

# Do conservation managers use scientific evidence to support their decision-making?

Andrew S. Pullin<sup>a,\*</sup>, Teri M. Knight<sup>b</sup>, David A. Stone<sup>c</sup>, Kevin Charman<sup>c</sup>

<sup>a</sup> *School of Biosciences, The University of Birmingham, Edgbaston, Birmingham B15 2TT, UK*

<sup>b</sup> *Solihull Primary Care Trust, Mell House, Solihull B91 3BU, UK*

<sup>c</sup> *English Nature, Northminster House, Peterborough PE1 1UA, UK*

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## Abstract

Conservation involves making decisions on appropriate action from a wide range of options. For conservation to be effective, decision-makers need to know what actions do and do not work. Ideally, decisions should be based on effectiveness as demonstrated by scientific experiment or systematic review of evidence. Can decision-makers get this kind of information? We undertook a formal assessment of the extent to which scientific evidence is being used in conservation practice by conducting a survey of management plans and their compilers from major conservation organizations within the UK. Data collected suggest that the majority of conservation actions remain experience-based and rely heavily on traditional land management practices because, many management interventions remain unevaluated and, although some evidence exists, much is not readily accessible in a suitable form. We argue that nature conservation along with other fields of applied ecology, should exploit the concept of evidence-based practice developed and used in medicine and public health that aims to provide the best available evidence to the decision-maker(s) on the likely outcomes of alternative actions. Through critical evaluation, we present the challenges and benefits of adopting evidence based practice from the decision-makers point of view and identify the process to be followed to make it work.

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## 1. Introduction

Conservation action is increasing globally as the scale of the threat to biodiversity is more widely recognized. Many organizations, both governmental and non-governmental, are currently reviewing policy and formulating conservation management strategies catalyzed by the Convention on Biodiversity. Conservation management involves day-to-day decision making by a wide range of individuals from office-based policy formers to field-based site managers. All face decisions regarding what actions they should take to achieve objectives and most will involve a level of uncertainty of outcome. In some cases the uncertainty may be minor and individual knowledge and experience may be good enough to make

sound decisions, but in cases involving more fundamental questions influencing the quality of the habitat, viability of a population or the functioning of an ecosystem, how can the decision-maker compare the effectiveness of possible alternative actions? For conservation practice to be effective decision-makers need to know what actions do and do not work, or how effective a given action has been in achieving objectives (Pullin and Knight, 2001). Ideally, decisions should be based on effectiveness of actions in achieving the objectives as demonstrated by scientific experiment. Can decision-makers get this kind of information when they need it?

The volume of information on conservation practice has increased enormously over the last 10–20 years. New scientific peer-reviewed journals have appeared and rate of paper publication increased. More practically based journals and magazines focusing on conservation management issues have also appeared and many in-house magazines are in circulation to keep decision-makers

\* Corresponding author. Tel.: +44-121-414-7147; fax: +44-121-414-5925.

E-mail address: [a.s.pullin@bham.ac.uk](mailto:a.s.pullin@bham.ac.uk) (A.S. Pullin).

and practitioners within larger organizations abreast of new developments. Added to this, the Internet revolution has made possible the rapid exchange of information that may have an influence on management policy. Is this all that decision-makers require?

Pullin and Knight (2001, 2003) argue that although good evidence for some actions does exist, indeed an increasing number of papers are providing scientific evidence to develop appropriate actions, in general, conservation actions lack thorough evaluation and are still based on anecdote, personal experience and interpretations of traditional land management practices. They further hypothesized that this was not because conservation bodies do not want to use evidence when it is available, but because decision-makers do not have the time to access it nor a supporting framework that provides the best quality information in a form they can readily absorb and use.

In this paper, we report on a test of the above hypothesis analysing how management plan compilers within the UK conservation community approach decision making. The results provide evidence of the lack of an appropriate support system for decision-makers that would make scientific information easily accessible in a usable form. To address this problem we propose the adoption of an evidence-based framework adapted from the fields of medicine, and more latterly, public health and social sciences. Medicine and public health have recently gone through an 'effectiveness revolution' in which the outcomes of actions have been evaluated by experiment and decisions on future actions made on the basis of scientific evidence of effectiveness (Cochrane, 1972; Stevens and Milne, 1997). The medical evidence-based framework provides the best available evidence to the decision-maker on the likely outcomes of alternative actions and enables decisions to be made on the basis of evidence that has been critically evaluated and widely disseminated in a format that is accessible to policy makers and practitioners alike (Dawes, 2000).

## 2. Methods

The extent to which scientific evidence is currently used in decision-making was investigated by examining the way in which a selection of conservation organisations formulates Nature Reserve Management Plans. Our aim was to gain an overall impression of the range of practice rather than to compare the practices of different organisations. Sources of information used by management plan compilers to support decision-making and information arising from their decisions was investigated in three ways; analysis of management plans, questionnaire returns from compilers, and interviews with compilers.

### 2.1. Analysis of management plans

Management plans were obtained from six organisations representing a mixture of statutory and non-governmental conservation bodies. Plans were selected on the basis of availability and the most recent were selected in preference to older plans. Each was reviewed and analysed using a checklist for key issues related to the gathering and use of information to support decision-making and the monitoring and evaluation of actions undertaken.

### 2.2. Questionnaire survey of management plan compilers

Questionnaires were sent to management plan compilers from seven medium to large organisations (including the six from which management plans were obtained) representing both statutory and non-governmental bodies. Most of the organisations sampled had conservation as a primary objective, but for some it was a secondary function. Compilers were asked to complete a questionnaire summarising their overall experience of management plan compilation. Questions were asked concerning their length of experience, use of information, access to information, and evaluation of their decision-making. The questionnaires were either distributed directly to the appropriate person in each organisation or given to a central co-ordinator within the organisation for distribution.

### 2.3. Interviews with management plan compilers

After the questionnaire returns had been received and analysed, a subset of 20 respondents was followed up by telephone interview. Further structured questions were asked to increase the understanding of earlier responses. The subset was selected on the basis of the responses being typical of the full range of replies.

### 2.4. Data analysis

Data from the management plans and questionnaire responses were collated on a spreadsheet using Microsoft Excel and subsequently analysed using SPSS Version 11.

## 3. Results and discussion

### 3.1. Management plan analysis

A total of 38 management plans, written between 1996 and 2002, were analysed. Caution was exercised in drawing information simply from reading the plan as decisions may have been made and processes undertaken in its compilation that were not apparent in the

Table 1  
Percentage of management plans in which proposed actions were justified by reference to the listed information sources

Information source type	(%)
Primary scientific literature	11
Secondary reviews of literature	16
Habitat management handbooks	29
Biodiversity action plans	29
Accounts of traditional management	71

plan itself. However, information subsequently obtained from compilers suggested that plans were a full reflection of the compilation process.

In 79% of cases, justification (usually by inclusion of a 'Rationale' section) was given for the choice of action and in 13% of cases it was unclear. In 8% justification was not given. Where justification was given it was by reference to one or more of the sources given in Table 1.

Of all practical management actions, 58% were direct continuations of traditional management and a further 26% were modifications of traditional management. This highlights a reliance on tradition as an indicator and guide to future management. In 66% of plans alternative actions did not appear to have been considered and in only 16% of plans were alternative actions discussed. In only 8% of the plans was any attempt to review the literature apparent and in no plan was it evident that the review had been extensive. In no plan was the quality of evidence in support of actions critically evaluated. It therefore appears that most management plans are being compiled using a limited amount of the total information available to support decision-making. The reasons for this were explored through the questionnaire analysis.

In 45% of plans, action to fill knowledge gaps was advocated, but in only 13% was this described in specific terms, and only 5% of plans contained specific time targets for this action. Methods to monitor the outcome were outlined in 53% of plans. In only 16% of plans was it clear that monitoring was sufficient to evaluate effectiveness and outcome. These results suggest that compilers are well aware of gaps in evidence and the need to monitor outcomes from actions. However, the process of addressing this lack of evidence was not formally included within the plans.

### 3.2. Questionnaire of management plan compilers

A total of 141 returns were received from the seven organisations. Contributions ranged from 1 from the smallest NGO, to 44 from a major conservation body. Estimating the return rate was complicated by the fact that one organisation was unable to provide an estimate of how many of their staff had actually compiled a management plan for a nature reserve and were therefore potential respondents. If this organisation is ex-

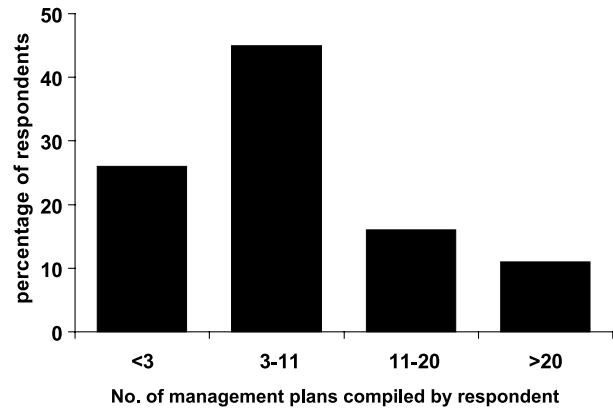


Fig. 1. Questionnaire respondent's level of experience of compiling management plans.

cluded from the analysis the return rate is 54%, ranging from 30% up to 100% for a small NGO.

Almost half of the group had compiled or contributed to the compilation of between 3 and 10 management plans (Fig. 1), a quarter less than 3 and 10% had written more than 20. When asked who was involved in the compilation of management plans, 29% responded that they always compiled their plans alone and a further 32% said that this was usually the case. This means that approaching two thirds of the group are making decisions apparently without active input from colleagues. It is not known to what extent this is personal choice or organisational practice. In contrast 23% of the respondents had never compiled plans on their own. The latter reflects policy of some contributing organisations to provide 'in-house' support to plan production. For 28% of respondents it was the norm to use a working group within their organisation to compile management plans. Only 11% normally used a working group derived from more than one organisation whilst 57% never did this (Fig. 2).

When asked about the extent to which they had to decide between possible alternative actions in order to achieve the objectives set in the plan, 67% said they always or usually had to make these sorts of decisions; 4% said they never had to do so. It is clear that most compilers have to actively consider a number of alternative actions.

#### 3.2.1. Information sources used in decision-making

Compilers were asked about the sources of information used to support their decision-making. The most frequently used sources were existing management plans (60% – the proportion that responded "always used" or "usually used"), expert opinion from outside the compilation group (49%), published reviews, books or handbooks (47%), and documentation or personal accounts of traditional management practices (46%) (Fig 3). Least frequently used sources of information were electronic/

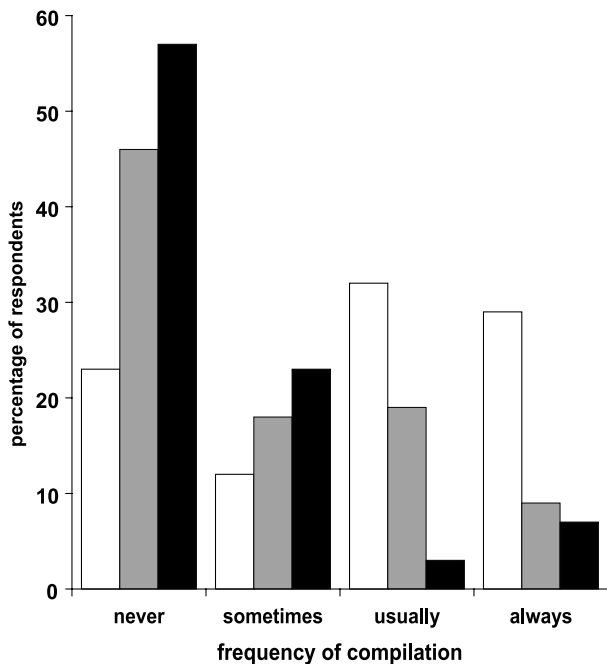


Fig. 2. The frequency with which management plans have been compiled by individuals (white bars), a working group within their organisation (grey bars), or a working group derived from more than one organisation (black bars).

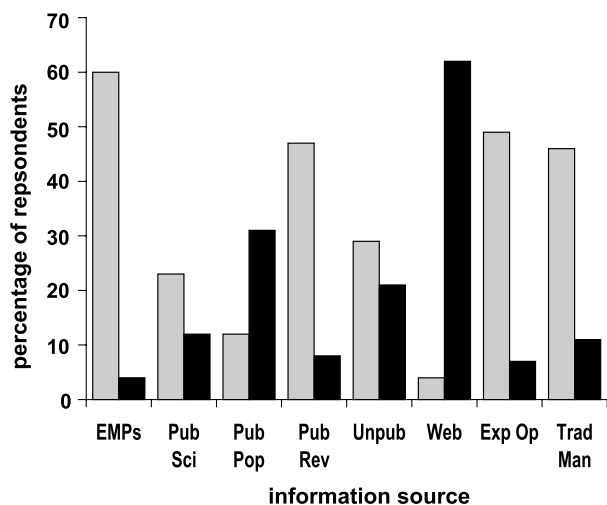


Fig. 3. The frequency with which different sources of information are accessed to support decision-making. Grey bars; 'always' or 'usually' used; black bars; 'never' used. EMPs = existing management plans; Pub Sci = published scientific papers; Pub Pop = published popular articles; Pub Rev = published reviews/books; Unpub = unpublished papers/reports; Web; web-based material; Exp Op = Expert opinion from outside compilation group; Trad Man; documentation or personal accounts of traditional management practices.

web-based materials (4%), published popular articles (13%) and published scientific papers (23%). It appears that, in terms of written material, compilers rely heavily on current or traditional practices to guide them, together with 'expert' opinion. Interestingly, compilers do fre-

quently use secondary literature (published reviews, books or handbooks), when it is available. Primary scientific literature is infrequently accessed and 12% said they never did so.

When a subgroup was asked at follow-up interview why they did not access primary literature to help them in their decision-making, the most frequent response (65%) was that this literature is too time consuming to locate and access. The majority (60%) also said this literature is too time consuming to read. A significant number (25%) said primary literature is too technical and difficult to interpret in the context of their decision-making. Importantly, 25% stated that they rely on 'in-house' advisors or expert groups to interpret information from primary literature for them. This reflects the fact that some conservation organisations have recognised and tried to address the problem of information retrieval and interpretation, although often not in a systematic way.

### 3.2.2. Locating information sources

To locate published information only 8% of respondents routinely hand search library resources (Fig. 4) and only 3% search library databases electronically. Percentages are even lower for unpublished material. The majority (72%) have never undertaken an electronic search of a library database in connection with management plan compilation. Less than 1% routinely used a web-search for publications and 76% have never done so. Most respondents rely on literature recommended by a colleague (42%) or use of their own or a colleague's personal collection (56%) to locate published material. Figures are similar for unpublished material. Considering the time constraints on the respondent group, it is

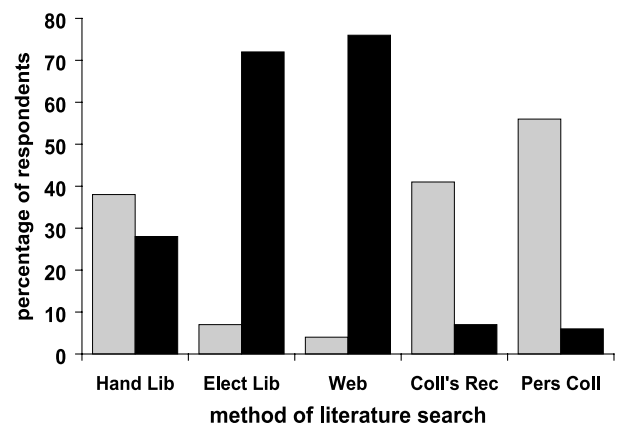


Fig. 4. A comparison of the frequency of use of different methods of locating information to support management plan compilation. Grey bars; 'always' or 'usually' used; black bars; 'never' used. Hand Lib = hand search of literature from library; Elect Lib = electronic searching of library databases; Web = web-based searching of publications databases; Coll's Rec = Literature recommendations from colleagues; Pers Coll = use of personal collection (own or colleagues).

not surprising that literature is not being systematically sought out or reviewed, but it is of interest that they are using literature that is immediately available to them.

### 3.2.3. Access to information

Of the respondents, 58% have easy access to a library, either at work or elsewhere; 4% have no access. The majority (65%) have easy access to the Internet, over 90% have some access, but 4% said they had access but were not trained to use it. This suggests that the majority could access electronic information if it was delivered in a suitable form.

### 3.2.4. General experience of compilation process

Respondents were asked for the general experience of finding relevant information to support decision-making. There was a relatively even spread between those who found it relatively quick and easy (22%) and those who found it difficult and time consuming (16%), with the majority expressing no strong preference (62%) (Fig. 5). A subset (17) who found the process quick and easy were selected for a follow-up interview to explore reasons for this. Nearly half (47%) replied that this was because they confined their search to material that was immediately available within their organisation (cf. 'locating information sources' above). Interestingly, 24% replied that they were already aware of all the information and 24% felt they had enough information after relatively little search effort. Three (18%) benefited from having information provided by others and another three said the process was quick and easy because they relied on their personal experience and that of their colleagues.

When asked if there was enough published material to support their decision-making, 37% thought there was enough, 9% thought there was none or next to none (Fig. 6). Equivalent figures for unpublished material

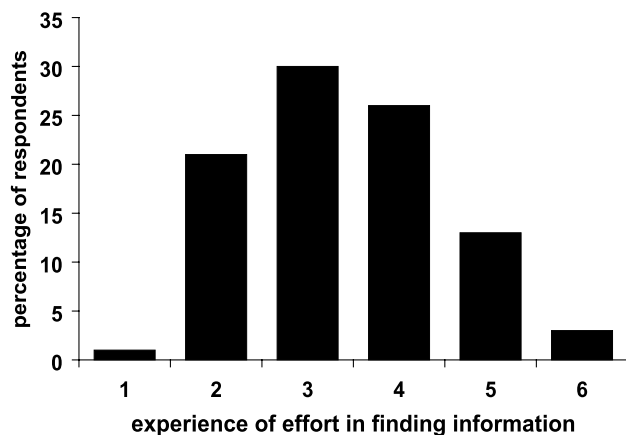


Fig. 5. Compilers' general experience of finding relevant information to support decision-making on a scale from 1 (quick and easy) to 6 (difficult and time-consuming).

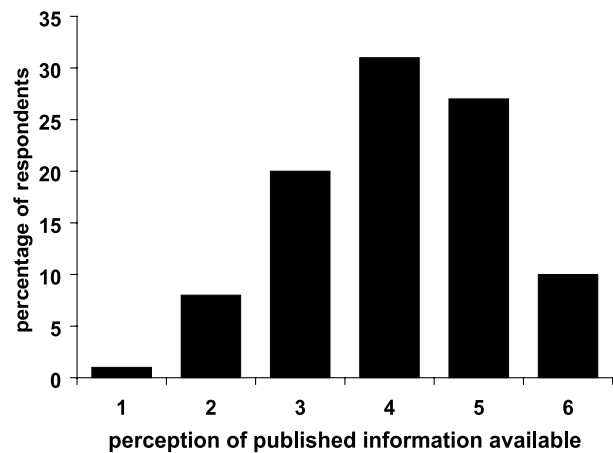


Fig. 6. Compilers' perception of the amount of published material available to support their decision-making on a scale from 1 (none) to 6 (enough).

were 28% and 23%. A subset (18) who felt there was enough published information were asked why. The majority (89%) thought this was partly or wholly because they had enough information to remove all reasonable doubt about the course of action required to meet their objectives. A third (33%) also felt that there was enough in the sense that they would not have time to digest any more.

### 3.2.5. Relative inputs of experience and evidence to decision-making

Respondents were asked to scale the relative inputs of 'experience-based' information (e.g. qualitative description, expert opinion) versus 'evidence-based' information (experimental analysis and quantitative measurement). The majority (75%) thought that the greater input was from experience-based information (Fig. 7). Analysed in a little more detail, 49% thought that experience-based information was more influential, whilst only 5% thought evidence-based information was more influential.

### 3.2.6. Responses to information deficit

When asked if they were able to identify knowledge gaps in the compilation process where further research was required, 63% responded that they were 'always' or 'usually' able to do so; 4% thought they were not able to do so. Those that answered yes were then asked if they were able to go further and describe the research required and 57% thought they were 'always' or 'usually' able to do so. A subset (20) of those able to identify knowledge gaps were asked at interview whether this extended to a description of the experimental design required and 95% responded that it did not. A minority (15%) said that they routinely asked experts from their own organisation to design appropriate experiments.

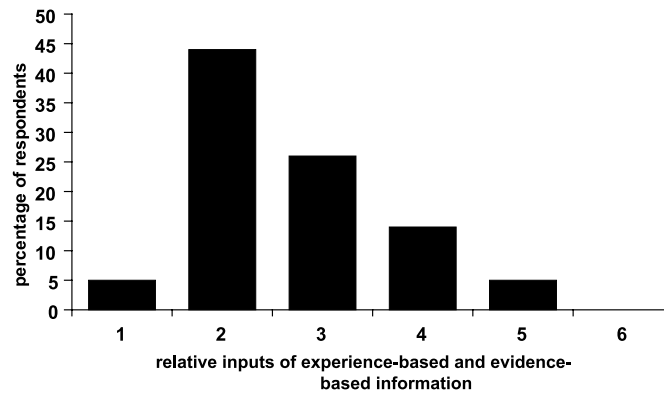


Fig. 7. Compilers' perception of the relative inputs of experience-based and evidence-based information to their decision-making on a scale from 1 (all experience-based) to 6 (all evidence-based).

Those identifying knowledge gaps were asked in the questionnaire if they had subsequently approached anybody to get the research done and 36% had 'always' or 'usually' done so; 11% had 'never' done so. Those who had approached other bodies were asked if any research had subsequently been initiated. Over 80% said it had, 9% said it had not and 3% didn't know. A subset (18) of those who said that research had been initiated were asked by interview what had been done with the results. Half (50%) responded that research was ongoing and results were awaited; 22% said some results had been published; whilst 72% responded that results had been written up in a report but either not disseminated or only locally disseminated within the organisation or local area. Some respondents (22%) reported cases of research being undertaken but not written up.

### 3.2.7. Monitoring and evaluation of actions

Compilers were asked if the actions proposed in the management plan had been implemented. Only 3% said all had, whilst 73% said most had. Asked if monitoring programmes had been put in place to measure the outcome of implemented actions, 22% responded that this was 'always' done, a further 48% said this was 'usually' done and 5% said it was 'never' done. Asked if they had been able to evaluate the effectiveness of actions in their management plans, 16% said all had, 36% said most had been evaluated, 37% said some had and 6% said none had. A subset (20) of those who said they had done some evaluation of the effectiveness of their plans was asked how effectiveness was measured. Nearly half (45%) said that evaluation was only qualitative and often experience-based. A smaller number (35%) said they used annual counts of species and species trends and 20% had put in place direct monitoring of progress toward outcomes. Each was subsequently asked what has been done with the information arising from the evaluation and 25% said the information was written up as a report but in no case was this widely disseminated. The remaining 75% said evaluations were not formally written

up, but 35% were referred to in the next management plan in some form.

## 4. Providing decision support through an evidence-based framework

Our results suggest that management plan compilers are not making full or systematic use of the information available to support their decision-making. Nor are they fully monitoring and evaluating the effectiveness of actions and disseminating it for use by others. Realistically, when faced with the day-to-day pressures of executing the actions, conservation decision makers (particularly those directly involved in practical management) do not have sufficient time to access the primary information they need to judge effectiveness of alternative actions, let alone evaluate it. In such cases they frequently rely on the status quo of continuing with an established but unevaluated practice. The hypothesis forwarded by Pullin and Knight (2001) is therefore largely supported.

If we expect decision-makers, without the time to do their own information search, to be aware of evidence relevant to their responsibilities and to apply that evidence in seeking solutions to conservation problems, they require a framework with associated infrastructure to support their decision-making. Pullin and Knight (2001) drew attention to an existing framework for supporting decision-making provided in the field of medicine and public health. These disciplines have much in common with conservation in that they are crisis disciplines that were established on experience of practitioners. In medicine it was recognized that even for some of the commonest procedures there was little evidence for their effectiveness; choice of which treatment to pursue, or surgical operation to perform, depended largely on the experience of the individual clinician. For some medical interventions, research on effectiveness had been carried out but the results had little impact on

practice. The challenge to develop ‘evidence-based practice’ was twofold:

1. to ensure that the results of research impacted upon practice;
2. to increase good quality research into the effectiveness of interventions.

The concept of “evidence based medicine” has been rapidly accepted and an industry supporting it has developed (Dawes, 2000). Fundamental to evidence-based practice is the systematic review in which research papers selected on the basis of their relevance to the question, are subjected to ‘critical appraisal’ using a standard protocol (Dawes, 2000; NHSCR, 2001). This covers the whole research process from the hypothesis to be tested, study design, selection of subjects, data collection and analysis. Studies that do not meet the required quality standard are either rejected or are further evaluated with their limitations in mind. Results from those remaining are summarized to enable common themes and messages to be drawn out. A specialized form of this process is meta-analysis, increasingly common in the ecological literature (e.g. Bender et al., 1998; Hartley and Hunter, 1998; Gates, 2002), the result of which is a more powerful analysis than was possible from the individual studies.

Systematic reviews are therefore not simply research reviews of a chosen subject area, as published in many ecological journals, but are reviews that result from systematic and explicit searches for evidence in the literature that has a bearing on a specific question (Petticrew, 2001; Gates, 2002). In conservation, the amount of evidence available is likely to be small and the quality of evidence relatively low (although not always) compared to that in medicine. In some cases, relatively few high quality experiments may be complemented by a larger number of lower quality data sets that provide valuable additional evidence on the wider application of an action. In cases of conflicting outcomes, the quality of the evidence is crucial in the interpretation and conclusion on the effectiveness of the action (Stevens and Milne, 1997).

Two important points need to be made to avoid misunderstanding of the evidence-based approach: 1. The evidence-based model is a strategy to produce more good quality evidence on which to base decisions and does not imply that decisions should not be taken if good quality evidence is not available. 2. The fact that we need a structured evidence-base to conservation should not be used to undermine the credibility of efforts currently being made to conserve species and habitats. It does not mean that current actions are wrong.

Despite the anticipated difficulties in rising to a standard of evidence-based conservation practice, the principle is established for care of our own species. We argue that effectiveness in conservation can improve by working to that principle, both with the evidence currently available to us and by putting in place a frame-

work to increase the quality of evidence available (Pullin and Knight, 2003).

We do not contend that it will be an easy task to develop evidence-based practice in conservation. The revolution will certainly be longer than the one experienced by medicine and it might possibly be a more vigorously fought one as conservation can be practiced by anyone, anywhere and control over standards is more lax. Some may view the apparent differences in the professions as evidence that the same revolution cannot occur in conservation. Medicine is after all much less complex than other social or ecological systems in only dealing with the human body. Although the impact of the evidence-based framework was initially experienced in medicine, the approach has quickly spread to public health and the social sciences (Stevens et al., 2001). In more complex systems such as these, evidence will always have to be interpreted and integrated within the context of the system’s dynamics. This will certainly be true of conservation as well, but we argue that the paradigm shift in decision-making achieved through the evidence-based approach in medicine and other fields is a template for significant improvement in conservation practice (Pullin and Knight, 2003).

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