Integrating the social and natural sciences in environmental research: a discussion paper

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Abstract   This paper considers the practical and intellectual challenges that attend efforts to integrate the social and natural sciences in environmental research, and the broader political, social and economic context in which this takes place. Based on the experiences of researchers in Australia—but with obvious relevance for researchers in many countries—it is the outcome of an interdisciplinary workshop which brought together social and natural scientists involved in environmental management. This event and the wider discussions that followed were initiated to enable researchers to exchange ideas about the obstacles to interdisciplinary collaboration, and to discuss ways to overcome these. The paper provides a summary of the issues and proposes some guidelines for interdisciplinary collaboration. These may be summarised as follows:

- There is an overarching need to begin with—and maintain—intellectual, social and practical equalities throughout the entire research process.
- There is a need, in the academe and in public discourse, for reflexive critiques of the conceptual models that are used to consider 'the environment', to challenge the dualism that separates and compartmentalises 'nature' as a kind of technical ecology.
- Research design needs to begin with an in-depth discussion about theory, and efforts to ensure that all participants are able to make use of (or at least see where their research fits into) a model that conceptually integrates socio-cultural and biophysical complexities.
- Participants need to have equal input into the design of all stages of the research: the key questions, the basic approach, and the kinds of methods, data and analysis that will be used.
- Collaboration requires a significant amount of time to be spent in communication between the participants, so that all achieve at least a basic understanding of the types of theory, methods, data and analysis used by the others. Time and funding should be built into the process to enable this.
- In major research projects, there is a case for employing someone with appropriate expertise, to facilitate the team's internal communications and to liaise with potential research users.
- Consideration should be given to the 'profile' of collaborative research projects, so that participants can feel confident that their disciplinary identities will not be denigrated, appropriated, or consumed by assimilation.
- In developing timetables and budgets for research, there needs to be greater recognition of different temporal needs. Rather than imposing a schedule that reflects only some disciplinary timeframes, each disciplinary area should be allocated time and funds in accord with its particular temporal realities.
- Interdisciplinary projects have to deal with types of data that are rarely comparable, and do not mesh readily. Collaborators should consider how their data will be managed and whether they can be incorporated into—or at least linked with—systemic schemes that will encourage integrative ways of managing and possibly reconceptualising their information.
- Rather than being homogenised, the outputs of collaborative research should reflect the diverse needs and qualities of each of the disciplines involved. Consideration should therefore be given to whether (and how) outputs will be integrated or at least positioned to inform and complement each other
- Project designers should be bold in allocating realistic amounts of time and funds to support the kinds of changes in research design that will lead to successful interdisciplinary collaborations.

1 Introduction

> Anthropologist: *'So, how are you integrating the social sciences into your research programme?'*
> Regional Catchment Group Manager: *'Well... er... we are talking to a lot of people, so we figure we have got that covered'*.[1]

This paper is an experiment in interdisciplinary[2] publication, being the outcome of discussions between social and natural scientists about the obstacles impeding their efforts to collaborate. It attempts to draw together the key issues, to consider the broader social, political and economic context from which these arise, and to propose some potential guidelines for successful interdisciplinary collaboration. The discussions on which it is based were initiated at an interdisciplinary workshop at the University of Queensland in 2004, bringing together a mixed group of social and natural scientists.[3] Most of the quotes in this paper are from that workshop, which was electronically recorded for this purpose. An early draft of this discussion paper was then circulated to all the participants and to other researchers in Australia, New Zealand and the UK. Additionally, one-to-one interviews with a wider range of researchers (mostly in the natural sciences) were carried out as an adjunct to a larger research project,[4] and a related paper was presented at the Australian Anthropology Society Conference in 2004. Both formal and informal feedback from all parties has been incorporated at various stages.

It appears that the issues described in Queensland are reflected in the experiences of researchers in other parts of Australia, and to some degree internationally. In accord with the precepts of anthropological research, this paper locates the issues in the specific cultural context that shapes and directs them, giving consideration to local and regional dynamics, and to the wider social and political currents that shape research policy and funding a national level. The location of this debate in an explanatory context is one of the major contributions that anthropology can make to questions about interdisciplinary collaboration, providing insights into the underlying dynamics that shape professional relationships, and offering a holistic model which is encompassing of diverse intellectual approaches. Plainly each specific social and political context will impose its own particular pressures on research, offering a commensurately different set of potential avenues for development. However, the methodological choice to locate the issues ethnographically is

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[1] Interview with Coordinator of the Northern Gulf Regional Management Group, 2004. In fact this group has, in the past, made some use of social survey research but, as the quote implies, this does not seem to have provided a vision of social research as an empirical science.

[2] Definitions about what constitutes 'interdisciplinary' or 'cross-disciplinary' research seem to differ from one country to another. Here I use the term 'interdisciplinary' to describe collaborative work by different disciplinary practitioners on a shared research project. To me, 'cross-disciplinary' would tend to mean drawing upon the methodologies of more than one discipline in a research task, and this might be done by a single researcher. For a useful set of definitions and explorations of these different approaches see Grigg (1999); Somerville and Rapport (2000); Lawrence et al. (2001); Lawrence (2003).

[3] I invited approximately equal numbers of social and natural scientists to the workshop, but higher numbers of social scientists accepted. As I am an anthropologist myself and my Australian colleagues are familiar with my work there was a particularly high proportion of fellow anthropologists. Considerable attempts were made to engage with a wider range of natural scientists subsequently, to even up the balance.

[4] Many such opportunities arose in the course of a lengthy research project concerned with water management in two major river catchments in Queensland. Entitled *Under Water: a comparative ethnographic analysis of water use and resource management in Queensland and Western Australia,* this project was funded by the Australian Research Council and carried out in collaboration with Associate-Professor Sandy Toussaint at the University of Western Australia.

readily replicable in other contexts, and I hope that the proposed guidelines will provide a usefully generalisable starting point.

The need to consider the obstacles to collaboration between the social and natural sciences was highlighted during the course of a long-term ethnographic research project focusing on the cultural issues surrounding water management in Australia. As well as dealing with water users directly, this research entailed considerable interaction between social scientists, environmental scientists, hydrologists, biologists and other natural scientists, and with the local, regional and state agencies responsible for managing rivers, water resources and the wider environment.

It was readily apparent, even in the preliminary stages of this research that, despite rhetoric about 'integrated catchment management' and 'triple bottom lines', people's efforts to manage and conserve resources, and the research activities that attended these endeavours, remained largely dominated by the natural or environmental sciences (see Pawson et al. 2003). Supposedly 'integrated catchment management' (ICM) in Australia is, in reality, largely directed towards practical ecological issues such as water quality and flow, feral animals and weeds, and the health of aquatic species. The social sciences, if not left out of the picture entirely, are often marginalised or 'tacked on' inadequately and ineffectually. At the same time, social and natural scientists agree that there is an urgent need to integrate social and cultural issues into land and water management, and to enable this more integrated approach through research collaborations. Both kinds of expertise are needed if we are to succeed in explaining the complexities of global environmental problems and assist decision-makers in finding solutions to these. It is plain, however, that meeting the need for interdisciplinary research is very challenging in practice, and as one of the anonymous reviewers of this paper commented, efforts need to be made by both sides:

> It is true that the social sciences seldom are included in natural science projects. When it happens, often the natural scientists get in contact with social scientists... It is just as important for us (social scientists) to invite natural scientists to join our projects. (Anonymous reviewer)

2 Conceptualising collaborative research

One of the most basic obstacles to integration is the differing conceptual frames to which social and natural scientists subscribe (see Eggins and MacDonald 2003; Nowotny et al. 2001). In Australia (as in most industrialised countries), discourses about environmental management are generally situated in a dualistic intellectual paradigm in which 'nature' is perceived as being separate from human 'culture'. Placed in the category of 'nature', 'the environment' is therefore objectified in primarily technical, ecological terms, rather than, as anthropologists have argued it should be, as simultaneously socio-cultural and ecological (see Descola and Palsson 1996; Ellen and Fukui 1996; Strang 2005a, b; Abram 2001). This is a fundamental problem, as it is impossible to consider the social and cultural aspects of human–environmental relationships without a model that recognises that oppositional dualisms are merely heuristic, and 'nature' and 'culture' actually interpenetrate each other.

In anthropological terms, humans are simultaneously biophysical and cultural, and their material surroundings are, likewise, composed of processes that can and do occur independently of human action, but are also constantly altered and acculturated by human action. In other words, both humans and their environments are composed of 'nature' and

'culture'. A dualistic model that reifies these as separate categories conceptually functions as a significant barrier to genuinely 'integrated' analyses of environmental issues. Nevertheless, the 'nature-culture' paradigm remains dominant in western thought, and adherence to it is reflected in the academic structuring of Universities and research organisations. In most Universities the social and natural sciences, though brought together in occasional attempts to induce collaboration, continue to function independently, and interdisciplinarity requires the crossing of a considerable divide (see Lattuca 2001; Lee et al. 2004; Weingart and Stehr 2000).

Another major obstacle is provided by the differing approaches to specialisation in the sciences. Anthropologists and other social scientists necessarily make use of holistic theoretical models that attempt to locate human behaviour in an explanatory social and cultural context. Within these large and encompassing models, there is ample room for consideration of biological and ecological processes (particularly in sub-disciplines such as cognitive anthropology, biological anthropology, and environmental anthropology). Natural scientists, while familiar with efforts to consider the dynamics of ecosystems as a whole, generally conduct much more specialised research and apply models to which social issues are extraneous. Yet, more often than not, interdisciplinary research projects are conceived from a natural science perspective, with an expectation that, if they do include social data and analysis, these will somehow be compressed to fit a more reductive theoretical paradigm. This is a recipe for frustration all round, affecting every subsequent stage of the research.

Clearly there are other factors that could be discussed here: a general academic shift towards more specialised and more technical types of inquiry; wide disparities in levels of funding and support; political pressure for reductive and above all readily 'applicable' research. The key point, though, is that there is a need for robust reflexive critiques of the theoretical models that are used to consider 'the environment', and more specifically a need to challenge the dualism that frames nature as a kind of technical ecology.

While according parity to the theoretical models of the social and natural sciences, such a discussion also needs to include an understanding that these are very different in form, and the large and necessarily holistic approaches of the social sciences cannot be 'reduced to fit' more specialised frameworks. An acceptance of this reality opens the way for more integrated research that could elucidate the links between socio-cultural issues and material ecological outcomes. There is thus a case for suggesting that a first stage of any collaborative project design should involve some very engaged discussions between the potential participants about the theoretical frameworks in which the research will be located.

3 Integrating knowledges

Disciplinary differences at a theoretical level are reflected in other incompatibilities in approach. As well as using different models for analysis, researchers in the social and natural sciences ask different kinds of questions, employ different methods, collect different kinds of data, use different analytic tools and produce different kinds of outputs. Participants in collaborative projects therefore need allow significant amounts of time simply to discuss all of these aspects of the research. For busy researchers, whose professional workloads make it difficult even to keep up with material emerging in their own fields, this is perhaps the most demanding aspect of cross-disciplinary work. It is easier, by far, to demand that the less dominant disciplines involved 'translate' their work into

familiar or reductive forms, and this pressure is most likely to be placed on the qualitative disciplinary areas. Unfortunately, this approach invariably fails to produce outcomes that cohere intellectually. It is apparent that collaborative projects would have much better prospects of success if researchers actually invested the time, funding (and commitment) necessary to enable a fuller interdisciplinary exchange in the first place, and to continue this throughout their collaboration.

This suggests a need for equality between the social and natural sciences, not just in considering theoretical frameworks, but also in formulating the research questions and making decisions about project design.

> The process has to be egalitarian... there has to be mutual respect and each regarding the other as indispensable... And equality of data too, so that my bit of participant observation counts... as much as somebody else's statistical analysis. (Franca Tamisari, Anthropologist, University of Queensland, workshop participant)

Such equality is rarely achieved. Research collaborations are also social, economic and political relationships to which people bring very unequal levels of social, economic and political capital. Given the *realpolitik* of the academe, and of national funding regimes, social scientists frequently find themselves as minority members of larger teams; as part-timers in projects otherwise populated by full-time researchers; or as 'afterthoughts' to projects dominated by more reductive approaches. This severely limits their potential contribution, and perpetuates their exclusion from research concerned with the 'natural' environment. In addition to these delicate issues of relative wealth and status, each disciplinary area has a distinct 'culture' and 'identity' composed of its ways of thinking, its theory and methods and its particular languages (see Somerville and Rapport 2000). Collaborative research needs to be organised so that people can be confident that their disciplinary identities will not be denigrated, appropriated, or consumed by assimilation.

Researchers differ widely in the extent to which they are comfortable engaging with other disciplinary 'languages'. Being 'multi-lingual' in these terms is relatively unproblematic for social scientists, whose training and research requires them to engage with multiple perspectives and adopt a culturally relative approach. Familiar with the challenges of cross-cultural translation, they are well situated to apply a similarly translatory approach in the micro-cosmic diversity of a mixed research group. Indeed, there is a good case for using researchers with these kinds of skills more directly, to assist the process of cross-disciplinary collaboration, and possibly to draw on the techniques of group facilitation developed in other disciplines (see Adler et al 2004; Heron 1993; Hogan 2002; Hunter et al. 1996).

The encompassment of new disciplinary 'languages' may appear less necessary and less achievable to the more specialised sciences occupying a dominant discursive position in the academe. The disparate levels of disciplinary status noted above mean that there are commensurately varied levels of motivation for change, or openness to it.

> It really depends on your position in the whole structure. Your attitude, and your interpretation, and your perception... depend on where you are. (Eva Abal, Scientific Coordinator, Healthy Waterways, Queensland, workshop participant)

Without a consciousness of the way that these underlying issues frame research, it is inevitable that wider inequalities will be reflected in the design of research projects. Though individual researchers may feel they can have little impact on the political and economic context in which they work, they can at least make a contribution to change by recognising, in their own research activities, a need to begin with—and maintain—

intellectual and practical equalities. The previous discussion suggests that the outcome of achieving equality in collaborative endeavours would entail a shift towards a more holistic and inclusive approach.

4 Concepts in practice

Dominant intellectual paradigms are, inevitably, reflected not just in research, but also in everyday practice. Thus a dualistic model of nature and culture can be readily discerned in the structural organisation of the Government and non-government agencies involved in caring for 'the environment'. In Queensland, for example, the key Government agencies deemed most directly responsible for land and water care, and given authority in this task by National and State legislation, are Natural Resources and Mines, the Environmental Protection Agency and, to a lesser degree, Queensland National Parks and Wildlife. The Government and non-government agencies directed towards 'social' issues—or example, the Department of Community Affairs—have no remit to consider environmental management. It is simply taken for granted that the 'natural' environment will be managed by 'environmental' agencies, which will be advised, in turn, by specialists located in the 'environmental' sciences.[5]

Visions of the 'natural' environment as a separate object, and all the assumptions that attend this conceptual dualism, also percolate down through the various levels of governance to the regional agencies, local councils, and community groups directly involved in managing land and resources. River catchment groups typically employ environmental scientists or conservation specialists as coordinators, and draw in as key participants a high proportion of people with related areas of knowledge and skill. Like the larger agencies, they also rely heavily on advice from natural scientists.

Most catchment management groups also try to include representatives from a disparate range of 'stakeholders'. In Australia, this generally includes Aboriginal communities, pastoralists, miners, fishers, environmental groups, tourism operators, farmers and so forth. While indigenous communities have their own (highly integrated) models of the environment,[6] most of these groups consider the issues in accord with the dominant cosmological model to which they are exposed, conceptualising the environment as a separate sphere of 'nature' to be managed in technical terms. As resource managers they tend to valorise practical and experiential knowledge, and while they can quite readily relate to the ecological material presented by natural scientists, very few have experience of the more abstract complexities of social theory, the kinds of data and analysis that are the focus of social science research, or the types of discourse that emerge from it. Social scientists observe that even where extensive social research exists on the environmental issues of concern, this is rarely—if ever—utilised by such groups. This is partly because many are anxious about having to engage with unfamiliar kinds of information, and cannot see how these might be usefully applied to environmental care. Sandy Toussaint cites a manager of a conservation and land management office in the Kimberley area, who said:

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[5] See Carr (1994); Strang (2005c); Toussaint et al. (2005).

[6] Aboriginal cosmology does not make meaningful use of any nature-culture dualism, and frames human–environmental engagements in a highly integrated model that has—I have argued—had considerable influence on theoretical developments in anthropology (see Strang 2006).

I've met a few anthropologists in my time. They are a pretty interesting group of people, but I just don't get it: I don't get what you are on about. (Research interviewee in 'Under Water' project)

As Toussaint observes:

Of concern to me was that, despite him having had some contact with anthropologists, he really didn't know what anthropology was. He had not engaged, had no understanding, despite being exposed to the discipline. Nor had he been exposed to the way in which the cultural activities of humans, of people as residents, workers, as tourists, as researchers, as engineers, as designers and so on, were an important part of any environmental equation... There has been a huge amount of ethnographic work put together by anthropologists on culture... but it is often evident that such depth of work is not accessible... it just doesn't get through. (Sandy Toussaint, anthropologist, University of Western Australia, workshop participant and collaborator on Under Water project).

Introducing more complexity to the process is inevitably somewhat at odds with building epistemological bridges, both in research terms, and in meeting political pressures to ensure transparency in communicating findings with the wider community. As Eva Abal also notes, with the promulgation of concepts such as 'citizen science', funding submissions are increasingly demanding that research should be ultra-accessible to local communities.[7]

Scientists are now under pressure to be accountable to the community... Submissions are getting tougher and tougher, and they are ensuring that they become more relevant or acceptable to the stakeholders. (Eva Abal, Scientific Coordinator, Healthy Waterways, Queensland, workshop participant)

There are further moves in this direction: as Geoff Lawrence observes, various funding bodies in Australia (for example the National Heritage Trust, and the National Action Plan for Salinity and Water Quality) have embraced the idea that research will be directed and funding by catchment groups and local communities.

It will be the catchment management groups who 'invite' scientists to tender for research that the community would like undertaken. (Geoff Lawrence, Sociologist, University of Queensland, workshop participant)

In Australia—and elsewhere—this is a political trend that social scientists should consider very carefully. Although promulgated under the mantra of 'democratising' the research process (and having obvious advantages for politicians keen to garner popularity), the idea that research questions and funding should be directed by local communities carries a significant threat to research quality. As well as radically disempowering academics by failing to acknowledge any need for genuine expertise in research, it leaves the process wide open to supporting only the interests, understandings and goals of dominant stakeholder groups. There is thus an urgent need to critique such a loss of research independence, and to ensure that funding decisions and research direction come from properly qualified and politically independent bodies (such as the Australian Research Council), and are not the handmaiden either of 'the community' or the Government.

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[7] See Lake Baroon Catchment Care Group (1995); Martin (1991); Nash (2001); Syme (1992); Verdec (1998).

A further threat to the independence and quality of research, as Helen Ross points out, comes from related political pressures to produce 'goal directed' research that can be applied directly to practical problems, which sets up a gap between rich data and putatively 'real' research. As Elaine Green comments, the abstractions of social science analysis do not translate readily into policy or practice. Having taken on a role with Queensland's 'Healthy Waterways' organisation, as a geologist, she worked with historians and people doing cultural mapping, but felt completely stumped when asked to turn this material into 'management actions'.

> Environmental management has come a long way, but it is beholden on anthropology to define its utility and provide accessible outputs and explanations. (Elaine Green, geologist, Healthy Waterways, Queensland, workshop participant)

Thus one of the major challenges of interdisciplinary research is to achieve forms of communication that not only allow bridge building between disparate disciplines, but also translate findings into widely accessible forms. As John Bradley observes, members of 'the community' want scientists to communicate in plain English, citing one informant from his own anthropological research:

> You bloodyologists have got to get real. (Research interviewee)

So there is both the challenge of encouraging researchers to 'learn each others languages', and the demand to produce findings in a form that allows communities to engage with them.

> Communities... don't really care about jargon... In the scientific expert panel we've got a scientist who we would never let out on the community, just because of that scientific barrier. Once you come up with the technical jargon, whether it is from a social scientist or a natural scientist, really you lose the community. (Eva Abal, Scientific Coordinator, Healthy Waterways, Queensland, workshop participant)

This is a large task and good communication with local research users can only be achieved realistically by including in research projects some extra time and expertise to bridge the gap not just between different disciplinary areas, but between researchers and communities.

It is useful to acknowledge that there is an important political dimension to this equation too. In practice, major social, economic, cultural and philosophical differences lie between the groups involved in land and water management, and there are some highly contentious issues relating to the ownership, control and use of resources. There are also major power disparities between groups, which mean that, as John Bradley puts it: 'people now know that ''stakeholder'' doesn't mean equality at all'.[8] These issues, while central to social science research, are rarely made explicit or examined in the process of land and resource management. On the contrary, in the interests of harmonious co-management, any potentially controversial social issues—although they may have very far-reaching implications for people's engagement with resources—are left firmly outside the door.

Thus, although many subtle social negotiations do take place in and around the managerial process, in overt terms there is both political and practical pressure to separate the messy and controversial 'human' side of the human-environmental interaction from discussions about the material 'natural' environment. Given the political tensions about the ownership of land and resources, some participants in catchment groups are also wary of

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[8] See Attwood and Arnold (1992); Pearson and Sanders (1995); Sinnamon (1992).

the potential of social analysis to upset the *status quo*, and are therefore not sympathetically disposed towards the social sciences.[9]

As Franca Tamisari notes:

> Knowledge is always embedded in power relations, and there are situations where you know the bridges are there, but they don't want to cross them because this is out of synch with what the most dominant stakeholders want to carry out. (Franca Tamisari, Anthropologist, University of Queensland, workshop participant)

Yet as Geoff Lawrence points out:

> We need social science, because when you add social sciences to Landcare we start to see some other things going on... people are being marginalised, just like the power relations in society in general. One of my students found that a number of Landcare groups established in inland Queensland were formed in an attempt to neutralise any critique of current agricultural practices, that is, by marginalising 'greens' and preventing them having a say. (Geoff Lawrence, Sociologist, University of Queensland, workshop participant)

He argues that the social sciences are integral to facilitating local community engagement with land and resource management organisations:

> With all these elements we can see how important it is for us as social scientists to understand how to collaborate with those involved, and to actually give some commentary to the way the process is shaped. (Id.)

Natural scientists working with the Healthy Waterways Partnership in South-East Queensland expressed similar concerns. The Partnership is a government sponsored 'expert' panel composed largely of natural scientists (though with a couple of quantitative social scientists), which is intended to assist the management of local waterways through a collaboration between scientists, government, industry and local community groups (see Abal et al. 2002).[10] But, though 'we feel it's all about working together', the group's scientific coordinator, Eva Abal, remains keenly aware that:

> The interactions of these different groups have not been documented... [although] the social interaction of our different groups is critical... Awareness is good in education, but I think we get to a stage where we would like to look at behavioural change. And what are the requirements to actually arrive at behavioural change? (Eva Abal, Scientific Coordinator, Healthy Waterways, Queensland, workshop participant)

Despite major efforts to incorporate the social sciences, the Partnership finds itself subject to all the factors that make this integration difficult to achieve. The core

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[9] Clearly, in the Australian context, the issue of land rights, and the perception that social scientists have assisted indigenous groups in this regard, has led to some political antipathy towards social science in general and anthropology in particular (as was evident in the Hindmarsh Bridge case). This reality is influential at various levels, but most particularly at a local level, where decisions are made by natural resource users (whose votes often go to the National Party or One Nation) about the kinds of science they want to incorporate into catchment management.

[10] The structure of the Healthy Waterways Partnership is based on strong links with State agencies, a scientific advisory group, a community and industry advisory group, and about 60 subsidiary catchment management, industry and community groups. It also has legal support and various implementation groups, and has gained considerably from the support of eminent (natural) scientists and the Lord Mayor of Brisbane.

model to which it subscribes is largely that of the natural sciences; the social sciences are present, but occupy a more marginal role; and the integration of social theories, discourses, methods and analyses has not happened as fully as the participants would like.

5 Obstacles and avenues

As the above account illustrates, collaborative research in Australia is challenged by some significant obstacles. It is confronted by a dominant intellectual paradigm that conceptually separates culture and nature, rather than considering human–environmental interaction as a dynamic, interpenetrative engagement. This conceptual separation is expressed in the legislation that frames the process, in structures of governance at each level, and in the devolvement of responsibilities for resource management to agencies and individuals. Although environmental management groups say they want to involve diverse communities and bring their views and concerns into the process, in fact, they generally function in such a way as to exclude or suppress complex social and cultural issues and non-reductive or non-technical forms of knowledge. This exclusion is further compounded by their demographic composition, and the levels of familiarity that their participants have with various kinds of knowledge. Further obstacles are created by major tensions in the current socio-political context. Given all of these factors, it is unsurprising that the focus of environmental resource management and related research remains, for the most part, largely practical and a-theoretical, and focused on specific technical and ecological issues such as weed control, land management practices and biodiversity.

Some major changes are needed to enable a more integrated approach. In broad terms, discourse on this issue would benefit from the much wider dissemination of theoretical models that acknowledge the human–environmental interaction as such, elucidating its complexities and integrating social and environmental issues. There is a need for critical social analysis of the research process and environmental management itself, so that their implicit assumptions and structural norms are illuminated and opened up to change. This form of analysis needs to extend to the social, political and intellectual context in which these activities take place, to show how this context valorises or rejects different kinds of knowledge (see Strathern 2004). There is also a need to deal with the reality that transparency about social relations and empowerment has the potential to be subversive, and is therefore not necessarily welcome.

This presents a 'chicken and egg' problem: the conceptual models and analytic approaches of the social sciences are needed to facilitate change and integration, but—as the above account makes plain—these are largely left outside the discussions and activities of those empowered to direct research and manage land and resources. Integration—both intellectually and practically—therefore depends on active efforts from both social and natural scientists to build bridges not only in their research, but in their interactions with the wider community and the political climate that it both generates and inhabits.

6 Designing interdisciplinary projects

It is plain that successful collaboration requires a major investment of time and energy. There is a strong case for employing, on any interdisciplinary team, someone whose role is

simply to enable communication and exchange between researchers, as well as between the research team and potential research users. In addition to funding this type of input, it is also essential to allocate sufficient time for this communication to happen not just at the outset, but at each stage in the research.

> It's part of the relationship building that needs to go on, a lot of building trust... We had half day weekly meetings... 10% of our time was in meetings, and we absolutely needed all that time. (John Bradley, Anthropologist, Monash University, workshop participant)

> In a truly interdisciplinary project, the time invested is different, You need a lot more time.... you need a lot of discussion time just for the team members to talk things through, get to know each other... a big upfront investment on just getting mutual understanding before you can power ahead. Building up teams of people with a history of working together can be very very useful. (Lesley Jolly, Anthropologist, University of Queensland, workshop participant)

There are various models for collective/group decision-making which may have some potential to assist interdisciplinary research processes (see Brewer and Stern 2005; White and O'Brian 1999). A useful example of good interdisciplinary practice is provided by the Rural Economy and Land Use Programme in the UK (RELU), which is based at the Centre for Rural Economy at the University of Newcastle. Funded by the Economic and Social Research Council, this interdisciplinary programme has a specific remit to 'inform policy and practice with choices on how to manage the countryside and rural economies', and it does this by 'harnessing the social and natural sciences for sustainable rural development' (RELU, url, see also RELU 2006). RELU's research projects contain a requirement that, at regular stages, the various disciplinary participants have to 'sign off' on its progress, indicating that they are happy with the direction of the research and feel that their particular input has been properly included. Projects cannot proceed further until all have done so.

Even academics are not immune to the need to form positive social relationships in order to work together.

> Traveling together was very good... Traveling together as a group, and interpreting the landscape to one another... Getting plastered together... Getting silly hair cuts – the younger ones went and got tee shirts with jokes on them. (John Bradley, Anthropologist, Monash University, workshop participant)

Something that is bound to emerge with a shared understanding of the different theoretical models and kinds of data involved, is an appreciation that social science research generally requires far more diverse types of data than is commonly encompassed in natural science projects, and that it takes more time to collect and analyse such a wide range of data.

> There is a huge variability in the time scales we are looking at. (Eva Abal, Scientific Coordinator, Healthy Waterways, Queensland, workshop participant)

The larger time frame needed for social science cannot be reduced simply by adding labour, as it may depend on long-term methods of data collection, such as participant observation, lengthy interactions with informants, and the ability to tease out complex social and cultural issues that have not previously been articulated.

This is particularly the case with most 'in-depth' qualitative disciplines such as anthropology, which could reasonably be described as the 'slow food' of the social

sciences.[11] Based on the premise that the only way to understand human behaviour is to locate it in its social and cultural context, anthropology is committed to collecting a comprehensive range of (largely qualitative) in-depth data about this context—or 'environment'—including its material and ecological aspects.[12]

Given these realities, it is practical to approach collaborative research, as Eva Abal puts it 'by recognising that we do have different time scales' and then incorporating the different time spans needed for social and natural science research into projects more realistically. While this may seem somewhat *outré*, it would be most logical to design projects that actually give a 'head start' to slower forms of research, and acknowledge their larger energy input with realistic funding allocations. This would begin to tackle the problem that in the majority of putatively collaborative research projects, the social science participants find that they are chronically underfunded in terms of conducting in-depth qualitative research, and that there is far too little time allocated for data collection, analysis and writing up.

This suggests that a useful principle would be to base project design on the idea that each disciplinary area would be allocated time and funds, not in some arbitrary or competitive sense, but in accord with its particular temporal needs, so that each could have an equal opportunity to produce the best possible research outcomes.

7 Data collection and analysis

Though they share a reliance on empirical data, there is considerable disparity in methods of data collection in the social and natural sciences, and in the types and range of data collected. There may be some common ground in quantitative approaches: for example between material on household social composition and measurements of water use patterns, but the material that is most likely to elucidate the relationship between these types of data tends to be qualitative, diverse, and not—in general—quantifiable. Interdisciplinary projects therefore have to tackle the problem that the types of data they produce are rarely comparable, and do not mesh readily. Some efforts have been made to consider all kinds of data as 'multiple variables', for instance with systems theory and other—for example— economic modelling techniques (see Crane 2000; Schweitzer 2002, 2003) and even 'agent based' modelling (see Paget 2000).[13] There may be some scope—with research designed in accord with some of the principles outlined below—for systems theory and modelling exercises to contribute, as heuristic devices, to discussions about how to integrate social and ecological systems. In the end, an interdisciplinary project will only produce a coherent outcome if it has a coherent process of managing and integrating diverse data, and this needs to be set up at the outset, managed carefully throughout, and brought into play in the production of outputs.

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[11] 'Slow food', as those interested in gourmet food will know, is food produced according to the premiss that quality is all. Produced 'traditionally', entirely according to organic principles, and steadfastly refusing any compromises towards 'convenience', it is meant to offer tastes, textures and experiences that are the qualitative polar opposite of mass-produced 'fast food'.

[12] Obviously I am implying here that it might be useful if we used the term 'environment' more holistically in the first place, acknowledging that it is both social and ecological.

[13] For those unfamiliar with computer modelling, 'agent based' modelling is a sort of 'organic' approach in which a number of 'agents' (variables) are given a set of rules or characteristics and then allowed to interact and 'evolve' behaviours.

However, although 'systems thinking' has achieved considerable popularity in natural resource management, and is often perceived as a way of integrating social factors, qualitative social scientists would tend to argue that it has limited value in encompassing what can be the most important factors in environmental management. Systems theory relies on keeping the multiplicity of variables at a manageable level, and ensuring that each factor is transparent, readily definable and to some extent homogenised. It is not suited, for example, to expressing the complex and intangible realities of power relations, belief systems, values, understandings of environmental processes, affective responses to place, identity, social relations and so forth. It distorts the subtle interrelationships within the social and material worlds that people inhabit and, perhaps most crucially, removes the capacity of the analysis to draw on an explanatory ethnographic context. In effect, this leaves human behaviour largely as a 'black box', rather than articulating the underlying dynamics of human-environmental interaction.

To encompass the real complexities of social behaviour, projects need to be conceived and designed with a broader theoretical base in order to integrate in-depth qualitative material successfully, leaving sufficient practical and intellectual space for different kinds of data. Rather than compressing qualitative data into extinction, or imposing heuristic models that are limited in their utility, interdisciplinary collaborators have to find ways for their data and analyses to 'talk' to each other. Thus there is a need to conceptualise systems capable of including far more variable kinds of data, and the potential to link these within a larger frame of metatheory (see Fiske and Shweder 1986) and, rather than reducing them, to treat them as a complex ecology of ideas (see Gasper 2001; Steiner 1993).

At a practical level, some success has been achieved in number of disciplinary areas with GIS and other databases to link qualitative and quantitative data systematically without trying to homogenise or reduce them. This has been particularly helpful in encouraging a broader vision of what constitutes an 'environment'. It is useful, therefore, to suggest that potential collaborators should give some thought to how their various kinds of data will be managed, and whether they can be incorporated into—or at least linked with—schemes that will encourage integrative ways of not just managing their information, but also conceptualising it in new ways.

8 Outputs

The disparities in form and approach that characterise data from the social and natural sciences are reflected equally in the kinds of outputs that they generate. A common expectation in research on environmental issues, because it has been largely dominated by the natural sciences, is that input from the social sciences will be summarised to fit a style of reporting that valorises brevity. This is a problem, particularly for the more qualitative social scientists, who find that although it is certainly possible to highlight key findings, the real value of their work lies in elucidating complexity and making sense of human behaviour by locating it in its explanatory social and environmental context. Extracted piecemeal from this context, much social data ceases to 'make sense' and seems either facile or impenetrable.

There is a clear case, then, for suggesting a similar approach to outputs as with data. Instead of trying to homogenise these to fit particular norms and expectations, it is more practical to produce a range of complementary outputs that reflect the needs and qualities of each of the disciplines involved, and to consider how these inform and support each other.

9 Conclusion

It is possible to distil, from the interactions of social and natural scientists referred to here, as well as from other writing on this topic, a set of general principles that I hope will facilitate cross-disciplinary research, from its initial design stages through to completion. Many of the suggested improvements involve the addition of time, funds or people specifically to assist the collaborative process and the communication of its findings. The implication is that collaborative research will, as a result, cost more than the sum of its parts. However—done successfully—I would argue that it also has the potential to yield much more than the sum of its parts, amply justifying the greater investment that it requires. Researchers embarking on collaborative projects might do well, therefore, to be bold in allocating time and funds to support the collaboration and ensure that 'integration' moves from rhetorical to real.

It is useful to summarise the suggestions that emerged from the workshop at the University of Queensland, and related discussions. These suggest, above all, an overriding need for equality between the social and natural sciences. This equality needs to be manifested at each stage in the research process: in constructing working relationships, in discussing and negotiating research questions, in dealing with different theoretical paradigms, in allocated resources realistically, and in using and valorising different kinds of data, analysis and output.

Another overriding need is for there to be, in the academe and in public discourse, a robust reflexive critique of the conceptual models that are used to consider 'the environment', to challenge the dualism that separates and compartmentalises 'nature' as a kind of technical ecology. Only when this dualistic model is questioned and found wanting, will it be possible to shift public discourse towards more integrated holistic models. In the academe, if social and natural scientists are to work together successfully, research design therefore needs to begin with an in-depth discussion about theory, and efforts to ensure that all participants are able to make use of (or at least see where their research fits into) a model that conceptually integrates socio-cultural and biophysical complexities.

At the proposal development stage of collaborative projects, participants need to have equal input into the design of all stages of the research: its key questions, the basic approach, and the kinds of methods, data and analysis that will be used. All of the disciplines in the research really need to achieve at least a basic understanding of the types of theory, methods, data and analysis used by the others. This implies considerable knowledge sharing, and thus a commitment of a significant amount of time to be spent in communication between the participants. Participants might consider drawing on techniques for group facilitation and collective decision-making. Time and funding should be built into the process to enable this interdisciplinary exchange. These discussions need to be maintained throughout the project, so that data is brought into a shared model systematically, and can be analysed and reported coherently. There is a good case for following the practice recommended by RELU (Ibid.), of checking that all participants are in accord and happy with the progress of the work at regular stages during the project.

Given the political demands for 'public accountability' and 'accessibility', time and funding should also be allocated to enable communication between the research team and potential research users. However, there are some question marks over the (often uncritically accepted) mantra that good research is accessible research. While public communication about research is useful and certainly politic, a requirement that research must be 'accessible to all' may not engender good research practice and high quality outcomes.

There is a real need for research to be conducted without undue influence from 'stakeholders' and external funders. Thus, in major projects, there is a case for employing someone with appropriate expertise, whose role is to liaise with potential research users, while also protecting the independence of the research. Such a person might also facilitate communication within the team.

Academics bring a great deal of passion and commitment to their work, and identity is thus an emotive issue. Careful consideration should therefore be given to the 'profile' of collaborative research projects, so that all the participants can feel confident that their disciplinary identities will not be denigrated, appropriated, or consumed by assimilation. They also need to be sure that their particular disciplinary needs will be met. For example, in the development of timetables and budgets for research, there needs to be much greater recognition of different temporal needs. Rather than imposing a schedule that reflects only some disciplinary timeframes, each disciplinary area should be allocated time and funds in accord with its particular temporal realities.

Interdisciplinary projects have to tackle the problem that the types of data they produce are rarely comparable, and do not mesh readily. Potential collaborators should give some thought to how their various kinds of data will be managed, and whether they can be incorporated into—or at least linked with—systemic schemes that will encourage integrative ways of managing and possibly reconceptualising their information. Similarly, at the other end of any collaborative project, rather than being homogenised, the outputs should also reflect the diverse needs and qualities of each of the disciplines involved. Consideration should also be given to how outputs will be integrated or at least linked systematically, and how they can inform and support each other.

Finally, any collaboration between different disciplines introduces into the research process a new set of challenges and potential advantages. The designers of interdisciplinary projects should therefore be bold in allocating realistic amounts of time and funds to support the kinds of changes in research design that will lead to successful collaborations between the social and natural sciences.

I would conclude by expressing a hope that this paper demonstrates the need to locate the issues in a specific cultural context, and to consider its particular effects on the research process. I also hope, though, that the issues and recommendations set out here provide a least a useful starting point for researchers in a variety of different cultural contexts.

References

Abal, E., Moore, K., Gibbes, B. & Dennison, B. (Eds) (2002). *State of South-east Queensland waterways report*. Brisbane: Moreton Bay Waterways and Catchments Partnership.

Abram, S. (2001). Anthropology versus science in *Anthropology Today*, Comment. Vol 17. No 4. pp 25.

Adler, N., Shani, A. & Styhre, A. (Eds) (2004). *Collaborative research in organisations*. London, Thousand Oaks California: Sage Publications.

Attwood, B., & Arnold, J. (Eds) (1992). *Power, Knowledge and Aborigines.* Special edition of the *Journal of Australian Studies*, Clayton, Victoria: La Trobe University Press in association with the National Centre for Australian Studies. Part 2.

Brewer, G. & Stern, P. (Eds) (2005). *Decision making for the environment: Social and behavioral science research priorities*. Washington, DC: National Academies Press.

Carr, A. (1994). Grass-roots and Green-tape: Community-based environmental management in Australia. PhD thesis. ANU.

Crane, D. (2000). Simulation modelling of complex human policy issues: Towards a broad interdisciplinarity. PhD Thesis. University of Edinburgh.

Descola, P. & Palsson, G. (Eds) (1996). *Nature and society: Anthropological perspectives*. London, New York: Routledge.

Eggins, H. & MacDonald, R. (Eds) (2003). *The scholarship of academic development*. Buckingham, UK and Philadelphia PA: SRHE and Open University Press.

Ellen, R., & Fukui, K. (1996). *Redefining nature: Ecology, culture and domestication*. Oxford, Washington: Berg.

Fiske, D., & Shweder, R. (1986). *Metatheory in social science: Pluralisms and subjectivities*. Chicago, London: University of Chicago Press.

Gasper, D. (2001). *Interdisciplinarity: Building bridges and nurturing a complex ecology of ideas.* Working Paper No 331. The Hague, The Netherlands: Institute of Social Studies.

Grigg, L. (1999). *Cross disciplinary research: a discussion paper*. Canberra: Australian Research Council.

Heron, J. (1993). *Group facilitation: Theories and models for practice*. London: Kogan Page.

Hogan, C. (2002). *Understanding facilitation: Theory and principles*. London: Kogan Page.

Hunter, D., Bailey, A., & Taylor, B. (1996). *The facilitation of groups*. Aldershot: Gower.

Lake Baroon Catchment Care Group (1995). *People power in catchment care*. Conference Proceedings, Maleny.

Lattuca, L. (2001). *Creating interdisciplinarity: Interdisciplinary research and teaching among college and university faculty*. Nashville: Vanderbilt University Press.

Lawrence, G., Higgins, V. & Lockie, S. (Eds) (2001). *Environment, society, and natural resource management: Theoretical perspectives from Australasia and the Americas*. Northampton, MA: Edward Elgar.

Lawrence, G. (2003). Sustainable regional development: Recovering lost ground. In B. Pritchard, A. Curtis, J. Spriggs & R. Le Heron (Eds.), *Social dimensions of the triple bottom line in rural Australia* (pp. 157–170). Canberra: Bureau of Rural Sciences.

Lee, R., Wallerstein, I, & Aytar, V. (2004). *Overcoming the two cultures: Science versus the humanities in the modern world-system*. Boulder, Colorado., London: Paradigm Publishers.

Martin, P. (1991). Environmental care in agricultural catchments: Towards a communicative catchment. *Environmental Management, 15*(6): 773–778.

Nash, R. (2001). Social harmony principles in waterways management: A communicative approach to catchment management. Final Report. Brisbane: University of Sunshine Coast.

Nowotny, H., Scott, P., & Gibbons, M. (2001). *Re-thinking science: Knowledge and the public in an age of uncertainty*. Cambridge: Polity Press.

Paget, J. (Ed) (2000). *Collaboration between human and artificial societies: Coordination and agent-based distributed computing*. New York: Springer.

Pawson, E., Dovers, S. & Racaut, L. (2003). Environmental history and the challenges of interdisciplinarity: An antipodean perspective. *Environment and History, 9*(1), 53–75.

Pearson, N. & Sanders, W. (1995). *Indigenous peoples and reshaping Australian institutions: Two perspectives*, Discussion paper, No. 102/1995. Canberra: Centre for Aboriginal Economic Policy Research.

Rural Economy and Land Use Programme. (2006). *The UK Rural Economy and Land Use Debates 2006.* Briefing Paper No 4. Newcastle: RELU. url: http://www.relu.ac.uk.

Schweitzer, F. (Ed) (2002). *Modeling complexity in economic and social systems*. New Jersey: World Scientific.

Schweitzer, F. (2003). *Brownian agents and active particles: Collective dynamics in the natural and social sciences*. Berlin, London: Springer.

Sinnamon, V. (1992). Gulf of Carpentaria coast and river management: An aboriginal management agency perspective. Paper presented to the Queensland Environmental Law Association Annual Conference. May 1992.

Somerville, M. & Rapport, D. (Eds) (2000). *Transdisciplinarity: Recreating integrated knowledge*. Oxford: EOLSS.

Steiner, D. (1993). Human ecology as transdisciplinary science, and science as part of human ecology. In D. Steiner & M. Nauser (Eds.), *Human ecology: Fragments of anti-fragmentary views of the world* (pp. 47–76). Routledge.

Strathern, M. (2004). *Commons and borderlands: Working papers on interdisciplinarity, accountability and the flow of knowledge*. Wantage: Sean Kingston.

Strang, V. (2005a). Common senses: Water, sensory experience and the generation of meaning. *Journal of Material Culture, 10*(1) 93–121.

Strang, V. (2005b). Knowing me, knowing you: Aboriginal and Euro-Australian concepts of nature as self and other, in *Worldviews* 9.1. pp. 25–56.

Strang, V. (2005c). Meaningful differences: Dis-integrated management in the Mitchell River catchment. In M. Minnegal (Ed.) *Sustainable communities, sustainable environments* (pp. 60–69). Conference Proceedings, Melbourne: SAGES.

Strang, V. (2006) A happy coincidence? Symbiosis and synthesis in anthropological and indigenous knowledges. *Current Anthropology, 47*(6) 981–1008.

Syme, G. J. (1992). When and where does participation count? In M. Munro-Clark (Ed.) *Citizen participation in government*. Sydney: Hale and Iremonger.

Toussaint, S., Sullivan, P., & Yu, S. (2005). Water ways in aboriginal Australia: An interconnected analysis. *Anthropological Forum, 15*(1), 61–74.

Verdec, N. (1998). Improving public participation in caring for urban catchments. Masters Thesis, Griffith University.

Weingart, P., & Stehr, N. (2000). *Practising interdisciplinarity*. Toronto: University of Toronto Press.

White, D., & O'Brian, K. (1999). *The collaborative decision making 'Tool Kit': handbook for planning effective meetings*. Blacktown NSW: K.D. Publications.