Young, Juliette C.; Jordan, Andrew; Searle, Kate R.; Butler, Adam; Simmons, Peter; Watt, Allan D.. 2013. **Framing scale in participatory biodiversity management may contribute to more sustainable solutions.** *Conservation Letters* , 28 (2). 100-109. 10.1111/conl.12012

Full title: Framing scale in participatory biodiversity management may contribute to more sustainable solutions

Running title: Scale framing in participatory biodiversity management

Abstract word count: 131

Full manuscript: 3,180

Number of references: 41

Number of tables: 3

Number of figures: 1

Keywords: Biodiversity; co-management; cross-scale interactions; human-environment systems; Natura 2000; public participation; scale; Scotland; Special Area of Conservation.

AUTHORS:

Juliette C. YOUNG[1]; j.young@ceh.ac.uk

Andrew JORDAN[2]; a.jordan@uea.ac.uk

Kate R. SEARLE[1]; k.searle@ceh.ac.uk

Adam BUTLER[3]; a.butler@bioss.ac.uk

Peter SIMMONS[2]; p.simmons@uea.ac.uk

Allan D. WATT[1]; a.watt@ceh.ac.uk

[1] NERC Centre for Ecology and Hydrology, Edinburgh, Midlothian EH26 0QB, UK

[2] School of Environmental Sciences, University of East Anglia, Norwich NR4 7TJ, UK

[3] Biomathematics & Statistics Scotland, JCMB, The King's Buildings, Edinburgh, EH9 3JZ, UK

Corresponding author:

Dr Juliette C. Young

NERC Centre for Ecology and Hydrology

Bush Estate, Edinburgh EH26 0QB

Tel: +44-(0) 131 445 8522

Fax: +44-(0) 131 445 3943

Abstract

There is general acceptance that biodiversity management should be adapted to ecological scale but only recently has the precise role of scale in participatory biodiversity governance begun to be explored. We investigated stakeholder perceptions in three case studies of biodiversity management planning to understand the effect of framing a management response according to the ecological and social scale of the problem on *i)* participatory processes and *ii)* their social and ecological outcomes. Perceptions of success were highest in the case study where stakeholder involvement reflected the perceived ecological scale of the problem. Other factors contributing to successful outcomes were identified, including effective boundary spanning and mutual recognition of conservation conflicts. Failure to take the latter into account, and to align management responses with socio-ecological scale, may jeopardize long-term sustainability of biodiversity.

1. Introduction

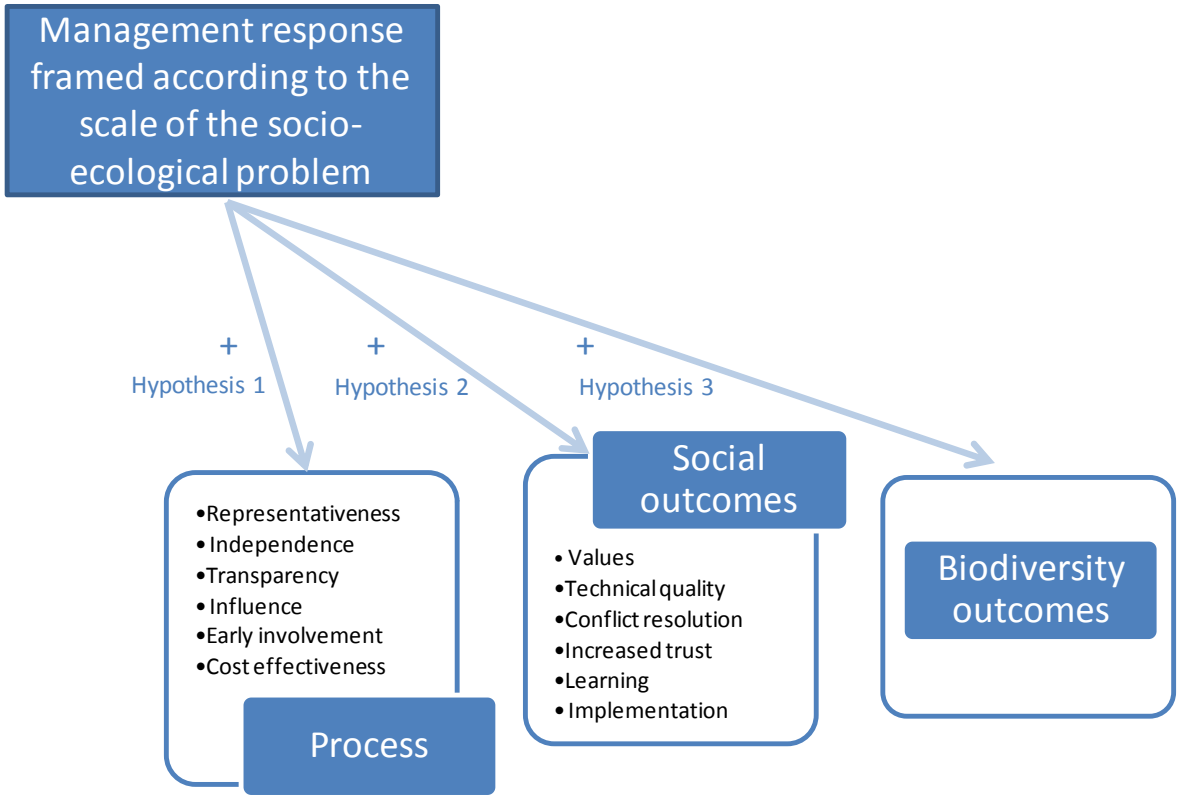
The current tenet underpinning the conservation of biodiversity in human-environment systems is scale-adapted governance (Buizer et al. 2011; Kok & Veldkamp 2011; Newig & Fritsch, 2009). Stakeholder participation in decentralised management processes has been adopted by many policy jurisdictions due to the substantive and instrumental benefits it supposedly generates (Carlsson & Berkes 2005; Young et al. 2012). Participation also takes place at local or regional levels for practical reasons (Newig & Fritsch, 2009) and brings together diverse stakeholders, potentially strengthening the quality and acceptance of decisions (Harrison & Burgess 2000; Parkins & Mitchell, 2005). However, stakeholders have different and potentially conflicting definitions of problems which, if ignored, can lead to flawed processes and ineffective outcomes (Young et al. 2013). These conflicting definitions can often be traced to the ways in which individuals and groups frame the problem and the scale at which it occurs (Cash et al. 2006; Lebel et al. 2005). Framing is "the interpretation process through which people construct and express how they make sense of the world around them" (Gray 2003, p12). Scale framing is the way in which people represent an issue in terms of a particular scale, which may significantly influence participation (Richards et al. 2004; Rockloff & Moore, 2006).

Biodiversity, and other common resources, are affected by problems that span multiple scales, including spatial, temporal, jurisdictional, institutional, management, network and knowledge (Cash et al. 2006). Human-environment systems operate through complex and multiple interactions between and within these scales (Adger et al. 2005; Berkes 2006; Cash et al. 2006; Young 2006). Although the political geography literature has examined the 'politics of scale' (Lebel et al. 2005), it has focused principally on social and political scaling processes and less on the characteristics of environmental processes (Padt & Westerink, 2012). Recent studies adopting a social-ecological systems perspective have, however, examined the problem of fit and of scale mismatches between institutions and systems (Olsson et al. 2006; Ostrom 2009) when incorporating social and ecological considerations into conservation practice (Lee 1993; Cumming et al. 2006; Folke et al. 2007). Participation, co-management and transdisciplinarity are being advocated as solutions to challenges of social-ecological systems and scale (Apostolopoulou & Paloniemi, 2012; Armitage et al. 2009; Cash et al. 2006; Rockloff & Moore, 2006; Young & Marzano, 2012). The way in which scale is framed in policy-making may however result in the misfit of management interventions (Cash et al. 2006), for example in the implementation of the Water Framework Directive (Borowski et al. 2008). It is important therefore to understand the effects of

scale framing in biodiversity management planning and implementation processes to achieve socially and ecologically sustainable outcomes. There is, however, scant empirical evidence on the complex relationship between scale framing and participatory approaches to biodiversity management.

This paper contributes to an emerging literature on scale and governance (e.g. Newig & Fritsch 2009; Kok & Veldkamp 2011) and on scale framing (Termeer et al. 2010; van Lieshout et al. 2011) by presenting a novel interdisciplinary evaluation of stakeholder involvement in three case studies where biodiversity management was undertaken at different scales. We hypothesised that criteria relating to process, social and biodiversity outcomes were more likely to be evaluated positively where the scale of the management response was framed according to the scale of the socio-ecological problem (Figure 1).

Figure 1. Conceptual model illustrating the potential relationship between scale framing and the process, social and biodiversity outcomes of involving stakeholders in the development of management plans



We evaluated stakeholder involvement using an analytical framework derived from public participation evaluation theories, specifically Rowe and Frewer (2000) and Beierle and Konisky (2001), and adapted to reflect the specific aims of the European Union Natura 2000 network. The framework incorporates thirteen criteria (see Annex A of the Supporting Information) which were used, drawing on both qualitative and quantitative data, to analyse the relationship between scale framing, stakeholder involvement processes and the direct (criterion 13) and indirect (criteria 7-12) links in terms of biodiversity conservation (Young et al., 2013). We discuss the implications of this analysis for the management of biodiversity across multiple scales.

2. Methods

2.1. Study system

Natura 2000 is a European ecological network of protected sites comprising Special Protection Areas (SPAs) and Special Areas of Conservation (SACs) established under the EU Birds and Habitats Directives, respectively. Active steps are taken to reconcile biodiversity conservation with "economic, social and cultural requirements" (Article 2(3) of the Habitats Directive). Member States are required to establish conservation measures – e.g. management plans, statutory, administrative or contractual measures – when sites are designated as SACs. The integration of local actors into the management plan process is seen as best practice (European Commission 2000).

A multiple-case design following theoretical replication logic was adopted for this study, with one case study at each spatial scale. Case studies were all SACs that a) had a management plan that required the active involvement of a range of local stakeholders in its development and/or implementation; and b) reflected different contexts of stakeholder involvement, namely different scales. They comprised:

A. One micro-scale case study: The River Bladnoch SAC Atlantic Salmon Catchment Management Plan. This is a single site (SAC) unit covering an area of 3 km^2. The river Bladnoch and its tributaries were designated as an SAC in 2005 for their population of Atlantic salmon (*Salmo salar*), listed under Annex II of the Habitats Directive (JNCC, 2009).

B. One meso-scale case study: The Forth and Borders Moorland Management Scheme. This covers 12 sites totalling 280 km^2. The scheme aims to maintain and improve moorland habitats and the species they harbour by helping land owners and managers promote good moorland management practices through individual management plans.

C. One macro-scale case study: The Moray Firth Seal Management Plan. This covers seven SACs totalling 5230 km^2. The Moray Firth was designated for its harbour seal (*Phoca vitulina*) and Atlantic salmon (*Salmo salar*) populations, listed under Annex II of the Habitats Directive. The Moray Firth Seal Management Plan was developed in 2005 to address the conflict between seal conservation and salmon fisheries (Butler et al. 2005). Only in this case study was the scale framing of the plan explicitly addressed.

2.2. Data collection and analysis

Our hypotheses were as follows:

- The process of stakeholder involvement is more likely to be evaluated positively in the case study where scale is framed explicitly (Hypothesis 1)
- Social outcomes are more likely to be evaluated positively in the case study where scale is framed explicitly (Hypothesis 2)
- Biodiversity outcomes are more likely to be evaluated positively in the case study where scale is framed explicitly (Hypothesis 3).

To test the hypotheses 59 semi-structured interviews were carried out from January to July 2009 (Table 1).

Table 1. Breakdown of interviewees in each case study: The first letter refers to the case study (B=Bladnoch; M=Moray Firth; F=Forth and Borders Moorlands); the middle letters refer to the stakeholder group:

- GA = Government and government department representatives, i.e. local and regional stakeholders responsible for implementing or regulating biodiversity policy;
- SA = Scientific and technical advisers, i.e. local or regional scientists external to governmental bodies (e.g. university, independent research organisations);

148 - BU = Biodiversity users, i.e. local stakeholders who were affected by or involved directly in the management
149 of the target species/habitats in the protected areas such as farmers, fishermen, fishery managers, foresters, local
150 businesses).
151

Interviewee background	**Bladnoch**	**Moray Firth**	**Forth and Borders Moorlands**	**Total**
Representatives of the Scottish government or government departments	BGA1-BGA5	MGA1-MGA4	FGA1-FGA6	15
Scientific advisers	BSA1-BSA2	MSA1-MSA6	FSA1-FSA4	12
Biodiversity users	BBU1-BBU12	MBU1-MBU10	FBU1-FBU10	32
Total	19	20	20	59

152
153
154 The selection of initial interviewees followed a purposive sampling strategy designed to ensure that the views of
155 each of the main types of stakeholder were included. Further contacts within the stakeholder network associated
156 with each of these sites were extended through a process of 'snowball' or chain referral sampling (Lewis-Beck
157 et al. 2004). Semi-structured interviews elicited interviewees' experiences of developing the management plan
158 and their perceptions of the social and biodiversity outcomes (see Annex B of the Supporting Information for a
159 full interview guide). The interviews also included a scoring exercise, with stakeholders asked to score on a
160 scale from 1-5 (five being highest) the thirteen evaluation criteria (Annex A of the Supporting Information).
161 Half-point scores were allowed, which means that criteria were effectively scored on a nine-point scale. Three
162 of the process characteristics ('transparency', 'early involvement' and 'cost-effectiveness') and one social
163 outcome characteristic ('implementation') were excluded from the quantitative analysis due to large numbers of
164 missing responses from interviewees in these categories (see Annex C Table S1 of the Supporting Information
165 for summary of responses). All interviews were transcribed verbatim and coded using NVivo qualitative data
166 analysis software (QSR International 2010).
167
168 We analysed the quantitative interview data to detect whether differences between case studies in terms of
169 participants' perceptions of process, social and biodiversity outcomes existed. Specifically, we tested whether

scored perceptions of process characteristics (Hypothesis 1), social outcomes (Hypothesis 2) and biodiversity outcome (Hypothesis 3) differed between case studies. We fitted statistical models to each of these nine variables, and, in each case, tested for an effect of "case study" upon score. We used ordinal regression models, which treat the data as categorical and exploit the ordered nature of the response variable when performing regression analyses (Christensen 2011). The ordinal regression approach provides a parsimonious way of evaluating differences between the three different case studies (it does this using just two parameters) without needing to make the potentially unrealistic assumption that the scores lie on a genuinely numeric scale. The ordinal regression approach assumes, for example, that a score of three is higher than a score of two, but does not assume that the difference between scores of two and three is necessarily the same as the difference between scores of one and two. Ordinal regression methods are widely used in analyzing questionnaire responses that are, as here, in the form of a Likert scale (Norusis 2011). The ordinal regression models were fitted using the 'clm' function within the 'ordinal' package in R (R Development Core Team, 2011), and are based on the cumulative logit. Full model structure details are in Annex C of the Supporting Information.

A categorical variable denoting social group (government advisors, scientists, and biodiversity users) was included in all models to structurally account for any systematic differences in scoring between different groups of participants, which had previously been found to be important (Young et al., 2013). For each of the nine variables we tested for differences between case studies by using a likelihood ratio test (with a chi-squared reference distribution and two degrees of freedom) to compare a model that included both case study and social group as categorical explanatory variables against a model that only included social group. If the likelihood ratio test showed evidence for significant differences between case studies, at the 5% level, then we interpreted these differences by looking at the estimates, standard errors and confidence intervals for the pairwise differences between the three case studies (see Annex C Table S2 of the Supporting Information for full model results).

3. Results

3.1. The process of stakeholder involvement is more likely to be evaluated positively in the case study where scale is framed explicitly (Hypothesis 1)

The quantitative analysis showed that 'influence' had a highly significant relationship with case study (Table 2).

Table 2. Overall assessment of whether perceived process, social outcomes and biodiversity outcomes, differ between the three case studies. For each perceived process or outcome characteristic statistical significance was assessed by using a likelihood ratio test to compare a model that contains case study and stakeholder group against a model that only contains stakeholder group. Asterisk denote significance at the 0.05 (*), 0.01 (**) and less than 0.001 (***) levels.

Hypothesis	Perceived process or outcome characteristic	Likelihood ratio	P-value
The process of stakeholder involvement is more likely to be evaluated positively in the case study where scale is framed explicitly (i.e. the macro-scale case study) (Hypothesis 1)	Representativeness	5.37	0.068
	Independence	4.79	0.091
	Influence	12.35	0.0021**
Social outcomes are more likely to be evaluated positively in the case study where scale is framed explicitly (i.e. the macro-scale case study) (Hypothesis 2)	Learning	4.71	0.095
	Values	1.03	0.60
	Trust	6.83	0.033*
	Technical quality	14.56	0.00069***
	Conflict resolution	5.18	0.075
Biodiversity outcomes are more likely to be evaluated positively in the case study where scale is framed explicitly (i.e. the macro-scale case study) (Hypothesis 3)	Biodiversity outcome	0.31	0.85

Participants in the macro-scale case study rated 'influence' significantly more highly than those at the micro-scale and meso-scale case studies, whilst differences between the meso- and micro-scale case studies were small and non-significant (Table 3). 'Representativeness' and 'independence' did not differ significantly between the case studies (Table 2).

Table 3. Model estimates and test statistics to summarize differences between case studies in perceived process, social and biodiversity outcomes, based on models that contain 'case study' and 'stakeholder type' as explanatory variables. This table presents results for those perceived outcomes which show statistically significant differences between case studies. Estimates represent estimated pairwise differences between each

pair of case studies, together with associated standard errors, 95% Wald confidence intervals and p-values. Asterisk denote significance at the 0.05 (*), 0.01 (**) and less than 0.001 (***) levels.

Perceived outcome	Pairwise comparison	Estimate	Standard error	95% Confidence interval	p-value
Influence	Meso – Micro	0.14	0.87	-1.56, 1.85	0.87
	Macro – Micro	2.78	1.00	0.83, 4.73	0.0053**
	Meso - Macro	-2.46	0.89	-4.21, -0.72	0.0057**
Trust	Meso – Micro	1.15	0.87	-0.55, 2.85	0.18
	Macro – Micro	2.22	0.89	0.48, 3.96	0.012*
	Meso - Macro	-1.24	0.81	-2.83, 0.35	0.13
Technical quality	Meso – Micro	-1.16	0.91	-2.95, 0.62	0.20
	Macro – Micro	2.96	1.32	0.38, 5.54	0.024*
	Meso - Macro	-4.01	1.35	-6.65, -1.36	0.0030**

The qualitative analysis showed that the process in the macro-scale case study of framing the management plan around the conflict between seal conservation and salmon fisheries allowed the identification of all key actors. This was mainly achieved by one key individual who ensured adequate representativeness and inclusion of all relevant actors, acting as "*an informed and trusted honest broker*" [MGA2] who could "*cross scales* […] *in terms of knowledge systems and also spatial scales*" [MSA1]. The involvement of decision-makers (i.e. the Scottish Government) ensured that the scope of the plan had clear boundaries in terms of what stakeholders could and couldn't do, leading to a situation where "*you had to stick to the rules - that was made quite clear and there was no grumbling about it*" [MBU10]. Within these constraints stakeholders were broadly able to voice their views and concerns, but no false expectations were raised. Despite the limits placed on it the process was perceived as independent and driven by the grassroots, which was reflected in the level of influence stakeholders felt they had in the process.

This was in marked contrast with the micro- and meso-scale case studies. In the former, many affected land owners of the catchment, notably the private forest owners but also other significant stakeholders, were not involved, despite the local focus of the process. This was due to unclear goals of the plan, the execution of the process and the perceived top-down nature of the plan. Similarly, in the meso-scale case study one land owner

remarked that during "*the development stage of the scheme there was no input at all from our side, none whatsoever*" [FBBU4]. Indeed, unless biodiversity users already had good relationships with government department representatives, opportunities for influence were perceived as poor.

3.2. Social outcomes are more likely to be evaluated positively in the case study where scale is framed explicitly (Hypothesis 2)

The quantitative analysis showed a highly significant difference between case studies in the scores given to the proposition that the process had improved the 'technical quality' of decisions (Table 2). This variable was scored significantly more positively in the macro-scale case study than in the micro- and meso-scale case studies, while the difference between the micro- and meso-scale case studies was non-significant (Table 3). There was also weaker, but still statistically significant, evidence for a relationship between 'trust' and case studies (Table 2). In this case scores for the proposition the process had increased trust were significantly higher for the macro-scale case study than for the micro-scale case study, while the meso-scale case study showed no significant differences with either of the other case studies.

Although the quantitative data did not show a significant difference between case studies in scores for stakeholder learning, conflict resolution and the incorporation of stakeholder values (Table 2), analysis of the qualitative data found that high quality decisions that integrated local values were seen as an important outcome in the macro-scale case study. This resulted in a situation where "*it was the salmon guys working directly with the scientists and actually getting some robust data*" [MBU1], thereby leading to acceptance of the science and buy-in to the management plan by fishermen and netsmen. Furthermore this cooperation improved trust and reduced conflict by promoting learning of how different stakeholders framed the problems affecting them, and a broader understanding of the social and political context of the conflict.

In contrast, biodiversity users in the micro- and meso-scale case studies perceived power imbalances, one farmer commenting that the plan reflected "*the values of those with the money rather than the values of the people on the ground*" [BBU3], differentiating between the national-level organisations, and the local stakeholders. The process led to frustration over the failure to adequately address or resolve conflicts (at the micro-scale, the conflict between salmon fisheries and silvicultural practices; and at the meso-scale between raptor conservation

and grouse management), which led to mistrust in national government organisations. The fact that a Fisheries Trust was heavily involved in the micro-scale case study did help bridge knowledge scales and was evaluated positively by biodiversity users.

3.3. Biodiversity outcomes are more likely to be evaluated positively in the case study where scale is framed explicitly (Hypothesis 3)

Perceived biodiversity outcomes did not differ significantly between case studies (Table 2).

It was clear from the qualitative interview data that, for all scales of case study, establishing *direct* biodiversity outcomes was made difficult by the complexity and uncertainty surrounding the ecology of the species for which the management plans were developed. Biodiversity users in both the micro- and meso-scale case studies had seen minor improvements to biodiversity in the short-term but whether these changes were necessarily linked to their individual management, or to the management plans, was unclear.

4. Discussion

This study provides empirical evidence that scale framing may lead to a more sustainable governance of biodiversity through improved social outcomes. Our results also highlight other contextual factors linked to scale that may impact on perceived success of conservation efforts.

The most positively evaluated case study in terms of processes and social outcomes was the macro-scale case study where scale was explicitly framed. Improved trust and reduced social conflict in the macro-scale case study may, in turn, impact positively on the way in which biodiversity is managed (Young et al., 2013). The management plan in the macros-scale case study reflected the broad spatial scale at which the problem (in this case the conflict between seal conservation and salmon fisheries) was perceived by local stakeholders. Following from this innovative framing around the conservation conflict, the process of involving relevant stakeholders was determined. In the other case studies, where scale was not framed explicitly, processes and social outcomes of participation were less positively evaluated. In the micro-scale case study, where one might have expected better representation of stakeholders and their values (Richards et al. 2004; Rockloff & Moore,

2006), some of the affected land owners residing outside the locality were not involved. In addition, power imbalances were perceived by biodiversity users, who also stressed mismatches in terms of knowledge scales. This highlights the importance of acknowledging the role, and socially constructed nature, of scale (Cash et al. 2006; Buizer et al., 2011; Kok & Veldkamp 2011; Mohan 2001) and the impact of scale frame mismatches (Apostolopoulou & Paloniemi, 2012; van Lieshout et al. 2011).

Contextual factors linked to scale also exerted an important effect on perceptions of processes and social outcomes. Much of the 'success' at the macro-scale was achieved by the efforts of one individual who functioned as an effective 'boundary-spanner' (Williams 2012) and tackled the challenges of larger scale co-management processes (e.g. numerous interests, limited social learning), seeking stakeholder input, and creating joint ownership of the management plan. In the micro-scale case study, spanning knowledge boundaries was achieved by an institution, the Fisheries Trust, which incorporated local scientific knowledge and helped improve the technical quality of decisions. These findings support the co-management principles emphasising the importance of champions (Armitage et al. 2009; Young et al. 2012) but also highlights the potential role of institutions in building capacity. The important relationship between levels of governance and socio-ecological scales was also highlighted in the macro-scale case study, where the involvement of national-level actors, providing clear boundaries on the scope of the plan and their involvement, and supporting long-term capacity-building, was seen by stakeholders as essential to the success of the process (Young et al., 2012).

Finally this study highlights the important links between conflicts and scale. All case studies were embedded in conservation conflicts, however, only in the macro-scale case study was conflict explicitly acknowledged and addressed, resulting in a scale-adapted approach involving all relevant stakeholders. The relations that form the focus of 'local' conflicts are rarely confined to the local scale but are connected in various ways to wider scales and patterns of political relationships and of biodiversity use (Meadowcroft 2001). Successful stakeholder involvement in biodiversity management depends on the mutual recognition of biodiversity conflicts (Redpath et al., 2013) and, while not widely discussed in the literature, the framing of management responses around socio-ecological conflicts may be an approach to sustainable scale-adapted biodiversity governance (Gray, 2003).

To conclude, we need to examine scale framing processes constructively and deliberately in biodiversity management planning and implementation processes to reduce conflict and achieve socially legitimate and ecologically sustainable outcomes. Otherwise there is a risk that policy may outstrip the evidence on the role of scale in biodiversity management (Cash et al. 2006; Young 2006).

Acknowledgements: This paper was supported by NERC CEH (Project NEC04049). We thank all interviewees and external experts who took part in this research. We also thank David Elston (BIOSS), Adam Vanbergen (CEH) and three anonymous reviewers for their valuable comments on an earlier draft of this manuscript.

References

Adger, W.N., Brown, K. & Tompkins, E.L. (2005). The political economy of cross-scale networks in resource co-management. *Ecol. Soc.* **10(2)**, 9.

Apostolopoulou, E. & Paloniemi, R. (2012). Frames of scale challenges in Finnish and Greek biodiversity conservation. *Ecol. Soc.* **17(4)**, 9.

Armitage D.R., Plummer, R. Berkes, F., Arthur, R.I., Charles, A.T., Davidson-Hunt, I.J., Diduck, A.P., Doubleday, N., Johnson, D.S., Marschke, M., McConney, P., Pinkerton, E. & Wollenberg E. (2009). Adaptive co-management for social–ecological complexity. *Front. Ecol. Environ.*, **6**, 95–102.

Beierle, T.C. & Konisky, D.M. (2001). What are we gaining from stakeholder involvement? Observations from environmental planning in the Great Lakes. *Environ. Plann. C*, **19**, 515-527.

Berkes, F. (2006). From community-based management to complex systems: the scale issue and marine commons. *Ecol. Soc.*, **11**(1), 45.

Borowski, I., Le Bourhis, J. P. Pahl-Wostl, C., & Barraque, B. (2008). Spatial Misfit in Participatory River Basin Management: Effects on Social Learning, a Comparative Analysis of German and French Case Studies. *Ecol. Soc.*, **13**(1), 22.

Buizer, M., Arts, B. & Kok, K. (2011). Governance, scale and the environment: the importance of recognizing knowledge claims in transdisciplinary areas. *Ecol. Soc.*, **16(1)**, 21.

Butler, J.R.A., Middlemas, S.J, McKelvey, S.A., McMyn, I., Leyshon, B., Walker, I., Thompson, P.M., Boyd, I.L., Duck, C., Armstrong, J.D., Graham, I.M., & Baxter, J.M. (2008). The Moray Firth Seal Management Plan: an adaptive framework for balancing the conservation of seals, salmon, fisheries and wildlife tourism in the UK. *Aquat. Conserv.*, **18**, 1025-1038.

354 Carlsson, L. & Berkes F. (2005). Co-management: concepts and methodological implications. *J. Environ.*
355 *Manage.* **75**, 65-76.
356 Cash, D.W., Adger, W.N., Berkes, F., Garden, P., Lebel, L., Olsson, P., Pritchard, L. & Young, O. (2006). Scale
357 and cross-scale dynamics: governance and information in a multilevel world. *Ecol. Soc.*, **11**(2), 8.
358 Christensen, R.H.B. (2011). *Analysis of ordinal data with cumulative link models - estimation with the R-*
359 *package 'ordinal'*. http://cran.r-project.org/web/packages/ordinal/vignettes/clm_intro.pdf. Accessed 11 July
360 2012.
361 Cumming, G.S., Cumming, D.H.M., & Redman, C.L. (2006). Scale mismatches in social-ecological systems:
362 causes, consequences, and solutions. *Ecol. Soc.*, **11(1)**, 14.
363 European Commission (2000). *Managing Natura 2000 sites, the provisions of article 6 of the Habitats Directive*
364 *92/43/CEE*.
365 http://ec.europa.eu/environment/nature/natura2000/management/docs/art6/provision_of_art6_en.pdf. Accessed
366 11 July 2012.
367 Folke, C., Pritchard, L. Jr., Berkes, F., Colding, J. & Svedin, U. (2007). The problem of fit between ecosystems
368 and institutions: Ten years later. *Ecol. Soc.*, 12(1), 30.
369 Gray, B. (2003). Framing of environmental disputes. In: *Making sense of intractable environmental conflicts*
370 (eds. Lewicki, R.J, Gray, B & Elliott, M.). Island Press, Washington D.C, pp. 11-34.
371 Harrison, C. & Burgess, J. (2000). Valuing nature in context: the contribution of common-good approaches.
372 *Biodivers. Conserv.*, **9**, 1115-1130.
373 JNCC, 2009. *UK SAC site list: River Bladnoch site details*.
374 http://www.jncc.gov.uk/protectedsites/sacselection/sac.asp?EUCode=UK0030249 [Accessed 23/08/2010].
375 Kok, K. & Veldkamp, T.A. (2011). Scale and governance: conceptual considerations and practical implications.
376 *Ecol. Soc.*, **16(2)**, 23.
377 Lebel, L., Garden, P. & Imamura, M. (2005). The politics of scale, position, and place in the governance of
378 water resources in the Mekong region. *Ecol. Soc.*, **10(2)**, 18.
379 Lee, K.N. (1993). Greed, scale mismatch, and learning. *Ecol. App.*, **4**, 560-564.
380 Lewis-Beck, M.S., Bryman, A., & Liao, T.F. (2004). *The Sage Encyclopaedia of Social Science Research*
381 *Methods*. Thousand Oaks, London.
382 Meadowcroft, J. (2002). Politics and scale: some implications for environmental governance. *Landscape Urban*
383 *Plan.*, **61**, 169-179.

384 Mohan, G. (2001). *Beyond Participation: Strategies for Deeper Empowerment*. In: Participation: The New
385 Tyranny? (Cooke B, Kothari U, eds). London: Zed Books; 153-167.
386 Newig, J. & Fritsch, O. (2009). Environmental governance: participatory, multi-level – and effective? *Env. Pol.*
387 *Gov.*, **19**, 197-214.
388 Norusis, M. (2011). *IBM SPSS Statistics 19 Advanced Statistical Procedures Companion*. Pearson.
389 Olsson, P., Folke, C., Galaz, V., Hahn, T., Schultz, L. (2006). Enhancing the fit through adaptive co-
390 management: creating and maintaining bridging functions for matching scales in the Kristianstads Vattenrike
391 Biosphere reserve, Sweden. *Ecol. Soc.*, **12(1)**, 28.
392 Ostrom, E. (2009). A general framework for analyzing sustainability of socio-ecological systems. *Science*, **325**,
393 419-422.
394 Padt, F.J.G. & Westerink, J. (2012). Addressing scale in open space preservation: learning from the Hague
395 region in the Netherlands. *Tijdschrift voor Economische en Sociale Geografie*. Published online May 9, 2012.
396 Parkins, J.R. & Mitchell, R.E. (2005). Public participation as public debate: A deliberative turn in natural
397 resource management. *Soc. Natur. Resour.*, **18**, 529-540.
398 QSR International (2010). NVivo 9 QSR International. Melbourne, Australia.
399 Redpath, S.M., Young, J., Evely, A., Adams, W.M., Sutherland, W.J., Whitehouse, A., Amar, A., Lambert, R.,
400 Linnell, J., Watt, A. & Gutièrrez, R.J. (2013). Understanding and managing conservation conflicts. *Trends Ecol.*
401 *Evol.* 10.1016/j.tree.2012.08.021.
402 R Development Core Team. (2011). *R: A Language and Environment for Statistical Computing*. R Foundation
403 for Statistical Computing, Vienna. ISBN 3-900051-07-0.31
404 Rowe, G., Frewer, L.J. (2000). Public participation methods: A framework for evaluation. *Sci. Technol. Hum.*
405 *Val.*, **25**, 3-29.
406 Richards, C., Sherlock, & Carter, C. (2004). *Practical Approaches to Participation*. SERP Policy Brief No.1.
407 Macaulay Institute, Aberdeen.
408 Rockloff, S.F. & Moore S.A. (2006). Assessing representation at different scales of decision making:
409 Rethinking local is better. *Policy Stud. J.*, **34**, 649-670.
410 Termeer, C.J.A.M., Dewulf, A., van Lieshout, M. (2010). Disentangling scale approaches in governance
411 research: comparing monocentric, multilevel, and adaptive management. *Ecol. Soc.*, **15(4)**, 29.
412 Van Lieshout, M., Dewulf, A., Aarts, N. & Termeer, C. (2011). Do scale frames matter? Scale frame
413 mismatches in the decision making process of a "mega farm" in a small Dutch village. *Ecol. Soc.*, **16(1)**, 38.

414 Williams, P. M. (2012). *Collaboration in Public Policy and Practice: Perspectives on Boundary Spanners*.
415 Policy Press, Bristol.
416 Young, J.C., Butler, J.R.A., Jordan, A. & Watt, A.D. (2012). Less government intervention in biodiversity
417 management: Risks and opportunities. *Biodivers. Conserv.*, **21**, 1095-1100.
418 Young, J.C., Jordan, A., Searle, K., Butler, A., Chapman, D., Simmons P., Watt, A.D. 2013. Does stakeholder
419 involvement really benefit biodiversity conservation? *Biol. Conserv.*, **158**, 359-370.
420 Young, J. & Marzano, M. (2012). Embodied interdisciplinarity: What is the role of polymaths in environmental
421 research? *Environ. Conserv.*, **37(4)**, 373-375.
422 Young, O. (2006). Vertical interplay among scale-dependent environmental and resource regimes. *Ecol. Soc.*,
423 **11(1)**, 27.
424

SUPPORTING INFORMATION

A. Theoretical framework for the evaluation of stakeholder involvement, based on criteria adapted from Rowe and Frewer (2000) and Beierle and Konisky (2001)

Evaluation focus	**Criteria measured**
Procedural evaluation	
Representativeness	1. Were the participants representative of the affected public?
Independence	2. Was the process carried out in an independent, unbiased way?
Transparency	3. Was the public able to see what was happening and how decisions were being made?
Influence	4. Did participant input have a genuine impact on the management plan?
Early involvement	5. Were stakeholders involved as early as possible?
Cost-effectiveness	6. Was the process cost-effective?
Social outcome evaluation	
Stakeholder values	7. Were stakeholder values incorporated into decision making?
Technical quality	8. Was the technical quality of decisions improved?
Conflict resolution	9. Was conflict resolved among stakeholders?
Increased trust	10. Was trust increased between stakeholders?
Learning	11. Did stakeholders become better educated and informed?
Implementation	12. Were organisations established to implement decisions?
Biodiversity outcome evaluation	
Biodiversity outcomes	13. How successful was the plan in ensuring the long-term conservation of the target species/habitats?

B. Semi-structured interview guide

Short introduction:

The aim of this research is to better understand how local people are involved in the management of protected areas. I'll be asking you a series of questions about your experience of the site and its management plan. The interview usually takes about an hour. There are no right or wrong answers, it's all confidential and your identity will not be revealed at any stage.

I've divided the interview into three main parts, just to help me remember everything: initially I'll just ask a few background questions about you and your experience of the area, the meat of the interview is really about the process of writing the management plan (that's where the table comes in), and then a quick look at the plan itself.

Background questions to be filled before-hand

Date of interview:	
Location of interview:	
Name and contact details of interviewee:	
Profession of interviewee:	

FIRST OF ALL, A FEW QUESTIONS REGARDING YOUR *PERSONAL EXPERIENCE OF THE AREA*

Q: **How well do you know the site** (**How long** have you lived in the area? **How often** do you visit the site? How well do you know **the local inhabitants**?)

Moving on to the Natura 2000 site:

Q: **Have things changed since the site was designated as a Natura 2000 site**? (Has the **use of the site** changed? Are there any **activities** you can no longer carry out? How will **future use** of the site be affected, i.e. increase in **tourism**? How might this future use affect you **personally**?)

NOW IN TERMS OF YOUR *PERSONAL LEVEL OF INVOLVEMENT IN THE DEVELOPMENT OF THE MANAGEMENT PLAN*

When did you first get involved? What were your **responsibilities**? How many **meetings** did you attend? Did you have any **other related activities** apart from attending the meetings? Generally, **how well** do you think the drafting of the management plan went?

Table exercise: Focussing still on the **drafting of the plan**, I've got a list here of different aspects that could be true of the process. It's my list and there are probably lots of aspects I've missed out, so

if you think of anything else as we're going along, just let me know. For each of these aspects I'd you think back, talk me through it and at the end score each of the aspects along a gradient from 1 to 5 where 1 is very bad and 5 very good.

How good was the process at:	1 (very bad)	2	3	4	5 (very good)
Representing the people affected					
Allowing people to have a real impact					
Incorporating the values of people					
Involving people as early as possible					
Increasing trust between all involved					
Resolving any existing conflicts					
Being unbiased and independent					
Being transparent and clear					
Being cost-effective					
Improving the technical quality of decisions					
Providing information and educating people					
Leading to new organisations or structures being established to implement decisions					
Leading to long-term biodiversity benefits					

Q: Were there any aspects **missing**? Irrespective of how you scored, what were the **three most important aspects** for you in the above list during the process of drawing up the plan?

Q: Do you think the process **could have worked better**? How?

MOVING ON THE **IMPLEMENTATION OF THE PLAN**:

Q: **How well** do you think the management plan is being **implemented**?

Q: Do you think **things could have been different** in the area if there wasn't a plan in place? What about in terms of **biodiversity** specifically?

Q: Do you have any **suggestions** as to who else I should interview?

Q: I fully appreciate that this is a very general approach and that there are probably lots of things I haven't mentioned. I don't know if anything comes to mind now? If later, provide contact details.

Q: Do you want to be **kept informed** of research findings? Yes or No? Contact details?

C. Full details of the statistical models

Notation

Let y_j be the response variable for the ith interviewee, which may take on a value between 1 and 5 (including half decimals), and let $v_j = (j + 1) / 2$ denote the nine possible values of y_j.

Let the variable z_{1i} be equal to one if interviewee i is a scientific advisor and zero otherwise.

Let the variable z_{2i} be equal to one if interviewee i is a biodiversity user and zero otherwise.

Let the variable x_{1i} be one if interviewee i belonged to the meso-scale case study and zero otherwise.

Let the variable x_{2i} be one if interviewee i belonged to the macro-scale case study and zero otherwise.

Model 1

The first model is of the form

$$\text{logit}\{\mathbf{P}(y_i \le v_j)\} = \theta_j - (\alpha_1 z_{1i} + \alpha_2 z_{2i}) \qquad j=1,\ldots,9, \quad i=1,\ldots,n \quad \textbf{Eq 1.}$$

The parameters θ_j provide a separate intercept for each category j, whilst the parameters α_1 and α_2 represent the differences between the three social groups.

Model 2

The second model is of the form

$$\text{logit}\{\mathbf{P}(y_i \le v_j)\} = \theta_j - (\alpha_1 z_{1i} + \alpha_2 z_{2i} + \beta_1 x_{1i} + \beta_2 x_{2i}) \qquad j=1,\ldots,9, \quad i=1,\ldots,n \quad \textbf{Eq 2.}$$

where the parameters β_1 and β_2 quantify the differences between the micro, meso and macro scales.

519 **Table S1**. Median scores for each social and process outcome characteristic and for perceived biodiversity

520 outcomes for each of the three case studies

521

	Micro-scale case study	**Meso-scale case study**	**Macro-scale case study**
Representativeness	3.0 (2.6,3.9)	3.75 (3.0,4.1)	4.0 (4.0,4.8)
Independence	3.0 (1.6,3.8)	3.0 (2.8,4.0)	4.0 (3.5,4.3)
Influence	2.25 (2.0,3.9)	3.0 (3.0,4.0)	4.5 (4.0,5.0)
Early involvement	3.0 (2.1,4.0)	4.0 (2.9,4.0)	4.5 (4.0,5.0)
Stakeholder values	3.0 (2.6,3.8)	3.75 (3.0,4.0)	4.0 (3.5,4.0)
Technical quality	4.0 (4.0,4.0)	4.0 (3.0,4.0)	4.5 (4.0,5.0)
Conflict resolution	3.0 (2.0,3.0)	3.0 (2.0,4.3)	4.0 (3.0,4.3)
Increased trust	2.75 (2.0,3.4)	3.75 (3.4,4.1)	4.0 (3.8,4.5)
Learning	2.75 (3.0,4.0)	3.75 (2.0,3.0)	4.0 (3.0,4.5)
Biodiversity outcomes	3.0 (2.1,4.0)	4.25 (2.0,4.5)	3.0 (3.0,3.5)

522

Table S2. Model estimates and test statistics to summarize differences between case studies in perceived biodiversity, process and social outcomes, based on models that contain 'case study' and 'stakeholder type' as explanatory variables. This table presents results for those perceived outcomes which are excluded from Table 3 because they do not show statistically significant differences between case studies. Estimates represent estimated pairwise differences between each pair of case studies, together with associated standard errors, 95% Wald confidence intervals and p-values.

Perceived outcome	Pairwise comparison	Estimate	Standard error	95% Confidence interval	p-value
Representativeness	Meso – Micro	0.95	0.87	-0.74, 2.65	0.27
	Macro – Micro	2.03	0.91	0.24, 3.82	0.026
	Macro – Meso	-1.39	0.83	-3.02, 0.23	0.093
Independence	Meso – Micro	0.34	0.84	-1.31, 1.99	0.69
	Macro – Micro	1.68	0.88	-0.045, 3.41	0.056
	Macro – Meso	-1.54	0.87	-3.24, 0.16	0.075
Learning	Meso – Micro	-1.27	0.88	-2.99, 0.45	0.15
	Macro – Micro	0.50	0.83	-1.13, 2.13	0.55
	Macro – Meso	-1.52	0.83	-3.15, 0.10	0.066
Values	Meso – Micro	0.33	0.82	-1.27 1.93	0.69
	Macro – Micro	0.82	0.83	-0.80, 2.45	0.32
	Macro – Meso	-0.57	0.86	-2.25, 1.12	0.51
Conflict resolution	Meso – Micro	-0.30	0.87	-2.00, 1.40	0.73
	Macro – Micro	1.39	0.81	-0.19, 2.97	0.086
	Macro - Meso	-1.76	0.86	-3.43, -0.079	0.040
Biodiversity outcome	Meso – Micro	-0.058	0.86	-1.75, 1.63	0.95
	Macro – Micro	-0.41	0.81	-1.99, 1.17	0.61
	Macro - Meso	0.11	0.75	-1.36, 1.59	0.88