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Governance and Ecosystems Management for the CONservation of BIOdiversity

in Simoncini, R. (2008) Work Package 5 report on

Governance matrix outcomes from case studies, Part B:

GEM-CON-BIO Case Study Report – Use Nationally of Wild Resources across Europe (UNWIRE)

Prepared by Anatrack Ltd

Robert Kenward & Robin Sharp
reke@ceh.ac.uk
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This document is an appendix to a report that combined case-study data in a matrix to identify links between governance types and ecosystem management characteristics. UNWIRE differed from studies of single areas or small groups because it collected data on six activities across 27 EU states. The extensive, standardised data could therefore be used to create a stand-alone matrix for simple correlative and multivariate analyses of how governance and management types related to trends in resources, resource users and biotopes. Data for this report were gathered by many members in the European Sustainable Use Specialist Group (ESUSG) of the Species Survival Commission in IUCN (The World Conservation Union), with special contributions from Stratos Arampatzis, Robert Arlinghaus, Sandor Csanyi, Sarah Durrell, Mikael Hildén, Mart Külvik, Melanie Mewes, Paul Morling, Fritz Reimoser and Riccardo Simoncini.

Anatrack

IUCN The World Conservation Union

Sustainable Use Specialist Group

Case study title: Use Nationally of Wildlife Resources across Europe (UNWIRE)
Spatial level analysed: The 27 states of the European Union
Study areas extension: Approximately 43 million sq. km
Time period analysed: 10 years) from 1996 to 2006
Prevalent governance type[1]: For use of wild resources, emphasis varies across EU states
Main ecosystem analysed[2]: All EUNIS habitat types were reported

UNWIRE is the only EU-wide case study in GEM-CON-BIO. It concentrates on provisioning and cultural ecosystem services from wild resources (e.g. food, recreation). It investigates how governance structures, including markets, regulations and other factors associate with trends in abundance of (a) wildlife resources, (b) the biotopes in which these resources occur (ecological sustainability) and (c) resource users (socio-economic sustainability). UNWIRE is based on an e-mail questionnaire survey administered by the European Sustainable Use Specialist Group (ESUSG) through 27 expert country coordinators. Six resource uses were surveyed, namely: (i) hunting birds, (ii) hunting ungulates, (iii) angling, (iv) collecting fungi, (v) collecting wild plant products and (vi) bird-watching.

Questionnaires were designed in English and translated into 18 European languages during February-April 2007. Data and opinions on the six activities were collected in May-July 2007 from national NGOs representing resource users and in June-July 2007 from government administrators (for hunting and angling only). In a few cases data were added by country coordinators. Trends in resources, biotopes and users were assessed for 1996-2006. There were 124 completed surveys from resource-user representatives (an overall response rate of 78%). There were responses on hunting topics and bird-watching from 85-93% of countries surveyed, from 70% for angling and collecting fungi, but only 48% for collecting plant products. Governments gave a 71% response (19 states) on hunting and 37% (10 states) on angling. The 94 questions in the resource-user questionnaires and the 21 in the government surveys were used to produce three types of analytic indicator, as follows.

(1) Institutional aspects: Two indicators of institutional capacity concerned ownership of areas and resources used for activities (percentage by state, local communities, private individuals and organisations, or open access) and how management planning, funding and labour fell into state, community and private categories or was absent. Another indicator was the extent of vertical integration (combining strength of local laws and other constraints, local participation levels, trust of resource users for government and vice versa and a World Bank score for 'voice and accountability'). There was a similar index of horizontal integration (combining trust of resource-use organisations for other national organisations and of users for other groups at local level, effectiveness of local collaboration and networking, and change in social relations). Institutional capacity was also indicated by the number of levels of government (national, regional, local) involved in regulatory and economic management, how strong was participation at local community level (combining local collaboration effectiveness, the voice and accountability score and whether local knowledge was used in management), and if frequent consultation of one knowledge source indicated strong leadership.

(2) Objectives and instruments: Indicators of objectives were the extent to which governments prioritised management for ecological, economic and social objectives. For instruments, indicators were generation of knowledge (combining market awareness, regulatory awareness, species and ecosystem awareness in management and public appreciation of biodiversity) and the extent of adaptive management (frequency of monitoring and whether management included species, ecosystems or both). Indicators of both objectives and process were the numbers of tools for regulation (averaging constraints registered by users and regulatory instruments recorded by governments), economic purposes (governments noted taxes, subsidies, etc.) and socially (the number of types of collaboration recorded by governments).

(3) Impacts: Four variables indicated impacts in UNWIRE. Short-term trends in participant numbers and resources (we averaged estimates across species or other taxa defined in the survey forms) were proxies for sustainability of ecosystem services and resource use, respectively. Trends in biotopes used by those

[1] The main types of governance are identified in the document "Governance Types in GEM-CON-BIO: their identification, application and integration with the analytical framework" (Andrew Terry, 2007).
[2] Annex 1 EUNIS Habitat type of the GEM-CON-BIO Guidance Manual, Vers.3. (Andrew Terry and Riccardo Simoncini, 2007)

resources (scores of -1=decline, 0= no change and +1=increase, again averaged across taxa) were a proxy for state of biodiversity. A longer-term indicator of impact was the current density of participants (numbers/km^2) in each country. All were estimated by representatives of resource-users

Variables included both 'hard' data (e.g. country area, if a license was needed, how many organisations) and 'soft' data. 'Soft' data came from subjective 5-point scores, for instance on awareness of regulations (on a scale from -2=negligible to +2=highly) or whether a factor was deemed to benefit conservation through use of the resources (from -2 for strong hindrance to +2 for strong benefit). Depending on the country, some variables (e.g. what proportion of funding was private) could be robust measurements, estimates or Best Professional Judgement (BPJ). Trend data, for resource populations, numbers of resource-users and biotope quality during the last decade, were typically based on licences for hunters and anglers and on estimates of species population records for birds and mammals, but were otherwise BPJ. For more survey details, see http://iucn.org/themes/ssc/susg/news/sept07esusgvienna.htm

Section I of this report gives information comparable with the governance matrix analysis across other GEM-CON-BIO case studies, by deriving correlation coefficients for indicators of institutional aspects (1), objectives and instruments (2) and impacts (3). Section II uses bivariate correlations and then multiple regression analysis of variance and covariance to assess which two factors, either indicators from stage 1 or individual (un-aggregated) variables, combine to give the strongest association with trend variables and participant density. Results of this analysis are reviewed separately for each activity, before Section III draws the findings together across the activities and arrives at conclusions for the case study.

Section I: Governance matrix results:

Mean values across countries for each activity and conversion to scores for combination with results from other case studies are shown in Table 1. Gaps occur where data were not sought from governments (on multi-level governance, objectives and tools) for collecting fungi and plant products and for bird-watching. There was appreciably less management of wild plants and fungi than of other resources, with state

TABLE 1. MEAN VALUES ACROSS COUNTRIES, WITH SCORING	VALUES (means)						SCORES					
	Bird-Hunting	Ungulate - Hunting	Angling	Fungi	Plants	Watching Birds	Bird-Hunting	Ungulate-Hunting	Angling	Fungi	Plants	Watching Birds
Institutional Aspects												
Percentage State Managed	35.8	38.6	52.8	21.4	11.6	45.8	0	0	0	-1	-2	0
Percentage Privately Managed	49.3	50.2	28.8	11.4	5.5	36.4	0	0	-1	-2	-2	0
Percentage Community Managed	8.7	11.0	12.7	4.0	7.1	4.3	-2	-2	-2	-2	-2	-2
Percentage Not Managed	6.3	0.2	5.8	63.3	75.8	13.7	-2	-2	-2	1	2	-2
Number of Management Types	2.16	2.30	2.21	0.94	0.64	2.13	1	1	1	-1	-1	1
Percentage State Owned	40.5	39.6	46.8	32.1	25.0	43.4	0	0	0	-1	-1	0
Percentage Privately Owned	36.2	38.7	30.5	28.0	41.6	36.7	0	0	-1	-1	0	0
Percentage Community Owned	5.8	8.2	6.0	12.1	3.7	19.6	-2	-2	-2	-2	-2	-1
Percentage with Free Access	17.4	13.5	16.7	27.9	29.6	0.3	-1	-2	-1	-1	-1	-2
Number of Ownership Types	2.18	2.09	1.74	1.73	1.36	2.58	1	1	0	0	0	2
Level of vertical integration	3.44	3.45	3.41	3.32	3.15	3.47	0	1	0	0	0	1
Level of horizontal integration	3.50	3.62	3.35	2.52	3.17	3.68	1	1	0	1	0	1
Local community participation	2.95	2.82	2.81	2.30	2.61	3.16	0	0	0	-1	0	0
Multi-level governance	3.45	3.34	2.74				1	0	0			
Leadership role	1.76	1.96	1.74	0.94	0.73	1.39	0	0	0	-1	-2	-1
Objectives and Instruments												
Main Management ecological objectives	0.76	0.84	0.64				2	2	1			
Main Management economic objectives	0.17	0.23	0.26				-1	-1	-1			
Main Management social objectives	0.16	0.12	0.11				-1	-2	-2			
Generation of Knowledge	3.24	3.53	3.47	2.53	2.73	2.84	0	1	1	-1	0	0
Adaptive management	2.86	3.20	2.26	0.89	0.73	1.39	1	2	2	-1	-2	-1
a) Market/Financial tools	2.42	2.41	2.75				1	1	1			
b) Regulatory tools	3.20	3.37	2.47	1.44	1.27	0.30	2	2	1	-1	-1	-2
c) Social tools	1.32	1.71	1.63				-1	0	0			
Impacts												
Local benefit from biodiversity	0.63	0.82	0.79	0.89	1.00	0.74	1	2	2	2	2	2
Local cost from biodiversity depletion	0.46	0.55	0.58	0.28	0.27	0.13	0	1	1	-1	-1	-2
Sustainability of resource use	-2.50	17.39	-5.63	-6.88	-2.22	-9.05	0	2	-1	-1	0	-1
State of biodiversity	-0.23	-0.04	-0.18	-0.43	-0.24	-0.29	-1	0	0	-1	-1	-1
Participation trend	-15.40	-12.80	2.04	4.51	4.81	18.00	-2	-1	0	0	0	2

management dominating, as is also the case for fish stocks and wild birds, while private management is relatively more prevalent for ungulate stocks and game-birds. Community management is relatively

infrequent in the EU. The land and resource ownership for all the activities except collecting plants belonged slightly more frequently to the state than to the private sector, with community ownership less frequent than free-access except, apparently, for bird-watching. Ownership diversity was least for fish, plants and fungi, with knowledge generation and adaptive management lowest for the vegetal resources. Regulations were least for bird-watching, increased somewhat for vegetal resources and again for fishing, with most regulatory tools for hunting, especially of ungulates.

Representatives at national level considered that benefits from biodiversity are mainly local for vegetal resources and least local for game-birds. Data on trends in resources, biotopes and participants were the most direct indicators of impacts, although only participant data from hunting and angling licences, and on resources from hunting bags, could really be considered robust. Numbers of hunters declined by 12-15% across the EU, whereas estimated numbers of bird-watchers increased and anglers and collectors of vegetal matter showed little change. The average percentage change for numbers of ungulates, such as deer and wild boar, increased strongly while some decrease was estimated for other wildlife resources. Average scores for biotope quality varied considerably between states but less between the six activities. Biotopes with fungi averaged slightly worse than for bird-watching and hunting birds, angling and collecting plants. There was on average little change perceived in quality of biotopes used by ungulates.

Section II. Associations of governance & management indicators with trend & density variables.

For each activity, coefficients were estimated for correlation of institutional, objective and instrumental indicators with impacts, including trends in participant numbers, resources and biotope quality (as proxies for sustainability and biodiversity) and participants/km^2. Correlation coefficients have values from +1 to -1; the difference from 0 shows how likely they will occur by chance. As a finding of significance at the 5% level is expected by chance for every 20 coefficients estimated and there were more than 20 for each trend or density variable in each activity, credence was given to individual correlations only (i) if they were beyond the 2% level of significance (i.e. with P<0.02) (ii) inspection of plots showed the correlation not to result from an outlier, and (iii) more than half the respondents had answered the question.

Thus although coefficients significant at the 5% level are underlined in Table 2, only those significant at the 2% level are emphasized with boxes (and underlined in boxes for the 1% level). Labels on the left for the indicators are boxed if more than one correlation significant at 2% occurs in a row. Data on collecting plant material are omitted from the analysis because, whereas trend and density estimates were available for 12-24 of the 27 EU states for five activities, only 6-9 states estimated these for plant material. Gaps in the table occur where data were not sought from governments (on objectives, multi-level governance, social tools and market or regulator benefits) for collecting fungi and bird-watching.

TABLE 2	Bird Hunt	Deer Hunt	participation-ch Fish	participation-ch Fungi	Bird Watch	Bird Hunt	Deer Hunt	resource-ch Fish	resource-ch Fungi	Bird Watch	Bird Hunt	Deer Hunt	biotope-ch Fish	biotope-ch Fungi	Bird Watch	Bird Hunt	Deer Hunt	participant/km² Fish	participant/km² Fungi	Bird Watch
StateManage%	0.21	0.03	0.33	-0.21	0.42	-0.29	0.09	0.05	0.21	0.04	0.46	0.46	0.45	-0.13	-0.29	-0.06	0.00	-0.39	-0.03	-0.39
PrivateManage%	-0.08	-0.25	-0.21	-0.18	-0.14	0.14	0.03	0.11	-0.36	-0.17	-0.10	-0.22	0.06	0.09	0.18	-0.07	0.06	0.38	0.22	0.38
CommunityManage%	-0.39	0.21	-0.45	-0.08	-0.19	0.17	-0.14	-0.17	-0.23	-0.17	-0.29	-0.12	-0.44	-0.31	-0.05	0.04	-0.09	-0.44	0.28	-0.03
NotManaged%	0.17	0.26	0.30	0.25	-0.22	0.02	0.16	-0.29	0.06	0.02	0.01	0.14	-0.34	0.11	-0.04	0.18	-0.02	0.30	-0.19	0.10
MultipleManaged	-0.30	0.07	-0.45	-0.21	0.03	0.38	0.15	0.03	-0.08	0.04	-0.42	-0.01	-0.37	-0.18	0.25	**0.61**	0.29	0.09	0.33	0.04
StateOwned%	0.18	0.32	**0.47**	-0.13	0.14	0.06	-0.18	-0.29	0.01	-0.26	0.07	0.15	-0.02	-0.08	0.01	0.00	-0.01	**-0.77**	0.14	-0.08
PrivateOwned%	0.06	-0.12	-0.37	0.22	0.09	-0.06	-0.19	0.29	-0.41	0.33	-0.10	0.26	0.06	-0.38	-0.01	0.03	-0.23	0.24	-0.01	0.32
CommunityOwned%	**-0.74**	0.26	**-0.63**	-0.19	-0.20	-0.21	0.28	0.07	-0.23	-0.16	0.09	-0.18	-0.32	-0.40	0.03	0.02	-0.10	0.10	-0.05	-0.39
FreeAccess%	0.07	-0.33	0.15	-0.05	-0.26	0.14	0.12	-0.14	0.30	0.04	-0.04	-0.38	0.30	0.58	0.34	0.08	0.27	0.50	-0.07	-0.27
MultipleOwned	-0.49	0.06	-0.43	0.16	-0.35	-0.27	0.41	**0.65**	0.00	-0.15	0.11	-0.36	-0.34	**-0.60**	-0.28	-0.25	0.12	0.15	-0.02	0.11
Vertical-Integration	0.22	-0.14	**-0.60**	0.05	-0.18	0.09	0.20	**0.64**	-0.45	0.22	0.26	0.20	-0.07	-0.52	0.11	0.18	0.32	0.05	-0.35	0.20
Horizontal-Integration	**0.56**	**0.44**	**-0.51**	-0.05	0.03	0.18	-0.30	0.36	-0.23	0.19	**0.52**	**0.58**	0.10	0.22	0.33	-0.33	0.20	-0.04	0.25	0.21
Local-Role	0.03	0.27	-0.35	0.13	0.18	-0.27	-0.32	0.18	-0.50	0.08	0.28	**0.66**	-0.14	-0.24	0.02	0.15	-0.19	-0.14	-0.05	**0.46**
Instruments Multi-Level	0.27	-0.15	-0.47			0.09	-0.05	0.32			-0.26	-0.04	-0.44			-0.08	-0.17	0.69		
Leadership	-0.28	-0.11	-0.46	0.07	0.18	0.19	0.41	0.36	0.49	-0.14	-0.45	-0.46	-0.11	0.02	0.44	0.05	0.31	0.36	-0.01	0.35
Objective-Ecological	-0.04	0.31	0.35			-0.16	0.10	-0.09			0.27	-0.33	0.10			-0.23	0.02	-0.24		
Objective-Economic	-0.32	**-0.59**	-0.26			0.05	0.02	0.31			0.18	0.25	-0.52			-0.15	0.01	-0.30		
Objective-Social	0.04	0.11	0.37			0.19	-0.05	-0.26			-0.08	0.11	-0.35			**0.67**	0.09	0.54		
Knowledge-Generation	**0.60**	0.42	0.02	-0.26	0.01	-0.15	-0.28	0.24	-0.50	0.41	0.30	0.18	-0.56	-0.28	-0.09	-0.18	-0.23	-0.06	0.38	0.09
AdaptiveManagement	-0.16	0.22	0.23	-0.16	-0.09	-0.37	0.16	0.07	-0.11	-0.29	-0.16	-0.01	0.25	-0.07	0.09	0.04	0.05	-0.09	0.48	0.11
Tools-Market	-0.12	0.28	0.47		-0.32	0.14	-0.02	-0.55		0.40	0.19	0.19	0.12		**0.51**	0.05	0.28	0.51		0.11
Tools-Regulatory	0.06	-0.10	0.35	0.05	-0.02	-0.12	0.28	-0.35	0.00	0.04	-0.40	-0.33	0.44	0.25	0.22	-0.10	-0.11	0.10	-0.05	-0.06
Tools-Social	0.25	-0.07	0.77			-0.15	-0.01	-0.70			-0.24	-0.03	-0.13			-0.04	-0.23	0.67		
Benefits-Local	0.21	0.06	-0.34	0.12	-0.04	-0.22	-0.02	0.04	-0.17	-0.28	**0.50**	0.14	-0.45	0.31	-0.19	-0.34	0.09	0.65	-0.16	-0.30
Depletion-Cost-Local	0.06	0.17	-0.42	-0.22	-0.16	-0.04	-0.29	0.07	0.00	0.11	0.06	0.35	0.01	-0.07	0.17	-0.05	0.08	0.19	0.50	0.10
Participant-Change						-0.08	-0.31	-0.25	-0.04	0.06	0.15	0.46	0.32	-0.24	-0.25	-0.29	-0.30	-0.01	-0.64	-0.33
Resource-Change	-0.08	-0.31	-0.25	-0.04	0.06						-0.03	**-0.56**	0.15	0.05	0.20	0.23	**0.52**	0.29	0.15	-0.11
Biotope-Change	0.15	0.46	0.32	-0.24	-0.25	-0.03	**-0.56**	0.15	0.05	0.20						**-0.52**	-0.17	0.30	0.24	0.03
Humans/km² (log)	-0.13	0.03	-0.28	-0.29	-0.02	-0.21	0.07	0.15	0.04	-0.13	**-0.58**	**-0.50**	0.30	0.00	**0.58**	**0.50**	0.16	0.23	-0.34	0.28

Among institutional aspects, the strongest combination of negative correlations across the matrix was for numbers of bird-hunters and anglers to decline where ownership was most community-based. Moreover, the only occurrence of negative coefficients across all five activities was for community management of biotopes. There were positive correlation coefficients across all activities only for biotope quality with horizontal social integration (with 5% significance for both hunting topics). This social factor was also strongly associated with maintaining numbers of hunters. In contrast, numbers of anglers declined where there was most vertical (top-down) social integration, and anglers were at low density where state ownership was prevalent, but vertical integration was also associated with a perception that fish stocks were being maintained. Management was most diverse where bird hunters were abundant, and biotopes quality was deemed highest where hunters reported a strong local role in management of ungulates.

Indicators of objectives and instruments did not correlate strongly with trends in resources or biotopes, although ungulate stocks were growing most strongly where there were most hunters, with government officials reporting most emphasis on economic management objectives where the number of hunters was decreasing. However, bird-hunter density was highest where government administrators emphasised social management objectives, with decline in numbers least where there was most growth in knowledge. Another contrast was for habitat quality to be considered worst for hunting but best for bird-watching where human population density was highest.

Multiple regression was used to focus on the dominant relationships among the correlations with the aggregated indicators in Table 1 and their components, with the analysis restricted to variables that gave a bivariate result significant at the 2% level. A step-wise procedure identified which variables related most significantly to the trends or participant density in regression equations, starting with the variable giving the most significant bivariate relationship. If a second variable was found to give an improvement at the 2% level, all other variables were tested to see if they could displace it. With tests based on 15-23 cases, only two variables were permitted with each trend or density variable.

In Table 3, central columns show the two measures that in combination gave the strongest association with the trend or density variables in the left-most column. Signs show the direction of the regression coefficient and the right-hand column gives the probability that the relationship occurred by chance. A single variable is shown if this statistical significance level was not enhanced by any combination of two variables. There were too few trend variable estimates for multivariate analysis in the case of fungi.

TABLE 3	**Sectoral**	**Socio-Economic**	**Socio-Economic**	***P***
increase in numbers of:				
Bird-Hunters	**-** Community ownership	**+** Knowledge generation		<0.001
Ungulate-Hunters		**+** Horizontal integration	**+** Benefit of limited-access	0.001
Anglers	**-** Community ownership	**-** Vertical integration		0.002
Bird-Watchers			**+** Biotope gain from hunting	0.001
increase in stocks for:				
Bird-hunting		**+** User prevalence	**+** Regulation awareness	0.003
Ungulate-hunting		**+** State-payment awareness	**+** Benefit of economics	<0.001
Angling		**+** Vertical integration		0.005
Bird-watching			**+** Benefit of regional laws	0.013
improving biotopes for:				
Bird-hunting		**-** Adaptive management	**-** % Population urbanised	0.003
Ungulate-hunting		**+** Use of local knowledge	**-** Benefit of licensing	<0.001
			- Population density	0.001
Angling			**+** Number of constraints	0.003
Bird-watching		**+** Volunteers in management	**+** Non-conservation laws	0.001
numbers per km² of:				
Bird-Hunters	**+** Mixed management	**+** Social objectives		<0.001
Ungulate-Hunters		**+** Local economic benefit	**+** Regional regulation benefit	<0.001
Anglers	**-** State ownership	**-** Vertical trust		<0.001
			+ % Population urbanised	<0.001
Bird-Watchers	**-** State management		**+** WB Governance quality	<0.001

Despite the strong significance of almost all these relationships, caution is necessary when interpreting them. One reason is that a positive correlation between two soft-data variables could result from opinion

bias, through optimistic respondents being more positive about resource trends and conservation benefit from particular factors. On that basis, relationships possibly resulting from opinion bias are those with horizontal integration, awareness of regulations and state payments, and benefits perceived from markets and legislation, including laws not aimed at conservation. However, negative correlation (i.e. dissonance between opinion and trend) would not result from opinion bias, nor should correlations with management information or third-party opinions (e.g. from government administrators). Great caution is also needed when considering cause and effect. For any association between variables, the arrow of causation can go from A to B, or from B to A, or from a third factor to both A and B without A being related to B at all.

Irrespective of these considerations, two broad findings are clear from Tables 2 and 3. One is that numbers of participants, and changes in their numbers, tended to associate more with sector-based management and ownership factors than did the trends in resource populations and biotopes. The other broad finding is difference across activities in the indicators and variables that were associated with trends in participants, resources and biotopes, and with participant density. This was not just a matter of local knowledge being important in one activity whereas local volunteer labour was more important for another, but of hunters tending to increase where social factors were positive whereas numbers of anglers declined, and of constraints on angling linking to improved fish biotopes while ungulate biotopes declined where licences were favoured. This makes it important to consider each activity separately.

1. Hunting Birds

Decline in number of bird-hunters was associated with high community ownership of land used for hunting and with low values of indicators for generation of knowledge and horizontal integration (Table 2). The most significant multiple regression combined the first two variables (Figure 1), with no significant improvement in the regression by including horizontal integration or any other variable.

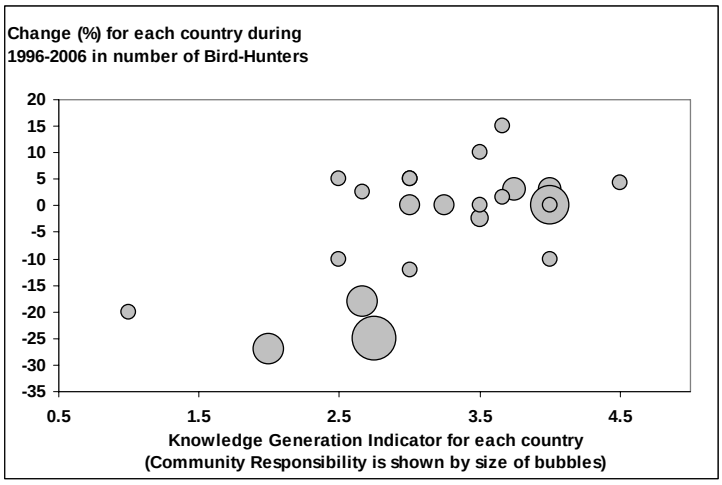


Figure 1. The percentage change in bird-hunter numbers (on the vertical axis) in relation to scores for conservation knowledge generation (from 0 for low to 4.5 for high, on the horizontal axis); size of bubbles indicates the proportion of hunting land in each country with community ownership.

Change in stocks of game-birds correlated at the 1% level only with the score given by hunting representatives for awareness of regulations by hunters in each country. However, there was a significant improvement if the regression also included the proportion of hunters in the population of each country. Game-bird stocks tended to increase in countries where hunters were deemed most aware of regulations and were most prevalent in the population (Figure 2).

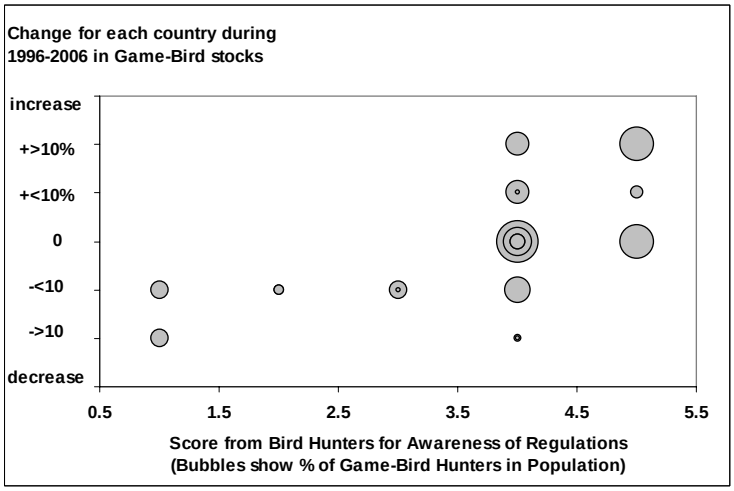


Figure 2. Recent change in game-bird stocks (2 for increase >10%, 1 for increase <10%, negative values for decreases, on the vertical axis) as assessed by hunting organizations, in relation to scores given by the organisations (on the horizontal axis) for awareness by bird-hunters of regulations (1=low to 5=high); size of bubbles indicates the proportion of bird-hunters in the population of each country.

The only relationships with game-bird biotopes at 2% significance were negative ones with human population density (Table 2) and urbanisation. The effect of urbanisation had a marginally significant improvement if the indicator for adaptive management was included in the regression (Figure 3).

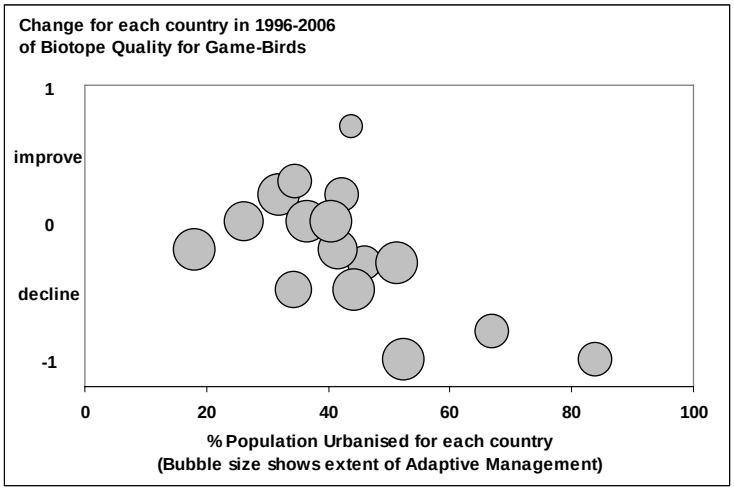


Figure 3. The assessment that hunting representatives made of change in biotope quality for game birds (from -1 for decline to +1 for improvement, on the vertical axis) in relation to World Bank data for urbanisation in each country (on the horizontal axis); small bubbles indicate lack of adaptive management, which was greatest where both species and biotopes were managed.

The number of bird-hunters per km^2 in 2006 was high where more sectors were involved in management of land used for hunting and social objectives were prioritised by government administrators (Figure 4).

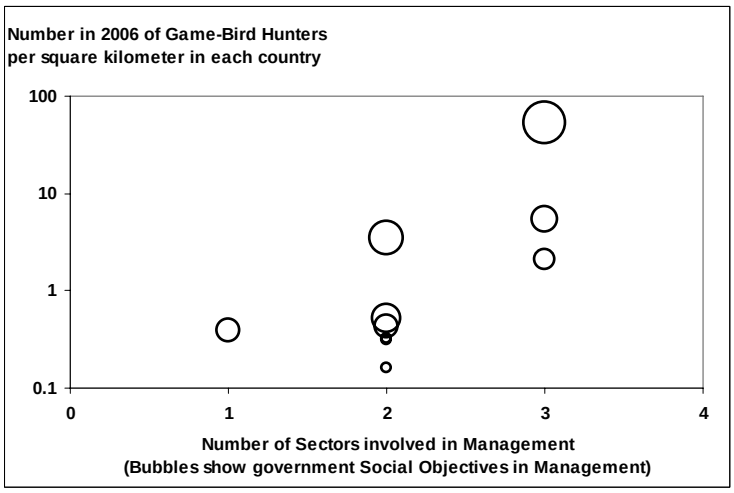


Figure 4. The density of bird-hunters in each country (on the vertical axis) in relation to the number of sectors (public, private, local community) thought to manage game birds (horizontal axis); the size of bubbles indicates the percentage of effort that government officers attributed to social objectives in their management of hunting.

The number of hunters in a country is the product of long-term effects and therefore probably reflects factors that also enabled diverse land management, while social objectives in management may well be a government response to hunter density. Similarly, poor biotope quality is probably ultimately a product of urbanisation (with the negative involvement of adaptive management probably spurious, due to one country claiming no management of game birds). That the increase in game birds was strongly linked to prevalence of hunters as well as awareness of regulations is an indication that responsible hunting may be beneficial for resource stocks. Except on small island states, where the density of bird-hunters exceeded 5 per square kilometre, the density was typically between 0.17 and 3.5 per square kilometre. At the higher densities, the average annual spend on their recreation of €2400 per hunter (as recorded in the first report from this survey[3]) gives them great potential to influence land use for conservation.

2. Hunting Ungulates

The factor most strongly related to change in number of ungulate-hunters was the conservation benefit perceived from access restrictions, with a marginally significant improvement provided by inclusion of horizontal integration. Numbers of ungulate hunters were increasing where most benefit was perceived

[3] GEM-CON-BIO Case Study Synthesis Report: Use Nationally of Wild Resources across Europe (UNWIRE). (Robert Kenward & Robin Sharp, 2007).

from access regulations and where the horizontal integration indicator was greatest (Figure 5, left). It is also worth noting that government officers recorded highest public perception of cost from biodiversity (F=8.35, n=15, P=0.013) where numbers of ungulate-hunters were declining most strongly (Fig. 5, right).

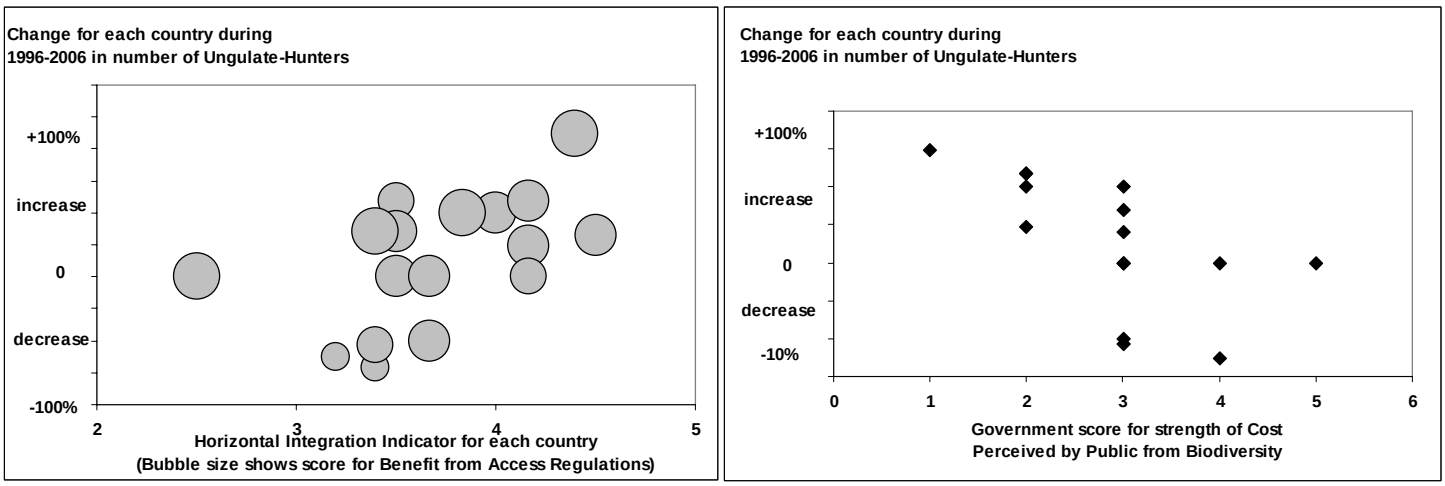


Figure 5. The percentage change in numbers of ungulate hunters (on the vertical axis) in relation to (left) aggregated horizontal integration scores and perception of conservation benefit from access regulations from hunting representatives, and in relation (right) to independent perception by government officers of the cost to society of biodiversity (from 1=low to 5=high).

Increases in ungulate populations were consistently linked to perception of conservation gain from economics. The strongest relationship was with conservation benefit perceived from state payments decreed at national level, and the regression was improved by including the score given by the hunting representatives for awareness of economic benefits (Figure 6). Ungulate numbers were increasing most strongly where economic payments were considered beneficial and there was most awareness of them.

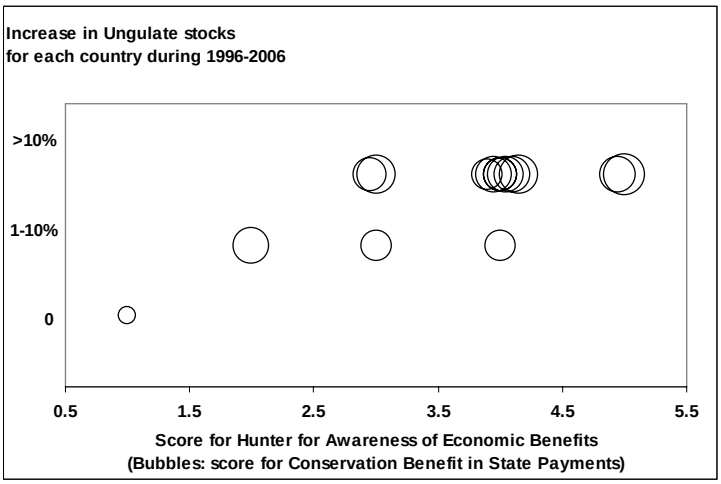
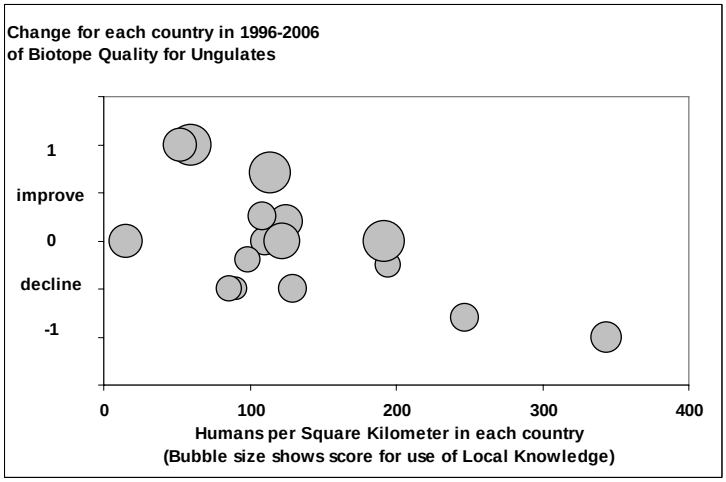


Figure 6. Recent increase in ungulate populations as assessed by hunting representatives (on the vertical axis), in relation to scores from the representatives (1=low to 5=high, on the horizontal axis) for awareness by ungulate-hunters of economic benefits; size of bubbles indicates a similar score for conservation benefit perceived from state payments agreed nationally.

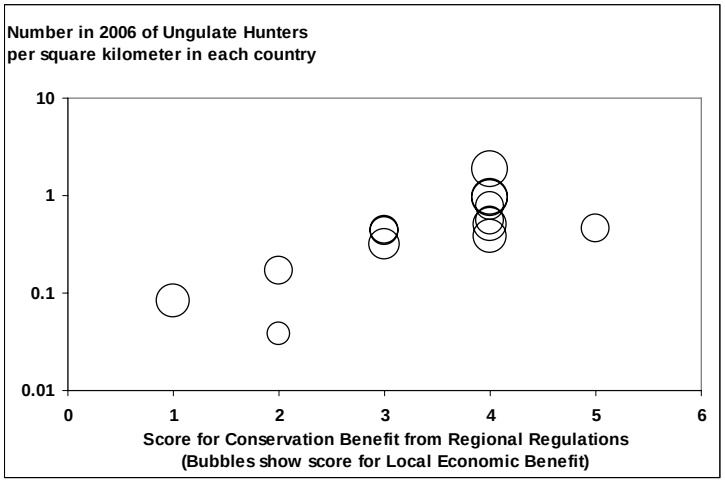
Decline in quality ungulate biotopes was most strongly related (negatively) as a single variable to market benefits, but also (positively) to use of local knowledge for management and (negatively) to human population density in each country (Table 2). The strongest combination of these two variables was an association of biotope decline with high human density and no use of local knowledge in management (Figure 7), with no further effect of markets. However, another strong combination was of local knowledge with conservation benefits perceived from licensing requirements (Table 3), to which relationship the human density would have contributed significantly if there had been enough data to justify including a third variable. Remarkably, approval of licences was associated with reporting of biotope decline.

Figure 7. The assessment that hunting representatives made of change in quality of biotopes used by ungulates (from -1 for decline to +1 for improvement) in relation to their perception of whether local knowledge was used for managing ungulates (bubble size) and the density of humans in each country (horizontal axis).



The strongest factor associated with a high density of hunters was approval by their representatives of regulations at regional level. Several economic variables significantly improved the regression (with the logarithm of density), of which the strongest was the score for conservation benefit from local economic measures, although there were only 14 cases with both variables (Figure 8).

Figure 8. The density of ungulate-hunters in each country (on the vertical axis) in relation to the score that their representatives gave (1=low, 5=high) for conservation benefit from regionally implemented regulations on ungulate-hunting (horizontal axis); the size of bubbles indicates the score given by the same representatives for conservation benefit from economic instruments implemented locally.



Those hunting ungulates were recorded as less abundant than bird-hunters in 6 states and more abundant in 5, with 12 other states recording the same number hunting both types of game. However, factors associated with trends in numbers and resources differed considerably for the two types of hunting. Thus, numbers of ungulate hunters were not related to land ownership but to approval of their representatives of regulations and economic factors, and growth in resource abundance. Decline in their numbers was associated with poor social relations, disapproval of access regulations (and perception by government of cost from biodiversity) rather than communal land management. Increase in ungulate stocks was associated with awareness and approval of state financial benefits, whereas it was awareness of regulations that correlated most significantly with increase in stocks of game birds. Biotope decline was associated with abundance of ungulates (Table 2), although this effect was lost when abundance of humans and use of local management knowledge was taken into account (equivalent to decline in game-bird biotopes with urbanisation and management for the system rather than the species).

An interpretation of these findings comes from the understanding that, in the absence of large carnivores in most of Europe, large ungulate populations have adverse impacts on crops and habitats in general. On that basis, the UNWIRE results are entirely consistent with a scenario in which, if hunter numbers decline (as a result of poor social relations) and local knowledge is little used for management, governments are obliged to spend more on controlling deer themselves. This reaches an extreme in one EU state, where recreational hunting of deer is not allowed but large numbers of people are permitted to manage deer.

3. Angling

The strongest single factor associated with change in number of anglers was vertical integration, with a small increase in significance if ownership variables were also included. Decrease in numbers of anglers was associated with high vertical integration scores and high community ownership (Figure 9, left). There

were also strong relationships for ownership diversity and vertical integration with perceived improvement of fish stocks (Table 2). However, these variables were highly inter-correlated and ownership did not improve the strength of the relationship with vertical integration (Figure 9, right).

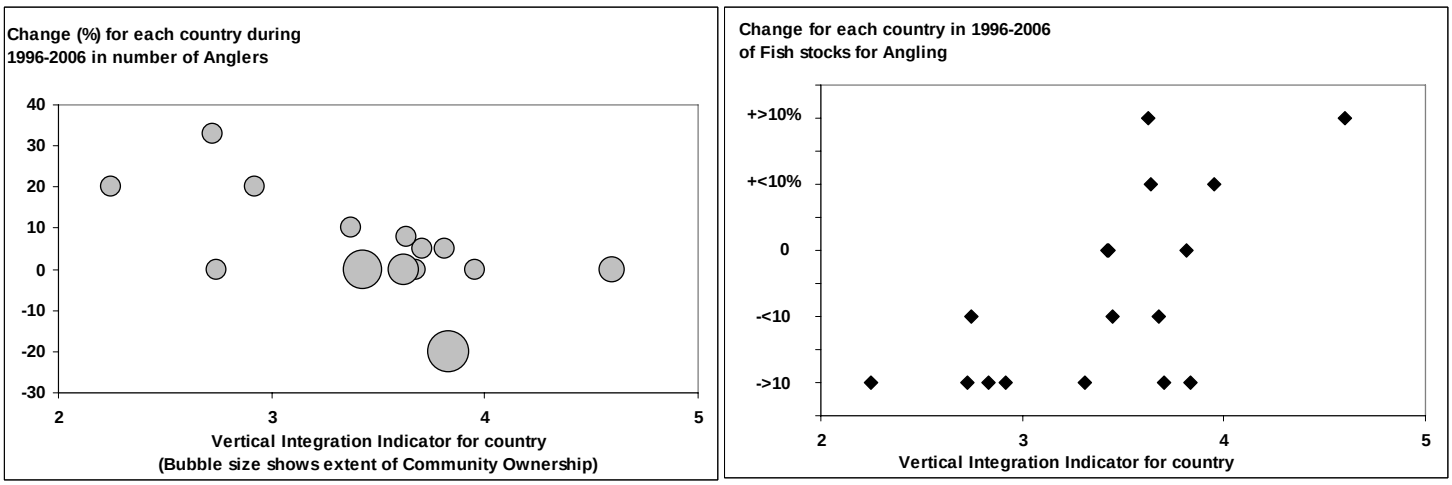
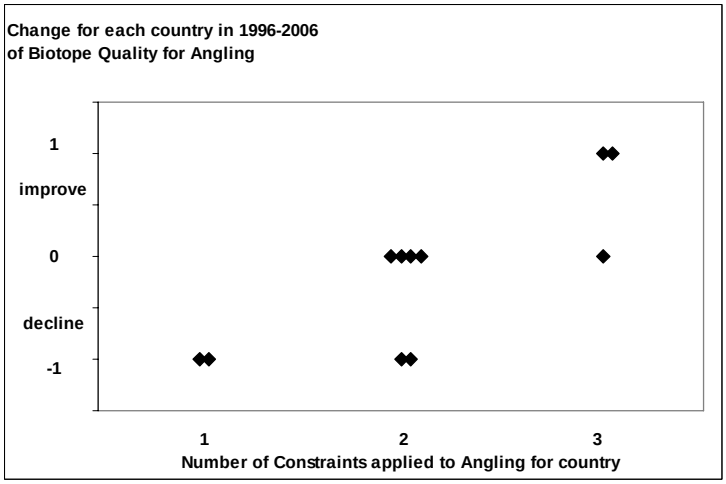


Figure 9. The percentage change, in both cases on the vertical axis, in (left) numbers of anglers and (right) fish stocks (2 for increase >10%, 1 for increase <10%, negative values for decreases) in relation to aggregated vertical integration scores (on the horizontal axis, with bubble size on left showing extent of community ownership of water resources).

A perception of improvement in biotope quality in countries where there were most constraints on angling (Figure 10) was also not affected by inclusion of any other variables. However, a tendency for the density of anglers to be lowest where there was most state ownership of water was made marginally worse where there was lack of vertical trust (Figure 11).

Figure 10. The assessment made by angling representatives of change in quality of biotopes (from -1 for decline to +1 for improvement) in relation to the presence of constraints (on the (horizontal axis) on access, quotas or close seasons in each country.



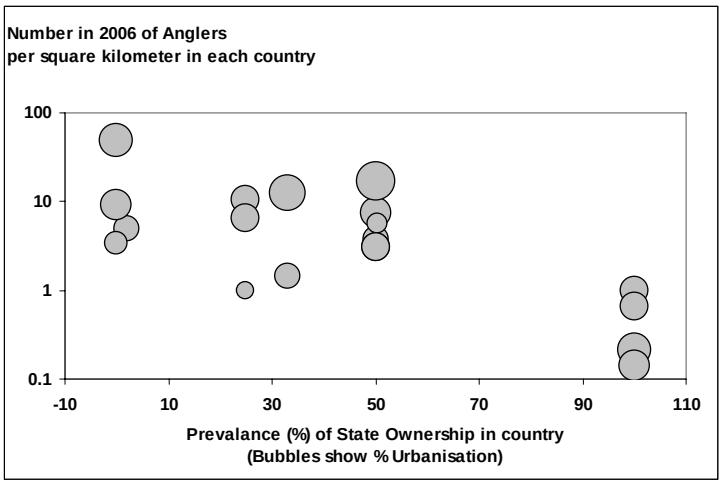


Figure 11. The density of anglers in each country (on the vertical axis) in relation to the prevalence of state ownership of water bodies (on the horizontal axis); the size of bubbles indicates urbanisation of the population in each country as estimated by the World Bank.

Numbers of anglers reached 48 per square kilometre in one state, although densities of 1-12 per square kilometre were more typical. With average spending of €500-770 per participant estimated in the first report from this survey[3], they can be an important economic resource for conservation. Their densities

are lowest where state ownership of water is extensive (and are not reduced by urbanisation), with decline in numbers linked to high top-down control (vertical integration) plus community ownership. On the other hand, fish stocks apparently benefit from vertical integration and biotope improvement is associated with increased constraints on angling. However, high state involvement was not benefiting fish stocks as a result of reduction in angling, because the relationship between change in fish stocks and angler density was positive. At high angler densities, a major constraint on angling is that fish are typically caught and released rather than consumed. Thus the relationship between constraints on anglers and biotope improvements may have reflected long-term benefit for biotopes where angling has become highly organised. If so, low numbers of anglers where there was high state ownership of water resources may not be a benefit to conservation of biodiversity.

4. Collecting Fungi

The analysis was strongly affected by a dichotomy in prevalence of using this wild resource. Respondent countries fell into categories of those in which less than 1% of the population collected fungi and those mostly in the north and east of Europe where 8-80% were estimated to collect fungi (Figure 12).

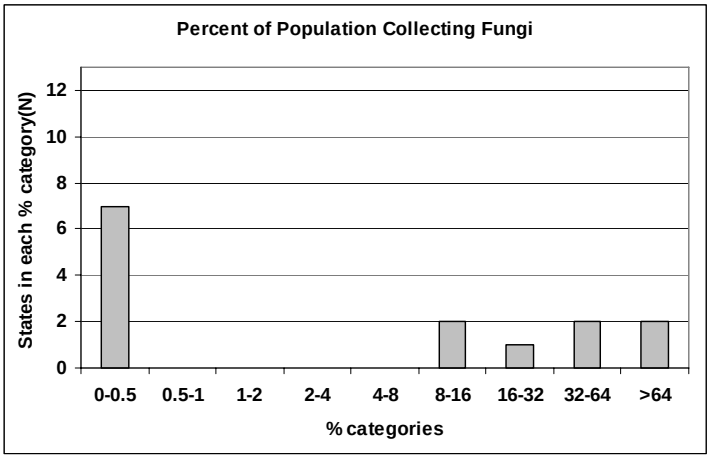


Figure 12. The number of respondent countries (on the vertical axis) summed according to the percentages of their populations (on the horizontal axis) that collected fungi.

This effect was even stronger for the density of people collecting fungi. Countries with more than 3 citizens collecting per square kilometre were all in eastern states that had recently joined the EU; this resulted in density of foragers correlating with a number of factors, including World Bank indices (especially strongly with Voice and Accountability) that reflected differences between two groups of countries with different cultures, rather than broad trends. Another corollary of this bimodal effect was a relationship between percentage of participants in the population and the score given by mycologists for their awareness of economic opportunities (Figure 13). There was a tendency for participants in long-standing EU member states to be more prevalent where there was high awareness of marketing opportunities, but for low awareness of economic opportunity in new states (indicated by low Voice and Accountability scores) where a high proportion of the population collected fungi.

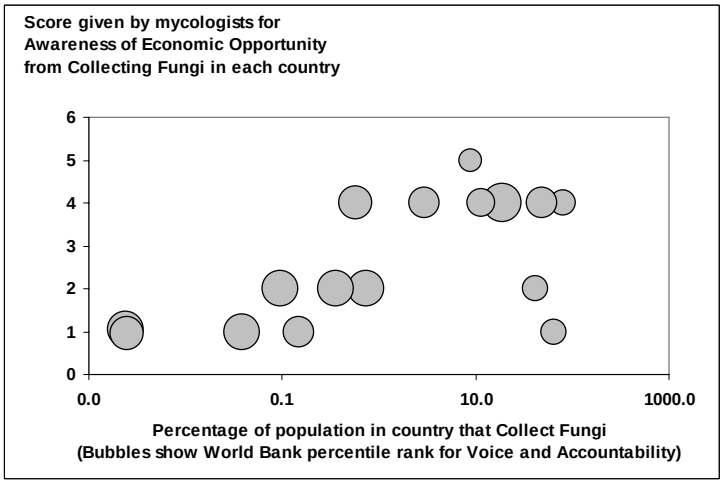


Figure 13. The attribution by mycologists of awareness of economic opportunity from collecting fungi (vertical axis) in relation to the proportion of the population in each country that collected fungi (horizontal scale), with small bubbles showing eastern states that recently joined the European Union.

Only 10 countries assessed change in numbers of people collecting fungi in the last decade; among four countries registering increase, in only one case was this based on data and in two others it apparently depended on immigration from the east. Relatively poor recording of economic assessments other than awareness scores, and lack of regulation, meant that there were too few data also for detection of significant relationships with estimates of change in fungal resources (Table 2). Similarly, although there was a tendency for biotope quality to be assessed most negatively where land for collecting fungi was most diverse (Table 2) and there was little mycological leadership (Figure 14), there were too few data for this result to indicate more than a need for more socio-economic study of collecting fungi.

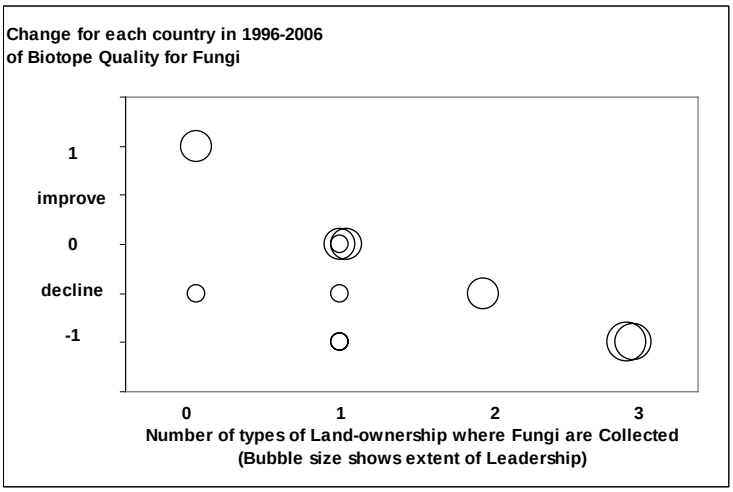


Figure 14. The assessment that mycologists made of change in biotope quality for fungi (from -1 for decline to +1 for improvement, vertical axis) in relation to the number of ownership types (public, private, community, none) for land where fungi were collected (horizontal axis) and an indicator of the strength of leadership (bubble size).

In two states the number of collectors was estimated at 85-89 per square kilometre. In neither state were the fungal resources assessed as declining, and the relationship between collector density and resource trends was positive overall (Table 2). This is in agreement with a recent long-term study in Switzerland that found no adverse impact of harvesting provided that extensive trampling was avoided[4]. The main factors associated with collection of fungi seem to be cultural and perhaps also economic, although it is worth noting that harvesting fungi was strongly discouraged by regulations in two of the respondent states. Data for spending on collecting fungi came from only three states and were mostly for transport costs. However, with the association of fungi with diverse woodlands and unimproved pasture, the potential for conservation from interest in collecting fungi is clearly very large, if it can be tapped.

5. Watching Birds

The single largest factor associated with gain in numbers of bird watchers was the extent to which bird-watching representatives perceived hunting as a benefit for bird habitats (Figure 15). Absence of state ownership gave a significant improvement (P<0.001), but only 12 countries recorded both variables.

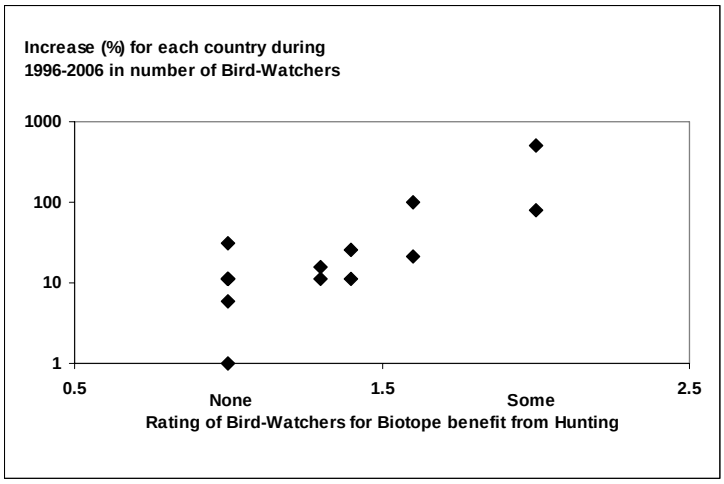


Figure 15. The percentage change in numbers of bird-watchers (on the vertical axis) in relation to scoring by their representatives of benefit to bird biotopes from hunting (on the horizontal axis).

[4] Egli, S., Peter, M., Buser, C., Stahel, W. & Ayer, F. 2006. Mushroom picking does not impair future harvests – results of a long-term study in Switzerland. Biological Conservation 129:271-6

The only variable that related singly to the pooled estimate of general bird populations (a rather imprecise indicator) at the 2% level was the pressure of laws implemented regionally; this regression was not improved by inclusion of any other variable. The strongest relationship with assessment of biotope quality for birds was with recent change in governance due to the European Union, with scores least positive where there was a perception of biotope decline. However, another highly significant association was with the use of volunteer labour for management, and this combined with perception of the effects from non-conservation instruments (CAP, the Food Hygiene Directive) to give the most significant (albeit relatively weak) association with assessments of recent change in biotopes (Figure 16).

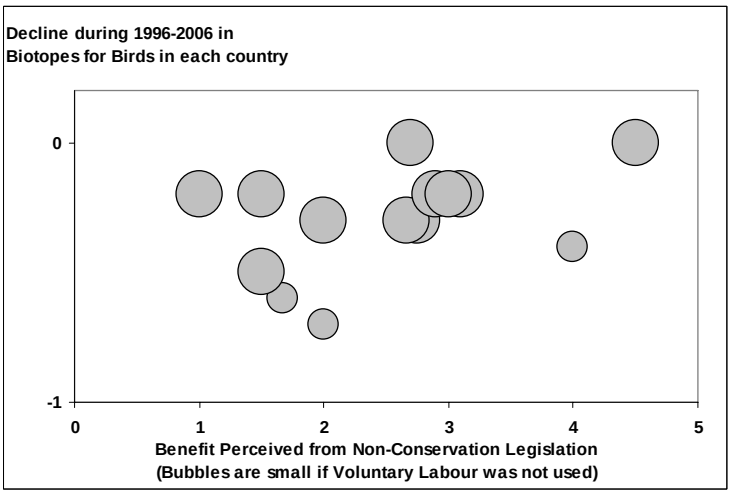


Figure 16. The assessment made by bird-watching representatives of change in quality of biotopes (from -1 for decline to 0 for no change) averaged across taxa (on the horizontal axis) in relation to effects of non-conservation legislation (1=strong hindrance, 5=strong benefit); bubbles are small if no voluntary labour was used.

The density of bird-watchers correlated strongly ($P<0.02$) with a number of World Bank indices, including per capita income, 'Voice and Accountability", "Regulatory Quality", "Rule of Law" and "Control of Corruption", but most strongly with the percentile ranking for Government Effectiveness. This relationship was improved by inclusion of the percentage of state management of wild birds, such that bird watchers were densest where government quality was high and there was least state management of wild birds (Figure 17). Emphasis on social objectives for managing birds would have entered as a significant effect if data from more states had permitted its inclusion.

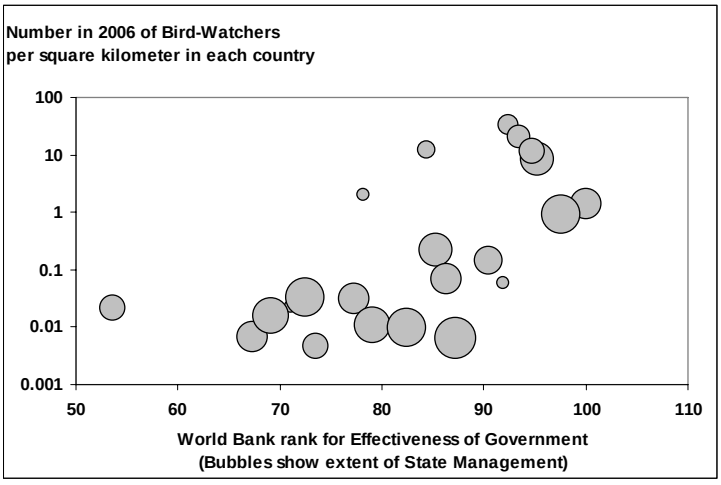


Figure 17. The density of bird-watchers in each country (on the vertical axis) in relation to the World Bank index of Government Effectiveness (on the horizontal scale); bubble size indicates the prevalence of state management of wild bird populations.

As with the collection of fungi, prevalence of bird-watching was highly variable across European states. Whereas four states estimated no more than 1 bird-watcher per 100 square kilometres, four states at the other extreme estimated more than 10 per square kilometre. Although the density of bird-watchers was highest in states with most effective government and largest incomes, it is not clear whether the association with state management was due to inhibition of bird-watching where the state takes much responsibility or to replacement of state management when there are many bird-watchers.

The association of perceptions that bird populations increase where land is privately managed and laws strong, and of perceptions that biotopes decline most where CAP and Food directives are deemed most damaging were not strong and may reflect observer bias. However, the relationship between assessment of growth in bird-watching and a more positive attitude to the role of hunting in bird conservation was so strong that it displaced all other associations except state management of land in the regression equations, which indicates that it was probably not merely a result of observer bias. It seems that bird-watching really benefits where there is a positive attitude to other uses of wild resources.

Section III. Findings across the 6 activities

The overall trends in surveyed states (Table 2) gave some strong correlations across activities. Two of the strongest (P<0.002) were for association between regulations and decline in participation (Figure 18).

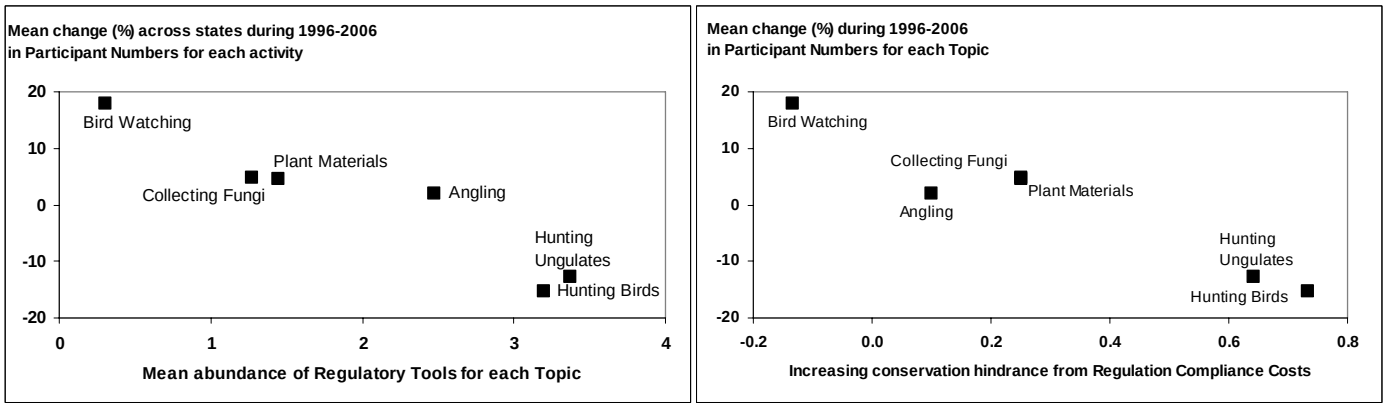


Figure 18. Trends in participant numbers, averaged across states for each activity, in relation to abundance of regulatory tools (left) and perception of hindrance from costs of compliance (right).

There were no strongly significant correlations across activities for trends in resources. However, there were several significant relationships (P<0.02) in which activities with most favourable assessment of biotope quality were given highest scores for awareness and appreciation of economic opportunities, especially at local level. Assessments of biotope quality by representatives for each activity were also most negative when there was least generation of knowledge (Figure 19).

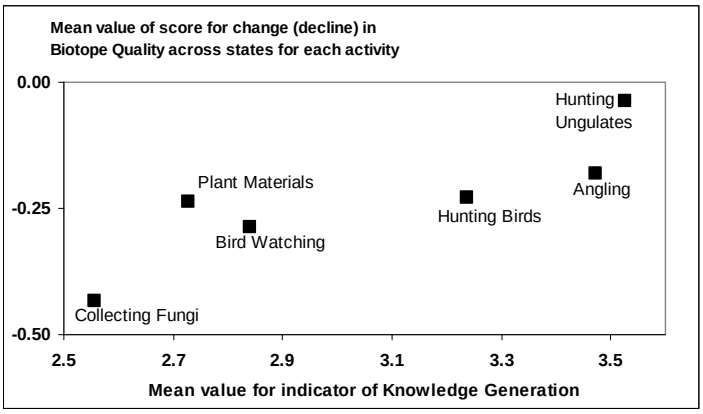


Figure 19. The trends in biotope quality perceived by representative organisations, averaged across states for each activity, in relation to the aggregated indicator of knowledge generation.

Thus, although a beneficial perception of regulations by both hunters and bird-watchers was associated with improving bird populations and abundance of ungulate hunters (Table 3), when viewed across activities both the number of regulations and perception of hindrance for conservation from complying with them were associated with decline in numbers of participants. Similarly, although a mixture of sectors with responsibility for management was positive for density of participants in each of the six activities, with strong significance for game birds (Table 3), when viewed across activities the density of participants was lowest for activities most dependent on mixed ownership (Figure 20). At the same time, biotope decline was associated with low appreciation of financial benefit from resources and lack of knowledge generation. The causality of such relationships deserves further consideration. It seems more likely that regulation induces decline in participation than vice versa, but social factors may drive both rules and participation. Evidence linking biotope decline to ignorance is seductive, but it is less easy to explain why activities with low participation were most associated with mixed ownership of land.

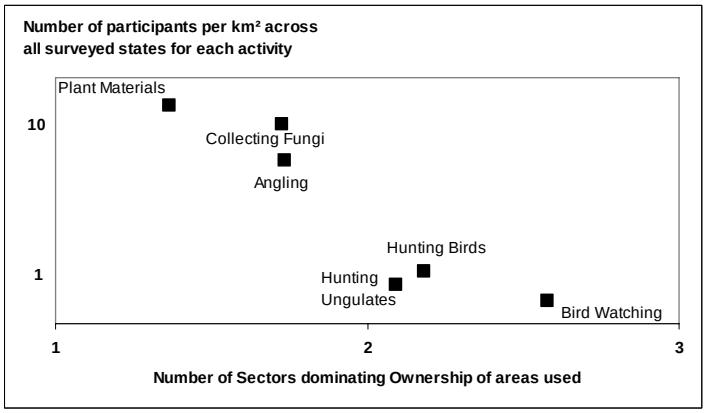


Figure 20. The number of participants/km^2, averaged across EU states for each activity, in relation to the average number of ownership categories (public, private or community) of land used for the activity.

Another interesting finding from analysis across activities concerned differences in perception of benefit when regulatory and economic measures were implemented at local or higher levels. We tested whether scores for benefit to conservation were more positive at national or local level with data for 1-3 questions across the 6 activities, which gave 6-18 comparisons in each case (Figure 21).

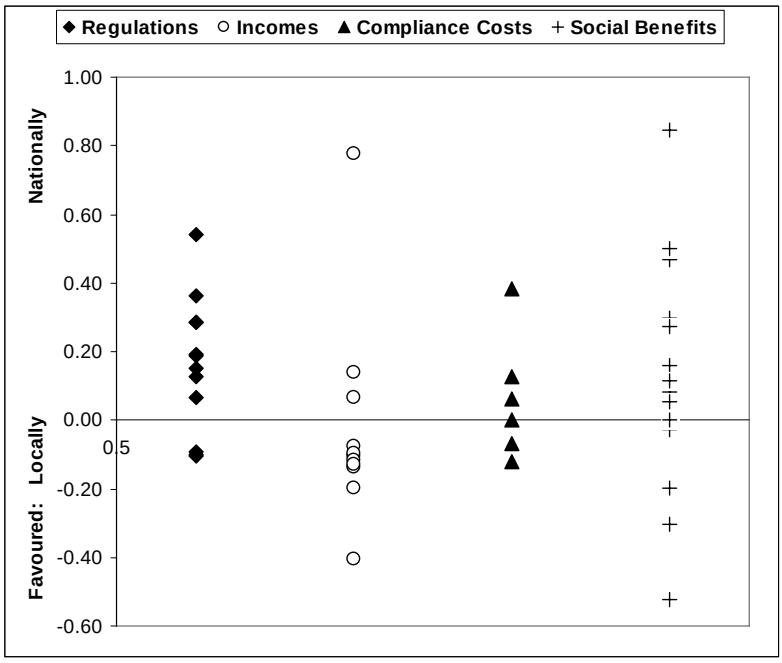


Figure 21. Each point represents the difference in value of a conservation benefit score at national and at local level for one activity, for two categories of regulation (laws, other constraints) and income factors (markets, state payment), compliance costs and social benefits (benefits of fashion, participation and trust). Values are positive (above the line) where benefit scores were larger at national than at local level.

Benefits of regulations were perceived to be greatest if implemented at national level (sign-rank test with N=12, P<0.05), whereas for variables affecting incomes the effects were stronger if implemented locally (N=11, P=0.015). Social factors and costs of compliance with regulations were not significantly dependent on scale.

Finally, it is worth considering in more detail the total numbers participating in the use of provisioning and cultural services from ecosystems across the European Union, together with their densities and scope for benefit to ecosystems from the funds they deploy and could deploy in future. The total EU participants in each activity were estimated by grossing up the sum of participant estimates in surveyed countries, using the sum of citizens recorded by World Bank for the countries and the total EU population of 490 million. The estimate for numbers of hunters used a sum of 5.3 million bird-hunters from the 25 states in the survey, with data for two other states and numbers of other hunters[5], to give a total 6.6 million hunters of all types. Similarly, inclusion of data from four more states[6] confirmed an estimate of 24 million anglers (for *94%* of the EU population surveyed). Participant densities and spend were estimated by summing numbers and expenditure for all populations and areas of the countries that provided data.

Table 4 includes ranges of values as deciles (excluding the highest and lowest 10% of values) in round brackets. Estimates should be fairly reliable (and show in **bold**) for hunting, angling and bird-watching, for which data on 81-100% of the EU population were available, but unreliable *[shown in square brackets and italicised]* for collecting fungi (42% surveyed) and especially for use of plants (6.5%). There were only 3-5 estimates of spending for collecting fungi, gathering plant products and watching birds, with bimodal distributions of participant prevalence (e.g. Figure 12) hindering estimation of total numbers in the EU.

TABLE 4 **Participant density & annual spend**	Percent of EU population in survey	EU participants (grossed up, millions)	**Across all surveyed states:**	
			Participant density (number per km^2)	Annual spend per participant (€1000)
Hunting Birds	**96-100**	**6.6**	**1.1 (0.2-3.5)**	**2.9 (0.9-3.4)**
Hunting Ungulates			**0.9 (0.2-1.7)**	**2.2 (0.7-2.5)**
Angling	**64-94**	**24**	**5.8 (0.7-12)**	**0.65 (0.2-1.4)**
Collecting: Fungi	**42**	*[45]*	*[10 (0.1-47)]*	*[0.26 (0.03-0.50)]*
Plant Products	**6.5**	*[135]*	*[13 (0.3-70)]*	*[0.11 (0.01-0.24)]*
Bird-Watching	**81**	**6.2**	**0.7 (0.01-12)**	1.3 (0.07-3.1)

[5] FACE. 2007. Annual report 2006-7. Federation of Associations for Hunting & Conservation of the EU, Brussels

[6] Pawson, M.G., Tingley, D., Padda, G. & Glenn, H. 2006. Final report on EU contract FISH/2004/011 "Sport Fisheries" (or Marine Recreational Fisheries) in the EU. European Commission Directorate-General for Fisheries

It seems that there are currently similar numbers of hunters and bird-watchers in the European Union, with four times more anglers than for either, and that perhaps a quarter of the 490 million EU citizens gather fungi and plant products. However, the decile range of 470-fold to 12-thousand-fold in density for collecting fungi and watching birds indicates very considerable scope to develop participation in some countries (and hence spending) through bird-watching and collecting fungi. The estimates of spend per person provided by 14 countries for hunting and 10 for angling were within an order of magnitude in each case. However, the three each for collecting fungi and plants were too few to be reliable and the five for bird-watching were perhaps influenced by data available from ornitho-tourism abroad (which was especially strong in two countries) rather than local feeding and watching of garden birds.

With 6.6 million hunters in the EU, each spending an average €2400 annually, hunters are spending more than €16 billion in Europe annually. With comparable estimates for angling (€19 billion) and bird-watching (€8 billion), total annual spending on these three activities should be at least €40 billion euros across Europe as a whole. In comparison, annual spending on these three activities was 108 billion dollars for the USA in 2001[7], income from all wildlife-related activities was 7.2 billion euros for UK[8] and spend on angling alone was 5.2 billion Euros in Germany[9]. With large preliminary values for the EU (possibly low for angling), it seems important to gain reliable estimates for the economy of this sector, how it may best be used to promote conservation and indicators for that process.

Conclusions from the survey

1. There are 6.6 million hunters in the EU, about 6 million bird-watchers and 24 million anglers, with possibly many more collecting fungi and wild plant products, albeit perhaps more intermittently than for hunting, angling and bird-watching. Hunter numbers declined by 12-15% during 1996-2006, but the survey suggests that participation in other activities increased, by up to 17% (for bird-watching).
2. Annual spending by hunters, anglers and bird-watchers in Europe probably exceeds €40 billion.
3. Institutional factors, management objectives and governance instruments were associated with trends in participation, resources and biotopes in ways that differed between activities. Numbers of hunters, anglers and bird-watchers were weakest in countries with a dominance of community or state ownership or management. Bird populations declined least where private ownership predominated.
.4. Biotopes in general, and numbers of hunters, declined most in countries with weak horizontal integration. Biotope quality was considered least degraded in countries with management based on local knowledge for ungulates and local volunteers for birds. Fish stocks appeared strong in countries with best vertical social integration. Bird-watching increased most strongly in countries where its representatives saw most benefit for biotopes from hunting.
5. Declines in wild resources or biotopes appeared to be unrelated to increasing use of the resource (as indicated by increasing participation). Density of those collecting fungi exceeded 80/km^2 in two eastern states without declines in resources being noted, and game-bird stocks had increased in countries with high hunter density and awareness of regulations.
6. Regulations were seen to be important. Ungulate hunting was strong where its officials had positive attitudes to regulations, especially on access. Hunters and bird-watchers estimated least decline in bird populations where there were good regulations and fish biotopes were deemed best where there were many constraints on angling.
7. Economic factors were also seen to be important. Perception by state officials of costs from wildlife was greatest where ungulate-hunting was in decline, perhaps because countries in which biotope quality declined also appeared to experience increases in ungulate stocks. In countries with growth of ungulate stocks, there was also increased awareness of financial instruments and of benefit from state payments.
8. There was preference for regulations at national level but local implementation of financial incentives: "national sticks but local carrots". Across activities, decline in biotope quality was observed in countries

[7] USDI & USDC. 2002. 2001 National survey of fishing, hunting and wildlife-associated recreation. United States Department of the Interior Fish and Wildlife Service and US Department of Commerce – US Census Bureau
[8] IUCN-UK & ESUSG. 2004. Wealth from the Wild: a Review of the use of wild living resources in the United Kingdom. UK Committee of the IUCN (the World Conservation Union) and European Sustainable Use Specialist Group of IUCN/SSC
[9] Arlinghaus, R. 2004. Angelfischerei in Deutschland - eine soziale und ökonomische Analyse. Berichte des IGB 18:1-160

with little generation of knowledge or appreciation of financial opportunities, while declining participation correlated with presence of many regulations and costs of complying with them.

Considerations for further research and policy

The UNWIRE survey has produced a wealth of data for individual EU states, much of which could not be set out in the foregoing report due to space considerations. It has also identified some serious data gaps, especially relating to the use of fungi and wild plants. Thirdly it has suggested interesting connections between governance factors, resource and ecosystem health and participation trends. All of these areas merit further work. Simple questions in regular omnibus surveys could be a relatively low-cost approach for estimation of participation levels, especially if combined with systematic organisation-based survey to estimate value from direct spending and voluntary work. Although direct spending may be most important for livelihoods, it is important also to know what can encourage the considerable added value of voluntary efforts, which range from informally monitoring biodiversity and pollution to the restoration of habitats.

Through Directives and the Natura 2000 initiative, the EU has focussed in recent decades on protection of species and habitats. In the meantime, other EU instruments have resulted in rapid and severe change to ecosystems (with CAP and Structural Funds attracting repeated adverse comment in responses to the survey). In terms of administration, protection is a relatively simple issue compared to the socio-economic governance and ecological management needed for multi-functional use of land and ecosystems, to encompass recreation that requires (and hence sustains) biodiversity as well as for crop production. This survey indicates that local implementation of economic measures and other use of local knowledge, as well as high level regulation that is simple and non-burdensome, is probably needed for effective conservation of wild species and the ecosystems that support them. The results provide quantitative support for recent commitments of parties to the Convention on Biological Diversity[10].

Moreover, with many millions of EU citizens spending billions of Euros on use of wild living resources, opportunity exists for EU policy to enhance conservation through sustainable use. Sustainable use of biodiversity provides benefits to local populations, without decreasing resources or biotope quality. Indeed, those who use biodiversity have a strong incentive to maintain habitats which are wildlife-friendly. A particular challenge must be to see how the numbers of participants and their spending on use of wild resources can be used maximally for conservation, notably in countries where collecting vegetal resources and bird-watching are (by comparison with other states) well below the capacity of the resources and especially if insufficient hunting of ungulates harms ecosystems. For instance, how can balance best be achieved between the benefits of regulations and the cost of compliance with them? How can economic tools be made most cost-effective for conservation?

Further comparative analyses could help develop governance structures for conservation from use of wild resources. An initial aim could be to discover where sustainable use provides effective examples towards good governance and conservation of natural resources. Then, they would aim at understanding the circumstances where governance could be improved, and guide policy makers into achieving such improvements. They would need more and better data, which are also needed to confirm relationships suggested by this study and to explain their causality. Particular questions include how the EU has affected land-ownership patterns, and whether this has benefited some activities through decreased state ownership. Also, in view of links between resource or biotope benefit and local knowledge or voluntary efforts, why is community ownership linked to declining participation in use of wild resources?

For governance of conservation through use, we conclude that social, economics and ecological factors must be considered together, at local as well as at national level, taking account of varying governance impacts between different activities. In modern societies, use of ecosystems for productive and cultural services, such as recreational use of biodiversity, involves complex and ever-changing socio-economic

[10] *Malawi Principles for the Ecosystem Approach* (CBD V/6, CBD VII/11)
http://www.biodiv.org/doc/meetings/cop/cop-04/information/cop-04-inf-09-en.pdf
Addis Ababa Principles and Guidelines for the Sustainable Use of Biodiversity (CBD VII/12)
http://www.biodiv.org/doc/publications/addis-gdl-en.pdf

conditions. These conditions add to the complexity of managing biodiversity and maintaining support and regulation services from ecosystems. We need adaptive governance as well as adaptive ecological management, and perhaps Governance Impact Assessment and Strategic Governance Assessment to complement Environmental Impact Assessment and Strategic Environmental Assessment.

It is conceivable that the monitoring of socio-economic and ecological indicators necessary for adaptive governance and management could occur best through a single system to link central strategic overview with local monitoring of ecological and socio-economic impacts. Indeed, it is conceivable that only a single integrated system could handle the complexity of gathering knowledge and supporting decisions at all levels, including the myriad daily decisions by individuals that summate to change ecosystems. A system to monitor governance factors in conjunction with impacts could also be used for deliberate variation of governance to test experimentally for cause-and-effect.

The strength of associations with social factors was noteworthy, including the tendency for bird-watching to grow where respondents showed most recognition of benefit from hunting. In view of the high potential for growth of bird-watching to contribute to conservation spending across Europe, governance instruments to promote conciliation between different interests in wildlife seem highly appropriate. These include the European Commission's Sustainable Hunting Initiative, with a Memorandum of Understanding between Birdlife International and the Federation of Associations for Hunting and Conservation of the European Union co-signed by the Commissioner for the Environment[11], and the recent Bern Convention Charter for Hunting and Conservation[12]. Conservation of biodiversity should benefit from further measures to promote cooperation and maximise conservation gain from recreational spending on all uses of wildlife.

As well as many government departments and non-government organisation at national level who filled in the questionnaires, we received additional help from the Federation of Associations for Hunting and Conservation of the European Union, the International Council for Game and Wildlife Conservation, the European Anglers Alliance, the European Council for Conservation of Fungi, several partners of BirdLife International and members of Planta Europa. We are very grateful to all of them.

[11] http://ec.europa.eu/environment/nature/conservation/wildbirds/hunting/docs/agreement_en.pdf
[12] http://www.coe.int/t/dg4/cultureheritage/conventions/Bern/Recommendations/tpvs07erev_2007.pdf