GUIDES TO BETTER SCIENCE

INTERDISCIPLINARY RESEARCH

BRITISH ECOLOGICAL SOCIETY

Contents

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British Ecological Society
britishecologicalsociety.org
hello@britishecologicalsociety.org

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Guide design by Cylinder.

Foreword

Jane Memmott, BES President

Few of the big environmental questions that the world currently faces can be solved by ecologists alone, rather we need to work closely with other disciplines such as social scientists, engineers, and agronomists.

Traditionally, interdisciplinary work has tended to be the preserve of early career researchers who are up for an adventure, and for late-career researchers with established careers who can take a risk, with those mid-career professionals being wary of the approach because of career pressures and the fact that it's less risky to fund and publish research within a single discipline. Looking forward, this needs to change for three reasons. First as stated above the really big environmental issues, for example, climate change, the biodiversity crisis and producing food sustainably, require an interdisciplinary approach. Second, we could learn a lot about ecology by considering it within a bigger picture, for example how it links to the social sciences, geography and oceanography. And finally, working on interdisciplinary projects is a lot of fun - it's tremendously interesting and exciting to work with people who think and solve problems using different approaches.

This BES guide to interdisciplinary working provides an excellent starting place for working in this field - and while the focus is on working with social scientists, the general principles extend to any discipline. We really hope you find this guide useful and good luck with your project. And if you're looking for a home for your interdisciplinary research, then check out the BES journal *People and Nature*, which publishes work at the hotspot where ecology juxtaposes with other fields of research.

Authors:
Lydia Cole and **Althea Davies**, University of St Andrews.

Introduction

Why do interdisciplinary work?

Many messages emerging from scientific panels on the state of biodiversity, climate change and the planet emphasise the importance of greater integration between disciplines. But there's no textbook to read before diving into interdisciplinary work. As a result, many interdisciplinary groups learn 'on the job' rather than starting with critical awareness of how to implement best practice and avoid common pitfalls from the start. Cue....this guide!

What is interdisciplinary work?

Engaging in interdisciplinary projects is becoming increasingly necessary to solve complex global challenges. But what does an interdisciplinary project involve? And how does it differ from cross-, multi- or transdisciplinary endeavours? The names may be used interchangeably, but a good rule of thumb is to think of these approaches as a gradient in terms of who is involved and how they work together.

Table 1. Common approaches to research projects involving more than one discipline, from an ecological science perspective. Note that the nature and degree of disciplinary integration under each approach may vary between disciplines.

Approach	Who is involved and how do they work together?
Multidisciplinary	Two or more academic disciplines working **in parallel** to meet multiple disciplinary goals, exchanging and borrowing ideas between the different disciplines, usually with the aim of comparing results
Interdisciplinary	A more **integrated** approach, synthesising ideas across two or more academic disciplines which may have contrasting research paradigms, so that they cross disciplinary boundaries and create new knowledge to answer a common question
Transdisciplinary	**Collaboration** between academic disciplines with contrasting research paradigms as well as non-academic partners to develop common goals, generate novel perspectives and seek transformative outcomes. High levels of participation are key throughout
Cross-disciplinary	A general term for research that involves two or more disciplines

Introduction

Who is this guide for?
This guide is designed primarily for ecologists embarking on work with social scientists; an increasingly common approach in recent years. However, many of the principles and strategies are applicable to anyone engaging in an interdisciplinary project, across topics and geographical contexts. Chapter 10, Lessons from other worlds, provides insights into interdisciplinary working within human geography and business management, sectors with a longer history of working across disciplinary boundaries.

What won't you find in this guide?
Non-academic partners are of great importance in applied ecological projects, but we do not cover transdisciplinary or participatory research involving collaboration outside academia. Understanding the tools and strategies for effectively and equitably working with the public, policy and other non-academic communities deserves a full guide in itself.

In summary...
Interdisciplinary research is a partnership. This guide distils the main challenges that an ecologist might face when embarking on an interdisciplinary project for the first time. Its goal is to empower a generation of truly interdisciplinary ecologists, of all career stages, by providing you with the tools and confidence to manage those challenges and become a more effective interdisciplinary researcher.

"Most disciplinary collaborations develop from chats over coffee, hanging around one another's office doors and catching up at meetings. They typically build on, and follow from, developing relationships. Interdisciplinary collaborations need to become natural; the challenge becomes one of giving people the opportunities to interact - hence why the university coffee shop is often the most important space. The simplest piece of advice to give people to help them develop interdisciplinary projects is to put themselves in situations where they get to know people from other disciplines and get interested in what those people are doing."

- Kevin Gaston, Editor-in-Chief, People and Nature

Before you start - checklist

Why do you want to do interdisciplinary research?

Many global and local ecological issues are intertwined with human lives and livelihoods, but not all projects should be interdisciplinary. It's useful to consider this question from three perspectives to decide if your topic would benefit from an interdisciplinary approach:

- The research problem: Einstein is often credited as saying that we cannot solve problems using the same mindset that created them. Examining long-running or new issues from multiple perspectives can generate a fuller understanding of the problem by recognising complexity from the outset.
- Research partners: It is essential to establish the relevance of both the ecological and social aspects of your project because superficial inclusion will weaken the work and potentially lead to conflict.
- You, the interdisciplinary researcher: Being an interdisciplinary researcher can be stimulating and challenging, so having an open, adaptive mindset is a real strength for leading or taking part in interdisciplinary work.

Where do you begin?

Developing an interdisciplinary project can feel like a circular problem: should you define the issues first (to drive the proposal) or identify the team first (to incorporate appropriate expertise from the outset)? We recommend that you:

- Start with an issue or question that has strong ecological and social dimensions, and then build a team to address it.
- Discuss the idea initially with one or a few researchers in another discipline. These safe explorations of ideas help create the shared ground needed to develop a joint application and set clear expectations for how each discipline might contribute.
- Expect that your initial question will be adjusted with input from multiple disciplines.

What's in it for you? Interdisciplinarity as a career choice

At times, interdisciplinarity can feel uncomfortable, but this provides an opportunity for learning and skills development that can make you a more effective researcher.

- Initiating or leading does not mean you are the 'expert': any interdisciplinary project involves a variety of experts, each contributing to shared goals.

Before you start - checklist

- Involving others and learning how to see an issue from different angles is one of the great benefits of interdisciplinary working because it encourages you to articulate the complexities and implications of your work in ways that can connect with multiple audiences.
- Interdisciplinary project discussions may feel a bit like an interrogation at times but having to explain your chain of reasoning can give you a deeper understanding of your own science.
- More journals in ecology and conservation are open to interdisciplinary contributions, with several explicitly interdisciplinary in focus. This creates more opportunities to develop a track record in interdisciplinarity.

Building a strong funding application

How to manage risk & innovation in interdisciplinary applications

Obtaining funding is often the first hurdle which determines if and when your career might take an interdisciplinary turn. While numbers of interdisciplinary papers published have risen and interdisciplinary funding schemes are more prominent, the statistics about funding success for interdisciplinary work are less positive. As a result, we offer both short- and longer-term guidance on engaging with funders and building a track record to support your interdisciplinary proposal.

Two reasons often cited for lower funding success are risk aversion by funders and the difficulty of convening appropriately qualified review panels to evaluate proposals. Many funders are wary of investing in untried approaches, where it can be difficult to know what the best research questions are or what goals are realistic and achievable at the outset. To tackle this we recommend that you:

- Make pre-submission enquiries to check on a funder's approach to reviewing proposals, to understand how they balance disciplinary excellence and interdisciplinary innovation, and to seek clarification on the funder's level of risk tolerance.
- Set time aside to identify key risks and explain mitigation strategies in a proposal to reassure funders of your preparedness.
- Build on previous efforts by team members or from relevant research to outline how the work will advance knowledge and in what ways, and make sure that your explanation is accessible to experts from the range of fields who might be reviewing your proposal.
- Crucially, be explicit about how your proposed research is addressing a gap in knowledge and how the blend of skills that you bring can address that gap.
- Explain what leadership and communication strategies are in place to promote group cohesion and adaptation. Where possible, include someone with prior interdisciplinary experience in the team.
- Research councils periodically call for reviewers so consider putting yourself forward to gain experience and to represent interdisciplinary interests.
- Provide feedback to funders and institutions to encourage more financial and institutional support for interdisciplinary projects and the real-world problems that they address. This can ensure that the unique requirements identified during interdisciplinary projects stimulate wider learning and support for such work.

Building a strong funding application

Demonstrate your suitability

Team effort and collaboration are central to interdisciplinary research. Obtaining funding can be especially challenging for early career researchers with smaller research networks and a limited track record of funding success to build on.

- Mentoring from more experienced single or interdisciplinary researchers can provide valuable support. Look into mentoring opportunities provided by your institution and organisations like the BES.
- Some institutions may also support cross-disciplinary events or networks to help connect researchers with shared interests.
- Using digital outreach formats like blogs can strengthen your scientific and non-specialist communication skills, as well as showing your willingness to step beyond disciplinary cultures and publication formats. Many BES Special Interest Groups, for example, welcome blog posts from members.

Building a team

Funding your interdisciplinary research is vital, but even before you have secured the financial resources, it is important to start gathering the human resources. Building an effective team can be the central factor that determines success in an interdisciplinary project. Gathering a group of trusted co-workers as an interdisciplinary idea evolves can contribute to the development of a compelling research proposal.

Who should/could lead the team?

Strong leadership is essential to coordinate a diverse team and multiple outputs, whilst maintaining group focus on shared goals. Here are some characteristics that an effective leader might possess:

- **Experience in accommodating & nurturing diversity**. You don't have to be an expert in a particular subject area, but you do have to be experienced in managing a mixture of people. Patience, open-mindedness, assertiveness and humility enable a leader to manage a diversity of characters and challenges, and instil confidence in the team.

- **Experience in managing conflict**. A leader must have the skills needed to diffuse and work through disagreements within a group, and to decide which topics require consensus from the start and which may lead to mission drift.

Mission drift: The pursuit of activities within a project that do not satisfy the original goals, usually due to identification of and enthusiasm for exploring additional important avenues, which may be discipline-specific

- **Creators of safe spaces for exchange**. When working with researchers at different career stages, from different cultures, genders and with differing levels of confidence and experience, it can be hugely beneficial if a leader can create a safe environment for people to share ideas and ask questions. A key part of this is being able to listen and to understand when everyone does or doesn't have a shared understanding of the situation, and to rectify that, leaving no one behind.
- **Level-headed and adaptable**. At key points in a project, it may be important for the leader to make a judgement about changing the direction of the work plan or pace, or potentially even the project's goal, in order to respond to emerging findings, to accommodate new team members or to prevent a project from stalling.
- **Support disciplinary diversity**. Including all relevant disciplines from the early stages of project development will allow more realistic planning. The leader must appreciate what they don't know, especially when it comes to the specific details of each discipline within the project; and consider the varied career stages of the different members of the team, being sensitive to their career and disciplinary needs.

Although the information presented here assumes that you have a leadership role, many of the principles still apply if you are a member of the team. An effective team involves a balance of decision making between members and team leaders.

What are the key factors to consider when picking your team?

When putting together an interdisciplinary team the lead may find that they need to bring in expertise, disciplines and people that they are unfamiliar with.

- Look for team members who are interested in working with and are respectful of the different disciplines involved, and who take the time to consider and contribute to the overarching goal of the project.

Building a team

- Do not assume that more experience in a given discipline is a good thing. You may know an outstanding expert, but they may not be interested in the bigger picture of the project, or they may not communicate their own research in an accessible way. It may be better to have someone with less experience but a broader outlook.
- Remember that no one person embodies an entire discipline and it can take time to find a suitable disciplinary representative for your team/project.

A key factor to consider in any research project is the involvement of researchers local to the environment under study. Globally, the geographical distribution of ecological research and publication is skewed towards researchers based in the Global North. You should involve local researchers to build local capacity to perform and lead research, to redress existing geographical biases, and support intellectual input from diverse perspectives.

Activities to help build and maintain cohesiveness and effective team work throughout the project:

- Write an early joint publication to provide an immediate shared goal, and alongside this, develop an agreed publication strategy with an emphasis on inclusivity.
- Encourage all team members to keep a record or diary of what works well and what works less well, and share examples with each other.
- Collaboratively develop a project-specific dictionary.
- Visit a field site and ask each team member to explain what they see and understand about the site - listen to and explore the differences.
- Create opportunities to get to know each other outside of the usual work place, e.g. outreach and STEM events are valuable as they place people in an impartial space, often outside their comfort zone, and create a shared experience.
- Jointly develop and regularly revisit a Gantt chart – if an activity is struggling, be proactive and do not be afraid to change direction if needed.

Designing your project

Collaboration from the outset

The first steps in developing an interdisciplinary project are critical and involve developing a joint approach as well as building a coherent team. While the initial idea for a project may come from one or few individuals, widen the discussion early and involve relevant disciplines in initial planning stages. This has multiple benefits:

- It recognises that team members often start from differing positions, with different motivations or expectations. This can include assumptions or misconceptions about one another's disciplines. Developing the project rationale and research questions iteratively – through open discussion, questioning and revision – can generate mutual understanding and accommodate epistemological pluralism (multiple ways of knowing).
  Do not underestimate how challenging it can be to achieve consensus on research questions and approach: take time in the initial stages of a project to have these discussions.
- Developing research questions and goals with input from the desired disciplines avoids the most common (and justified!) complaint about interdisciplinary environmental research: that social science is involved in a superficial way to help communicate the natural science and facilitate uptake of research outputs. Discuss the relationship between natural and social science evidence from the start and decide, as a group, what role each set of information will play to address any prejudice or unacknowledged hierarchy associated with the different types of evidence.

Take time to understand the bigger picture

Begin with a review of the relevant literatures across disciplines to ensure that all team members, especially project leads, have a thorough understanding of the context from all disciplinary angles, to help to identify research gaps and an overarching hypothesis or research questions. This is never a waste of time! It provides context for the whole team, avoids duplicating existing findings or pitfalls, and will be essential when writing up your research.

Plan for flexibility when designing methods

It can be difficult to specify the precise methods that will be needed to fulfil project objectives or the likely outputs, particularly when a project involves human perspectives and behaviours that have a bearing on ecology, but which have yet to be studied. Outline methods that are considered most appropriate to the socio-

ecological context (i.e. social science approaches, ecological survey design) and state that the precise choice will be determined following preliminary engagement with stakeholders. Having this outline indicates the likely direction of travel and the disciplinary expertise that will be required. It helps with risk management and indicates preparedness to adapt: both are important considerations for funders.

Developing interdisciplinary questions takes time

Designing a highly inclusive interdisciplinary project takes time and patience. Estimating time requirements can be difficult, both at the start and throughout the project. A suitable timeframe must allow for open discussion from the outset, regular communication throughout (see p15), and recognise that some forms of data take longer to generate than others. Aligning contributions from the various disciplinary perspectives also requires careful planning (see p19).

Communicating

Communication is perhaps the most important component of any effective community. Interdisciplinary communities are no different. It ensures that you have a shared understanding of project goals, of timelines, of individual and group aspirations, of inevitable challenges and of changes to all of the above. As a result, regular and clear communication is key. It is not, however, easy.

Develop a shared language

Each discipline brings with it a culture and a language, complete with specific words to describe objects and concepts that may be alien to others or may be familiar under a different name. It is vital to find a shared language amongst all members of the team. Developing a shared glossary or wiki of key terms can help achieve this. It provides a learning resource and a reference to return to, for example, between early planning stages and later writing, to avoid mission drift.

Create safe spaces to ask questions

Developing a shared language is just one step towards understanding everyone's perspectives but communication goes beyond words. It is essential to create an environment where:

- People feel safe to share their approach and are open to differing approaches to common questions.
- Everyone is encouraged to ask and answer all questions to avoid misconceptions and assumptions, explore different forms of knowledge and to actively break down any deference towards a particular project discipline.
- Individuals are encouraged to feel confident in acknowledging and communicating the strengths and weaknesses of their own discipline.

If an external facilitator can be employed to help create a space and culture of trust initially, or at any point during the project, this can prove a hugely valuable opportunity to prevent or manage conflict.

Communicating

Establish a communication strategy that serves everyone

Every project should have a communications strategy. The box on p17 provides an overview of a strategy developed by a large, international and interdisciplinary project. The strategy must be developed by the whole team to promote uptake and effectiveness, and it must be in place from the start, creating a schedule for regular and clear exchanges on all aspects of the project.

- It is important to revisit the strategy often, monitor efficacy and adapt it if and where needed.
- Think creatively and collectively about how effective communication can work, especially where it must happen in an online environment. How can informal spaces be created for building and nurturing relationships? If you are collaborating across time zones and cultures, consider who cannot easily communicate online. Who might be missing out or unfairly gaining from your communication strategy? Learn, share findings, adapt as a community and ensure no-one is left behind.
- Effective and equitable communication is the responsibility and priority of everyone on the team, following the direction of the team leaders.

Communicating

Ideas for building communication

Reading groups - reading literature from other disciplines helps you become familiar with their vocabularies, writing conventions and epistemologies and encourages team members to teach rather than just present their disciplinary perspective.

Field visits, away days and work-place shadowing – where project meetings can be held in person, rotate the venues to help equalise opportunities across the team. Team field visits can stimulate questions and conversations that might not happen in a formal, office setting.

Newsletters - where reading groups and face-to-face meetings are not possible, other forms of regular communication are essential. A newsletter can be used to communicate appropriate news and views to the mixed audience, with space for a glossary of specialist terms.

An example communications strategy
(extracted from the Sentinel Top-Line Communications Strategy)

The Sentinel Project **(https://www.sentinel-gcrf.org/)** has an overarching communications strategy (co-created by all project colleagues) "to support the Sentinel project objectives in all focal countries (Ethiopia, Ghana, Zambia and the UK) and globally". Nested within that are country-specific communications strategies. The strategies are "designed to support [the] geographical emphasis [of the project] as well as to ensure the best possible impact for the project's three objectives... Each communications strategy will present a mix of activities that address four kinds of communication needed for maximum impact... The first two sets of activities are more focused on engagement, building an enabling environment and responding to policy demand. The second two are more about making sure information is available, that the project is transparent and accessible and builds legitimacy."
Further information can be found at **https://pubs.iied.org/17096iied**.

Collecting, analysing and synthesising data

Ensuring a smooth process of data collection, analysis and synthesis requires thought and planning, especially when working in an interdisciplinary team. The more planning that can go into this, the better! The worst possible situation is to rush out to collect data, and then realise you collected the wrong kind, have no idea how to analyse or integrate it with other disciplines, or to discover when you're writing it up that someone has done this before and better...

Case Study: Juliette Young talks about her experiences working on TRANSFORM and how useful developing a theoretical framework was for creating a shared understanding of the goals of the project, and in deciding on methodologies and analysis techniques to adopt.

"As part of a recent project that aimed to understand the role of conflict in transformations towards more sustainable agriculture, we developed our theoretical framework based on our overarching hypothesis and then split this into three hypotheses, and smaller research questions (for example: What is the vision of a more sustainable agriculture and the steps to get there held by the current actors in the conflict?). This really helped clarify what kind of data were needed, what methodologies to use to best obtain that data, and how to analyse it. We ended up selecting three methodologies: semi-structured interviews, a Social Network Analysis and Transformation Labs. The analysis is also much easier with a strong foundation. Taking the example of the interviews, the majority of our codes were already in place before any interviewing took place. We of course added a few when we started coding, but we already knew, from the literature, what we could expect to find."

Analyse disciplinary data prior to interdisciplinary synthesis

Data synthesis can be tricky in interdisciplinary teams. Agree prior to any data collection who will collect and analyse what, and then interpret findings using your disciplinary methods before sharing with other colleagues in an interdisciplinary setting. Being too eager to share can result in certain findings being misinterpreted or dismissed by others. Similarly, comparing and combining disciplinary lines of evidence too early can result in bias and 'cherry-picking', particularly if there are power imbalances between disciplines or researchers.

When interpreting the data, expect differences and discuss whether these are due to disciplinary bias or whether they are meaningful. For instance, reflect on how

different disciplines or stakeholders perceive problems. This may cause tension between disciplines and/or in the real world (e.g. conservation models often assume 'rational' human behaviour). Seek examples of how to synthesise qualitative and quantitative data and explore mixed methods approaches, paying attention to the growing body of literature which encourages or requires interdisciplinary approaches.

Take a structured approach

During the analysis and synthesis phase, it is essential to always go back to the overarching hypothesis and research questions (or theoretical framework if you have one), to avoid being drawn down too many rabbit-holes. Whilst finding new questions can be very exciting and interesting, it can also be very time consuming and distract you from the main question you are trying to address.

As a group, keep asking which data answer the project's research questions, which offer supporting evidence, and which provide additional perspectives that lie beyond current project boundaries. The synthesis across disciplinary teams is also easier if you are all developing disciplinary inputs to answer the same research question.

Publishing your results

Publishing is another area of interdisciplinary research where teamwork and shared goals are essential. Here are some suggestions on how to navigate this vital stage of an interdisciplinary project:

- Develop a road map of intended publications, recognising that not all disciplines will play an equal role in all outputs
- Discuss authorship early and often
- Discuss the intended target audience for publications: who would be most interested in the conclusions? Be ready to revise the intended audience over the course of the project to reflect the main findings
- Discuss potential publication venues and the type of article that could be developed. This is often easier when the scope and key messages in the article have been decided on
- Decisions made by the corresponding author/project lead need to be clearly communicated to avoid any sense of inequality between disciplines or team members
- Ensure sufficient time is allowed for collective brainstorming and meaningful input by co-authors from 'supporting' disciplines to inform interpretation
- Consider your audience: ensure terms and concepts are clearly explained for all disciplines you want to read the work
- Consider the differing needs of individuals within a team, e.g. different career stages and output requirements, need for support, potential cultural differences (both geographical and disciplinary) and provide time to mediate these
- Be creative! Although you need to meet the needs of a particular journal, innovation is increasingly welcomed by interdisciplinary journals

Many of these points are important considerations when publishing any research, not only interdisciplinary work. For more information see the **BES Guide to Getting Published**.

"I would encourage people to be innovative and push the boundaries. There is much more flexibility now that many journals are online only. As long as the presentation serves to communicate the work clearly and faithfully, then journals such as People and Nature would be very open to new ways of presenting work." - Rosie Hails, Lead Editor, People and Nature

Lessons from other worlds

How do other disciplines approach interdisciplinary work? What can ecologists learn from academic schools that have been formally practicing and building interdisciplinary expertise for longer? Here are two interviews which discuss interdisciplinary working in the worlds of business and medicine.

Dr Alexandra Budjanovcanin
Alexandra is a lecturer in Work Psychology and Human Resources Management at King's Business School, King's College London. Her focal research areas are careers, emotions in the workplace and gender. She works in a faculty with an expressed aim of interdisciplinarity that employs scholars from a mix of disciplines.

What key aspects should people be trained in when starting to do interdisciplinary work?

Communication, teamwork and reflective practice. Effective communication is imperative to ensure that members from different disciplines are understood and feel heard – so the skill of emotional intelligence is important. Learning to be a team-player means being open to others' viewpoints as well as feeling able to challenge and be challenged. Finally, becoming a reflective practitioner enables individuals and teams to learn from the instances when things haven't gone well and to make changes in the light of those.

However, it's not just about training; supporting structures are also important. An interdisciplinary team requires organisational structures that facilitate this kind of working. My own institution recognises the value of interdisciplinary research and has created four schools and a policy institute, all of which employ scholars from a mix of disciplines, in order to create environments geared towards collaboration.

What are the greatest challenges to interdisciplinary working that you have faced and how have you overcome these?

There can be a tension between achieving your own aims as a researcher and the interdisciplinary team's wider aims. This can mean that the team are not always pulling in the same direction. To overcome this tension, it's important to be realistic and honest about what's achievable at the outset of the project and ensure that there is sufficient space and resource to achieve the aims that have been agreed at both the individual and group level.

Lessons from other worlds

Another issue I have encountered relates to communication. Team members from other disciplines usually have particular ways of working (norms/cultures/languages) as well as discipline-specific approaches to problem solving and different audiences for and expectations about research outputs. To navigate these, a lot of communication is key. Just being alive to the fact that working across disciplines is fraught with challenges and vocalising those is an excellent start.

What do you wish you'd known when you started?

I wish I had understood the elements that contribute to effective inter-disciplinary working. I have come across various ways of thinking about coordinating across boundaries such as multidisciplinary teams in healthcare and cross-functional teams in service work. Applying the thinking from those worlds to interdisciplinary working could help to avoid some of the inherent challenges. For example, Dr Jody Hoffer Gittell – a social scientist – has a theory of relational coordination, taken from the context of frontline service workers. She proposes that highly interdependent work is most effectively coordinated when the different functions working together have shared goals, shared knowledge and mutual respect, and they are most supported when communication is frequent, timely and accurate.

Lessons from other worlds

Professor Jo Sharp
Jo is a feminist political geographer with varied research interests including postcolonialism, health, and critical geopolitics. She has recently worked as part of an interdisciplinary team of epidemiologists, vets, modellers and social scientists to evaluate the key drivers of zoonotic disease in northern Tanzania, understand the impacts of these diseases, and develop interventions that will be appropriate for the various affected communities.

What key aspects should people be trained in when starting to do interdisciplinary work?

I don't believe that interdisciplinarity means that each member of the team does everything, or even fully understands everything. For good interdisciplinary work, each partner has to bring their disciplinary expertise. What has to be learned, then, are excellent communication skills. This involves an intellectual modesty and a trust in the other disciplinary contributions. And, I think we need to move away from the idea that interdisciplinarity is about completeness – it should be a more disruptive, even radical, approach.

What are the greatest challenges to interdisciplinary working that you have faced and how have you overcome these?

We use different language and can easily talk past each other, and this is why we put communication at the heart of postgraduate training. What statisticians and qualitative social scientists each mean by the term "risk" for instance, is quite different. And each discipline has its own shorthand and precisions that often come across as jargon to those from different backgrounds. In our zoonoses project, I quickly had to learn a lot of epidemiological terms and had to be aware of my own shorthand. It often wasn't the things I was expecting to cause confusion either.

Time is the other issue because gaining ethical clearance, getting permissions, setting up and undertaking research, and then analysing it, takes different times for different methods – and it means that we don't always get the different findings at the stage that we would want to in terms of feeding in to the interdisciplinary process. Qualitative social science results take longer if we recognise the importance of multiple visits to participants (to create trust)

and the longer time required to do qualitative data analysis than statistical analysis of pathogen levels or machine-readable household surveys.

What do you wish you'd known when you started?

That interdisciplinary work needs time to develop trust and understanding between partners. This is challenging, of course, because projects always have to run to particular timescales and these are generally short-term – most funding lasts no more than 2-3 years. But it has taken the zoonoses team the best part of 10 years and multiple grants together to find a method of effective communication, and to get to the stage where we really trust what each of us can contribute to the project as a whole. The success of a project depends on developing effective communication, and an openness to what each contributor can offer and what their expectations are – this is really important when it comes to outputs: what sorts of outputs will be prioritized, how will authorship be decided, what are the different disciplinary expectations (first author vs last author, the importance of single authorship in the social sciences vs expectations of shared authorship in the sciences...).

Key messages from other worlds

1. Preparation for interdisciplinary collaboration: communication, team-work and reflective practice are key skills and can be acquired and encouraged through effective leadership and institutional structures, even if formal training is lacking.

2. Time for collaboration: all projects almost always need more. Don't shy away from an explicit message about this in a proposal and involve contributors with interdisciplinary experience, who will appreciate the extended time commitment and patience required.

3. Common language and aims: are often more challenging to achieve than anticipated! Focus on a communication strategy, on shared goals and on creating safe spaces, built around mutual respect, for questioning and knowledge exchange.

Resources & further reading

General resources

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Resources & further reading

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Acknowledgements

This guide was written by Lydia Cole and Althea Davies (University of St Andrews), with contributions from Nicola Beaumont, Juliette Young, Rosie Hails, Alexandra Budjanovcanin and Jo Sharp. Thank you to Emilie Aimé, Kevin Gaston, Cecily Maller, Callum McGregor, Erika Newton and Sam Ross for reviewing and providing feedback, and to Kate Harrison for editorial support. The authors also thank the BES for the opportunity to run a workshop at the BES Annual Meeting in 2019, which provided the initial focus and contacts for developing this guide. Kath Allen is also thanked for her invaluable involvement in that workshop.

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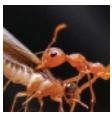

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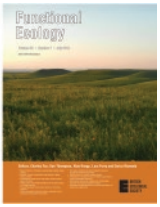

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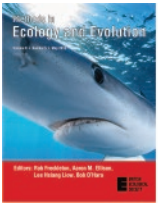

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