DOI: 10.1007/s00267-004-0092-z

RESEARCH

Public Perception as a Barrier to Introducing Wood in Rivers for Restoration Purposes

HERVÉ PIÉGAY
CNRS-UMR 5600, Environnement, Ville, Société
18 rue Chevreul
69 362 Lyon Cedex 07, France

KENNETH J. GREGORY
Department of Geography
The University, Southampton, S017 1 BJ, UK

VALERY BONDAREV
Earth Science Museum at Moscow State University
Moscow, 119992, Russia

ANNE CHIN
Department of Geography
Texas A and M University, College Station
Texas, 77843, USA

NIKLAS DAHLSTROM
Department of Natural and Environmental Sciences
Mid Sweden University
SE-851 70, Sundsvall, Sweden

ARTURO ELOSEGI
Lab. Ecology
Faculty of Sciences
University of the Basque Country
P.O. Box 64448080, Bilbao, Spain

STANLEY V. GREGORY
Department of Fisheries and Wildlife
Oregon State University
Corvallis, Oregon, 97331, USA

VEENA JOSHI
Post Graduate and Research Centre
S.P. College
Pune, 411030, India

MICHAEL MUTZ
Brandenburg University of Technology
Postfach 101344
03013, Cottbus, Germany

MASSIMO RINALDI
Department of Civil Engineering
University of Florence
Via S. Marta 3
50139, Firenze, Italy

BARTLOMIEJ WYZGA
Nature Conservation Institute
Polish Academy of Sciences
A1, Mickiewicza 33
31-120, Kraków, Poland

JOANNA ZAWIEJSKA
Institute of Geography and Spatial Management
Jagiellonian University
ul.Grodzka 64
31-044, Kraków, Poland

ABSTRACT / Reintroduction of wood in rivers for restoration purposes is now recognized in a positive way by scientists. Nevertheless, the perception of wood in riverscapes is strongly affected by the socio-cultural environment. This cultural influence might explain why wood reintroduction is accepted and promoted in some regions of the world but not in others, despite the demonstrated ecological benefits. From an extensive student perception survey, we show that most of the groups from nine countries in the world considered riverscapes with wood to be less aesthetic, more dangerous, and needing more improvement than riverscapes without wood. By contrast, this way of thinking was not observed in Germany, Sweden, and Oregon (USA), where the first instances of wood reintroduction occurred.

Since the 1980s, it has been recognised that large pieces of wood are significant natural elements of temperate river systems (Triska 1984, Sedell and others 1988, Gregory 2003). Wood in rivers and streams is a key influence on aquatic and riverine ecology, providing food for invertebrate and fish communities as well as habitats for different stages of their life cycles (Sedell and others 1985, Harmon and others 1986, Inoue and Nakano 1998). Nevertheless, wood in rivers is often perceived as a hazard to be avoided in order to prevent

KEY WORDS: Large woody debris; Water policy; Public perception; River landscape; River restoration and maintenance

Published online September 28, 2005.

*Author to whom correspondence should be addressed; *email:* piegay@univ-lyon1.fr

flooding and bank erosion (Shields and others 1984, Gippel and others 1994) as well as causing damage to bridges and other infrastructures (Dielh 1997), so that, in much national legislation, landowners or public agencies are required to remove wood (Piégay 2000). Some scientists have recognized the inherent paradox between politic and management and have tried to promote a balance between the satisfaction of human need and the preservation of ecosystems by emphasizing the positive ecological role of wood (Gurnell and others 1995, Piégay and Landon 1997). The consequences of wood removal for ecosystems following channel maintenance have been highlighted (Shields and Smith 1992, Abe and Nakamura 2003) so that some researchers are now working on wood reestablishment for restoration purposes (Crispin and others 1993, Abbe and others 1997, Hilderband and others 1997, Shields and others 2000, Giannico 2000), and river management guidelines have been written in some countries to rehabilitate wood in rivers (Boyer and others 1998, Gerhard and Reich 2001).

Following discussions with managers in different countries and debates during the international conference on Wood in World Rivers held in Oregon in October 2000, we hypothesized that the perception of wood in riverscapes could differ according to sociocultural areas, possibly signifying that wood reintroduction might be acceptable in some parts of the world but not in others, independently of ecological needs. To test this hypothesis, we evaluated the extent to which individuals recognize that wood is beneficial in rivers by conducting a survey to analyze the perceptions of controlled groups of individuals (students usually aged 20–25 years from 10 areas in contrasting parts of the world) of river landscapes with and without woody debris.

Material and Methods

Survey Structure

The survey has been designed to compare the visual perception of standard pictures of distinctive river scenes with and without wood. Evaluation of landscape perception from ground photos is now a well-established procedure (Mosley 1989, Brown and Daniel 1991, Gregory and Davis 1993), whereas interviewing large numbers of observers at a variety of sites introduces practical difficulties (Shuttleworth 1980), which can be solved by analyzing perceptions from submitted pictures. A few studies have compared observer perceptions in the field with those of ground photos, demonstrating no statistical difference (Shuttleworth 1980, Zube and others 1987, Vining and Orland 1989). We devised a procedure whereby students, from 10 areas (9 countries) chosen to reflect a diversity of world environments, were individually invited to grade 20 photographs (Figure 1) according to their perception of aesthetics, naturalness, danger, and need for improvement on a Visual Analog Scale (VAS) from 0, the lowest score, to 10, the highest score. The VAS is a straight line of a specified length with short, written descriptors at each end that are easily understood. VAS is used to measure the intensity or magnitude of subjective feelings and the relative strength of opinions about specific stimuli. All respondents make a cross on the scale to indicate their personal view. The score is then determined after the survey using a graduated scale. The VAS answers can be then compared using parametric tests [*t*-test or analysis of variance (ANOVA)] (Gift 1989).

The questionnaire and the set of colored and large-format pictures are available on the website http://www.univ-lyon3.fr/umr5600/questionnaire/tabmatriv.html.

Selection of the Photographs

The 20 photographs were selected by the authors using a website for Internet discussions. Each author initially sent a set of pictures of rivers and streams to the webmaster. Of the 300 pictures identified at the beginning of the process, 50 were downloaded for a final selection by the authors involved. Three sets of photos were distinguished: views of rivers, streams, and scenes inappropriate for the survey (e.g., because of structures, views that were too scenic beyond the channel itself, or dominated by people). The authors sent their individual suggestions as to which pictures should be selected or removed from the 50. Comments received were summarized and the reduced number of pictures circulated to the group. Finally, a few original pictures were replaced and a set of 20 agreed upon by all of the scientists in the group.

Because wood in the river was the main parameter of interest, we suggested that all photos should focus on the river channel landscape and not on the valley landscape. The openness, the patchiness of the landscape, as well as the type of view all strongly influence perception in terms of aesthetics, naturalness, danger, and need for improvement. We therefore decided to select views focused on the channel itself, not on its banks or the floodplain, without a scenic setting and excluding human activity.

In order to facilitate the survey, we distinguish 2 sets of 10 pictures: 1 set for streams (width from 2 to 5 m) and 1 for rivers (channel width wider than 10 m). In

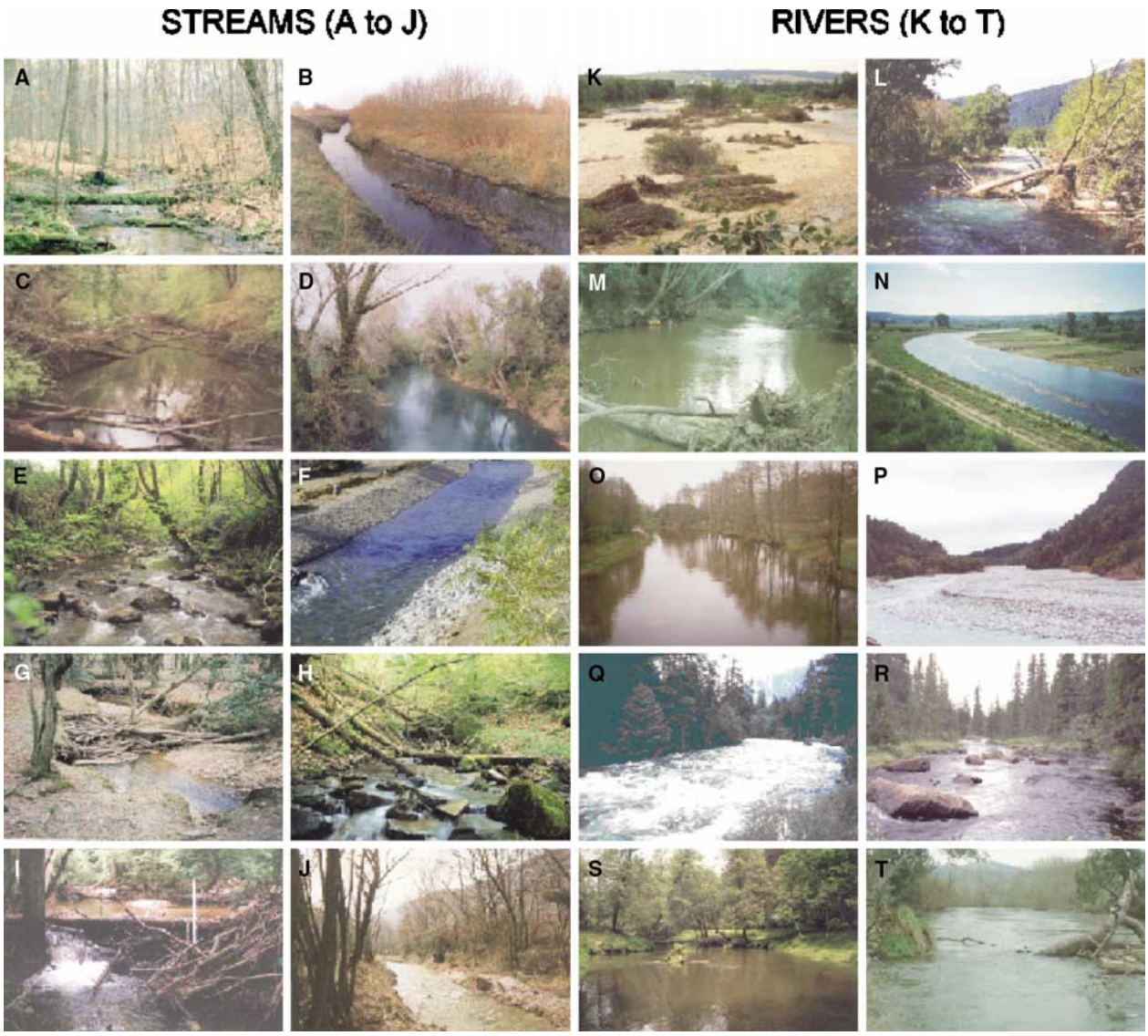

Figure 1. General overview of the 20 scenes selected for the survey (from A to J, the streams with 5 scenes with wood and 5 without ; from K to T, the rivers with 5 scenes with wood and 5 without). The set of colored and large-format pictures are available at http://www.univ-lyon3.fr/umr5600/questionnaire/info.htm.

each of the two sets, five scenes had some wood, whereas the other five had not. In each group of five scenes, the photos were selected to be ordered on a gradient from lowland to piedmont and then to upland. Each set of 10 pictures was placed on the website randomly in two columns labeled from A to J for streams and K to T for rivers (Figure 1).

Definition of the Sample

Because our hypothesis was that different perceptions of landscape relate to socio-cultural environment, we decided to use the student community to provide a consistent basis with a specific age structure. However, there could be differences in perception according to the discipline studied. We therefore collected data in each of the 10 areas from 4 groups of students who might have a different perception of environment: students from biology and ecology departments, who might have a positive ecosystem view; geography and environmental management students with formal training in environmental principles; students in civil and hydraulic engineering departments, who might view channels from a design perspective; students from a discipline significantly

Table 1. Number of students surveyed per discipline and sites involved

	Civil and hydraulic engineering	Geography and environmental planning	Biology and ecology	Other disciplines[a]	Total
France	50	50	50	50	200
Germany	52	78	54	46	230
India	50	50	50	50	200
Italy	46	54	50	50	200
Poland	53	59	52	51	215
Russia	20	61	50	65	196
Spain	24	23	29	39	115
Sweden	48	45	56	55	204
USA–Texas	42	55	52	57	206
USA–Oregon	20	16	38	46	120
Total	405	491	461	509	1886

[a]Distinct from enivornment.

distinct from environment, such as political economy, business sociology, marketing, or public health, presumably with relatively little background in environmental sciences (Table 1). The 1886 respondents did not know that the questionnaire was focused on perception of wood but would assume that it was directed to riverscape. The students had no knowledge regarding the ecological importance of wood in rivers prior to the survey. Their answers were assumed to reflect knowledge of nonexperts and should represent the perception of young people with a high school education.

Questionnaire

The questionnaire had four main questions related to the perception of the scenes: aesthetics, naturalness, danger, and need for improvement. The observer had to score each of the 20 pictures independently of the others. We provided a specific Visual Analog Scale for each of them. The structure of the questionnaire, as in the case of photo selection, was determined by a collective approach and after Internet discussions. We drafted possible questions and discussed their validity particularly considering the character of the different regional areas in the survey. Preliminary stages undertaken included the following: (1) questions elaborated in Corvallis by the working group; (2) summary of the comments formed the first draft proposal; (3) amended proposition further improved by comments; (4) when all authors had agreed on the questions and the photos to be used, each scientist translated the questions into the national language and piloted the questionnaire on a set of 10 people; (5) comments arising leading to final decision about questions to be posed, survey procedure, and photo sample.

Questionnaire Submission

The survey was undertaken using the same protocol in the 10 different areas to ensure that differences observed in any one area are ''cultural'' and not due to technical or methodological aspects. Each questionnaire was completed in a classroom after a few minutes of preliminary introduction, explaining the purpose of the two sets of photos, that students have to score each picture independently of the others, and that the scoring was to be done in columns from aesthetics first, followed by naturalness, danger, and need for improvement. During the scoring of the photos, the students could look at the whole set on a paper copy and on a continuous parallel projection with overhead and beamer on a large color screen. By separating the period for the stream set and after 20 minutes (ascertaining that most of the students had finished the first part of the questionnaire) undertaking the river set, the whole survey was done in around 45 minutes.

Analysis

Each contributor has downloaded his data and checked randomly for errors. The two datasets provided from each country were then added on a single Excel sheet with the respondents raw data tabulated. A second error-checking was then done systematically by identifying minimum and maximum values of each the eight variables, with river and stream sets being distinguished. When a value is below 0 or above 10 (less than 1% of cases), the respondent is identified and the correction was performed by the contributor. As each picture is scored independently from the others on a specific VAS, each is a single scene so that the scores can be averaged and compared in various ways. We then considered the averages for photos with wood ($n = 10$) and those without ($n = 10$). Because the

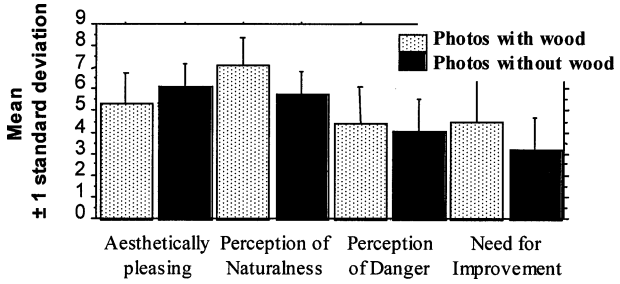

Figure 2. Mean and standard deviation of the scores given by the students to the photos with and without wood for the four gradients: aesthetic preference, perception of naturalness, perception of danger, and need for improvement.

was wood in the river channel when data from all 10 areas are grouped together (Figure 2). Observers considered scenes with wood to be less aesthetic (*P*-value of *t*-test < 0.0001), more natural ($P < 0.0001$), more dangerous ($P < 0.0001$), and needing more improvement ($P < 0.0001$) than the riverscapes without wood.

Considering aesthetic preferences according to area, all of the means were statistically different between the scenes with and without wood, with the exception of Sweden (Figure 3A). In all areas, respondents considered the scenes with wood to be less aesthetic, with the exception of Germans and Americans from Oregon, for whom the inverse was statisti-

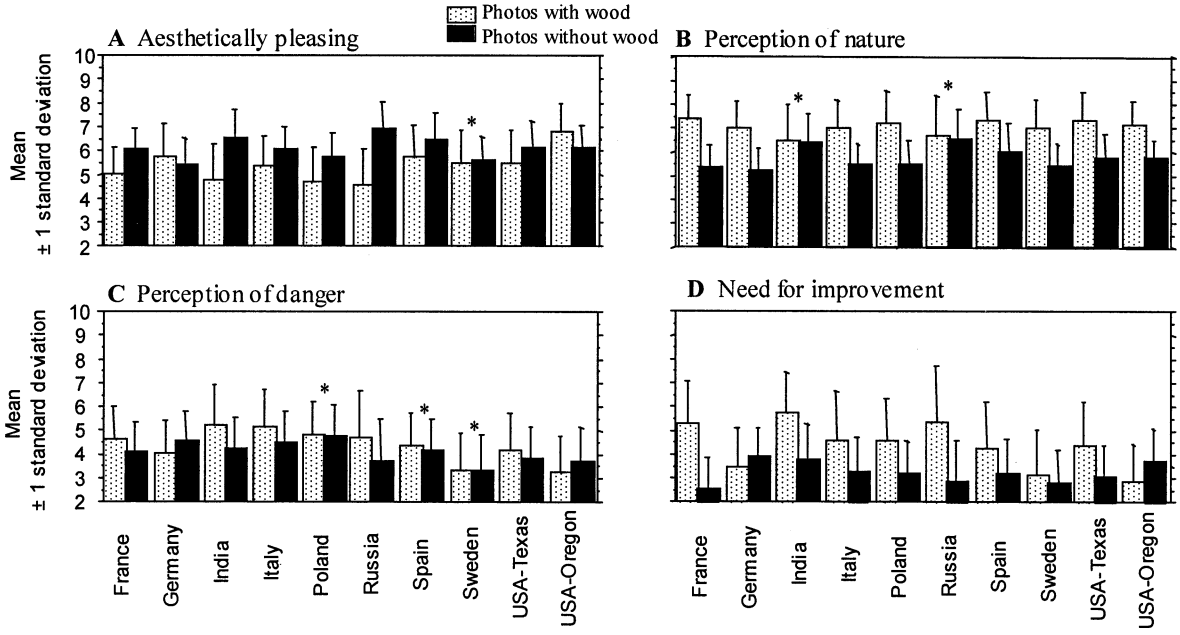

Figure 3. Mean and standard deviation of the scores given by students to photos with and without wood according to the different sites and the four gradients. (A) Aesthetic preference, (B) perception of nature, (C) perception of danger, (D) need for improvement. *No statistical difference of means (*P*-value of *t*-test > 0.05).

average scores had a Normal distribution, a *t*-test was used to test the difference of means between the groups of scenes with and without wood. When we analyzed the subgroups (each of the disciplinary sets in each of the countries), the average scores did not follow the Normal distribution and statistical differences were then tested by nonparametric method (Wilcoxon signed rank).

Results

There were clear statistical differences in term of overall perception according to whether or not there

cally validated (respectively $P = 0.0038$ and $P < 0.0001$). The mean score of scenes with wood was 5.8 versus 5.5 without wood for Germany, and 6.8 versus 6.1 for Oregon. The greatest differences between the picture sets with and without wood were observed in Russia, followed by India, Poland, and France. When comparing the four disciplinary groups in each area, most of them did not exhibit differences (India, Russia, France, Texas, Oregon) (Table 2). In Spain and Sweden, the ecology group behaved differently from the three others by considering the landscape with wood to be more aesthetic than that without. Italian engineers perceived much more difference in aesthetics between

Table 2. *P*-values of Wilcoxon signed rank tests between mean scores of pictures with (LWO) and without wood (WLWO) for each disciplinary group in each of the countries

	Aesthetically pleasing LWO versus WLWO *P*	Perception of nature LWO versus WLWO *P*	Perception of danger LWO versus WLWO *P*	Need for improvement LWO versus WLWO *P*
France 1	<0.0001	<0.0001	0.0096	<0.0001
France 2	<0.0001	<0.0001	0.0906	<0.0001
France 3	0.0116	<0.0001	0.0439	<0.0001
France 4	<0.0001	<0.0001	0.0023	<0.0001
Germany 1	0.2176	<0.0001	0.0916	0.4896
Germany 2	<0.0001	<0.0001	<0.0001	<0.0001
Germany 3	0.0414	<0.0001	0.1289	0.0358
Germany 4	0.3851	<0.0001	0.4969	0.6751
India 1	<0.0001	0.1875	<0.0001	<0.0001
India 2	<0.0001	0.0282	0.0020	<0.0001
India 3	<0.0001	0.6119	<0.0001	<0.0001
India 4	<0.0001	0.4984	0.0030	<0.0001
Italy 1	<0.0001	<0.0001	<0.0001	<0.0001
Italy 2	<0.0017	<0.0001	<0.0143	<0.0001
Italy 3	<0.0001	<0.0001	<0.0591	<0.0001
Italy 4	0.0545	<0.0001	<0.0003	0.0007
Poland 1	0.0032	<0.0001	0.3435	0.0006
Poland 2	<0.0001	<0.0001	0.6223	<0.0001
Poland 3	0.0006	<0.0001	0.5548	0.0004
Poland 4	<0.0001	<0.0001	0.0959	<0.0001
Russsia 1	<0.0001	0.1701	0.0130	0.0010
Russsia 2	<0.0001	0.8297	<0.0001	<0.0001
Russsia 3	<0.0001	0.0005	<0.0001	<0.0001
Russsia 4	<0.0001	0.4876	0.0011	<0.0001
Spain 1	0.0002	<0.0001	0.0058	<0.0001
Spain 2	0.0340	0.0002	0.0261	0.0056
Spain 3	0.4059	<0.0001	0.1962	0.0780
Spain 4	0.0020	<0.0001	0.9875	0.0010
Sweden 1	0.0189	<0.0001	0.5572	0.0009
Sweden 2	0.3596	<0.0001	0.5324	0.8810
Sweden 3	<0.0001	<0.0001	0.2889	0.0159
Sweden 4	0.0009	<0.0001	0.5240	<0.0001
USA–Texas 1	0.0300	<0.0001	0.0879	<0.0001
USA–Texas 2	0.0137	<0.0001	0.7217	0.0056
USA–Texas 3	<0.0001	<0.0001	0.0063	<0.0001
USA–Texas 4	<0.0001	<0.0001	0.0040	<0.0001
USA–NW 1	0.0018	0.0003	0.0096	0.0009
USA–NW 2	0.0061	0.0008	0.0465	0.0054
USA–NW 3	<0.0001	<0.0001	0.0152	0.0007
USA–NW 4	0.0050	<0.0001	0.0499	0.0002

Note: 1 = civil and hydraulic engineering; 2 = geography and environmental planning; 3 = biology and ecology; 4 = other discipline distinct from environment.

scenes with and without wood when compared to the three other groups. In Germany, civil engineers and the group of students without any training in environmental studies did not see any differences in term of aesthetics, whereas geographers and biologists did.

Responses on the perception of the naturalness of the scenes showed that all of the groups rated the scenes with wood as more natural than those without wood (Figure 3B). The *t*-test was significant for eight groups ($P < 0.0001$), except India and Russia ($P > 0.05$). The maximum range of means was greatest for France, followed by Germany, Poland, and Texas. No real differences appeared among the disciplinary groups regardless of the country.

Perception of danger showed greater contrasts (Figure 3C). Scenes with wood were considered more dangerous in India, Russia, Italy, France, and Texas ($P < 0.0001$). Germany ($P < 0.0001$; mean 4.08 with wood

versus 4.5 without) and also Oregon ($P < 0.0001$; mean 3.25 with wood versus 3.62 without) considered the scenes without wood to be more dangerous. Polish, Spanish, and Swedish students did not see any difference in danger between the two sets of scenes. In results from France, India, Poland, Russia, and Sweden, there is no difference of means between the disciplines (Table 2). The Spanish and Italian ecologists as well as the disciplinary group without any attachment with environmental issues in Texas and in Spain did not see any differences of means in term of danger between the scenes with wood and the scenes without. In Germany, the ecologists and the geographers considered the scenes with wood as less dangerous than the scenes without, whereas this difference was not validated by the two other groups.

Considering the need for improvement, there were also clear differences between scenes with and without wood (Figure 3D). All of the means were statistically different for $P < 0.001$. Germany and Oregon had distinctive results, as the scenes with wood were thought to need less improvement than the others. The main differences arose in the order: France, Russia, India, and Poland. There were no differences among the four disciplinary groups except in the cases of Spain and Sweden (Table 2). In Spain, ecologists did not give different scores to the scenes with and without wood, whereas in Sweden, they considered the scenes with wood to need less improvement than the scenes without ($P = 0.01$).

Discussion and Conclusions

Following the discussions conducted during the wood conference in Corvallis in 2000, many scientists have stressed that it is not really appropriate to speak about woody ''debris'', as the scientific community has done over the last two decades, to characterize the wood in streams and rivers because of the negative sense that is introduced. Such comments underline the fact that the collective perception of wood in rivers is often not positive and that opinions about landscapes with wood are often associated with cleanness, human negligence, and disharmony. The consequences of such previous reactions and judgmental interpretations might explain why wood reintroduction in rivers is still very infrequent, thus justifying the survey results described in this article.

Our survey showed different student perceptions for the scenes with and without wood, the presence of wood affecting the aesthetics, the feeling of danger, and in their inclination to act to modify the state of the river. We validated the previous hypothesis of negative perception of wood by respondents but also demonstrated clear cultural differences among the countries.

Regarding naturalness, some observers thought that wood is not natural, statistically evident for India and Russia. People have a perception that the landscape is disfunctional because of the presence of wood. Natural landscape (i.e., landscape structured by natural elements) is now so influenced by human pressure that woody debris is usually absent because it has been cleared or the source of supply removed. When it does appear, it is considered as being not natural and possibly a result of human impact. In the part of India where the survey was undertaken (Maharashtra, Deccan plateau), the students might never have seen any rivers with wood. Their local rivers are swift and large, so that they might not think of wood in rivers as a natural phenomenon.

Such negative perception of the scenes with wood has not been reflected in results from some areas, including Germany, Sweden, and Oregon. We expected that respondents from Sweden and Oregon, where there are extensive forests and a forestry culture, would consider the forest more positively and would perceive the deadwood as a beneficial element of the forest. Regions with abundant forests and active research investigations of the role of wood in ecosystems might be more receptive to conservation and restoration strategies designed to maintain the ecological functions of wood in streams and rivers.

The case of Germany is unexpected because population density is high, the forest is not so extensive, and the society has a long history of farming, as in France, Italy, or Poland. In the national heritage of Germany, forests are of significant traditional value, but, moreover, during the last two to three decades, several campaigns have been launched by nongovernmental and governmental organizations to promote the value of natural forests and streams. In nature conservation, particularly in forest management, the guiding principle of wilderness, including deadwood, has been widely discussed and established (e.g., in national parks and the state) by Kölbel (1999). Bcause a large percentage of the German population wants to live in a way that is beneficial for the environment (Kuckhartz 2000) or sustainable, we assume that due to the educational efforts, German students evaluate wood in streams and rivers more positively, compared to nationalities that have inherited a longer experience of natural wood-rich river landscapes. The relatively positive evaluation of natural wood in streams and rivers by German students agrees with the results of the

International Environmental Survey 1993 of the ISSP (International Social Survey Program), in which the attitude of Germans toward nature clearly differed from other nations. In this study, 64% of the Germans declared that any action taken by humans in the natural world would increase environmental problems (Kuckhartz 1997).

It is interesting to see that wood reintroduction in streams and rivers has occurred in areas where wood is not perceived negatively in term of aesthetics and danger, as in Oregon (USA) and Germany. In other areas, because of social disagreement, such approaches have not been tried or have failed even where the forest is increasingly widespread in countries like Italy, Spain and France, where managers have now to manage forested river corridors rather than agricultural and grazed corridors.

These different results emphasize that reintroduction of wood for restoration purposes will not be politically easy, with the need for education about what constitutes a natural river in a forested context. If people consider that wood is not natural, is not aesthetic, and is dangerous, then these perceptions could have important effects on the decision to abandon restoration measures. It is now difficult to contemplate such possibilities in France, Russia, and Poland, for example. It seems easier to reintroduce some wood into river channels in traditionally forested landscapes, where it is viewed as a modification of existing forestry practices; in traditionally agricultural landscapes, even if forest is actually dominant, as in the Basque region (Spain), it appears as a new innovation, contrasting with established practice over recent centuries. Whereas in traditionally forested environments, the place of wood in the landscape has been debated, such debates have not occurred in formerly agricultural landscapes, even after afforestation. In cultural landscapes of Europe where most of the forests are recent, planted, and managed, surrounded by villages and other human infrastructures, wilderness disappeared centuries ago, so that Europeans have no collective memory of what has been lost. There, ''wild'' features are feared, and the associated risks tend to be eliminated. Wildlife is a good example; the risk of bear attack is accepted in Northwestern United States and many parts of Scandinavia, but it is considered almost unacceptable in France or Spain. Perception of the intrinsic character of the landscape is evolving more slowly than the landscape itself, because some collective behavior and perceptions are inherited from an older environment that no longer exists. In such cases, where science is moving more rapidly than public thinking, education and appropriate means of communication are important aspects that need to be considered.

Our results have also shown that the differences between cultural areas are much more pronounced than the differences between the disciplinary groups within each area. It is interesting to see, for example, that the scenes with wood were considered as being more dangerous in France or Russia, whatever the disciplines of the respondents, whereas in Sweden, none of the disciplinary groups differentiated the two. This demonstrates how cultural background is driving the way of thinking, irrespective of the disciplinary background. This general observation must be tempered by the fact that the ecological group might react slightly differently to questions such as those concerning aesthetic preference (Spain, Sweden, and Germany), need for improvement (Spain and Sweden) or perception of danger (Spain, Italy, and Germany). The ecological group might consider the scenes with wood as being more aesthetic, where improvement is not needed, less dangerous, or at least not more dangerous than the other scenes. From our results, we believe that environmental education should endeavour to improve the understanding of how river or other ecosystems function in order to slowly modify our way of thinking, inherited from centuries of fight against nature. Science is needed to improve knowledge of ecosystems, to propose sustainable solutions, and to restore damaged environments, but public education is also essential to help understand why such solutions are necessary.

Acknowledgments

We thank C. Arrese-Igor, I. P. Balabina, K. G. Bondareva, D. Borchhardt, T. A. Budykina, B. Chocat, S. Dufour, F. Y. Dzerzhinskiy, L. Erriondo, K. Forest, J. Given, B. Gumiero, C. Jackson, P. Joly, V. Kale, J. Kippenberger, L. Kshirsagar, J. Lach, R. Loire, C. Montoya, O. Ormaetxea, S. Painter, A. A. Protsenko, A. Radecki-Pawlik, M. Reich, A. I. Stifeyev, N. E. Voinova, L. Wang, and N. A. Yasamanov for helping during the survey process and data downloading and validation. The first author would also like to thank the European Community (Life Program Forests for Water, 2003–2007) for providing funding for studying the effect of the forest on rivers as well as the Zone Atelier Bassin du Rhône (CNRS) for providing an active spot for developing interdisciplinary research. We also thank V. H. Dale, the Editor-in-Chief of *Environmental Management* and two anonymous reviewers for their helpful comments.

Literature Cited

Abbe, T. B., D. R. Montgomery, and C. Petroff. 1997. Design of stable in-channel wood debris structures for bank protection and habitat restoration: an example from the Cowlitz river, WA. Pages 1–6 in Proceedings of the Conference on Management Disturbed by Channel Incision, University of Mississippi, Oxford, USA.

Abe, T., and F. Nakamura. 2000. Effects of experimental removal of woody debris on channel morphology and fish habitat in a small low-gradient stream in northern Japan. *In* International Conference on Wood in World River, Corvallis, Oregon, USA.

Boyer, M., H. Piégay, C. Ruffinoni, A. Citterio, C. Bourgery, and P. Caillebote. 1998. Guide technique SDAGE n°1—La gestion des boisements de rivière: Dynamique et fonctions de la ripisylve. Agence de l'Eau Rhône Méditerranée Corse, 49 pp.

Brown, T. C., and T. C. Daniel. 1991. Landscape aesthetics of riparian environments: Relationship of flow quantity to scenic quality along a wild and scenic river. *Water Resources Research* 27(8):1787–1795.

Crispin, V., R. House, and D. Roberts. 1993. Changes in instream habitat, large woody debris, and salmon habitat after the restructuring of a coastal Oregon stream. *North American Journal of Fisheries Management* 13:96–102.

Diehl, T. H. 1997. Potential drift accumulation at bridges. US Department of Transportation, Federal Highway Administration Research and Development, McLean, Virginia, USA.

Gerhard, M., and M. Reich. 2001. Totholz in Fliessgewässern, Empfehlungen zur Gewässerentwicklung. GFG mbh und WBW, Mainz.

Giannico, G. R. 2000. Habitat selection by juvenile coho salmon in response to food and woody debris manipulations in suburban and rural stream sections. *Canadian Journal of Fisheries and Aquatic Sciences* 57:1804–1813.

Gift, A. 1989. Visual analog scales: Measurement of subjective phenomenon. *Nursing Research* 38(5):286–288.

Gippel, C. J., I. C. O'Neill, B. L. Finlayson, and I. Schnatz. 1994. Hydraulic guidelines for the re-introduction and management of large woody debris in degraded lowland rivers. Pages 225–239 *in* 1st International Symposium on Habitat Hydraulics, SINTEF-NHL (Norwegian Hydrotechnical Laboratory), Norwegian Institute of Technology, Norwegian Institute for Nature Research, Trondheim,Norway.

Gregory, K. J. 2003. The limits of wood in world rivers, Pages 1–20 in S. V. Gregory, K. Boyer, and A. M. Gurnell (eds.). The Ecology and management of wood in world rivers, American Fisheries Society, Bethesda, Maryland.

Gregory, K. J., and R. J. Davis. 1993. The perception of riverscape aesthetics: An example from two Hampshire rivers. *Journal of Environmental Management* 39:171–185.

Gurnell, A. M., G. E. Petts, and K. J. Gregory. 1995. The role of coarse woody debris in forest aquatic habitats: Implications for management. *Journal of Aquatic Conservation: Marine and Freshwater Ecosystems* 5:1–24.

Harmon, M. E., J. F. Franklin, F. J. Swanson, P. Sollins, S. V. Gregory, J. D. Lattin, N. H. Anderson, S. P. Cline, N. G. Aumen, J. R. Sedell, G. W. Lienkaemper, K. Cromack, and K. W. Cummins. 1986. Ecology of coarse woody debris in temperate ecosystems. Pages 133–302 *in* A. MacFadayen, and E.D. Ford (eds.). Advances in ecological research, Academic Press, London.

Hilderbrand, R. H., A. D. Lemly, C. A. Dollof, and K. L. Harpster. 1997. Effects of large woody debris placement on stream channels and benthic macroinvertebrates. *Canadian Journal of Fisheries and Aquatic Sciences* 54:931–939.

Inoue, M., and S. Nakano. 1998. Effects of woody debris on the habitat of juvenile masu salmon in northern Japanese streams. *Freshwater Biology* 40:1–16.

Kölbel, M. 1999. 25 Jahre Naturwaldreservate in Deutschland—eine Standortbestimmung. In Buchennaturwald-Reservate—unsere Urwälder von morgen. *Nalur-und üschatz-akademie Seminarbericht* 4:32–39.

Kuckhartz, U. 1997. Grünes Trikot für Deutschland? Das Umweltbewußtsein der Deutschen im internationalen Vergleich. *Zeitschrift für Umweltpolitik und Umweltrecht* 4:433–462.

Kuckhartz, U. 2000. Umweltbewusstsein in Deutschland 2000—Ergebnisse einer repräsentativen Bevölkerungsumfrage. Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit—Referat Gesellschaftspolitische Grundsatzfragen (eds.). unpublished report. 11055 Berlin, Germany.

Mosley, M. P. 1989. Perception of New Zealand river scenery. *New Zealand Geographer* 45:2–13.

Piégay, H. 2000. Le bois mort en rivière, faut il toujours l'enlever ? *Compte Rendu de l'Académie d'Agriculture de France* 86(7):97–107.

Piégay, H., and N. Landon. Promoting an ecological management of riparian forests on the Drôme River, France. *Journal of Aquatic Conservation: Marine and Freshwater Ecosystems* 7:287–304.

Sedell, J. R., F. J. Swanson, and S. V. Gregory. 1985. Evaluating fish response to woody debris. Pages 222–245 *in* Pacific Northwest stream habitat management workshop.

Sedell, J. R., P. A. Bisson, F. J. Swanson, and S. V. Gregory. 1988. What we know about large trees that fall into streams and rivers. Pages 47–122 *in* C. Maser, R. F. Tarrant, J. M. Trappe, and J. F. Franklin (eds.). from the forest to the sea: A story of fallen trees, Pacific Northwest Research Station, USDA Forest Service, General Technical Report PNW-GTR-229, Portland, Oregon.

Shields, F .D., N. R. Nunnally, and A. M. Asce. 1984. Environmental aspects of clearing and snagging. *Journal of Environmental Engineering* 110:152–165.

Shields, F. D., and R. H. Smith. 1992. Effects of large woody debris removal on physical characteristics of a sand-bed river. *Journal of Aquatic Conservation: Marine and Freshwater Ecosystems* 2:145–163.

Shields, F. D., S. S. Knight, C. M. Cooper, and S. Testa. 2000. Large woody debris structures for incised channel rehabilitation. In proceeding of ASCE 2000 joint conference on water resources engineering and water resources planning and management, ASCE, Roston, Virginia.

Shuttleworth, S. 1980. The use of photographs as an environment presentation medium in landscape studies. *Journal of Environmental Management* 11:61–76.

Triska, F. J 1984. Role of wood debris in modifying channel geomorphology and riparian areas of a large lowland river under pristine conditions: a historial case study. *Verhandlungen International Vereinigung für Limnologie* 22:1876–1892.

Vining, J., and B. Orland. 1989. The video advantage: a comparison of two environmental representation techniques. *Journal of Environmental Management,* 29:275–283.

Zube, E. H., D. E. Simcox, and C.S. Law. 1987. Perceptual landscape simulations: history and prospect. *Landscape Journal* 6(1):62–80.