Doing Interdisciplinary Environmental Change Research Solo

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Abstract Interdisciplinary research on people, plants, and environmental change (IRPPE) typically requires collaboration among experts who each bring distinct knowledge and skills to bear on the questions at hand. The benefits and challenges of interdisciplinary research in principle are thus confounded by the dynamics of multidisciplinary collaboration in practice. However, broadly trained researchers can do IRPPE with little or no need of collaborators. For them, collaborative challenges may be negligible, but others arise. This paper reflects on experiences doing (mostly) solo research on peoples' use of trees and their impacts on forests in the Caribbean and Philippines. Multidisciplinary collaborations are often plagued with problems of communication, theoretical disagreement, and methodological incompatibility because the habits and conceits of a rigorous disciplinary education are difficult to undo. These are problems that novel concepts, theory, and analytical frameworks promise but often fail to resolve. By contrast, going solo fosters an epistemic humility and pragmatic sensibility that encourages focused, efficient application of methods, and integration of research findings. Epistemic breadth encourages solo IRPPE researchers to apply theory sparingly and deploy clear concepts and precise analyses of the kind readily grasped by natural and social scientists and policy makers, alike.

Key Words: Tropical forests, Interdisciplinary, Multidisciplinary, Research methodology.

Introduction

Interdisciplinary research entails the integration of knowledge derived from different disciplines of inquiry, in this case, the human/social and natural/environmental sciences. The mantra of interdisciplinarity is pervasive and viewed by scholars and policy makers as necessary for addressing many social and environmental challenges (Bruine de Bruin and Morgan 2019; Fischer et al. 2011; Harris et al. 2008; Lélé and Kurien 2011; Liu et al. 2007; Newell et al. 2005; Palsson et al. 2013; Wallace 2021; but see Mitra et al. 2020). Many ethnobotanists are experienced, interdisciplinary researchers, although only some explicitly study "environmental change," i.e., how people influence the composition, structure, and distribution of plants in space and over time. This kind of research is challenging because it entails knowledge of botany, ecology, and human behavior, as well as causally relevant economic, cultural, and political factors.

Interdisciplinary research on people, plants, and environmental change (IRPPE) thus often requires collaboration among multiple natural and social scientists, each bringing specialized knowledge and skills to bear on the research questions at hand. The potential benefits of multidisciplinary research scientist collaborations appear straightforward: diverse perspectives, expertise, and material resources can be brought to bear answering questions that entail understanding complex phenomena. However, the benefits of interdisciplinary research *in principle* are confounded by the dynamics of multidisciplinary collaboration *in practice*.

By contrast, broadly trained scientists often do IRPPE with little need for fellow scientific

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collaborators (e.g., Leblond 2019; Lukas 2014; Walters 2019). For these "solo" researchers, collaborative concerns may be negligible, but others arise. What are some of the upsides and downsides of going it alone when doing IRPPE? Are there valuable insights about interdisciplinary thought and practice that emerge from doing so? In this paper, I will reflect on these questions, drawing from experiences doing (mostly) solo IRPPE on tropical trees and forest change. I make no attempt here to systematically review the upsides and downsides of solo interdisciplinary vs. multidisciplinary collaborative research. The presumed benefits/advantages of the latter are now so widely recognized that they are taken for granted, often uncritically. The modest goal of this paper is to redirect attention to the strengths offered by the solo researcher and the diverse advantages of doing IRPPE solo.

Barriers to Interdisciplinary Research

The barriers or challenges to doing effective interdisciplinary research fall broadly into three interrelated categories: institutional, managerial, and epistemic. *Institutional* barriers include such things as the discipline-based structure of academic institutions, societies, and journals, and the way these structures re-enforce or reward discipline-focused research and discourage interdisciplinary research and collaboration (Campbell 2005; Fischer et al. 2011; Harrison et al. 2004; Holm et al. 2013; Newell et al. 2005). Barriers of this kind remain common but have been lowering. For example, many new academic programs and departments are structured around interdisciplinary themes, like the environment, and funding often explicitly targets interdisciplinary, collaborative forms of research (Liu et al. 2007). An increasing number of academic journals also encourage publication of this kind of research (e.g., *Economic Botany*, *Human Ecology*, *Global Environmental Change*, *Ecology & Society*, *Environmental Conservation*, *Land Use Policy*).

The second set of barriers, the so-called *herding-of-cats* problem, are *managerial* and reflect the practical challenges associated with doing research collaborations where multiple individuals are involved (Alexiades 1996a; Andersen and Wagenknecht 2013; Bruine de Bruin and Morgan 2019; Fischer et al. 2011; Harris et al. 2008; Pooley et al. 2014). For example, how are research agendas and questions established? What is the appropriate sequencing of research? How are field investigations coordinated? How are data and findings integrated? Where and in what form should research outputs be reported and published? These are challenges of communication, coordination, and leadership. They may seem minor at the outset but often plague multidisciplinary research initiatives as these unfold (e.g., Massey et al. 2006). As a solo researcher, however, these are typically negligible concerns.

Third, *epistemic* barriers are the most frequently cited and arguably most complex set of challenges to doing interdisciplinary research (Andersen and Wagenknecht 2013; Castree et al. 2014; DiFrisco 2019; Fischer et al. 2011; Lélé and Kurien 2011; Lowe et al. 2009; Newell et al. 2005; Persson et al. 2018; Pooley et al. 2014; Rindfuss et al. 2003; Strang 2009). Scientists are products of their educational training, and each discipline inculcates different ideas, theories, and assumptions about how the world works and how best to learn about it (Levin et al. 2021). Disagreements on such matters are often large *within* disciplines, but epistemic gulfs *between* disciplines—especially where they span the humanities, natural, and social sciences—can appear (and sometimes are) insurmountable. Great time and effort are invested to master a discipline, so it is no surprise that with such mastery comes a fervent attachment to ideas and ways of doing research that reflect the conventions of one's discipline. Interdisciplinary research is hard to do in large part because the habits and conceits of a rigorous disciplinary education are difficult to undo. In fact, by parsing individual researcher responsibilities into distinct, discipline-based components, multidisciplinary collaborations may reinforce rather than break down disciplinary identities and boundaries (anonymous reviewer, personal communication).

Reflections on Solo Interdisciplinary Research

My development as an IRPPE scholar was enabled by completing degrees in three different fields of study (biology, environmental studies, and human ecology) and by working

internationally on field-based, conservation, and development projects between bouts of academic study. This eclectic education and experience enabled me to view the world through the lenses of both the natural and social sciences, theoretical and applied. It also encouraged me to approach IRPPE with an openness and flexibility that is unusual for a scholar. My largest academic research projects, on Philippine mangrove forest change and Caribbean forest and land use change, included bio-ecological assessments of forests, interviews of forest and land users, spatial mapping of habitat and land use change, and historical-archival investigations (Walters 2003, 2004, 2017, 2019). Both studies demonstrated that methods and information from the social and natural sciences and history can be rigorously integrated in the service of compelling explanations of environmental changes. The following presents key insights and lessons about doing IRPPE based on these experiences.

Collaborations Should Be Limited and Targeted

Going solo avoids many of the challenges associated with team-based research, but even a broadly educated researcher has knowledge gaps, and so there are times when it is beneficial or even necessary to seek collaborators. For example, I was able to quickly master identification of Philippine mangrove trees because only 20 or so species were present in my study areas (Walters 2004), but identifying upland tree species in Saint Lucia was an order of magnitude harder, so I recruited a graduate student and in-country expert to perform this task (Walters and Hansen 2013). Similarly, I conducted rudimentary but useful GIS analyses of land use changes from historical air photos of Saint Lucia, but required technical assistance to build the core, digitized database. The key point here is that multidisciplinary collaborations were not sought up-front and for their own sake, as happens with many interdisciplinary projects, but in response to specific research needs that emerged through the course of planning and implementation of the research (see Thagard 1998, 2006; Vayda 2013). Such targeted collaborations made efficient, timely, and productive use of others' expertise where it was clearly needed and entailed modest administrative hassle and financial cost.

The main concern of this paper is whether and when collaborations between fellow academic scientists make sense. Additional considerations of a practical, strategic, and ethical nature arise of course where local people—especially where these are indigenous peoples—are collaborators in research, which they often are. These are important concerns that apply to research planning and practice in general and so are mostly beyond the scope of this paper. That said, two general points can be made that are relevant.

First, the character and degree of local collaboration are not something that can or should be prescribed in advance. What form it takes will depend to a large degree (although not only) on the nature and scope of question(s) guiding the research and the requirements for obtaining answers to those questions (Vayda 2013; Vayda et al. 2004). And it will often be the case that guiding research questions themselves emerge through processes of local participation and collaboration. In-depth ethnobotanical research aimed at the documentation of novel plant species or uses, for example, would almost certainly entail more intensive local collaboration than would studies aimed at describing and explaining broad patterns of plant resource or land use change.

A second related point is that effective collaborations with local people are typically based on relationships of familiarity and trust, and these take effort, time, and consistent behavior to cultivate. I concur with one reviewer who suggested that collaborative relationships between local people and solo researchers are likely to be more straightforward and amenable to building trust than where teams of researchers are involved. This is because different members of research teams are likely to prioritize relationships with local collaborators differently, and local people may struggle with apparent inconsistencies in their behavior towards them.

Maintain Focus on the Research Questions and Explanandum Events

Difficulties of collaboration often hinge on simple misunderstandings about the specific research questions being investigated (Bruine de

Bruin and Morgan 2019; Chernoff 2012; Lélé and Kurien 2011; Priest 2017; Vayda 2013). Consider a hypothetical proposal to research tropical deforestation. Is the intent of the research primarily descriptive (what has happened?) or explanatory (why has it happened?), or both? What constitutes "deforestation" in the case under study? Is it loss of forest cover, degradation of existing forest, conversion of natural forest to plantations, or all of the above? What are the spatial boundaries of the deforested area and the time frame to be considered? These and other considerations need to be clarified and agreed upon in collaborative efforts. Otherwise, researchers with different backgrounds and expertise risk pursuing answers to different questions. Even as a solo researcher, I experienced times when investigations veered off course because I lost focus amidst the jumble of disparate information and competing priorities.

It is thus crucial in IRPPE to establish and maintain focus on research questions that are clearly stated and based on a precise description of the environmental change of interest (the so-called *explanandum* event). For example, in both research projects, I devoted much effort early on to the measurement and mapping of trees, forests, and patterns of forest and land use within study areas to better ascertain the characteristics of environmental changes that became the explanatory target of subsequent investigations (Walters 2004, 2005a, b; Walters and Hansen 2013). In short, we need to be as clear as possible about what we want to explain (the "what?") before seeking an explanation for it (the "why?"). Such clarity provides a basis for organizing research efforts and later integrating findings from different components of the study (e.g., Friis and Nielsen 2017; Lukas 2014; Moritz et al. 2016; Ruin et al. 2014; Vayda 2013). Otherwise, there is a tendency for research components to splinter along different and often disconnected lines of inquiry, resulting in a superficial patchwork effort of integration at the end. That said, focused questions are not necessarily "fixed" because research investigations and the questions guiding them may evolve over time, which leads to the next point.

Be Adaptive and Flexible Through the Course of Investigations

There is value in up-front planning of IRPPE research (e.g., Liu et al., 2013; Tobi and Kampen 2018), but the complexities and uncertainties associated with the subject matter often necessitate large adjustments as research unfolds and unexpected findings emerge. Researchers should be prepared to adapt the direction and methods of inquiry, seeking additional tools or collaborators where new information needs are identified and dispensing with others whose utility is found unnecessary or superfluous. As such, heavily prescriptive conceptual frameworks and organizational schemes (e.g., Liu et al. 2007; Machlis et al. 2007; Scoones 1998), with their cumbersome analytics and daunting information requirements, should be resisted where more flexible and efficient approaches might suffice (Walters 2012, 2019).

To illustrate, while conducting fieldwork that sought to explain patterns of mangrove planting and cutting across a dozen coastal villages in the Philippines, I stopped doing standardized household surveys as it became apparent these were time-consuming and poorly suited for my research needs. I used semi-structured interviews thereafter. From these, I learned (among many other things) that the coarseness of intertidal soils might be an important causal factor influencing whether mangroves planted by local people survived or not. This discovery led me to consult biology colleagues at a neighboring university to learn and apply a simple but effective technique for sampling and measuring soil particle size. Subsequent findings from this analysis were *not* consistent with local interpretations about the possible influence of soil and mangrove planting success and so helped refute this particular causal hypothesis (Walters 2004).

Keep Theory in Its Proper Place

Appeals to general theory and conceptual schemes in IRPPE should be viewed with skepticism. The conundrum is this: the more varied and complex the subject matter, the less likely any one theory or set of theoretical principles will account for it. IRPPE researchers are intimately familiar with such complexity because their subject matter often includes dozens of species or varieties of plants and diverse patterns of use of those plants that vary in space and change over time. This kind of complexity is a core justification for doing interdisciplinary research in the first place. However, the

tensions between theoretical parsimony and empirical complexity only grow as researchers broaden their scope to include different disciplines in their analyses (Cartwright 2020; Klein 2004; Persson et al. 2018; Pigliucci 2013; Sagoff 2016; Walters 2022).

The experience of environmental economics is instructive here (Beder 2011; see also Taconi 2011). Among social sciences, economics arguably has the most coherent theoretical core. Since the 1970s, efforts from within and outside of the discipline sought to expand economic theory in ways to better reflect environmental concerns. These efforts bore some novel insights, but environmental economics has more recently experienced a theoretical retrenchment where novel ideas and concepts developed under the rubric of interdisciplinary ecological economics are being mostly shed in favor of modest revisions to core neoclassic theory (Beder 2011). This illustrates that there are trade-offs between expanded interdisciplinary breadth and theoretical coherence (Persson et al. 2018). It should serve as a warning to those who propose grand theoretical synthesis across disciplines, for example, as some advocates of socio-ecological systems and political ecology have done (Demerrit 2009). In short, what is achieved at the level of grand synthesis typically comes at the expense of explanatory relevance and application to real-world cases.

What about the role of discipline-based theories in interdisciplinary research? The problem is, the more disciplinary theoretical baggage one brings to interdisciplinary research, the harder it is to break down disciplinary barriers and integrate research in a rigorous way across disciplines. Theory is thus often more a hindrance than an asset to interdisciplinary thinking and research. This, again, is where the solo researcher may be at an advantage because scholarly immersion in more than one discipline tends to cultivate a skeptical attitude towards theory given one's exposure to a more diverse range of theoretical ideas and recognition that they are often incommensurate with one another.

This is not an argument against the application or development of any and all theory per se. My own research has drawn from and contributes to various theoretical concerns on such topics as property rights, conservation strategies, forest and agrarian transitions, and forest succession (Walters 2004, 2019). Rather, it is an argument against elevating one theory above others or placing too much emphasis on theory development as the goal of interdisciplinary research (Walters 2022). Instead, IRPPE should adopt the practical sensibility of the solo researcher and draw upon a variety of theoretical ideas from the relevant literatures to potentially aid in the formulation of hypothesis and analysis of findings (Goertz 2012; Kincaid 2000; Meyfroidt et al. 2018; Walters 2022; Walters and Vayda 2020).

Keep Analytical Concepts Clear and Precise

IRPPE should strive to use clear language intelligible to natural scientists, social scientists, and policy makers alike and adopt analytic concepts that are precise and scientifically defensible (Alexiades 1996b; Editors 2016; El-Hani et al. 2022; Newell et al. 2005:302; Walters 2012). Ambiguous concepts and jargon (e.g., "sustainability," "resilience," "socio-ecological systems") have nonetheless taken hold within some interdisciplinary environmental research fields (e.g., Adger 2000; Folke 2006; Liu et al. 2007, 2013; Miller et al. 2008). It has been argued that such concepts serve as cross-disciplinary, *boundary objects* (Baggio et al. 2015; Brand and Jax 2007; Strunz 2012; Welsh 2014) because of their intuitive appeal and seeming relatability to diverse audiences (Basken 2013; Béné et al. 2014; Cairns and Kryzwoszynska 2016; Gibbs 2009; Grimm and Wissel 1997; Neocleous 2013; Olsson et al. 2015).

The problem is such boundary concepts are subject to widely varied interpretations across and even within disciplines, and it is difficult to integrate research from different fields where disagreement over basic definitions and analytic concepts persist (Jax 2006, 2007). Conceptual clarity is also essential for doing good explanatory research should that be one's goal (Chernoff 2012; Meyfroidt 2016; Santana 2018; Taconi 2011; Walters 2017; Woodward 2015). For these reasons, ambiguous concepts like resilience and sustainability are mostly a distraction to the solo researcher who, instead, seeks precise, scientifically sound descriptions of plants and their uses and understanding of

the relationships between concrete environmental changes, human actions, and the specific causes of those actions (Vayda 2013; Vayda et al. 2004; Walters and Vayda 2009).

Think Historically

Bridging the natural and social sciences is vital to IRPPE, but an historical perspective is also invaluable (c.f. Balée 1998, 2006). Environmental change *is* historical change, after all, and this means explanations of environmental changes of interest will often entail understanding the "causal histories" of those changes (Walters 2017; Walters and Vayda 2020). This is *not* an argument for rejecting the rigor of scientific analysis in favor of a more humanistic-interpretive approach to IRPPE. Rather, it is an argument to take seriously the now quite widely held view in philosophy, including the philosophy of science, about what constitutes good explanation (Gaddis 2002; Hawthorn 1991; Lewis 2011; McCullagh 1998; Vayda and Walters 2011; Walters and Vayda 2020). Analytically speaking, a causal-historical approach can serve as a productive means by which to integrate diverse kinds of data and information that have been derived from different natural and social scientific methods. As committed interdisciplinary scholars who have worked both solo and within larger collaborative projects, my collaborator, Andrew Vayda, and I have long grappled with and written about these issues (see Vayda and Walters 2011; Walters 2019, 2022; Walters and Vayda 2009, 2020).

Embrace Curiosity and Epistemic Humility

Disciplinary chauvinism is pervasive and an obstacle to effective interdisciplinary thought and collaboration. By contrast, an interdisciplinary education instills intellectual humility and openness. The more one studies across different fields, the more it is clear that no one discipline, theory, or method is inherently superior. The value or limitations of each depend on the research context and questions (Bennett et al. 2017; Stone-Jovicich 2015; Taconi 2011:243). But in general, social scientists should learn to think like environmental scientists, and vice versa. This poses real challenges and entails risks (see Rogga and Zscheischler 2021), but it is intellectually rewarding for those who, like many solo researchers, prefer to be on the steep slope of the learning curve. It is the sort of work that many scholars have the freedom to pursue.

Conclusion

In an influential article, fifteen prominent advocates of interdisciplinary research on environmental change declared, "Gone are the days of the solo scientist: researchers must learn the languages of multiple disciplines" (Liu et al. 2007: p. 646). The literature on barriers to interdisciplinary research emphasizes the challenges of knowledge integration where researchers from different academic backgrounds struggle to find common understanding and agreement over concepts, methods, and evaluative criteria for evidence. These struggles are likely to endure so long as IRPPE is built on the collaborative efforts of disciplinary-trained scholars. One way around this problem is to reaffirm and encourage a central role of the broadly trained, interdisciplinary researcher who works either solo or in the capacity of project leader of collaborative initiatives.

The cultivation of this is no simple task, and it comes with real risks and trade-offs. It is the atypical scholar that is genuinely interested and sufficiently motivated to master more than one discipline, and, despite all the cheerleading for interdisciplinarity, specialization is still more likely to be rewarded in today's highly competitive academic environment. Working in teams, at least when such teams work reasonably well, can also deliver enormous practical and epistemic benefits. For example, just as team-based researchers are at risk of hardening their disciplinary boundaries where research integration is weak, solo researchers may become intellectually isolated by depriving themselves of the direct and sometimes intense scholarly engagement that often accompanies multidisciplinary collaborations. Partnering with local collaborators is likewise often essential and offers diverse practical and epistemic benefits. In this regard, it is rhetorical exaggeration to suggest IRPPE researchers who work largely outside of multidisciplinary academic teams are truly acting "solo."

That said, teachers and mentors can encourage students to broaden their educational reach across the social and natural sciences and engage them early in diverse tasks associated with interdisciplinary research projects, rather than simply pigeonhole them for efficiency sake. We can also encourage "double majoring" in undergraduate education and recruit graduate students who have a demonstrated propensity for study in both the natural and social sciences. Established scholars should embrace life-long learning and follow their curiosity where and when it leads them to learn new fields and methods of study. In fact, there are abundant published resources in ethnobotany that render basic ethnographic and ecological methods straightforward to those with only modest academic background in these areas (e.g., Albuquerque et al. 2014; Alexiades 1996a). As many ethnobotanists already know, even modest investment in the study of another discipline has great value for our learning about peoples' relationships with plants and their impacts on the environment.

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