Participatory Monitoring Networks: A Literature Review

The Drive for Data

There is unanimous agreement among ecologists, biologists and environmental policy makers that scientific monitoring of species and habitats is an essential tool for the conservation of biodiversity across the world (Cuthill 2000; Danielsen et al 2000; Danielsen et al 2003; Hopkins and Freckleton 2002; Newman et al 2003; Stevenson et al, 2003). Since 1992 the governments of European Union member states have been required to measure biodiversity as part of their obligations under the EU Birds and Habitat Directives. A distinctive feature of the Habitats Directive is its establishment of the Natura 2000 programme. Natura 2000's creation of a European level ecological network of Special Areas of Conservation depends heavily on extensive monitoring activities.

In some member states, such as the UK, there is a long history of public availability of "biological records that describe the presence, abundance, associations and changes, both in time and place, of wildlife." These records have been used to shape and to challenge policy decisions relating to resource use and spatial planning (Burnett 1995). Indeed, Bowker (2000) argues that it is in "the relatively new science of biodiversity" that increasing momentum towards data collection and the building of archives for scientific research and management tools achieves its apogee (ibid: 611).

This incremental demand for biological recording far outstrips the capacity of professional natural scientists, leaving a gap to be filled with data supplied by volunteer naturalists. Processes entailed in locally based monitoring activities, including amateurs, has become a focus of research in its own right. For example, an entire issue of *Biodiversity and Conservation* (14:11 2005) was recently given over to the topic via the publication of case studies from 15 developing countries. The editors concluded that shortfalls of professional monitoring can be addressed by properly designed locally-based monitoring. "*Most importantly, local approaches have the potential to be low cost, rapid, locally relevant and capable of building capacity among the local constituents. However, without rigorous validation studies, professional scientists will remain sceptical about the results of local monitoring schemes*."(Danielson, F. et al 2005).

Volunteer monitoring schemes take place in a host of organisational contexts. They range from small, groups of enthusiasts monitoring either species or habitats in a village or neighbourhood, to the governance oriented programmes described below, and the extremely large, nation-wide schemes. An example of the latter is the British Broadcasting Corporation's Springwatch programme, which is undertaken in association with a variety of national wildlife NGOs and involves many thousands of respondents, some of whom might make only a single contribution.

Deliberating the Role of Volunteers

While there are plenty of scientists ready to work with volunteer monitoring schemes (Bennun et al 2000; Canon A.R. et al; Duff, D.A. 1993; Firehock, and West 1995; Nerbonne and Nelson 2004; Pattengill-Semmens and Semmens 1998; Pattengill-Semmens and Semmens, 2003) the scientific literature reveals a general preoccupation with the accuracy of data produced by volunteers and discussion about what might be considered acceptable margins of error.

McLoughlin and Hilts (1998) investigated the baseline knowledge of amateur wildlife monitors at a wetland in Ontario, Canada to determine the types and frequency of error. Researchers found that without special training volunteers more often missed than misidentified birds and vegetation, while they more often misidentified than missed mammals and herptiles. The purpose of the research was not to argue for restrictions against volunteers, but to inform the amount and type of training subsequently given to volunteers. McLoughlin and Hilts concluded that more rigorous training is required to correct for errors when more than one taxonomic group is being monitored. The authors suggest that in general training regimes for volunteer naturalists need to be linked to regular research, in a reiterative process that identifies errors to be further addressed through targeted training. Here they concur with Danielson et al, who recommend quantitative assessment of the ability of all locally-based monitoring methods (2005: 2537).

Hopkins and Freckleton are worried about what they consider to be the "biggest obstacle" to gathering data for the effective conservation of biodiversity (2002:245) namely "long and persistent decline since the 1950s" of professional and amateur

taxonomists, especially in their own field of entomology. Hopkins and Freckleton point out that in the UK for example, there are few people with the taxonomic skills to identify taxa for which no reliable field guides exist. They argue that conservation efforts in Britain and elsewhere are likely to continue to be hampered by lack of people able to assess the future conservation status of taxa that are difficult to identify (cf. Noss 1996).

A decline in amateur taxonomists leads to a chain of consequences: "The loss of amateurs rather than professionals may have a disproportionate impact on conservation efforts for a number of reasons. First, amateurs are more widely distributed across the country than professionals and their activity therefore provides a better geographical coverage of the fauna. Amateurs are also perhaps more likely to generate background information of interest to conservation, since they are free to pursue whatever they find interesting and can devote effort simply to recording the occurrence of species, while professionals may not have the time and inclination to pursue general surveys of our flora and fauna. Finally, amateur taxonomists frequently attend the meetings of amateur entomological societies, which provide an opportunity for them to share the unrivalled body of knowledge that they possess (Blackmore, 1998), serves to raise standards of study and encourages members to expand their interest (G.W. Hopkins, pers. obs.)" (ibid 248).

Lawrence (2006) points out that some governmental agencies express suspicion of the possible "environmentalist" agenda of volunteers, fearing it could lead to the collection of biased data (Root and Alpert 1994; Senner and Drennan, 1995)).
This suspicion survives despite the glowing appreciation of the potential of volunteer naturalists expressed by Hopkins above, and the fact that volunteer efforts have, over many decades, contributed enormously to nature surveys in the UK, North America, Netherlands and Finland (Battersby amd Greenwood; Ohenoja 1994; Preston et al. 2002; Saris et al. 1996; Schmidt and Ostfeld 2003; Swengel 1990; Tefler et al. 2002; Verstrael 1996).

It is argued that certain habitats are most suited to volunteer monitoring. For example researchers at the School of Natural Resources at the University of Arizona suggest urban environments that undergo rapid and persistent change need additional

volunteers and professional input. Their own Tuscon Bird County programme experiences these kinds of difficulties in keeping pace with the expansion of the boundaries of the city of Tuscon. The count is used not only for survey purposes, but also to help wildlife managers identify important sites for birds within the city as well as land-use practices that sustain native birds (School of Natural Resources 2005). Where additional skills are required, for example in marine monitoring where trained divers or snorkelers are required, or high altitude environments requiring familiarity with mountaineering, the scarcity of professional monitors can be even more keenly felt. This problem has been addressed with spectacular success by the Reef Environmental Education Foundation at the Florida Keys National Marine Sanctuary.

The Foundation's Fish Survey Project has enlisted thousands of recreational divers and snorkelers visiting coastal areas each year since its inception in 1993. It has since expanded to include the entire tropical western Atlantic, southern Atlantic states, the West Coast of the United States and Canada and the Hawaiian Islands (Pattengill-Semmens and Semmens, 2003: 44). In 2004 a scheme developed in co-operation with the UN Environment Programme – World Conservation Monitoring Centre (UNEP-WCMC) in Cambridge, UK was launched. Known as Earthdive, the scheme urges all SCUBA divers and snorkelers to contribute to record information on the Earthdive website (www.earthdive.com) to create a Global Dive Log (Conservation News, 2004).

Some scientists argue for the benefits of correlating ecological data provided by volunteers with other survey data (Lepczyk 2005; Canon et al 2005). Canon et al investigated trends in the use of private residential gardens by wild birds in the UK in up to 16,000 garden sites over 8 years. They examined correlations with national scale survey data, producing new insights suggesting that "garden reporting rates are related to general population trends in a number of species, including several of conservation importance. Other species exhibit important differences between national and garden trends" (Canon et al 2005).

Others such as Johnson and Daley (1991) warn that government agencies and others should not treat volunteer programmes for stream surveys and water quality monitoring as panaceas. They urge fellow scientists not to underestimate the "most

under budgeted, least accounted for agency expense in a volunteer programme" which is the allocation of sufficient time (ibid: 60). For Johnson and Daley scientific credibility is "the bottom line" against which all else must be measured. Yet even here, as in much of the scientific literature, the motivations of the scientists to increase the size and range of data sets is accompanied by more than a nod towards the importance of volunteer monitoring schemes for engaging "the public" in conservation projects and encouraging stewardship of the resource. "We feel in many instances," write Johnson and Daley, "this is the true measure of success in a volunteering program" (ibid: 61).

The involvement of amateur naturalists in the biological recording of species and habitats, especially in Europe and North America, has a long and significant history in the development of natural science (Jardine et al 1996; Allen 1976; Allen 2001). Indeed in the earliest days, from the 18th through to the middle of the 19th century, there were no professional scientists in the modern sense of the term. Furthermore, as David Allen, the historian of British natural history points out "'Professional' is one of those sponge words ….which tends to be used in a confusing variety of senses," (2001: X1).

In Europe, writes Allen, Germany might be said to have had the earliest most fully professionalized naturalists (closely followed by the French). This holds true if what counts as "professional" is the ability to derive the greatest portion of one's livelihood from pursuing natural science activities, together with sharing in a collective consciousness about "standards of what constitutes expertise" (ibid). Allen proposes that in Britain "science, like so much else in British life, was in thrall to the idea of the leisured gentlemen amateur" (ibid X2). This combined with the fact that natural history happened to be most amenable and acceptable to members of the leisured class meant that: "These novel, sophisticated amateurs brought to the subject an intensiveness and a standard of expertise which could well be mistaken for those of professionals" (ibid X2). Research into monitoring schemes in Britain reveals a very similar situation today, despite subsequent changes in the structure and meaning of the British class system and has led to the coining of the term "expert-amateur" (English Nature et al 2005).

A further difficulty with the amateur/professional distinction is the fact that a proportion of people classified as amateur biodiversity monitors may have professional training and even a career as a biologist or ecologist, though they partake in unpaid monitoring through their affiliation to a conservation group or a nature association outside working hours. Some researchers have noted that "amateur-expert" naturalists - in the UK or elsewhere - often occupy a position at the "end of the spectrum that also embraces the generally more visible campaign and policy activities of environmentalist groups" (English Nature et al 2005).

Meanings Attached to Volunteer Monitoring

The connection between the growth of volunteer monitoring and environmentalism is complex: so much so that in some countries people may conceal their professional or amateur involvement with observing and recording nature. Wilson claims to have encountered this behaviour in Poland because of "the negative sentiments that some people express towards environmentalists…." (Wilson 2006). However, in other countries, particularly the USA and Canada, a positive link between the development of volunteer monitoring schemes and notions of environmental citizenship (Ellis and Waterton 2004; Irwin 1995) is clearly articulated.

Although there are many exceptions (Stokes et al 1989), including the famous example of the Cornell Lab of Ornithology in Ithaca, New York which can claim half a century of volunteer monitoring activities (Bhattacharjee 2005), large numbers of monitoring schemes in the USA derive from the emergence of the "watershed movement" in the 1990s. The movement was facilitated by the enactment of the Clean Water Act (1972) which coincided with a decentralising trend in U.S. governmental institutions (Tysiachniouk n.d.) encouraged by the U.S. Environmental Protection Agency (EPA). It grew through the involvement of local volunteers in monitoring and assessing the implementation of policies in river catchments.

Biological monitoring became the touchstone of the watershed movement, inspired by bespoke techniques, including the use of aquatic insects, as refined by Richard Klein during the 1970s for the Save Our Streams programme in Maryland. These techniques later spread to other states, partly through promotional efforts by the Izaak Walton League of America (Firehock and West 1995). In the 1990s the League's Save Our

Streams staff developed a quality assurance and quality control plan for the use of macro invertebrates in citizen monitoring which was approved by the EPA and acted as a model for other states.

By the end of the 1990s there were over 1500 locally-led management initiatives in the USA (Lant 1999), variously described as co-operative eco-system management, community conservation, collaborative conservation and grassroots ecosystem management. In the Western United States, the movement involved over 40,000 core participants and volunteers in over 500 communities (Weber 2003:5). The fifth and current edition of the EPA's National Volunteer Monitoring Directory estimates that altogether there are almost half a million volunteer monitors in the USA (http://www.epa.gov/owow/monitoring/monintr.html).

With all of this activity it is not surprising to find that much of the literature describing what participants and scientists consider to be the wider advantages of volunteer monitoring schemes comes from North America[i]. These advantages are judged to include some or all of the following:-

- Participants' "desire to help out with an authentic research project" is met (Evans et al 2005) and/or participants become more engaged with science and learn to think scientifically (Trumbull et al 2000)
- Participation lays the foundations for understanding resource use (Nerbonne and Nelson, 2004) and demonstrates the willingness of public agencies to involve the public in management of the resource (Johnson and Daley, 1991)
- Participants become more conservation minded and "responsible for the stewardship of the resource" (Johnson and Daley, 1991)
- Participants experience increased attachment to "place in their local environment" (Evans et al 2005).
- Participation creates confidence and empowerment among local communities (Whitelaw 2002).
- Participation offers opportunities for networking and partnerships with both government and other agencies (Firehock and West 1995)

One of the most ambitious projects that attempts to incorporate and manage all of these perceived benefits is a nationwide voluntary initiative in Canada entitled *Linking Community Based Ecosystem Monitoring to Local Decision-making and Policy Development on Sustainability*. The project is more generally referred to as the *Community Based Monitoring Initiative* (CBM). The initiative is led by the Canadian Nature Federation (CNF) in partnership with the Ecological and Assessment Network Co-ordinating Office (EMAN-CO) and is based on the principles of Adaptive Environmental Management (AEM) sometime also known as Adaptive Collaborative Management (Buck et al 2001).

CNF and EMAN-CO commissioned a review of the processes of community engagement as experienced by many organisations and agencies in Canada in order to create a background model for how such engagement can be best accomplished. A pilot project sought to explore 31 approaches in diverse communities on how to implement demand-driven ecosystem monitoring and to create local capacity for sustainability (Whitelaw 2002). The work was also concerned with how CBM contributes to nationally standardized data sets and linkages to management policy and research at local, regional and national levels (www.ccmn.ca; EMAN-Co and CNF 2003).

EMAN-CO developed accessible protocols for identifying and tracking ecosystems changes in soil, water, air, vegetation, frog and salamander species as well as lake and river ice formation. The CBM stresses that local monitoring information needs should be grounded in a community's own requirements and identification of valued ecosystem functions and characteristics. "This fact gives emphasis to capacity building within communities and to the design of ecological monitoring based on the identification and characterisation of the information required by decision-makers. The initial step in monitoring design is the establishment of a community definition of sustainability based for example on the question 'what would we not wish to compromise in the pursuit of local development.' Items like swimable/fishable waters; healthy air, trees, wildlife and soils are the usual result and scientific indicators based standardized protocols can be provided for tracking these attributes. Other aspects of interest including valued ecosystem components (VECs) or socio-

economic indicators can be easily included according to the needs of the individual community" (www.ccmn.ca).

This interface between science and policy has recently become known as public ecology (Robertson and Hull 2003) and is concerned with issues of environmental citizenship. One of the major planks of this emerging interdisciplinary field is the view that science itself is a "realm of contention and discensus as much as it is a body of coherent and accumulated knowledge. It is an interactive social activity and a dynamic cultural practice as much as it is a formalized procedure and set of agreed upon norms" (ibid). In the model of public ecology uncertainty is acknowledged and managed rather than banished and interactive dialogue replaces formalized deduction as the model for scientific argument, where the interlocutors consist of professional scientists and a wider community of stakeholders. However, the principles on which public ecology and the practices of the watershed movement are based ensure it not immediately transferable to all countries of the world. Indeed, in its most radical form, public ecology seeks to subvert national boundaries and establish governance based on ecological units or bioregions.

Maria Tysiachniouk undertook a comparative analysis of citizen involvement in watershed protection in the USA and Russia. She discovered that volunteer monitoring programmes in Russia "are not working in conjunction with the government or policy process" (Tysiachniouk: 5) and are "rarely used for policy implementation" (12). Tysiachniouk found some parallels for success in both countries, particular the importance of voluntary monitoring schemes having strong partnerships with other institutions, which in Russia often took the form of universities or other educational institutions. Partnerships improve access to more resources which in turn assist with the recruitment and retention of volunteers (ibid 13).

In the United States the growing numbers of participatory environmental programmes have come under attack for being less democratic than they might superficially appear to be. Detractors fear that hard won state and federal environmental regulatory statutes will be weakened by the new models of environmental governance. There is also an argument that some sections of the population do not have the personal

resources, time or inclination to participate. "'Stream teams' may be effective, but it should not be the obligation of citizens to form [monitoring] teams for every stream, lake or river to ensure their cleanliness" (Sabel et al 2000:53). Others acknowledge the need for new models of environmental governance and the role that participation of all stakeholders can play through collaborative decision making and the creation of self regulatory programmes. However, concerns persist over problems of accountability and the need to strengthen rather than diminish the need for centralised, or federal, legal regulatory frameworks (Sabel et al 2000).

In the UK a group of researchers at the Environmental Change Institute which is part of Oxford University's Centre for the Environment are have worked on the link between volunteer monitoring and environmental citizenship. Anna Lawrence wrote an interesting critique of the "participatory approach", especially the frequent appeal for "bottom up" (as opposed to "top down") approaches as essential for "true" participation. Lawrence (2006) challenges the polarisation inherent in this kind of terminology. She examines various typologies of a model known as the "ladder of participation", finding that: "Broadly speaking, power relations remain unchanged at the 'top down' end of the ladder and are transformed at the 'bottom end' of the ladder'" However, when she goes on to examine five examples of volunteer biodiversity monitoring schemes from UK, Canada and the USA it emerges that motives and outcomes do not necessarily correlate with the binary analysis of the ladder model. It turns out that personal change (transformation) can happen through participation in 'top down' schemes "whether organisers intend it or not" whereas more consultative schemes may fail to empower groups or individuals.

Elsewhere Lawrence's research, involving interviews and focus groups with volunteers, explores the assumption that participation in data collection can or should be equated with citizenship (2005)). Lawrence finds instead that the most meaningful aspects of data collection for volunteers engage their emotions and involve experiential and social learning. These latter, Lawrence characterise as the "missing link" between emotions and empowerment. In her conclusion Lawrence ponders the contradictions in which the volunteers find themselves caught.

"There is an odd mismatch between the volunteers' faith in their own data and the process to which they are contributing, and their alienation from the rationalistic, industrialistic world created by that same dependence on scientific culture. In part we see the volunteers turning to science (or citizen science) for security as evidenced by the discussions around data, what they are 'allowed' to do, and the purpose and meaning monitoring can give to their otherwise apparently shameful rambles in the countryside. Science, or the structured methodology required of surveys, provides at least the illusion of a framework or rules and procedures. Most significantly, however, these people are doing something because it is important and meaningful to them, and also links them up with other people because of that shared sense of meaning" (2005:11).

These findings prompt Lawrence to call for a reappraisal of the term empowerment, which is most often used in the standard sense of the building of citizenship. "That type of active citizenship, moreover seems to be low on the participants' priorities. Advocates of participation may find that analyses based on meaningfulness, and reflexive methods including social learning, may provide a stronger indication of the empowering potential of participation in nature" (ibid:12).

Other British social scientists researching voluntary monitoring schemes, such as Ellis and Waterton (2004) assert – contrary to Lawrence - that such schemes can be regarded as "a form of environmental citizenship in the making" (Ellis and Waterton 2004). Ellis and Waterton examine some of the assumptions that policy-makers and volunteer make about one another through the history of the UK Biodiversity Action Plan which prompted statutory and voluntary agencies "to experiment in new ways with the social networks and knowledge that make up British biodiversity expertise" (ibid: 97). They suggest that these different communities need to expand the imagined ideas they have about one another that guide their mutual interactions (ibid: 96). Because of the participatory model government agencies can no longer legitimately regard volunteers as "automated data drones". Yet the alternative view of volunteers as experientially engaged with the natural world presents agency staff with problems for "quantification and for a clear vision of what public engagement can in fact afford for biodiversity policy" (ibid: 98). Citizen participation therefore requires accommodation with new realities by relevant agencies. Ellis and Waterson

(2005) concur with the Oxford researchers in calling for deeper, holistic insights into volunteers' experience. "Acknowledgement of what it is to observe, describe, learn about and experience nature in fuller, more connective, aesthetic or emotive ways might help to bind a new citizenry of conservationists, naturalists and lay people to create new common axes among them" (ibid 103).

Data

Data and data sets in the management of planetary biodiversity are highly problematic. To begin with some entities have not been systematically classified or the classification systems available are inconsistent. Things which do not have clear boundaries such as soils are very difficult to classify, other things such as vegetation communities are hard to define and while biodiversity data itself is often "singular and scattered" so that data cannot easily be assimilated from one set into others (Bowker 2000). Finally there is the problem referred to above of a decline in the number of professional and amateur taxonomists to assist with remedial work. Bowker, points out that, in addition to the entities that are hard to classify, entities exist that have not been named or studied. Existing data bases and retrieval models create a "skewed view of the world" (ibid 659). "With these structures in place, it is easier to get funding and support for research which reproduces this view – your work will be understood more easily, you can make good use of material from cognate areas and so forth. Thus, the world that is explored scientifically becomes more and more closely tied to the world that can be represented by one's theories and one's databases; and this world is ever more readily recognised as the 'real world'…" (ibid).

Through these processes data cannot be regarded as neutral or "raw", even before it gets to be interpreted by policy makers. Lawrence and Turnhout (2005) found that "the perceived importance and value" of data was a motivating factor for volunteer monitors in the UK and the Netherlands. The authors detect two aspects to this orientation. The first focuses on "the personal value of data in increasing the recorder's understanding of the ecosystem" (ibid: 8) while the second relates to the potential contribution that recordings make to the conservation of nature (ibid). Recorders also experience a great deal of pride and achievement from amassing their records (ibid: 9).

Conflicts over data exchange and sharing is more marked in the UK than it is in the Netherlands, because in Holland the volunteers have had a greater hand in establishing the data-sharing platforms. However, even here there is a sense that the Dutch government does not appreciate the hard work of the volunteers. Lawrence and Turnhout (2005) describe the commoditisation of biological data in both countries and rumblings of discontent associated with it. "The natural history recorders have the sense that, although the government may be using the data, it is not adequately addressing the values, needs and ambitions of the recorders."

These findings are also supported by research in the UK undertaken by Ellis and Waterton (2005). They discuss the contractual nature of the exchange of data between amateur and professional naturalists and the terms of agreement on which it is based. Taking their cue from Marcel Mauss's seminal, anthropological treatise on the nature of the gift in human affairs, Ellis and Waterton conclude: "Such exchange between naturalists of their hard earned data, gleaned from painstaking observations or organisms in the natural world, is predicated upon an expectation of reciprocity sustained within a 'gift' economy" (ibid:685). This "vital contract" depends on the idea that because it is classified as scientific knowledge amateur records contribute to the greater good. Recorders are also it also satisfied when their data contributes to "a broader interpretative frame" such as a distribution atlas or database (ibid: 685). Ellis and Waterton also identified alternative, implicit understandings. They include the contract that amateur naturalists have with nature; contracts that amateur naturalists have between themselves, involving apprentice/mentor type relationships as well as contracts between expert amateurs who assist one another, for example, in the identification of species. These activities create a "circle of experts" able "to become witness to some of the steps made to document and represent nature" (ibid: 686).

In some circumstances the more implicit values shared by amateur naturalists are compromised by the introduction of pecuniary transactions and shifts towards the commoditisation of data (for example the use of data by consultancies) which lead to certain discontents noted by Lawrence and Turnhout (2005).

The kinds of issues raised in these contributions return us to the situation in North America and discussion of the water shed movement where monitoring underpins a

more holistic enterprise, so that citizens are involved in decisions about what data might be produced where and for what purposes, rather than merely supplying data to managers of distant databases who decide how it should be manipulated, interpreted and put to use.

Conclusion

The scientific literature on volunteer biodiversity monitoring tends towards a preoccupation with arriving at techniques for the production of reliable data. The incipient body of social science literature is more concerned in detailing the relations between a) volunteer participants b) between "amateurs" and "professionals" c) between participants and the nature they observe d) between participants and the data they produce. Together these separate perspectives provide valuable guidance for managers and policy makers. What is missing, however, is a corpus of grey literature. It would be helpful if organisations operating effective volunteer monitoring schemes could produce printed or web-based literature with a view to sharing monitoring schemes and techniques together with organisational practices. There is a demand for this type of literature especially in former communist countries in Europe where the presence of guides and how-to-do literature could support the spread of participatory monitoring enterprise among students and amateur naturalists.

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[i] For insight into the multiple activities of volunteer monitoring groups in the United States see *The Volunteer Monitor: The National Newsletter of Volunteer Watershed Monitoring* http://www.epa.gov/volunteer/vm_index.html