

Local residents' perceptions of floodplain restoration measures in Luxembourg's Syr Valley

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ARTICLE INFO

Article history:

Received 13 June 2008

Received in revised form 7 April 2009

Accepted 27 May 2009

Available online 26 June 2009

Keywords:

Grazing
Human dimension
Landscape planning
Public preferences
River restoration
Wetlands

ABSTRACT

The need for the restoration of semi-natural floodplain-river systems in Europe is widely recognised, and is currently a major task facing those responsible for conservation policy and water management. However, the long-term success of restoration measures and subsequent floodplain management depends largely on their cultural sustainability, which is related to perceptions of the resultant land use changes. In this study, residents of three communities adjacent to a floodplain restoration project in the Syr Valley (Luxembourg) were surveyed on their perception of the threat to floodplains, and their attitudes towards the restoration measures applied. The restoration involved the relocation of the River Syr into the valley bottom and the installation of a low-intensity grazing system. Although local residents did not perceive the floodplains of Luxembourg to be threatened on the whole, a large majority wanted to see more natural and healthy floodplain ecosystems and sought the implementation of eco-agricultural practices in future floodplain landscapes. Support for river restoration and low-intensity grazing was high, and support for their specific implementation to restore the Syr floodplain even greater. The direction of opinions could be predicted on the basis of basic beliefs, lifestyle concept and environmental behaviour, whereas socio-demographic variables were only of minor importance. These results suggested that the mimicking of past floodplain landscapes was viewed positively by the public, but to guarantee its long-term cultural sustainability landscape planners should direct their information and participation efforts actively towards different lifestyle groups.

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1. Introduction

"Societies interpret their environment according to the way they manage it, and they manage their environment according to the way they interpret it" (Berque et al., 1994).

Including the human dimensions in restoration efforts and in landscape management is vital in Europe, because the sustainability and the survival of the resulting 'new landscapes' in the evolved cultural context depend to a large extent on public support (Connelly et al., 2002). The term 'human dimensions' covers the range of perceptions and attitudes of people in regard to topics such as ecological restoration and landscape planning, and includes aspects of management, aesthetics, naturalness, cleanliness and health, and recreational uses (Gobster, 2001; Gobster and Westphal, 2004). Restoring the ecological value of certain areas has the potential to provoke greater controversy than the setting aside of near pristine habitats (Jackson, 1992). These observations would appear to be particularly true for the restoration and rehabilita-

tion of floodplains and their wetlands. Riparian landscapes may be considered the oldest cultural landscapes in Europe, but also one of the most severely impacted upon by human interventions (Konold, 2005). These interventions have been motivated by agricultural production, but also by protective and sanitary motives. Over recent centuries this economically and socio-culturally driven development has intensified, leading to a deterioration of biodiversity and ecosystem functions in floodplain landscapes (Tockner and Stanford, 2002). Consequently, the restoration of floodplain habitats and the rehabilitation of key ecosystem functions is now a major focus of European environmental policy and science (Middleton, 1999; SER, 2004).

Cultural landscapes require restoration goals that integrate biological and cultural diversity with landscape heterogeneity, health and integrity, and must lead to a restoration of ecosystem services rather than a reconstruction of certain pristine states (Konold, 2007). The final decision on restoration goals, and the long-term approval of the resultant development of the landscape, is subject to public debate and is greatly influenced by emotional and aesthetic factors (Pfadenhauer, 2001). This public discussion is central to overcoming the main obstacles to restoration, namely finances, land availability and the motivations of those who own and value riparian open spaces (Bright et al., 2002; Rispoli and Hambler, 1999).

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The implementation of floodplain restoration in peri-urban areas in particular, where complex land use interests have evolved (Antrop, 2004; Hale and Adams, 2007), requires that the commitment of stakeholders and the general public be maintained by means of appropriate and lasting human management; its 'cultural sustainability' must be ensured (Nassauer, 1997).

In spite of the importance of cultural sustainability in floodplain restoration and management (Zedler and Leach, 1998), the cultural preferences of residents in relation to riparian landscapes, and their specific perceptions of restoration and management measures, have been the focus of little investigation in Europe to date (Decamps, 2001). Policy makers, landscape planners and ecosystem managers must refer to anecdotal information concerning local residents' perceptions and to the opinions expressed by those people actively involved. Existing studies of public perceptions of wetlands have revealed that these areas are less highly appreciated than other habitats, or are even negatively labelled by society as a habitat merely for pests (Anderson and Moss, 1993; Matthews, 1993). However, this trend is changing with recent studies documenting an improved awareness of the biological importance of wetlands (Rispoli and Hamblen, 1999), and the greater attractiveness of landscapes dominated by water (Kaltenborn and Bjerke, 2002). Nassauer (2004) stated that the characteristics of wetlands do not comply with certain cultural values such as a sense of control, neatness and safety, and that wetland attractiveness is strongly influenced by cultural features like mown areas and structures providing views onto open water.

It is not only physical features, however, but also the management and landscape context that are responsible for either positive or negative perceptions of restoration measures. Connelly et al. (2002) found in relation to the restoration of the Hudson River Valley that beliefs and past behaviour better explained people's support for ecosystem restoration than socio-demographic characteristics. The groups expressing either a positive or a negative attitude towards ecological restoration in the Chicago metropolitan region differed with respect to their perception of the outcomes and of the importance of restoration, basic beliefs, knowledge and behaviour (Bright et al., 2002). Solecki (1998) underlined the importance of a knowledge of and familiarity with specific management measures in relation to an individual's support for landscape management.

Value orientations and affiliations to certain social interest groups were also strong predictors of an appreciation for landscapes and of conservation attitudes, but also socio-demographic variables such as gender, age and residential situation (Kaltenborn and Bjerke, 2002; Rispoli and Hamblen, 1999; Sah and Heinen, 2001). A problem in relation to measuring support for ecological restoration is that restoration goals are often welcomed by residents, but the implementation of specific measures and projects to accomplish these goals frequently lacks the necessary public support (Barro and Bright, 1998; Connelly et al., 2002). There has been little research into the relationship between the public's perception of the threat to floodplains and the support for floodplain restoration and the implementation of specific measures in Europe's peri-urban environments. Correspondingly, there is a lack of information on the appraisal by different lifestyle and social groups of landscapes after river restoration has taken place, and of the reintroduction of traditional land management approaches such as low-intensity grazing.

In this paper the human dimensions of riparian landscapes and floodplain restoration in a peri-urban area of Luxembourg are explored. The objective of the study was to measure local residents' perceptions of riparian landscapes, floodplain restoration measures in general and the Syr Valley Restoration Project (SVP) specifically, and to link them with the perceived threat to the floodplain, basic beliefs, lifestyle concept, knowledge and socio-demographic variables. The following research questions were tackled in a quan-

titative survey of residents in three towns participating in the SVP:

- Are floodplains perceived as threatened, what are the threats to riparian landscapes and what are the prevailing notions with respect to future landscape planning in floodplains?
- What are the local residents' opinions in relation to river restoration and low-intensity grazing as a restoration strategy for riparian landscapes?
- What relationships can be identified between the perceived threats of floodplains and the general perception of restoration measures and their implementation?
- Can support for the measures be predicted on the basis of socio-demographics, lifestyle concept or environmental value orientations?

The results of this study can help those involved in the landscape planning and ecosystem restoration of floodplain areas to better anticipate public support for or opposition to certain measures, to adjust floodplain restoration measures and to develop a future riparian landscape management concept for the peri-urban context that is culturally sustainable.

2. Syr Valley Restoration Project (SVP)

2.1. Site characteristics and historic land use

The Syr is a medium-sized, carbonate upland river. It flows over 32 km within the Luxembourgian escarpment landscape of the Gutland bioclimatic region, to its estuary in the River Mosel. The Upper Syr Valley is located in the gently rolling foothill zone of the Luxembourgian sandstone plateau, which consists mainly of keuper and alluvial formations (Administration des Eaux et Forêts, 1995). The SVP restored a 2.2 km stretch of the River Syr, and over 45 ha of valley bottom shared by the communities Betzdorf, Niederanven and Schuttrange (49°38'N, 6°17'E). The SVP took place in the 375 ha large 'Vallée de la Syre de Moutfort à Roodt/Syre' Special Protected Area, which was designated in January 2004 under the EU Conservation of Wild Birds Directive, and which forms part of the Natura 2000 network.

The earliest historical documents, dating from the late 18th century, show the deforested floodplains of the SVP area with open wetlands and the River Syr in the valley bottom, with livestock grazing as the main land use (Schaich and Konold, 2006). From the beginning of the 19th century massive river regulation and land improvement measures were executed in the floodplain to serve water mills in the adjacent village and to drain unproductive wetlands. The meandering course of the River Syr was completely redirected into a straightened channel along the edge of the valley, and drainage ditches made possible the use of grassland as combined meadow-pasture. In the second half of the 20th century the drainage measures were expanded to allow for the intensification and mechanisation of the floodplain meadows in a two-cut regime. As a consequence, the wetland character of the area vanished, riparian dynamics were impeded, vegetation and site characteristics impoverished, and the floodplain landscape became uniform and less resilient. The SVP area is now located within a peri-urban environment, as it is under the influence of Luxembourg city, but it still exhibits a rural character.

2.2. Planning procedure and restoration measures

The Luxembourgian State Water and Forestry Service assumed responsibility for the planning of the SVP, and collaborated with several landowners in a land consolidation effort in 2002, to amass sufficient floodplain area for the implementation of the project.

Table 1
Likert items used to calculate mean index values and their internal reliability.

Index	Cronbach's α	<i>n</i>
Perception of the current status of floodplains in Luxembourg (LUX)—threat index	0.68	230
1. Wastewater disposal is threatening floodplains in LUX		
2. Drainage activities are threatening floodplains in LUX		
3. Local recreation facilities are threatening floodplains in LUX		
4. Fisheries are threatening floodplains in LUX		
5. Canalisation of water bodies is threatening floodplains in LUX		
6. Agriculture is threatening floodplains in LUX		
7. The provision of drinking water is threatening floodplains in LUX		
8. Livestock grazing is threatening floodplains in LUX		
9. Dams and weirs are threatening floodplains in LUX		
10. Housing is threatening floodplains in LUX		
11. In the past floodplains in LUX have been more ecologically intact		
12. There is more flooding in LUX today than in the past		
Perception of water body restoration (WBR)—restoration index	0.82	239
1. WBR measures defend against flooding		
2. WBR measures result in a deterioration of water quality ^a		
3. WBR is important for nature conservation		
4. WBR is destroying traditional cultural landscapes ^a		
5. Mosquito plagues are aggravated by WBR ^a		
6. WBR measures are too expensive ^a		
7. WBR raises the recreational value of landscapes		
Perception of low-intensity grazing systems (LGS)—grazing index	0.64	240
1. LGS create habitats for fauna and flora		
2. LGS mean a loss of agricultural area ^a		
3. LGS can provide high-quality meat		
4. LGS pollute water bodies and worsen water quality ^a		
5. LGS should only be based on local livestock breeds ^a		
6. LGS are a species-appropriate form of range management		
7. LGS in floodplains enrich the landscape experience		
Appraisal of the Syr Valley Restoration Project (SVP)—project index	0.89	170
1. The combination of WBR and LGS supports nature conservation		
2. I prefer spending time in the area now than before the SVP		
3. Scottish Galloway cattle enrich the floodplain landscape		
4. Settlements at the underflow are now better protected against flooding		
5. Farmers should obtain a financial reward for the implementation of LGS		
6. The measures of the SVP have improved the water quality of the River Syr		
7. The SVP is a burden on residents ^a		
8. In the long run endangered bird species will resettle the area of SVP		
9. The SVP has created a new local recreation area in the Syr Valley		
10. It is principally vermin that have profited from the SVP ^a		
11. Farmers have lost valuable production area to the SVP ^a		
12. The SVP fits well into the landscape scenery of the Syr Valley		
13. How do you judge the SVP overall? ^b		

^a Coding reversed.

^b 5-point Likert scale: very good, good, so/so, bad, and very bad.

Ultimately, private owners contributed 24 ha to the project, the communities 16 ha and a national environmental foundation 5 ha. The goal of the SVP was to re-establish river dynamics and floodplain function, to restore open wetlands in line with Natura 2000, to enhance biodiversity, particularly that of wetland bird species, and to make the re-established wetlands perceptible to the public. A low-intensity land use regime had to be implemented in order to retain an open landscape and to impede succession.

The historic land use situation of the late 18th century served as a point of reference for the restoration measures to be undertaken. The water body restoration measures completed in 2003 comprised the re-routing of the River Syr out of the channel at the valley edge and into a partly modelled and raised riverbed in the valley bottom. In the summer of 2004 a low-intensity, year-round grazing system employing Scottish Galloway cattle was installed on a 26 ha fenced area within the rewetted floodplain grasslands. The breed is robust, insensitive to cold and low quality grasslands and, up to its introduction as part of the SVP, was not common in Luxembourg. The animals are owned and managed by three regional farmers who sell the meat to local restaurants, and also receive a financial reward called a 'biodiversity bonus'. The remaining wetland areas were set aside to conserve reed habitats important for bird breeding. The SVP

area was made accessible to the public in the summer of 2005 with the installation of a nature trail around the fenced pasture. Observation posts and a cattle refuge open to the public were also set up to provide visitors with views across the SVP area and to bring them nearer to the animals.

3. Methods

3.1. Study area

Located at the edge of the metropolitan area of Luxembourg city and crossed by the wide open Syr Valley, the three communities Betzdorf, Niederanven and Schuttrange cover an area of 83.6 km². The agricultural census of 2006 indicated that the proportion of farmed land ranged from 53% in Schuttrange and 50% in Betzdorf to 21% in Niederanven. The farmers in the communities mostly specialise in dairying, which explains the considerable grassland areas of 35%, 27% and 13%, respectively. The population of each community lives dispersed across villages comprising several streets. From the 1970s the population pressure in all three communities increased rapidly, resulting in population densities of 107 (Betzdorf), 135 (Niederanven) and 213 (Schuttrange) people per km². In

Table 2

Complex variables 'social status' and 'lifestyle concept' and the corresponding social environments (Blinkert and Klie, 2004; Hradil, 2002).

Social status (structural resources)	Lifestyle concept (symbolic resources)		
	Pre-modern <75	Mixed 75–125	Modern > 125
High > 125	Conservative bourgeois milieu	Conservative bourgeois milieu and liberal bourgeois milieu	Liberal bourgeois milieu
Medium 75–125	Conservative, middle-class milieu	Social centre (classical middle-class)	Liberal middle-class milieu
Low <75	Traditional working-class milieu	Traditional working-class milieu and new working-class milieu	New working-class milieu

2006 the unemployment rate was very low at between 2.5% and 2.8%, with more than two-thirds of the working population active in the tertiary sector. A vast majority of the employees commute to the city of Luxembourg, adding to the peri-urban picture of the three communities.

3.2. Survey instrument

The survey population comprised those living in the households of the study area that were ≥ 16 years of age. An eight-page questionnaire with different sections was developed as a quantitative survey instrument, primarily using a qualitative exploration of the thematic dimensions (Myers and Oetzel, 2003) of riparian restoration. Key aspects of the thematic sections were filtered out during 14 in-depth interviews with people with a stake in shaping riparian landscapes in Luxembourg (e.g., agricultural syndicates, environmental NGOs, tourism associations, state and community administrations). The problems identified were condensed in the questionnaire, which was set up identically in German and French. Both language versions of the questionnaire were pre-tested by eight and seven locals, respectively. The final version of the questionnaire contained 7 thematic sections and 79 questions, which consisted mainly of ranking questions with regard to perceptions and opinions, but also multiple choice questions on the wishes for future landscape development and closed questions about concept knowledge. The participants answered all of the questions about perceptions using a 5-point Likert scale, ranging from 'agree strongly' to 'disagree strongly', and 'very threatening' to 'not threatening' in the threat status section. The Likert scale offered no 'don't know' option in order to encourage people to think about the issue and to commit to an answer (Krosnick et al., 2002). The perception questions were set up in such a way that similar questions querying different aspects of one particular area ('items') could be grouped into four multiple-indicator measures: perceived threat to floodplains in Luxembourg (threat index), perception of water body restoration (restoration index), perception of low-intensity grazing in floodplains (grazing index) and appreciation for the SVP (project index) (Table 1). This procedure allows for the inclusion of a wider range of aspects of an issue than single indicators, and reduces random errors (Bryman, 2004).

The Ingelhardt index, with its ranking procedure for four main goals in politics (freedom of opinion, price stability, public participation in political decisions, security and order in society), was used in the general perception section to identify the basic beliefs of residents, ranging from a 'materialistic' to a 'post-materialistic' attitude towards society and politics (Ingelhart and Abramson, 1999). Complemented by a battery of Likert questions on the role of woman in society (six items), respondents could be classified on the basis of different 'lifestyle concepts'. A modern lifestyle concept was defined by a preference for values such as participation, freedom of opinion and self-realisation in society, expressed by a post-materialistic specification of the Ingelhardt index and a more professional than familiar interpretation of the role of women in society (Hradil, 2002; Ingelhart and Abramson, 1999). People with a pre-modern lifestyle tend to give higher priority to 'materialistic' values such as order, security and price stability, and the role of women, which is concentrated on the family. Questions regarding income and education

formed the variable 'social status', which in combination with the 'lifestyle concepts' could be used to characterise the social environment of the respondents (Table 2).

3.3. Survey organisation and participants

The survey was carried out by means of household visits, so as to provide the participants with a questionnaire in their preferred language and to explain the goals of and the background to the study. People were offered the choice to respond immediately or to fill in the questionnaire privately and to deliver it to their local community administration within 1 week. The first house sampled in a village on each new day of surveying was selected at random from a map and subsequently every second house in the neighbourhood was sampled. The participants in the study were those who opened their door or who were encountered in front of their houses.

All of the villages making up the three communities were included in the procedure, resulting in an even sample size distribution in terms of the total household numbers in every community. A total of 1427 households were sampled, corresponding to 38% of all households in the 3 communities. On 508 occasions nobody was home, and a further 226 people refused to participate. Overall the rate of acceptance by residents (mean percent of residents approached who agreed to participate in the survey) was high at 75%. A total of 255 completed questionnaires were ultimately obtained, by means of either interview or self-completion, yielding an average rate of return of 37%. The response rate was comparable to that of other studies of landscape perception (Ryan, 2002; Van den Berg and Koole, 2006). Ten questionnaires were discarded, because they contained nonsensical answers or data were missing. Hence, the final sample comprised a total of 245 residents, representing 6.5% of the total household number.

The socio-demographic characteristics of the final sample were largely representative of the total population of the study area (Table 3). There were minor under-representations of people belonging to younger age classes (20–29, 30–39), those with primary school education only, and those with foreign citizenship. The median net household income was €4500 to €5000 per month. The average respondent was a medium-time resident (mean time of residence 24 years), but this was influenced considerably by a relatively high proportion of short-time residents (32.2% <15 years). Altogether 15.2% of the interviewed residents lived in the immediate vicinity of the SVP (radius of 1.5 km). Social engagement by the participants in landscape-relevant NGOs was relatively high at 30.6%.

3.4. Data analysis

The data collected were analysed using SPSS 15.0. Ordinal data resulting from Likert perception rankings were used to build four cumulative indices with a continuous scale ranging from 5 to 0 by calculating the mean value for the whole range of statements of each index (Table 1). Each item of the four indices was weighted equally. The coding of the items was organised so that high Likert values stood for a positive perception, and a high perceived threat to floodplains. The internal reliability of the grouped perception items was tested using Cronbach's α (Cronbach, 1951) and revealed

Table 3
Socio-demographic parameters of the residents in the study area compared to the residents sampled in the survey.

Socio-demographic parameters	Study area ^a	Sample
Total population		
Population	11.066	
Population > 15 years	8.905	
Households	3.787	245
Age structure (%)		
15–19 years	9	5
20–29 years	15	7
30–39 years	18	8
40–49 years	22	22
50–59 years	18	31
60–69 years	9	17
>70 years	9	9
Gender ratio (%)		
Females	51	49
Males	49	51
Citizenship (%)		
Luxembourgish	60	75
Others	40	25
Education (%) ^b		
Primary school	30	9
Vocational school	35	24
Secondary school (technical)	5	5
Secondary school (general)	9	20
Polytechnic	7	10
University	10	29
Other	4	3
Employment status (%)		
Workers	19	18
Salaried professionals/functionaries	70	70
Self-employed	11	12
Non-working		34
Missing cases		28

^a From the most recent Statec Luxembourg census data from 2001.

^b The reference area for the parameter 'education' was the whole of Luxembourg, because the census data were not specific to the commune level.

a high ($\alpha > 0.80$; restoration index, project index) and an acceptable ($\alpha > 0.60$; threat index, grazing index) degree of fit between the items of the indices (Berthoud, 2000) (Table 1). For key perception questions, the frequencies of the answers were tabulated and mostly simplified by reclassifying affirmative answers in a single category 'agree' and negative answers as 'disagree'.

For the statistical analysis all distributional data were tested for normality. The level of significance applied to all tests was $p < 0.05$. In addition to the use of ANOVA statistics to compare the index values of residential groups and the calculation of correlation coefficients for the predictor variables, the complex variables social status and lifestyle concept were also included in the exploration (Blinkert and Klie, 2004). A principal component analysis (PCA) was carried out to reduce the data for the structural parameters 'household income' and 'education' to the variable 'social status' (one axis, eigenvalue 1.22, explaining 61% of the total variation) and of the symbolic parameters 'Engelhardt index' and the 'role of women' to the variable 'lifestyle concept' (one axis, eigenvalue 1.39, explaining 70% of the total variation). Both variables were standardised on a scale with a mean value of 100 and a standard deviation of 50, and pooled into three categories (*social status*: high, medium, low; *lifestyle concept*: modern, mixed, pre-modern; see Table 2). Simple and stepwise multiple linear regression was used to evaluate the relative influence of predictor variables on index values and on specific appreciation of the SVP. A threshold of $p < 0.1$ was used to identify candidate variables, by means of univariate analysis, for inclusion in the final models. Only variables significant at $p < 0.05$ were included in the final multiple regression models.

Table 4
Residents' appraisal of general statements concerning nature conservation, the use of nature and the perception of the regional landscape.

Statements ^a	Agree (%)	Neutral (%)	Disagree (%)
Nature conservation is really important to me	93.8	1.3	4.9
Landscape should primarily serve human livelihood	54.1	33.7	12.2
I spend much time in nature	85.7	10.6	3.7
I use nature trails and information panels	47.3	32.1	20.6
I like the landscape scenery of my community	63.2	4.6	32.2

^a *n* varied between 243 and 245.

4. Results

4.1. Perception of landscape, threats to floodplains and landscape planning

The participants' assessment of the importance of nature conservation in their own lives suggested that the overwhelming majority were conservation supporters, but also that a majority supported the notion of human primacy in landscape use (Table 4). The threat index, with a mean value of 3.45 (± 0.48), indicated that floodplains in Luxembourg were perceived to be only slightly threatened. A one-way ANOVA showed a significant difference in the perceived threat between resident groups with different lifestyle concepts ($F = 3.11$, $p = 0.047$), but not for resident groups of different social statuses ($F = 2.18$, $p = 0.115$). When asked about existing threats to floodplains in Luxembourg, residents mainly ranked construction activities such as housing, canalisation and drainage amongst the top five perceived threats (Table 5). Wastewater disposal was also seen as a major threat, while productive and non-productive land use practices were seen as neutral or non-threatening. Interestingly, residents distinguished clearly between the potential threat posed by agriculture and that of grazing.

The evaluation of potential threats was reflected in residents' wishes for the future development of floodplains in Luxembourg. The three most highly sought after development goals for the future of the floodplains – more space for fauna and flora (71.8%), reduction of pollution and improvement of water quality (71.0%) and more space for water body dynamics (63.3%) – corresponded with the highest ranked threats, posed by construction and sewage disposal. A re-organisation of current land use practices through the area-wide implementation of eco-agriculture, the conservation of historic monuments and the renewal of traditional land use practices was deemed to be important by 54.7%, 47.8% and

Table 5
Residents' concern for floodplain landscapes in Luxembourg^a.

Perceived threats to floodplains ^b	Ranking	Mean	S.D.	Median
Housing	1	4.24	0.84	4
Wastewater disposal	2	4.21	0.94	4
Drainage of floodplain sites	3	4.12	1.03	4
Canalisation of water bodies	4	3.98	1.08	4
Longitudinal and lateral dams and weirs	5	3.55	1.00	4
Agriculture	6	3.10	1.08	3
Local recreation	7	2.85	0.96	3
Drinking water	8	2.80	1.05	3
Fisheries	9	2.46	1.01	2
Livestock grazing	10	2.37	0.99	2

^a In the questionnaire respondents were confronted with the following: "Below is a list of potential threats to floodplain landscapes in Luxembourg. Please indicate for every issue that which best reflects your opinion on the matter (5 = very threatening, 4 = threatening, 3 = moderately threatening, 2 = not really threatening, 1 = not threatening at all)."

^b *n* varied between 240 and 244.

Table 6

Mean values associated with threat, restoration, grazing and project index by the different lifestyle groups (standard deviation in parentheses; ranking threat index: 5 = very threatening, 4 = threatening, 3 = moderately threatening, 2 = not really threatening, 1 = not threatening at all; ranking other indices: 5 = agree strongly, 4 = agree, 3 = neutral, 2 = disagree, 1 = disagree strongly).

Index	Resident groups			F/ χ^2	p
	Modern ^a	Mixed ^b	Pre-modern ^c		
Threat index ^d	3.52 (.42)	3.47 (.50)	3.33 (.49)	3.11	0.047
Restoration index ^e	4.07 (.56)	3.79 (.71)	3.72 (.88)	9.05	0.011
Grazing index ^d	3.82 (.54)	3.75 (.57)	3.55 (.66)	4.04	0.019
Project index ^e	4.09 (.56)	4.00 (.66)	3.74 (.76)	6.23	0.044

^a n varied between 57 and 79.

^b n varied between 61 and 86.

^c n varied between 49 and 69.

^d Assessed with one-way ANOVA.

^e Assessed with Mann–Whitney U-test.

33.1%, respectively. A third of all participants wished to see the state become the owner of all floodplain sites so as to further sustainable development, whereas another third of those questioned would like to see recreational facilities improved. Only 5.3% of the residents stated that they would not like to see any transformation. A tiny minority of 1.6% wanted to promote housing activities. Asked about future tasks for landscape and conservation planning in Luxembourg's floodplains, many respondents perceived a lack of information in relation to planning activities by state authorities (4.12 ± 0.93) and wanted greater participation by citizens in the planning of conservation projects (3.80 ± 0.99). The residents accepted overwhelmingly the suggestion that an integrative conservation strategy be fostered – with nature conservation and agriculture working hand in hand – in the floodplains of Luxembourg in the future (4.36 ± 0.79).

4.2. Perceptions of restoration measures and their implementation in the SVP

The respondents generally agreed with the river restoration measures and low-intensity cattle grazing in floodplains, with the mean ratings for river restoration (3.87 ± 0.73) higher than for grazing (3.72 ± 0.59). In spite of the high restoration index, a considerable percentage of residents' had doubts about the sanitary and financial aspects of river restoration measures. As much as 30.9% of the residents felt that river restoration would enhance mosquito plagues and 23% agreed with the statement that river restoration measures are too expensive. The grazing index revealed more contentious statements, with 30.7% of the respondents indicating that only native breeds should be used in such projects, 28.4% agreeing that low-intensity grazing represents a loss to the area available for husbandry and 16.5% rejecting the idea that grazing in floodplains can be used to generate top-quality meat. A very high percentage of respondents declared that they were familiar with the concept of river restoration (86.9%), and two-thirds (66.7%) stated that they were familiar with low-intensity grazing systems before participating in this survey. A Mann–Whitney U-test of the restoration index ($z = 3.49$, $p < 0.001$) and a Student's *t*-test of the grazing index ($t = 3.014$, $p < 0.01$) revealed that support for both measures was significantly influenced by concept knowledge. The complex variable social status did not show a significant influence on the degree of acceptance for either measure (restoration index: $\chi^2 = 5.760$, $p = 0.056$; grazing index: $F = 0.066$, $p = 0.936$). By contrast, lifestyle concept did have a significant effect on the general perception of both measures. The modern lifestyle group was characterised by a more positive perception than the mixed and the pre-modern lifestyle groups (Table 6).

The specific implementation of both measures in the SVP received greater public support (3.96 ± 0.67) than both measures in general. Again, social status did not significantly influence support with respect to the specific implementation of restoration measures in the SVP ($\chi^2 = 1.459$, $p = 0.482$), whereas lifestyle concept did impact significantly upon acceptance of the SVP (Table 6). Residents of the study area exhibited a high level of familiarity with the SVP, with three quarters (74.7%) of all respondents acquainted with the project and more than every second resident (53.1%) claiming to have experienced the SVP in action. Nevertheless, the people who had personally experienced the SVP demonstrated no significant difference with respect to their opinions towards the project ($z = 0.966$, $p = 0.334$). Altogether 32.2% of the residents were familiar with the floodplain area before the restoration measures were conducted, but this did not influence support for the SVP significantly ($z = 1.509$, $p = 0.137$). Most residents had read about the project in the commune bulletin (60.1%) or in the newspaper (54.6%), while a minority heard about it from friends (33.9%) or from radio or television (21.3%). Project information contained in a project brochure and presented at an information event held by the commune were availed of by only 27.3% and 11.5%, respectively. An overwhelming majority (75.4%) of those residents who had experienced the SVP stated that they visited the project area regularly. The regularity of these visits influenced support for the SVP significantly ($\chi^2 = 16.527$, $p = 0.005$), with 'monthly' (4.21 ± 0.52) and 'several times a year' (4.02 ± 0.49) visitors demonstrating a more positive perception than those visiting either 'daily' (3.73 ± 0.73), 'weekly' (3.56 ± 0.99), 'once a year' (3.82 ± 0.86) or 'not regularly' (3.56 ± 1.27).

4.3. Variables influencing residents' perception of the degree of threat and restoration measures

Correlations between the independent variables and the four indices as dependent variables were consistent with the results obtained from the complex variables social status and lifestyle concept. Socio-demographic predictor variables were of minor importance for index direction, whereas variables characterising the respondents' belief system, behaviour and opinion of landscape management correlated strongly with the four indices (Table 7). Concept knowledge was positively correlated with all four indices, whereas personal experience of the SVP only demonstrated a significant relationship with general acceptance of river restoration. Support for the promotion of integrative conservation strategies in floodplain management showed a highly significant relationship with all four index values. A detailed analysis of the socio-demographics showed the only significant correlations to be that residents who dwelled within a 1.5 km radius of the SVP, or had a lower educational level, perceived floodplains to be less endangered than people living at a greater remove or with a higher educational level; that long-time residents viewed river restoration more negatively than short-time residents; that older residents supported low-intensity grazing in floodplains more than younger; and that respondents with higher incomes had a more positive perception of the SVP. Strong significant correlations were detected between parameters measuring the respondents' basic belief system and the index values (Table 7). Moreover, the perceived threat was important for the degree of support for restoration. The data contained in Table 8 emphasise this fact, indicating a significant correlation between the perceived current level of threat to Luxembourg's floodplains, which was derived from questions 11 and 12 of the threat index (see Table 1) and another question about the overall threat to floodplains in Luxembourg today, and other index values. Engagement in different NGOs significantly influenced the support for river restoration and low-intensity grazing in general and for the specific measures implemented in the SVP, but not the perception of the threat status (Table 9).

Table 7
Bivariate associations between indices and independent predictor variables.

Independent variable	Correlation coefficient or <i>t/z</i> -value of the variable ^a			
	Threat index ^b	Restoration index ^b	Grazing index ^b	Project index ^c
Socio-demographics				
Age class ^d	ns	ns	$r = 0.189^{**}$	ns
Citizenship ^e	ns	ns	ns	ns
Income ^d	ns	ns	ns	$r = 0.218^*$
Education ^d	$r = 0.143^*$	ns	ns	ns
Sex ^e	ns	ns	ns	ns
Social status ^d	ns	ns	ns	ns
Duration of residency ^d	ns	$r = -0.163^*$	ns	ns
Proximity to project area ^e	$t = 2.677^*$	ns	ns	ns
Belief system				
Ingelhardt index ^d	$r = -0.221^{**}$	$r = -0.225^{**}$	$r = -0.195^{**}$	$r = -0.231^{**}$
Importance of nature conservation ^d	$r = 0.236^{**}$	$r = 0.303^{**}$	$r = 0.274^{**}$	$r = 0.436^{**}$
Lifestyle ^d	$r = 0.143^*$	$r = 0.162^*$	$r = 0.157^*$	$r = 0.173^*$
Threat index ^d	–	$r = 0.379^{**}$	$r = 0.218^{**}$	$r = 0.406^{**}$
Behaviour				
Presence in nature ^d	$r = 0.200^{**}$	$r = 0.195^{**}$	$r = 0.189^{**}$	$r = 0.285^{**}$
Use of nature trails and info-panels ^d	$r = 0.160^*$	$r = 0.272^{**}$	$r = 0.285^{**}$	$r = 0.424^{**}$
Membership of agricultural syndicate ^e	ns	$z = 3.692^{**}$	$t = 4.544^{**}$	$z = 3.335^{**}$
Membership of environmental group ^e	$t = 2.170^*$	$z = 3.090^{**}$	ns	$z = 2.086^*$
Subjective knowledge				
Concept knowledge ^d	0.161 [*]	0.213 [*]	0.229 ^{**}	0.200 ^{**}
Personal project experience ^d	ns	0.203 [*]	ns	ns
Perception of floodplain management				
Promotion of integrative conservation ^d	$r = 0.266^{**}$	$r = 0.426^{**}$	$r = 0.393^{**}$	$r = 0.393^{**}$
Restoration index ^d	$r = 0.382^{**}$	–	$r = 0.572^{**}$	$r = 0.666^{**}$
Grazing index ^d	$r = 0.228^{**}$	$r = 0.572^{**}$	–	$r = 0.654^{**}$

^a ^{**}Significant at the $p < 0.01$ level, ^{*}significant at the $p < 0.05$ level, ns not significant.

^b *n* varied between 244 and 226.

^c *n* varied between 170 and 165.

^d Assessed with correlation analysis (Spearman's rank correlation coefficients).

^e Threat and grazing index assessed with Student's *t*-test; restoration and project index assessed with Mann–Whitney *U*-test.

A stepwise multiple regression model, plotted in Fig. 1, revealed that the variables 'support for integrative conservation management' and 'concern for conservation' intensified and a high Ingelhardt index value (a materialist attitude) decreased the perception of threat to floodplains in Luxembourg. The four variables of the regression model represented 16% of the total index variance as the adjusted R^2 was 0.158. Acceptance of low-intensity grazing as a means to manage floodplain wetlands was influenced positively by support for integrative conservation management and the use of nature trails and information brochures, as did a modern lifestyle and a higher age. Membership in an agricultural syndicate was negatively associated with support for grazing and the index of preoccupation with the threat to floodplains did not enter into the model. The adjusted R^2 calculated for this model was 0.287. Support for river restoration generally was positively correlated with a higher perceived degree of threat to floodplains, the support for

integrative conservation management, and a concern for nature conservation. The adjusted R^2 for the model of the restoration index was higher than for the grazing index model at 0.400. Public acceptance of the specific measures implemented, as expressed by the project index, was positively associated with support for restoration and low-intensity grazing generally. Again, the support for integrative conservation management and a high presence in nature were other significant and positively correlated variables in the project index model. The variance explained by this model was rather high at 70%, with an adjusted R^2 of 0.701.

5. Discussion

5.1. Low perceived threat to floodplains—no restoration necessary?

The perceived degree of threat to floodplains in Luxembourg was not as high as was expected of residents living in a highly dynamic peri-urban environment. This was mainly due to the low threat potential residents attributed to agrarian and non-productive land uses such as recreation, or the provision of drinking water. Apparently, the residents viewed agricultural land as an original part of the river corridors, and those river corridors as inter-related landscapes out of different land use zones such as farmland, forests and built areas (Ryan, 1998), where every zone has a right to exist.

This unexpected trend might be explained by the neglect by the public of the importance of wetlands for biodiversity (Matthews, 1993; Rispoli and Hamblen, 1999) or just by the 'natural' appearance of floodplains generally, which appear a relatively healthy ecosystem in comparison to other peri-urban landscapes (Crow et

Table 8

Mean index values of different groups of residents with respect to the perceived current degree of threat to floodplains in Luxembourg (standard deviation in parentheses; ranking of indices: 5 = agree strongly, 4 = agree, 3 = neutral, 2 = disagree, 1 = disagree strongly).

Index	Resident groups		<i>t/z</i>	<i>p</i>
	Perceived threat ^a	No perceived threat ^b		
Restoration index ^c	3.94 (.68)	3.58 (.86)	2.973	0.003
Grazing index ^d	3.77 (.55)	3.45 (.74)	3.288	0.001
Project index ^c	4.04 (.59)	3.53 (.84)	3.878	0.000

^a *n* varied between 27 and 42.

^b *n* varied between 143 and 193.

^c Assessed with Mann–Whitney *U*-test.

^d Assessed with Student's *t*-test.

Table 9

Mean index values of different resident groups with membership in environmental, agricultural and citizens' organisations (standard deviation in parentheses; ranking threat index: 5 = very threatening, 4 = threatening, 3 = moderately threatening, 2 = not really threatening, 1 = not threatening at all; ranking other indices: 5 = agree strongly, 4 = agree, 3 = neutral, 2 = disagree, 1 = disagree strongly).

Index	Resident groups				F/ χ^2	p
	Eco ^a	Agri ^b	Citizens ^c	None ^d		
Threat index	3.63 (.41)	3.24 (.58)	3.37 (.46)	3.45 (.48)	1.36	0.073
Restoration index	4.23 (.56)	2.48 (.98)	3.82 (.67)	3.88 (.66)	22.52	0.000
Grazing index	3.85 (.57)	2.76 (.75)	3.71 (.47)	3.75 (.58)	9.30	0.000
Project index	4.22 (.44)	2.81 (.80)	3.94 (.61)	3.99 (.63)	15.24	0.002

^a Membership in an environmental NGO; n varied between 24 and 33.

^b Membership in an agricultural syndicate; n varied between 9 and 10.

^c Membership in a citizens' group; n varied between 23 and 34.

^d Residents with no engagement in an environmental, agricultural or citizens' organisation; n varied between 115 and 164.

al., 2006). A disregard amongst the residents of the importance of floodplains for nature conservation could not be detected. An overwhelming majority wants to see more biodiversity and space for river dynamics. The predominance of agricultural land in the floodplains of Luxembourg may play a decisive role in the explanation of this trend. The low perceived threat to the floodplains might be due to a relative judgement based on a comparison of this landscape to other landscapes types with a more technical and unnatural appearance. The majority of the residents recognised human-induced problems affecting the floodplains and wanted to see them changed into a more natural state, with an integrative conservation concept incorporated into future landscape planning and combining agricultural practices and conservation in riparian landscapes.

The threat to floodplain landscapes was perceived to be lower by people living closer to the floodplain. This finding was not unusual as these residents become familiar with the human-induced changes to the floodplain landscapes, but it did contrast with the findings of Ryan (1998), who found that concerns in relation to water quality problems (which are more directly related to human well-being) were expressed by residents in close proximity to a river. However, the fact that those living at a greater remove perceived a higher threat showed that the residents were preoccupied with this habitat type even when there were no floodplains in their immediate vicinity.

The respondents also indicated clearly that they would like the planning authorities to make more information concerning landscape planning in floodplains available, and that they wished to participate in the decision-making process. A variety of studies have demonstrated that the application of organisation, analytical tools and participation strategies to convey complex technical information to stakeholders and the wider public are profitable, as is investment in participatory decision-making, as the quality of planning is enhanced and public acceptance improved (Carnes et al., 1998; Höchtl et al., 2007; Sisk et al., 2006).

5.2. Support for rewetting and grazing—anachronisms as sustainable future concepts?

The concerns surrounding human interventions in floodplain ecosystems were reflected in the high levels of support for river restoration generally. A high proportion of residents agreed with broad restoration goals (important for nature conservation, enhancing cultural landscapes) and with the perceived positive outcomes of river restoration (protection from flooding, improvement of water quality, higher recreational value of floodplain landscapes). Apart from concerns over the threats, the very high level of knowledge might also have played a role in the positive rating. Minor controversy revolved around the statements about the poten-

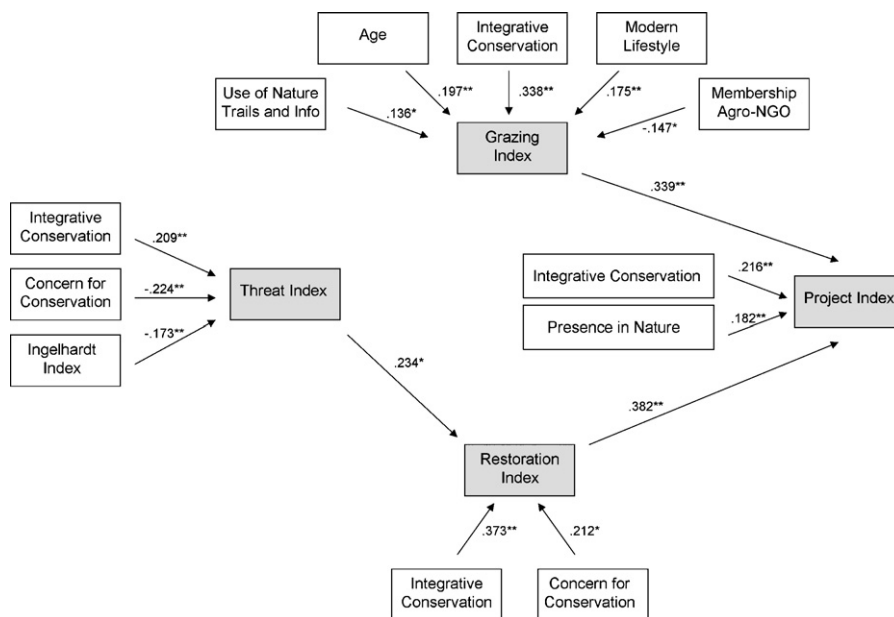


Fig. 1. Models developed to explain perceived degree of threat (threat index), and support for the general restoration measures (restoration and grazing index) and specific project implementation (project index) (**significant at the $p < 0.01$ level, *significant at the $p < 0.05$ level).

tial for mosquito plagues and the financial costs of restoration measures. Concerns over public health and insects in the vicinity of restored river corridors are common amongst those living in their proximity (Rispoli and Hambler, 1999), but can to some extent be addressed through adequate information and educational programmes prior to restoration (Purcell et al., 2002). A transparent information policy with respect to the financial resources, incentives for farmers and potential savings arising from the new ecosystem services provided by a restored river corridor might further enhance acceptance and cultural sustainability (Dutcher et al., 2004).

The installation of a low-intensity grazing system in floodplains was also rated positively by the residents, although a third of the respondents were not aware of what this meant in terms of the practical details. This result was remarkable, because grazing practices in combination with nature conservation goals have often been rated negatively, especially by residents of urban environments (Brunson and Gilbert, 2003; Huntsinger and Hopkinson, 1996). Indeed, the often perceived negative impact of grazing on habitats and landscape aesthetics, and the corresponding traditional rural image (Mitchell et al., 1996), seemed to represent no problem in Luxembourg. A high proportion of respondents agreed with the proposed positive outcomes for floodplain ecology, landscape perception and animal health. Low-intensity grazing is mainly seen as a multiple-use concept fostering conservation issues, yet also tying in with the husbandry tradition in Luxembourg. People seem to accept modern grazing systems as a part of landscape management in areas where grazing has been common traditionally. This view was supported by the tendency of the older people in the study area to be more strongly in favour of grazing practices than the younger.

The specific implementation of a restoration scheme of this type in the SVP received even more support from residents than mere grazing and river restoration concepts in general. This finding was interesting, because often the general goals of restoration are supported only until the public is required to consider the specific consequences of these goals in terms of costs, actions and changes to their familiar landscapes (Barro and Bright, 1998). Hence, the support for specific actions often falls far short of the positive perceptions of general goals (Connelly et al., 2002). The high degree of familiarity with the SVP and the different sources from which the residents obtained information about the project might have been relevant in this context. Newspaper and commune bulletin articles played a vital role in contributing to people's knowledge of the SVP, in which the reporting seemed to be predominantly in favour of ecosystem management.

Although it may reasonably have been expected, the residents' personal experience of the SVP had no significant influence on their assessment of the project. However, the frequency of visits to the area did increase the respondents' support for the project, which contrasted with the findings of Purcell et al. (2002) in relation to the restoration of an urban creek. Knowledge of the area prior to restoration did not affect people's perception of the SVP. The same was found in the case of the implementation of a grazing system within a protected area in the US (Brunson and Gilbert, 2003). These results relating to the influence of personal experience may indicate that the residents' expectations of the restoration and grazing measures prior to their visit largely corresponded with their actual performance in the Syr Valley. Positive perceptions of general measures, and the even greater support for their implementation, indicate that the restoration of a semi-natural floodplain landscape employing measures mimicking traditional land uses could be a socio-culturally viable concept for appropriate river sections in future.

5.3. Lifestyle concept, basic beliefs and behaviour—predictors of public acceptance

In spite of the relatively high acceptance of the restoration concept, future projects must analyse key factors to ensure that they are supported. Structural resources such as the classical socio-demographic parameters income and education, or the complex variable 'social status', did not really influence the perception of restoration measures, whereas symbolic resources like basic individual beliefs regarding society and politics were decisive. This corresponded with the conclusions drawn by Hradil (2002), who stated that classic socio-demographic parameters alone are less likely to explain peoples' social differences adequately nowadays without information on lifestyle concept or belief systems. Previous studies of public perceptions of wetland restoration have also shown that beliefs, past behaviour and knowledge are better predictors than socio-demographics (Bright et al., 2002; Connelly et al., 2002). By contrast, public acceptance for wetland conservation in a threshold country like Nepal was dependent upon education and resource use (Sah and Heinen, 2001). In the US public support for ecosystem management was found to be dependent on education as well as beliefs and environmental behaviour (Solecki, 1998).

Some significant correlations with single socio-demographic variables were also confirmed in this study. The variable age class entered the regression model to explain the grazing index and, therefore, indirectly influenced support for the SVP. Obviously, older residents were more supportive of grazing practices in floodplains, representing a potential starting point for the future cultural sustainability of this management type. Environmental value orientations and the behaviour of residents were also important for the prediction of the direction of perception by all indices. For example, another starting point to increase support for the relatively unknown concept of grazing practices as restoration tool could be the upgrading of nature trails and specific project information. Opinion on integrative restoration schemes, which is related to environmental value orientation, was a strong predictor for all indices.

A principal task of public managers and planners is to incorporate the advantages and possible limitations of such a restoration concept into public communications. Major differences arose between the members of environmental groups and those of agricultural associations, with environmentalists supporting and farmers disagreeing with all of the measures evaluated. Although the sample sizes for these social groups was low, the results corresponded adequately with those of other studies of landscape perceptions, in which farmers have been shown to favour farm and developed areas over wilderness and non-intensively managed landscapes (Kaltenborn and Bjerke, 2002; Ryan, 1998), and are generally more sceptical of policy changes in watershed management than non-farmers (Kaplowitz and Witter, 2008). Interestingly, environmentalists were also partly indifferent to the concept of low-intensity grazing, revealing some scepticism about the environmental impacts of this management scheme in floodplains. In the face of relatively broad public support for restoration measures, the embedding of all stakeholder groups into restoration concepts from the outset of the planning process would appear to be a key to achieving cultural sustainability.

6. Conclusions

Taking into consideration the residents' considerable support for the expansion of integrative conservation measures, landscape planners and policy makers could adopt a combination of restoration and grazing systems as a template for the future development of the floodplain landscapes. The combination of both measures would appear to be a suitable compromise between nature con-

servation, land use and recreational interests. This is especially relevant in peri-urban environments, because the options for the spatial segregation of the various competing interests existing at an urban fringe are limited. Unexpectedly, the residents' support for the specific implementation of river restoration and low-intensity grazing in the Syrdall Valley project was even higher than for the general measures, indicating that the mimicking of a traditional landscape condition could be a realistic and socio-culturally sustainable concept in landscape planning. The perceptions of river restoration and grazing generally were a very important predictor of the support for their specific implementation, and concern over the threats to the floodplain was positively associated with acceptance of the general measures. This points to the need to explain the functioning of floodplain ecosystems and the general consequences of human interventions in order to gain people's support, rather than merely explaining the background to a specific restoration measure in a certain area.

This study showed that basic beliefs, lifestyle concept and environmental behaviour are more important determinants of individuals' perceptions of floodplain restoration measures than socio-demographic parameters. On the one hand this result implies that a rapid adjustment of the perception of environmental management by means of educational programmes will be difficult. At the same time, planners can better predict possible types of opposition and react consistently by integrating and facilitating the participation of stakeholder groups in planning activities. Although there is broad public support for land use mimicking traditional elements in riparian landscapes, the opposing minority is also of considerable importance as it comprises farmers and established landowners. Therefore, a lifestyle group-specific strategy of information and integration to foster acceptance and cultural sustainability should be directed more specifically towards those lifestyle groups and stakeholders likely to oppose the project in question. A strategy combining broad ecological information and the open integration of both supporting and opposing social groups could ultimately lead to the creation of 'new floodplain landscapes' on a socio-culturally sustainable basis.

Acknowledgements

This study was made possible by a research grant of the State Ministry of Culture, Higher Education and Research, Luxembourg. I would like to thank Claudia Bieling, Werner Konold, David Butler Manning and three anonymous reviewers for improving earlier drafts of this manuscript by their critical comments and Eric Degrand for his assistance during data collection phase. Moreover, I am grateful to the community administrations of Betzdorf, Niederanven and Schuttrange for their continued support throughout this project.

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