term.

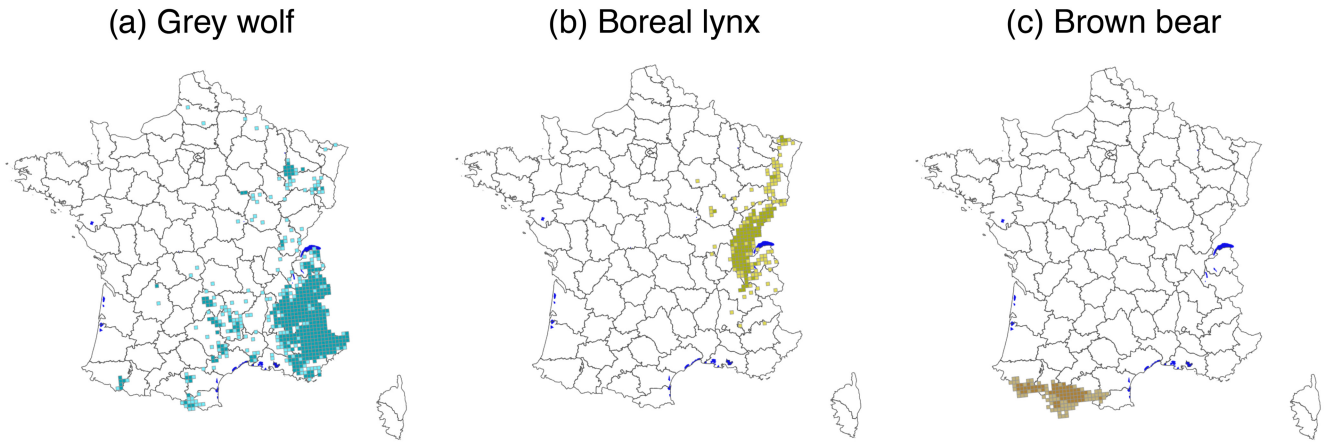

FIGURE 2 Regular and occasional presence in 100 km^2 gridded map in France for (a) grey wolf in 2020 (dark and light blue respectively), (b) boreal lynx in 2020 (dark and light yellow respectively) and (c) brown bear in 2021 (dark and light brown respectively). OFB data freely available online at https://professionnels.ofb.fr/fr/node/1089.

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4 | BENEFITS AND CHALLENGES

These two case studies illustrate two modalities of collaborative work between public institutions acting at different levels of biodiversity conservation. They correspond to two possible levers of actions defined by Gordon et al. (2014) to strengthen links between staff from institutions involved in conservation area: (i) the co-construction of research agendas; and (ii) knowledge exchange.

The co-construction or co-production (sensu Caro et al., 2022; Hyman et al., 2022) of research agendas here mainly refers to the co-definition of appropriate research questions to address the problems determined by managers (Merkle et al., 2019) while being scientifically relevant. They are therefore based on a solid understanding of management issues, the extant literature and scientific methodology. Connecting research and management early in the process results in a more collaborative, integrative and efficient approach to the research and the integration of the results into the management (Merkle et al., 2019).

The knowledge exchange in our case studies is supported by the existence of staff at the interface between research and management institutions, either through the alternation of the schedule in both institutions or through field experiences shared with managers (Fabian et al., 2019). This contributes to building up a shared scientific culture between both institutions, with higher knowledge of issues related to management decisions, fieldwork constraints, but also scientific approaches, including literature research, hypotheses development, use of statistical methods, etc.

These two levers of action—the co-construction of research agendas and knowledge exchange—generate mutual benefits, by responding both to the needs of managers and to the production of scientific knowledge. They also lead to the emergence of new applied or more fundamental research questions, possibly involving interdisciplinary approaches crossing ecology, statistics and social sciences (geography, ethnology and psychology; e.g. Chandelier et al., 2018; Piédallu et al., 2016). These research topics may offer opportunities to train PhD students who will, as future generations of professionals, enhance wildlife management (Cook et al., 2013).

These collaborations also bring out some challenges. Building up a shared scientific culture remains difficult at wider scales than the teams of the institutions concerned. For instance, the productions carried out by these two case studies, even if accessible through specialized website in national language (e.g. technical portal https://professionnels.ofb.fr/fr/node/400) thus following the recommendations of Fabian et al. (2019), do not easily disseminate to the manager community.

Another challenge is the evaluation of academics and the use of impact factors (IF; Garfield, 2006) to gain a position or be promoted. The pressure to publish—often referred to as 'publish or perish' (Garfield, 1996)—leads academics (in particular early career researchers; Niles et al., 2020) to value journals with high IF which are more oriented towards basic or focus on ecological problems without clear management applications rather than applied research. How to cure this IF mania (a 'medical' condition discovered by Casadevall & Fang, 2015)? There is a need to reform the evaluation of academics for employment and career advancement, acknowledging that 'impact does not necessarily equal importance' (Casadevall & Fang, 2015). There has been recent progress in that direction, notably through the development of open and responsible research. One example is the San Francisco Declaration on Research Assessment (DORA), which was signed by CNRS in 2018, calling for researchers, publishers, administrators and granting agencies to no longer use journal-based metrics (including IF) for research assessment, but to "consider the value and impact of all research outputs (including datasets and software) in addition to research publications, and consider a broad range of impact measures including qualitative indicators of research impact, such as influence on policy and practice" (https://sfdora.org/read/).

Last, staff working at this interface require good listening skills, respect for all partners' needs and flexibility (Merkle et al., 2019). Knowledge exchanges also require time, thus reducing the 'productivity' according to quantitative metrics such as scientific publications (see previous paragraph; Arlettaz et al., 2010) or institutional reports redaction. These collaboration modalities can therefore be difficult to assume socially for this staff in their respective working environment, and remain tenuous because they rely on a good understanding by the governance of the institutions of their added value.

5 | RECOMMENDATIONS AND CONCLUSIONS

There are a few elements we believe are essential to achieve a successful collaborative work between researchers and managers. First, the relationship should be long term. Working on a single project together is not enough to benefit from the full potential of the collaboration. With time, trust becomes stronger and each partner better learns the different skills and expectations of the others, making the design and achievement of subsequent projects more efficient. Second, projects should be co-constructed (Caro et al., 2022; Merkle et al., 2019). Projects should not be managed by one instance with the other one being a service provider. Projects should be defined together where the role of each collaborator is made explicit and accepted by everyone. Here, communication between parties is the key, from the start to the end of the project (Gordon et al., 2014). Third, partners should have regular in person and/or remote and/or hybrid meetings (Hyman et al., 2022). Trust and knowledge during a long-term relationship can only arise through regular interactions. Similarly, achieving good communication throughout a project can only happen with regular interactions to readjust or reinforce elements defined at the start of the work. Predefined weekly or monthly meetings help keep the regularity of the communication as each person and each institution's schedule are likely unaligned. Finally, sharing a space (i.e. office or building) facilitates and reinforces all previous points as well as it provides new learning opportunities for all (e.g. scientific presentations, casual discussions,

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trainings). Face-to-face interactions during planned work sessions as well as casual meetings (e.g. coffee breaks, social events, fieldwork) are easier and more frequent when sharing the same space. Inter-knowledge and mutual learning are largely fostered by informal exchanges during off times such as coffee breaks (Tam, 2019), lunch breaks, afterworks, etc.

Shared spaces hosting people from different institutions have proven to effectively reduce the gap between research and implementation (Cook et al., 2013). Having employees from different institutions interacting closely with each other, and with multiple institutions is very valuable, both for the work these agents perform as well for the other members of the institutions. Besides its collaboration with CEFE, OFB has formalized a form of space sharing that should be encouraged. In these so-called research and development clusters, OFB managers are hosted in research institutes or universities to work closely with academics on applied research questions (e.g. in ecohydraulics, Guiot et al., 2023, on the ecology of lake ecosystems, Salmon et al., 2022, or on fisheries management, Drouineau et al., 2021), and support public policies on water and biodiversity by identifying priority scientific and technical needs.

Closing the gap between scientific research and field management is possible, as long as the two parties are willing to build a strong relationship. It is mostly up to the people, rather than their institutions, to make a step towards the others. Finally, even if these kinds of collaboration have professional objectives, good personal relationships between people are as much important in the success of the projects.

AUTHOR CONTRIBUTIONS

Olivier Gimenez and Aurélien Besnard conceived the ideas for the manuscript. All authors contributed to writing, with Thibaut Couturier and Sarah Bauduin leading. All authors contributed critically to drafts and gave final approval for publication.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

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Our manuscript does not include any data.

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