Community versus research-based conservation: what are the paradigms?

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ABSTRACT

A clearly-articulated paradigm is described that guides much current research-based conservation effort. This paradigm, which uses a reductionist approach, provides a method for unambiguously identifying threats to biodiversity, such as causes of species' declines, and a method for distinguishing optimal management solutions. In contrast, it is argued that community-based conservation is not guided by any evident paradigm; actions can be grouped instead into different themes that have been labelled here as *reactive, interactive, proactive* and *opportunistic*. Because research can address only some conservation problems and community efforts usually are broad but diffuse, conservation of biodiversity would be best served if the two approaches were integrated. To achieve this objective, scientists must become more involved in activities at the community level, whereas community groups must ensure that their 'on-ground' actions are rigorous and defensible. Some examples of successful collaborations are provided in the paper.

Key words: Community, research, conservation, biodiversity, reductionist paradigm

Introduction

Although conservation biology is a relatively young discipline, there have been several shifts in thinking about how best to achieve conservation goals. Species-based approaches to conservation have long sought to identify taxa at risk and to manage the processes that threaten them. Management may use a variety of techniques to maintain species in their natural environment, such as reservation and protection of land or control of exotic organisms (Danks 1997; Low 1999), or resort to intensive techniques such as captive breeding (e.g. Clark and Seebeck 1990). Cryopreservation of genetic material is sometimes advocated (Maniatis *et al.* 1982), although this approach is likely to be a futile measure for conservation in the real world. Conversely, area-based approaches to conservation seek to identify areas of high conservation value and to preserve them. Such areas may be remnants of local bushland, representative land or aquatic systems, or regional environments. With this broad-scale approach, small organisms such as microbes and invertebrates should be retained, and ecological systems may continue to function unimpaired (Franklin 1993).

The enterprise of conservation biology has traditionally been based on research and management and has been the preserve of concerned amateur and professional practitioners working in academia, government, and non-government organisations, including zoos and aquaria. Recently, however, there has been a surge in involvement in conservation projects by the broader community. This involvement reflects the view that communities should benefit from monitoring and managing their own local biota, either directly through sustained harvesting or ecotourism, or indirectly through maintenance of amenity and aesthetic values (Kothari 1998; Wells and Brandon 1992).

In Australia, governments have also encouraged active community participation in conservation projects. In New South Wales, for example, the first chapter of the State's Biodiversity Strategy (Anon. 1999) is devoted to community consultation, involvement and ownership. At the level of commonwealth government, massive funding has been allocated to community groups

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via the Natural Heritage Trust and Threatened Species Network schemes. Conservation research has been virtually jettisoned under these latter schemes in favour of achieving direct, 'on-ground' outcomes. Research appears to be eschewed similarly in the workings of many catchment and vegetation management committees. This 'on-ground' approach assumes that we already know the solutions to conservation problems, despite evidence that this assumption may often be seriously flawed (Caughley and Gunn 1996). Political considerations may also dictate conservation directions and outcomes with little reference to research (or community) imperatives, but these are beyond the scope of discussion here.

In this paper, I attempt to identify the processes, or paradigms, that drive research- and community-based conservation. I suggest that a clearly-articulated paradigm is needed to achieve conservation goals and that, at present, such a paradigm is available only for the research enterprise. I also describe in brief the relationship between research and community-based conservation and suggest ways in which the relationship may be improved. To restrict the focus I emphasise examples of species conservation rather than process, ecosystem or landscape conservation. There is, however, no evidence that the paradigms underlying conservation of these entities differ from those underlying the conservation of species (Caughley and Gunn 1996; Dickman 1996).

Research-based conservation

Despite ongoing debate about the nature of scientific research and its application to ecology and conservation biology (Calver *et al.* 1999; Goodall 1999; Weber 1999), there is some agreement that the reductionist logic of Popper (1968) can provide a particularly rigorous structure for distinguishing among competing explanations for any observation. As an example, we may observe that a certain species has declined in abundance or distribution over some specified time frame and wish to understand the cause. Following the initial observation of decline, the next step is to specify an explanation, or set of explanations, to account for it (Fig. 1). Such explanations are here termed models, following Underwood (1990, 1991). Models might invoke predation by introduced carnivores, epidemic disease, loss of habitat or other processes, and clearly should be derived from the sum of observations, knowledge of natural history and other information that is available on the target

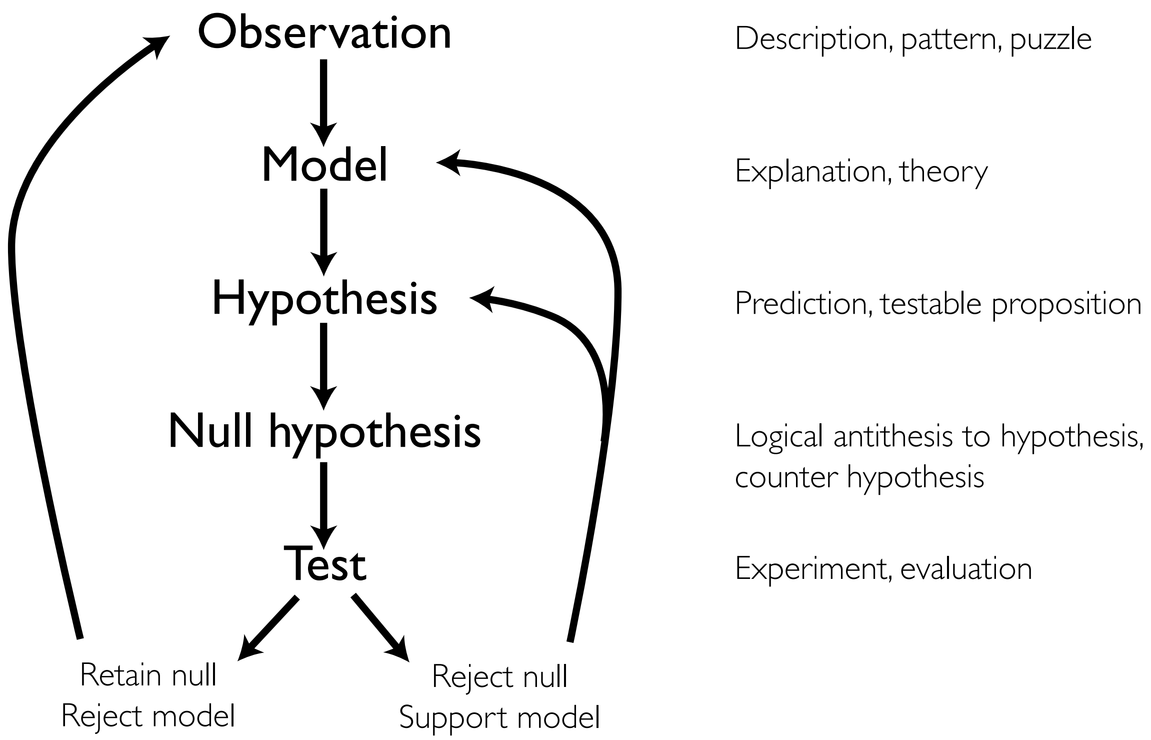

Figure 1. Steps in the experimental evaluation of explanations proposed for any observation or pattern. Redrawn from Underwood (1991).

species. When relevant models have been specified, the next step is to derive predictions, or hypotheses, from them (Fig. 1). For example, if predation is suspected to be a causal agent in the target species' decline, the relevant hypothesis would predict that the species will occur in greater numbers where predators are scarce or absent than in areas where they are prevalent. For habitat loss, the hypothesis would predict that the target species will occur in greater numbers where its habitat is intact than where the habitat has been removed or degraded. If several plausible models have been constructed, they can be distinguished if they yield contrasting hypotheses. To evaluate the hypotheses, testing can be carried out using either mensurative or manipulative experiments. For example, mensurative testing of the predation hypothesis would require comparisons to be made of the density of the target species in sites where predators are present and absent; manipulative testing would require similar comparisons to be made in control sites and in experimental sites from which predators have been experimentally removed.

Because of the simplicity of obtaining disproof rather than proof in hypothesis testing (Popper 1968), it is most convenient in the final step to test *null* hypotheses that express all logical alternatives to the hypothesis, rather than the original hypothesis itself (Fig. 1). With respect to the predation hypothesis, the null form would predict that the density of the target species would be the same in sites with and without predators, or would be greater in sites where predators occur. If experimental evaluation rejects the null hypothesis, this provides support for the hypothesis and the model from which it was derived. In contrast, support for the null hypothesis indicates that the original model should be rejected, and hence that alternatives then need to be evaluated (Fig. 1). It should be noted that appropriate sampling and analytical procedures must be used in hypothesis-testing to avoid drawing the wrong conclusions. If a poorly-designed experiment led to the erroneous conclusion that predators have no effect on the density of the declining target species (i.e. the null hypothesis was accepted), predator management would be difficult to justify and the prey species could easily be lost. Robust and efficient methods for testing hypotheses are well known (e.g. Mead 1988; Fletcher and Manly 1994; Underwood 1997).

The reductionist approach has been used extensively and successfully in conservation biology to identify the causes of species declines, the causes of failure in captive breeding or translocation programs and also to prescribe effective management actions (e.g. Caughley and Gunn 1996; Dickman 1996; Denton *et al.* 1997; Chazal and Niewiarowski 1998; Fisher 2000). Sometimes emphasis may be placed more on development of models, such as when observations are contradictory or difficult to interpret (Laurance *et al.* 1996), or on tests of hypotheses when several models are available, such as in adaptive management or some 'research-by-management' approaches (Innes 1992-95). Adaptive management approaches, in particular, have been used increasingly in recent years in situations where there are complex interactions among processes, where data are insufficient to suggest optimal management actions (e.g. Costello *et al.* 2000), or where social science or policy perspectives need to be incorporated in decision making. Dovers and Mobbs (1997) provided an excellent overview of the effectiveness of adaptive management, while Sharley (1997) illustrated the utility of the approach in managing the Chowilla floodplain near the junction of the New South Wales, Victorian and South Australian borders. Despite differences in emphasis, these approaches arguably are still contained within the research paradigm and illustrate its flexibility. Conservation actions that have been undertaken without regard to the research paradigm, such as those based solely on politics, hope or guesswork, may sometimes be successful. However, many are not, and the failures they engender can be costly and spectacular (e.g. Springer *et al.* 1978; Kiff 1989; Rabinowitz 1995).

Community-based conservation

In most societies the 'community' is a heterogeneous collection of individuals and groups with competing and often conflicting values. Community attitudes toward conservation vary accordingly. At worst, some segments of the community may demand the destruction of certain species and their habitats. For example, the demands made by sheep farmers in Tasmania to protect their flocks from the Thylacine *Thylacinus cynocephalus* resulted in the government-sanctioned extirpation of the species by 1936 (Paddle 2000). The government of Queensland currently allows the clearing of up to 400 000 ha of native vegetation each year, with the concomitant loss of habitat for large numbers of animal species, while the housing development industry views land set aside for conservation purposes as 'sterilised' (but *cf.* Jerogin 1997). Such groups, clearly, are little concerned about the ethic of conservation, and are not considered further here. At the other extreme, however, some segments of the community are very concerned about the loss of biodiversity, and commit considerable time and resources to achieving conservation goals. These segments include many indigenous groups, land managers, bush and native species carers, catchment and vegetation management groups, non-government organisations and individuals. In the following section I propose that the conservation efforts of these disparate groups are not based on any single, clearly-identifiable paradigm, but rather that actions can be categorised into a number of different themes.

In the first theme, community conservation can be labelled *reactive.* Conservation action here may be initiated if a threat is perceived to a well-known species, patch of habitat or ecosystem. The entity often is threatened locally, although some reactive conservation efforts, such as by the World Wide Fund for Nature, are continental in scope. In one highly successful reactive conservation program, community action has helped to stabilise formerly-declining populations of the Richmond Birdwing *Ornithoptera richmondia* in south-eastern Queensland and north-eastern New South Wales. This large and spectacular butterfly has declined markedly over the last century, primarily due to loss and fragmentation of rainforest plants that provide food for the caterpillars. In 1992 the Richmond Birdwing Conservation Project was set up to encourage school children and other members of the community to assist the Richmond Birdwing by planting out large numbers of one of the species' favoured food plants, the vine *Pararistolochia praevenosa* (Sands *et al.* 1997). Now coordinated by CSIRO's Double Helix Club, some 130 schools, several hundred householders, government and non-government organisations are involved in promoting the recovery of this butterfly (Sands and Scott 1996). Similar community groups have been formed to conserve many other threatened species, such as Friends of the Helmeted Honeyeater (Smales *et al.* 1995), Friends of the Brolga (McIntyre 1995), the Mantung/Maggea Malleefowl project (Williams 1996) and Ducks Unlimited (Saunders 1996). These groups often monitor population trends in the target species, collect data on use of habitats and threatening processes, disseminate information and interact with managers from government conservation agencies.

Some of the most striking examples of reactive community conservation occur when planned new developments threaten local remnants of habitat in urban and suburban areas, or larger areas of coast, forest or bush. These situations can trigger rapid assessments of biodiversity to identify the presence of threatened species, populations or communities, mobilisation of people in and near the affected area, and direct protests. Political lobbying may also occur. For example, plans put forward in mid-2001 to develop much of the Australian Defence Industries (ADI) bushland site in western Sydney triggered considerable political debate and the formation of a single-issue political party, the Save the ADI Party, to prevent development taking place (O'Rourke 2001). Community involvement in these situations sometimes halts or modifies proposed developments, such as the plan to dam the Franklin River in Tasmania in 1982, but sometimes fails, as in the decisions to flood Lake Pedder in Tasmania and to build a road through the Daintree rainforest in north Queensland.

A second theme in community conservation can be termed *interactive*. For this approach, members of the community interact intimately with the biotic environment, often depending on it for material, economic, spiritual or aesthetic values. Interactive conservation is most obvious, and important, for people living on the land and deriving sustenance directly from it. In central Australia, 'looking after country' by Aboriginal people relies on very detailed knowledge of the biota and interactive management, using fire, to ensure continued supply of biotic resources (Baker *et al.* 1993; Latz 1995). Holistic knowledge of this kind is often documented orally, and may be lost if the traditional way of life is eschewed. In some regions there is concern also that traditional lifestyles may not be sustainable if mixed with new technologies. For example, increased use of outboard-powered dinghies by indigenous people across parts of the 'top end' of Australia is likely to make the harvest of Dugong *Dugong* *dugon* unsustainable (Marsh *et al.* 1997). Widespread use of shotguns by traditional hunters in Sarawak and Sabah is rapidly depleting many species of wildlife (Bennett *et al.* 2000); Karen villagers may be impacting similarly on wildlife in Thailand (Steinmetz and Mather 1996).

Interactive conservation may be carried out by other segments of the community, such as farmers (including native animal farmers), pastoralists, ecotourism operators and animal carers, but will be less intense than for traditional people because some material resources are derived from outside the system. Thus, while a farm property may comprise just grassy paddocks, the homestead would have to be constructed from materials imported from another area. Nonetheless, for people engaged in day-to-day management of natural and modified habitats, or for those involved in regular care of injured wildlife (e.g. Wildlife Rescue Service, WIRES), considerable knowledge of the species or system under management must be acquired if the enterprise is to succeed.

A third theme in community conservation is the *proactive* approach. Here, community action may be undertaken in the absence of threats to particular species or habitats, and is often aimed at improving awareness of conservation issues generally so that the likelihood of future biodiversity loss is reduced. Proactive conservation is seen in the efforts of groups such as field naturalists' clubs, bird watching clubs and local natural history societies, especially where newsletters and other educational materials are produced for broad distribution. In New South Wales the National Parks Association encourages many people to assist in faunal surveys, while the Wildplant Rescue Service deploys hundreds of volunteers to remove plants from designated development areas for use in revegetation and restoration projects elsewhere. Larger organisations, such as the World Wide Fund for Nature and the Australian Conservation Foundation (ACF), also promote proactive conservation via education programs and community engagement; the ACF additionally acquires some properties to prevent future development. Primarily State-based organisations such as the Royal Zoological Society of New South Wales or the Royal Society of Western Australia have conservation and education as key parts of their constitutions, and achieve their missions by holding public fora and producing newsletters, books and journals. Other groups such as catchment and vegetation management committees and boards also have great opportunities to achieve proactive conservation. No doubt some do, although Burgin (2002) has pointed out that 'community' representation is often equated with 'farmer' representation on committees, and consequently that conservation efforts sometimes rest in the hands of narrow sectional interests.

A final theme in community conservation can be labelled *opportunistic*. In this theme new conservation activities may be undertaken in response to shifts in legislation, political alignment, funding or other opportunities. The NSW Biodiversity Strategy (Anon. 1999), for example, explicitly emphasised the need for community participation in biodiversity management, and encouraged the provision of incentive schemes to involve private land owners. Voluntary Conservation Agreements (VCAs) show how such schemes might work. A VCA is an agreement between a landowner and the NSW Minister for the Environment to maintain and enhance conservation values on private land. It is also a covenant that binds the present and future landowners. Local councils are empowered to offer rate rebates on land subject to VCAs, thus providing a financial incentive to owners to enter into negotiations. By 1999 some 45 agreements had been made and another 100 were under negotiation (Anon. 1999). Some direct funding has been made available under the NSW Biodiversity Strategy, and much greater opportunities are available under the Commonwealth's Natural Heritage Trust awards.

There are many other examples of community involvement in conservation, such as in community monitoring or surveys (e.g. Lunney *et al.* 1997, 2000; Otley 2001), submissions of nominations to State or commonwealth committees that are charged with listing threatened species and ecological communities, or public comments on Environmental Impact Statements. However, my intention here is not to provide an exhaustive list, but rather to demonstrate that community-based conservation is multi-faceted. There is no single paradigm that dictates how the community should participate in conservation, nor who should be responsible for setting, achieving and evaluating conservation goals.

One paradigm, or many: who cares?

The research paradigm described above offers a clear and transparent means of identifying both the causes of species declines and management prescriptions that should best reverse them. It also provides a means of progressing if a suspected threatening process is discovered to be unimportant, and a means of assessing the achievement of conservation actions. In contrast, community-based conservation lacks a clear framework. Conservation goals are not always set; when they are, milestones and methods of achieving them may vary greatly for the people concerned. A simple goal, for example, may be to conserve a bush block surrounded by paddocks. Putting a fence around it, erecting a sign, or entering a Voluntary Conservation Agreement may fulfil the immediate goals of a community-based project, but the bush block may still not be conserved. Unless there is ongoing management of rabbit grazing there will be little regeneration of trees and shrubs, and the block will degenerate within decades. If there is no control of mobile predators that operate across the block's boundary, many animal species may disappear long before the habitat itself has eroded. As a further example, consider an ecotourism venture that seeks to increase the public's appreciation for some wild place. Unless the development is carried out with sensitivity, there will be a trade-off between achieving the intangible benefit of improving conservation awareness and the cost of degrading the place's wild values. If the venture does not make a profit, there is a further risk that a subsequent development would be much less sympathetic to the environment. These examples are abstract. However, there are numerous case studies that illustrate how the divergent themes in community-based conservation can lead to the adoption of different goals, agendas and expectations that do not always achieve effective conservation outcomes (e.g. Cox and Elmqvist 1993; Western *et al.* 1994; Hackel 1999; McCoy *et al.* 1999; Burgin 2002). A workable paradigm for community-based conservation thus should help to clarify goals, methods and means of evaluation of success more effectively than the divergent approaches that are used at present.

Conclusions

On its own, scientific research can address only some of the many problems afflicting biodiversity conservation. Conversely, community-based action can achieve conservation outcomes more broadly, but lacks a framework to direct and channel the effort effectively. Clearly, conservation of biodiversity would be better served if the two approaches were more integrated (Anon. 1999; Yaffee and Wondolleck 2000). How might this be achieved? On the one hand, scientists, conservation researchers and other professionals must become more involved in activities at the community level. The involvement of researchers in the community conservation of the Richmond Birdwing provides an excellent illustration of what can be achieved, but there are many other examples (e.g. many papers in Bennett *et al.* 1995; Craig *et al.* 2000). Concomitantly, short-sighted government policies that allow no research input into the workings of catchment and vegetation management committees and community funding schemes should be reversed to ensure that the value of research is recognised. On the other hand, community groups must ensure that their 'on-ground' actions follow logical and rigorous protocols that will maximise the chance of those actions achieving measurable and clearly-stated conservation goals. Although Underwood and Chapman (2002) noted that problems can occur when untrained personnel initiate community projects, seeking scientific collaboration from an early stage should assist in all aspects of project design and progress. Such collaboration may occur via community-organised workshops and open days where researchers are represented, involvement of researchers on community groups, committees and field programs, and as contributors to community manuals. Good examples of the latter include those produced by the Threatened Species Network (Kessler *et al.* 1998), the National Parks Association (Carlton 1998), and the Wildlife Conservation Society (Rabinowitz 1997). The value of integrating research- and community-based approaches to conservation is clear, and it is encouraging to see that this is being recognised in major documents such as the NSW Biodiversity Strategy and the State of the Environment report (State of the Environment Advisory Council 1996).

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QUESTIONS & ANSWERS

RON STRAHAN: On the issue of single species and the value of single-species programs, can you enlighten us on how you'd make a rational choice about which species we should prefer to conserve above others?

Secondly, I wonder if we could ask about the role of the community in making a choice about which species to conserve. Do we seek out those species that represent the last twigs on an evolutionary tree - the single members of families, for example? Or do we say, "It doesn't really matter. We'll conserve what the public, the community wants," which are the warm and cuddly koalas and so on.

No-one seems to be worried, for example, about the demise of Notoryctes, the marsupial mole (Notoryctes is the sole member of an entire order of marsupials). It isn't seen, it isn't cuddly. We're much more concerned about dolphins than we are about the ugly grass-eating, grazing dugong. I suggest that leaving the choice in the hands of the community is rather dangerous.

CHRIS DICKMAN: They're good questions. From a rational point of view, I think the criteria we should look at to identify priority species for conservation recovery are rate of decline and current population size. Species that have declined to very small numbers and which can be demonstrated to have shown a very steep rate of decline should be of most concern.

These criteria don't allow for any considerations of cute and cuddliness or charisma, or taxonomic uniqueness. From a purely rational point of view, we should be most concerned about the likelihood that a species will disappear in a certain span of time, and size of population and rate of decline should yield that information.

STRAHAN: So the loss of a species with many close relatives, such as Antechinus, is just as important as the loss of the last marsupial mole.

DICKMAN: From a rational point of view, if the rate of decline of any Antechinus species was faster than that of the mole, then it would be of concern and perhaps should get first treatment. But that's looking at it without any other criteria and I think that most people would be extremely sad to see a marsupial mole disappear or any other species that was taxonomically quite unique; numbats, koalas, would be other examples.

GEE CHAPMAN: What you've said applies very well to terrestrial habitats

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and vertebrates but doesn't apply at all to invertebrates where we don't actually have knowledge about population levels and declines. We're far more concerned with preservation of habitats rather than single species. But it seems to me that your approach could be broadened and if you talked about single species or habitats, the same principles could apply.

DICKMAN: Yes, agreed. Although most of my examples were based on the terrestrial environment, they should be able to be generalised. I would also point out that the use of the research paradigm shouldn't be seen as being restricted to single species, but should be generalised to look at populations, communities or any of these other big picture things that people are also rightly concerned about. I just ran out of time to elaborate on these issues.

MARTIN DENNY: Just carrying on from that, Chris, is the issue of emphasis that is placed these days on being able to assess the value of a site based on the presence of a single species. This is particularly so now, with legislation underpinning a threatened species act. You can end up with a farcical situation where somewhere like Elizabeth Bay House can be kept aside because a common bentwing bat is found in its wine cellars. I fear that we're losing a general approach to looking at communities, at productivity, and concentrating on single species, because you can pick them up and put them down and deal with them so easily.

DICKMAN: I think it is important to realise that, although it is very easy to use the research paradigm for single species, it can and should be generalised across to other entities like habitats, systems and so on. Probably the two ways in which conservation is going are quite complementary. For many of the small things that it's difficult to record and which don't have names, such as many invertebrates, microbes, non-vascular plants, fungi and so on, the best way to conserve these presumably is not to go in and name them one by one and look at them individually, but to take the area-based or process-based approach. If you conserve habitats and other areas, hopefully this will work for many of those small things. However, for the bigger things with greater aerial requirements, perhaps we still ought to be looking at the single-species approach. Together the two approaches should be complementary, and will maximise our chance of conserving most biodiversity.