Environmental Web Sites: An Empirical Investigation of Functionality and Accessibility

Irene Pollach, Andreas Pinterits, Horst Treiblmaier
Vienna University of Economics and Business Administration, Austria
{irene.pollach, andreas.pinterits, horst.treiblmaier}@wu-wien.ac.at

Abstract

Although the critical role of the Internet for disseminating environmental information to achieve sustainability is widely recognized, academic research has not paid much attention to the functionality and accessibility of environmental Web sites maintained by organizations in the public or the voluntary sector. To fill this gap, the present study seeks to suggest ways in which environmental Web sites could make more effective use of the Internet's capabilities for disseminating information. This paper investigates 226 environmental Web sites, taking into account features such as orientation devices, interaction, information exchange, timeliness, accessibility and the possibility of donating online. Different types of Web sites (air, forest, water, directories) are compared and examined for significant differences. The results strongly suggest that environmental Web sites have not yet fully tapped the Internet's potential, since only few environmental Web sites meet the overall technical, functional and design-related standards their commercial counterparts have adopted.

1. Introduction

The diffusion of any social change ideology requires social interactions ranging from formal education to advocacy group activity, and from mass to interpersonal communication in order to alter people's attitudes and behaviors [39]. The World Wide Web (WWW) has the capabilities to facilitate such interactions, offering a combination of mass communication and interpersonal communication as well as enabling many-to-many interactions among spatially distributed and temporally disjointed participants [17].

In view of multiplying ecological problems, sustainable development is one area in which information disseminated on the WWW may catalyze social change and promote societal learning. The World Wide Web may be a key enabler of a more sustainable future if educational institutions, policymakers, and advocacy organizations make environmental information available online to their audiences [48]. However, to close the gap between the production of environmental information and its efficient use, it must be easily accessible and should open up opportunities for multi-way communication [32]. By integrating theory on evaluation frameworks for the design of environmental Web sites with data on current practices, this paper seeks to suggest ways in which environmental Web sites could make better use of Internet technologies for disseminating environmental information.

2. WWW-Mediated Dissemination of Environmental Information

The earth's population growth places greater and greater pressure on already dwindling resources. Environmental communication and education may reduce the speed of this process and pave the way for a more sustainable future [25]. Accordingly, the Rio Declaration on Environment and Development adopted at the United Nations Conference on Environment and Development in 1992 called for the widest possible participation and involvement of citizens in the process of environmental education [42]. The Rio Declaration thus embraces the dissemination of and access to environmental information as a cornerstone of worldwide sustainable development [2]. Similarly, the European Environment Agency has recognized the critical role of environmental information in achieving sustainability and has therefore called for more interactive and participatory methods of sharing and disseminating environmental information. These methods include the use of technology to eliminate time and space constraints and the adoption of new approaches to disseminating economic, institutional, and environmental information and turning it into knowledge [12]. Although WWW-based communication and interaction are well suited to meet these demands, the unprecedented opportunities they afford also present challenges, both of which will be outlined below.

2.1 Opportunities

The concept of environmental informatics, which evolved long before the mainstream use of the WWW, denotes all stages in the life cycle of environmental information, including the collection, management, and

usage of environmental data in a manner that aids decision-making in environmental matters [21]. Possible applications of environmental informatics include forest regulation and urban development [48], predictions of future climate changes [7], or coastal management [8].

The WWW's enhanced opportunities for communication and interaction are capable of solving existing environmental problems and preparing for new challenges. Its power lies in its ability to enable millions of people to share ideas, data, and knowledge without being constrained by geography, time, or control structures [24]. In addition, the Internet breaks down barriers of information among individuals and organizations. It facilitates vertical and horizontal flows of environmental information inside and outside organizational boundaries rather than top-down, inside-out flows only. Publishing and disseminating environmental information on a wide scale also means that the public is better informed and will come to expect greater levels of transparency from governments and corporations, which may spur more sustainable behavior [1].

2.2 Challenges

The opportunities environmental online communication creates are accompanied by two major challenges — access to technology and access to information. Although the Internet is generally believed to break down barriers, rapid technological change may build new barriers in the form of limited access to new technologies. Advancements in Internet technology put pressures on individuals or organizations maintaining Web sites, requiring them to acquire the skills, knowledge, and resources necessary for capitalizing on new technological opportunities [9].

The second challenge is the increasing complexity of finding information made available on the WWW. The dynamic nature of environmental information means that it loses its value rapidly if it is not retrieved, stored and analyzed in a timely manner [29]. Therefore, it is not sufficient to make information merely available to the public via WWW-mediated channels. Rather, environmental information needs to be disseminated in a format that is useful to and understandable by non-specialist recipients [2].

2.3 Previous Research

This paper is based on the notion that improving the design and functionality of environmental Web sites and therefore the accessibility of environmental information may further sustainable development. The existing body of research on the WWW-mediated dissemination of environmental information is rather small and typically based on specialized samples or confined to particular applications. For example, Wenham et al. investigated the marketing effectiveness of environmental charity Web sites in the United Kingdom [47], Isenmann focused on the provision of environmental information on corporate Web sites [20], and Scharl et al. assessed Web sites of socially responsible investment funds [38]. In addition, related research has been conducted in the form of case studies, e.g. examining one environmental Web site in its particular context [33], describing the development of an environmental Web portal [18], or assessing the potential benefits of mobile environmental communication [10].

There have been numerous studies on the uptake of information and communication technologies by not-for-profit organizations [6, 9, 15, 16, 26, 40, 41]. However, we have not come across any piece of research that assesses the design and functionality of a large and varied sample of environmental Web sites, which we define as non-commercial Web sites maintained by educational institutions, government agencies, or voluntary organizations. To fill this gap, this paper analyzes a sizable sample of environmental Web sites to identify key areas for improving their functionality and accessibility and thus the dissemination of environmental information.

3. Web Site Evaluation

No clear-cut standards have emerged yet for the analysis of a Web site's quality. In the information systems literature, a multitude of instruments have been developed in order to measure content-related and design-related aspects of Web sites, all of which may influence a site's overall performance and success [27] and may place an organization in a better competitive position [31].

After reviewing the relevant literature, we decided to focus on the functionalities and metrics listed in Table 1. Instead of using subjective assessments by Internet users we concentrate on aspects of Web sites that are objectively measurable. In particular, our analysis considers metrics pertaining to navigation and orientation devices, interaction, information exchange, timeliness, accessibility, and online donations. We identified a total of 22 features relevant to environmental Web sites. While the majority of the features listed in Table 1 can be considered success factors, site rankings are a measure of success. The number of links pointing to a particular Web site can be considered to be both antecedents and measures of success. Since many non-commercial Web sites are dependent on voluntary financial support, accepting donations online may improve their financial standing. Therefore, we also took into account whether or not the sites accept donations online.

Table 1. Metrics for Web Site Evaluation

Function Type	Metrics	Scale		Literature Support
Navigation/Orientation	Site Map	yes/no	(nominal)	Waite and Harrison, 2002 [45]
	Search Facilities	yes/no	(nominal)	Waite and Harrison, 2002 [45]
	Home Button	yes/no	(nominal)	
Interaction	Newsletter	yes/no	(nominal)	González and Palacios, 2004 [13]
	Contact Online	yes/no	(nominal)	van Iwaarden et al., 2003 [43]
	Contact Offline	yes/no	(nominal)	van Iwaarden et al., 2003 [43]
Information Exchange/Timeliness	Glossary	yes/no	(nominal)	
	Frequently Asked Questions	*yes/no*	*(nominal)*	Palmer, 2002 [30]
	Last Update	# of days	(ratio)	Madeja and Schoder, 2003 [28]
	Organizational Information	yes/no	(nominal)	Robbins and Stylianou, 2003 [36]
	Number of Broken Links	# of links	(ratio)	Kim et al., 2002 [23]
Accessibility	Availability in Multiple Languages	yes/no	(nominal)	Robbins and Stylianou, 2003 [36]
	Size of Home Page	size in kB	(ratio)	Rose et al., 2005 [37]
	Number of W3C Standard Errors	# of errors	(ratio)	Kim et al., 2002 [23]
	WAI Accessibility Conformance	# of errors	(ratio)	
	Number of Sites Linked in *Google*	# of links	(ratio)	González and Palacios, 2004 [13]
	Number of Sites Linked in *Yahoo*	# of links	(ratio)	González and Palacios, 2004 [13]
Site Ranking	*Site Rankings*	ranking	(ordinal)	
Donations	Online Donations	yes/no	(nominal)	Wenham et al., 2003 [47]
	Payment Systems Available	yes/no	(nominal)	Hung and McQueen, 2004 [19]
	E-payment Security	yes/no	(nominal)	

4. Methodology

This paper seeks to explore the functionality and accessibility of international environmental Web sites. We decided to analyze only well-established environmental Web sites and therefore chose to take our sample from the *Google Directory* [14], which contained links to a total of 251 environmental Web sites. After excluding those sites not available at the time of data collection, 226 sites in four different categories (not including subcategories) remained in the sample: "Environmental Directories" (46 sites), "Air Quality" (38 sites), "Forests and Rainforests" (94 sites), and "Water Resources" (48 sites).

The rationale behind the decision to use the *Google Directory* was to ensure that the sample was geographically dispersed. Other directories, especially environmental Web link directories, often focus on specific topics, countries or regions. To minimize the danger of country bias or censorship and to make sure that none of the most well known sites was excluded from the sample, it was cross-validated against *Yahoo* [49] and the *Dmoz Open Directory* project [11].

All 226 Web sites were then coded for the presence or absence of the 22 features listed in Table 1. In addition, three automated tools for Web assessment were employed. *Audit IT* [4] was used to count the number of sites listed in popular search engines (*Google*, *Yahoo*). Further, a traffic ranking was calculated with the help of *ALEXA* [3], and, ultimately, *WebXACT* [46] was used to measure the sites' adherence to the W3C's guidelines. The codes were factual rather than referential in nature. Factual codes condense the information contained in a text by denoting precisely defined facts, whereas referential codes represent only themes in a text [22]. In this study, the factual codes referred to countable features or were closed-ended questions with the response categories "yes" and "no".

Clearly, this type of metric has a bearing on the types of analyses that may be performed and the reliability of the coding procedure. The nominal scales used in the coding procedure achieve higher accuracy than ordinal scales, since the former do not require human judgment and interpretation [5], in particular if automated tools are used. Three graduate students with sufficient Internet experience were chosen for the coding of the Web sites. The survey was conducted under the close supervision of the authors in order to ensure that the data collected were accurate and reliable.

5. Results

The 226 Web sites examined are predominantly sites maintained by organizations located in the US or Canada (64%) and to a considerable extent also in Europe (22%). The remaining 14% are from the Asia-Pacific region (7%), South-America (2%), and Africa (1%). Only 4% of the sites did not specify their geographic origin.

5.1 Navigation and Site Orientation

Web users satisfy their information needs either by browsing or by searching and are ideally provided with the opportunity to use both modes. Further, Web sites need to provide users with content representation devices such as site maps to help them identify the site's micro-

structure and macrostructure and develop a mental image of a Web site's content [35].

Overall, the environmental Web sites analyzed provide comparatively few navigation and orientation devices capable of helping visitors satisfy their information needs in an efficient manner. 73% of the sites provide home buttons on lower-level pages, which take visitors back to the home page, even fewer provide full-text search facilities (60%), and a mere 35% provide visitors with site maps to give them an idea of what information the site has to offer and where it can be found. Figure 1 shows a breakdown of these features by site category as well as the results for the total sample.

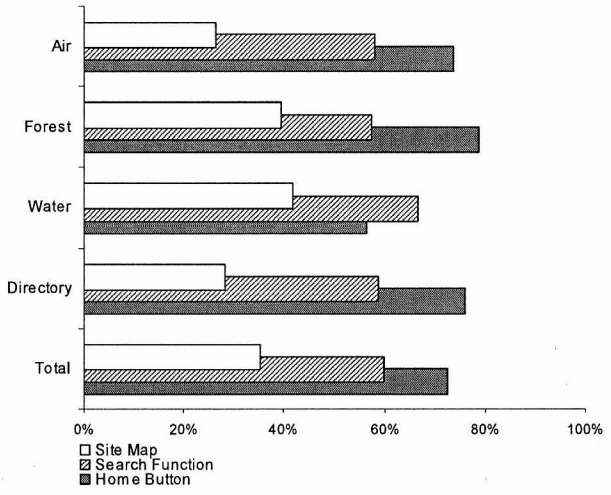

Figure 1. Navigation and Orientation Devices

Chi-square tests were conducted to test for significant differences among individual categories. While no significant differences as to the usage of search functions ($\chi 2 = 1.238$, $p = .744$) and site maps ($\chi 2 = 3.866$, $p = .276$) were found, the use of home buttons differs significantly among the four categories ($\chi 2 = 8.519$, $p = .0364$). For example, while 79% of the forest-related sites have home buttons, only 56% of the water sites do so.

5.2 Interaction

Tools facilitating interaction between users and the organizations hosting the Web sites include newsletters for one-to-many communication and contact details of the organization for one-to-one communication. A distinction was made between contact opportunities for online communication (e-mail addresses) and offline communication (telephone numbers, postal addresses). As shown in Figure 2, newsletters are used to a relatively small extent only. Meanwhile, features enabling people to get in touch with the organization online are used more frequently, reaching even 100% in the category "Water". A total of 82% of all sites analyzed provide some kind of offline contact information, while 66% include an e-mail address. These results clearly indicate that environmental Web sites rely on pull communication vehicles (e-mail, telephone) for stakeholder communication rather than exploiting push technologies such as newsletters for relationship building and awareness raising.

Significant differences regarding the usage of online ($\chi 2 = 38.237$, $p < .000$) and offline ($\chi 2 = 9.850$, $p = .02$) contacts were found, while differences among the sites regarding the use of e-mail newsletters turned out to be non-significant ($\chi 2 = 4.123$, $p = .248$).

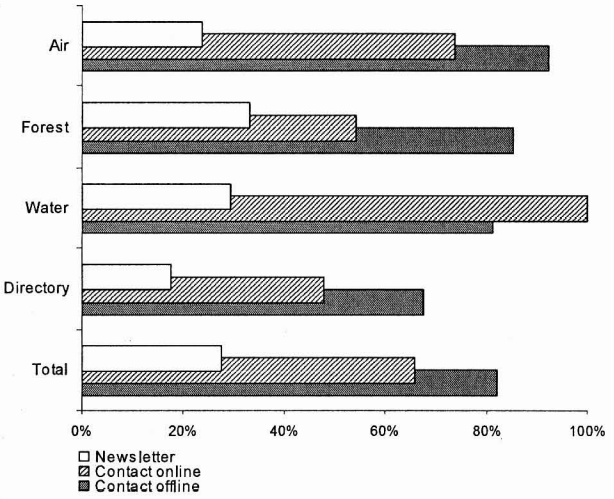

Figure 2. Interaction Devices

5.3 Information Exchange and Timeliness

Content such as glossaries, frequently asked questions (FAQs), and general information about the organization may facilitate information exchanges between users and organizations. Only few Web sites offer glossaries (12%) or an FAQ section (20%). The provision of update information was more common (42%), with more than half of the Web sites in the category "Forests and Rainforests" (52%) displaying the date on which a page was last updated. By contrast, only slightly more than a quarter (27%) of the sites in the category "Water" provide this information. Even more widespread is the provision of organizational information (83%). Figure 3 shows a breakdown of these features by category.

Again, we used chi-square tests to compare the four categories. Differences regarding the availability of glossaries ($\chi 2 = 5.700$, $p = .127$), FAQs ($\chi 2 = 1.353$, $p = .717$) and organizational information ($\chi 2 = 5.583$, $p = .133$) turned out to be non-significant across all Web sites analyzed.

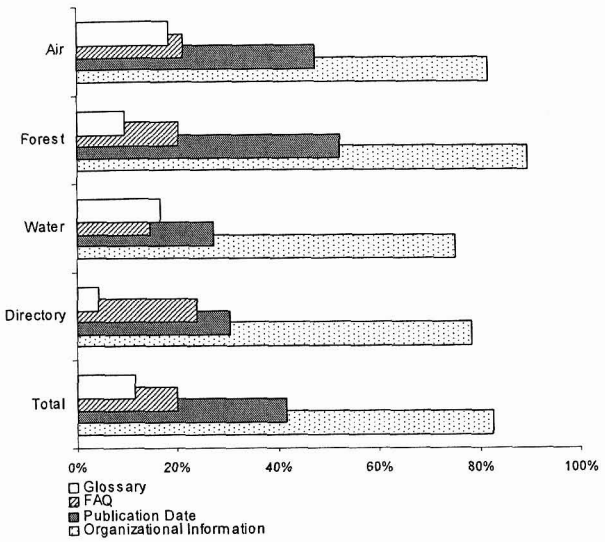

Figure 3. Information and Timeliness Devices

Broken links on a Web site are an indicator of how well the site is maintained. In our sample, the average number of broken links per site was rather small, ranging from 1.33 to 3.21, as shown in Table 2. We also calculated the average number of days passed since the last update, which was alarmingly high across all sites. Differences in the publication date turned out to be significant ($\chi 2 = 11.333$, $p = .001$).

Table 2. Broken Links and Frequency of Updates

	Broken Links per Site	*Last Update (avg. Days/Site)*
Air	3.21	360 (n=22)
Directory	2.51	429 (n=19)
Forest	2.63	286 (n=58)
Water	1.33	373 (n=26)
Total	2.43	339 (n=125)

5.4 Accessibility

In addition to navigational devices, orientation support and interactive capabilities, accessibility also plays a crucial role when evaluating an environmental Web site's quality. Accessibility includes criteria pertaining to information retrieval, technical accessibility, and personal accessibility, i.e. different languages and the site's accessibility to people with disabilities. Table 3 summarizes measures of accessibility, including the provision of information in more than one language, the number of sites linked in *Google* and *Yahoo,* and the size of the home page (i.e. the starting page) in kilobyte (kB).

Table 3. Accessibility Metrics (I)

	Multi-lingual	*Google Links*	*Yahoo Links*	*Size kB Mean (S.D.)*
Air (n=37)	16%	21,869	177,258	84 (52)
Directory (n=46)	11%	37,836	21,332	79 (52)
Forest (n=90)	15%	1,776	18,759	83 (57)
Water (n=44)	27%	25,864	92,145	74 (58)
Total (n=217)	17%	17,730	61,210	79 (57)

Since all Web sites in our sample have an international focus to some extent, all sites offer content in English. A few sites, especially those located in non-English speaking countries, have content in other languages as well. However, our sample showed no significant deviations for the four different categories regarding content offered in multiple languages ($\chi 2=5.004$, $p=.172$).

The metrics "Google Links" and "Yahoo Links" represent the average number of sub-links per site which are indexed in the search engines' databases. The number given for each category indicates how well the sample Web sites are indexed in these two search engines. Basically, a high number of links indicates that the sites are well indexed. However, the results have to be interpreted with caution, since they strongly depend on the number of available indexable sub-sites offered by the Web sites.

The fourth metric shown in Table 3 displays the average size (in kB) of the sites' home pages and the corresponding standard deviations. The size of the home page together with the bandwidth available to a user determines how long it takes for the page to load on the user's screen. Long delay times may have a negative impact on user attitudes toward the Web site [37]. Since there are no obvious differences across the four categories, statistical tests were not performed for the metric "home page size".

Table 4 shows the results from the analysis of the sample Web sites' compliance with the W3C's recommendations for markup languages. Compliance with these Web standards ensures that the site loads well on all HTML/XHTML-compatible Web browsers. In the literature, compliance with these standards is seen as a criterion of Web sites' firmness [23]. Table 4 includes absolute and relative frequencies for all sample sites, which were validated against several HTML or XHTML markup standards (see "Validation"). The columns labeled "Error Free" give the proportion of sites that explicitly adhere to a certain standard and thus contain no errors.

Table 4. Accessibility Metrics (II)

W3C Standard	*HTML 2.0/3.2*		*HTML 4.0/4.01*		*XHTML*		*No Standard*	*Total*	
	Validation	Error Free	Validation	Error Free	Validation	Error Free		n	Error Free
Air	1 (3%)	0 (0%)	26 (68%)	1 (4%)	4 (11%)	1 (25%)	7 (18%)	38	2 (5%)
Directory	3 (7%)	1 (33%)	32 (70%)	0 (0%)	1 (2%)	0 (0%)	10 (22%)	46	1 (2%)
Forest	3 (3%)	0 (0%)	73 (78%)	3 (4%)	7 (7%)	1 (14%)	11 (12%)	94	4 (4%)
Water	1 (2%)	0 (0%)	39 (81%)	2 (5%)	0 (0%)	N.A.	8 (17%)	48	2 (4%)
Total	8 (4%)	1 (13%)	170 (75%)	6 (4%)	12 (5%)	2 (17%)	36 (16%)	226	9 (4%)

Another quality criterion is compliance with the W3C's recommendations of the Web Accessibility Initiative (WAI). The WAI Guidelines have been developed to suggest ways in which Web sites can be accessed by people with disabilities. They specify three different levels of compliance, including A, AA, and AAA [44]. These guidelines are categorized into Priority 1 (e.g. documents must be readable without style sheets), Priority 2 (e.g. tables should not be used for site layouts unless the table makes sense when read horizontally) and Priority 3 (e.g. a logical tab order should be created through links, form controls, and objects). To comply with level A, all guidelines classified Priority 1 have to be fulfilled. Level AA embraces all guidelines of Priority 1 and Priority 2. Ultimately, Level AAA requires that all guidelines are satisfied.

Table 5 shows the results for the three compliance levels. Whereas approximately 25% of all Web sites examined comply with Level A, only 2% can fulfill level AA and no Web site passed the automated evaluation for Level AAA.

Table 5. Accessibility Metrics (III)

WAI Accessibility Conformance	A	AA	AAA
Air	24%	3%	0%
Directory	22%	2%	0%
Forest	30%	2%	0%
Water	19%	2%	0%
Total	25%	2%	0%

5.5 Site Ranking

To determine the popularity of the sample Web sites based on users' navigation behavior, we used Web-site rankings calculated by *ALEXA* [3], which collects data from users through the logs it obtains from the free toolbar it offers to Internet users. Figure 4 shows the ranks of the Web sites in box and whisker plots. Comparing the location of the medians and the other quartiles, the popularity of the four different categories of Web sites can be determined. To eliminate effects of other sites included in the original ranking and to improve overall readability, the pages of our sample sites were re-ranked in such a way that the most frequently visited site in our sample was ranked as #1, the second most frequently visited as #2, etc.

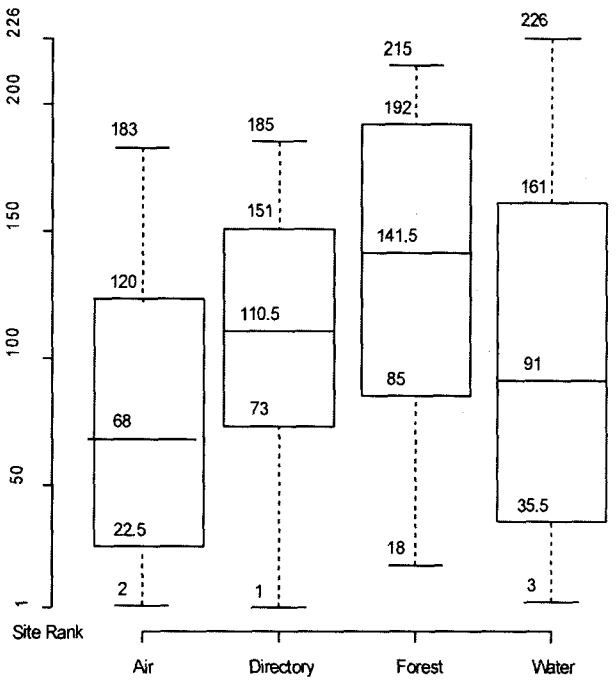

Figure 4. Rank Comparison

On average, the Web sites in the categories "Water Quality" and "Air Quality" are the most frequently visited sites in our sample, although the distribution of the popularity is rather divergent in these two groups. While the more popular Web sites in the category "Water Quality" are rather concentrated, less popular sites exhibit greater distance in the rankings, having the greatest spread of ranks in our sample. By contrast, the distribution of air-quality site ranks is rather symmetric but narrower. Although the most popular Web site was from the category "Directories", Web sites in this category are, on

average, less popular than air-quality and water-quality sites. The least popular sites are those pertaining to forests and rainforests.

We tested for correlations between site rank and the number of days since the last update but did not find any significant interrelations. Also, we did not find a correlation between site rank and compliance to W3C standards. A significant correlation was, however, found between site ranks and accessibility. On average, more popular Web sites contained fewer errors regarding accessibility conformance level "A" than less popular sites. The reason for this causal relationship remains to be explored in future studies.

5.6 Online Donations

Of all Web sites analyzed, only 16% enable people to donate money online. Given the preeminent importance of fundraising for environmental organizations, which for the most part do not offer marketable products and services, it is somehow baffling that this channel of fundraising is not used more often. While technical complexities and the costs associated with online fundraising may deter organizations from accepting online donations, issues such as distrust in the medium or privacy concerns may prevent users from donating online [34].

Essentially, online donations are accepted by Web sites in all four categories: Forest (29%), Directories (13%), Air (8%), Water (2%), Total (16%). The differences among the categories are significant ($\chi 2=19.997$, $p<.000$). Nevertheless, considering that most of the Web sites are maintained by non-profit, governmental or educational organizations, the results strongly suggest that environmental organizations could make much better use of the WWW for acquiring funds.

In addition to evaluating the mere availability of online donation systems, we also analyzed the different payment systems available to donors. Not surprisingly, most of the sites that offer online payment facilities accept credit-card payments (19). Other payment systems offered include checks (14), direct debit or debit transfer (9), PayPal (8) and the opportunity to donate by clicking on a sponsored link (1).

6. Discussion and Conclusion

The results of the above analysis strongly suggest that environmental Web sites have not yet fully tapped the potential benefits and opportunities of the WWW. Overall, the results call for improvements in all areas examined to help these Web sites disseminate environmental information more effectively. First and foremost, the limited use of search capabilities and site maps indicates that not all environmental Web sites recognize that their multiple audiences have varying information needs. Navigational features and content representation devices would not only help users find what they are looking for much faster but would also enable them to grasp what the site has to offer, which may entice them to view parts of they site they would otherwise not have chosen to see.

Furthermore, environmental Web sites need to make much better use of the WWW's interactive capabilities. These could be used to enter into a dialogue with visitors to the site. In particular, e-mail newsletters sent to subscribers could be valuable tools for environmental Web sites to keep in touch with people who have been to the Web site and are thus potentially interested in the organization maintaining the site and its work. In addition, the results clearly show that the Web sites tend to neglect offline communication, often failing to provide telephone numbers and postal addresses. Such information would not only enable users to contact the organization behind the Web site using traditional communication channels, but may also serve to engender trust in the organization, demonstrating that there is more to it than a Web site.

Considering the technical nature of the information disseminated on environmental Web sites, the rare use of glossaries and frequently asked questions indicates that the sites are not particularly attuned to the unique problems and opportunities associated with WWW-mediated environmental communication. Only very few sites recognize the possibility of information overload. Explanatory information such as glossaries and FAQ would make it easier for non-expert visitors to understand technical subject matters. In addition, relatively few sites indicate the date of the last update, which leaves visitors to the sites in doubt as to whether the information made available is accurate and whether the site is still updated at all.

As for accessibility, the sites are well indexed and can thus be found using search engines. However, validation against pre-defined standards of Web-site quality was particularly low. Further, site accessibility to people with disabilities is another starting point for improving the quality of environmental Web sites.

Accepting donations online is another area that warrants more attention from organizations disseminating environmental information on the WWW. Interestingly, Web sites in the categories "Forest" and "Directories", which offer online donations most frequently, are on average less popular than Web sites in the other two categories. However, a Mann-Whitney U test revealed that there are no significant differences in ranks between sites with donation facilities and sites without such functions. Although not all of the Web sites surveyed are dependent on voluntary donations, since they are hosted by government agencies or educational institutions, accepting donations online could still be a way of raising additional funds. Further, such organizations should also consider the use of donation brokers (e.g. *Justgive.org*), which accept credit-card donations on behalf of non-profit

organizations, thus sparing them the need to implement electronic payment systems themselves.

The findings of the study are limited in that the large sample and the manual coding of each site come at the expense of the amount of features that were investigated. The use of additional automated Web site analysis tools may enable researchers to examine a higher number of features, albeit not necessarily the ones considered in this study. Also, some of the features investigated in this study were derived from studies on corporate Web sites and may not be perceived as indicators of quality by visitors to non-commercial Web sites. Therefore, future research could supplement the findings from this study by addressing users' expectations of environmental Web sites and the information needs they seek to satisfy when they visit such Web sites. Since the purpose of this paper was to assess the state of the art of the functionality and accessibility of environmental Web sites, future research is needed to examine the direction and strength of relationships among the variables studied in this paper.

References

[1] Ahmed, P.K. and Hardaker, G. (1999). "The Role of On-line Communities on the Internet for Sustainable Development", *Business Strategy and the Environment*, 8(1), 75-81.

[2] Alabaster, T. and Hawthorne, M. (1999). "Information for Environmental Citizenship", *Sustainable Development*, 7(1), 25-34.

[3] *ALEXA*, http://www.alexa.com

[4] *Audit IT*, http://www.auditit.com/urlcheck/

[5] Bauer, M.W. (2000). "Classical Content Analysis: A Review", *Qualitative Researching with Text, Image and Sound.* Eds. M.W. Bauer and G. Gaskell. London: Sage, 131-151.

[6] Burt, E. and Taylor, J.A. (2000). "Information and Communication Technologies: Reshaping Voluntary Organizations?", *Nonprofit Management and Leadership*, 11(3), 131-143.

[7] *Climate Prediction*, http://climateprediction.net/

[8] *Coastal Management*, http://coastalmanagement.com/

[9] Cukier, W. and Middleton, C.A. (2003). "Evaluating the Web Presence of Voluntary Sector Organizations: An Assessment of Canadian Web Sites", *IT & Society*, 1(3), 102-130.

[10] Dickinger, A., Heinzmann, P., and Murphy, J. (2005). "Mobile Environmental Applications", *Proceedings of the 38th Annual Hawaii International Conference on System Sciences*. Los Alamitos: IEEE Computer Society.

[11] *Dmoz Open Directory*, http:// www.dmoz.org.

[12] European Environment Agency (1999). *A New Model of Environmental Communication for Europe. From Consumption to Use of Information.* Environmental Issue Report No. 13. http://reports.eea.eu.int/92-9167-125-8/en.

[13] González, M.F.J. and Palacios, B.T.M. (2004). "Quantitative Evaluation of Commercial Web Sites: An Empirical Study of Spanish Firms", *International Journal of Information Management*, 24(4), 313-328.

[14] *Google Directory*, http://www.google.com/dirhp.

[15] Handy, F. (2001). "Advocacy by Environmental Non-Profit Organizations – An Optimal Strategy for Addressing Environmental Problems?", *International Journal of Social Economics*, 28(8), 648-666.

[16] Hart, T.R. (2002). "ePhilanthropy: Using the Internet to Build Support", *International Journal of Nonprofit and Voluntary Sector Marketing*, 7(4), 353-360.

[17] Herring, S. (1999). "Interactional Coherence in CMC", *Journal of Computer-Mediated Communication*, 4(4), http://jcmc.indiana.edu/vol4/issue4/.

[18] Hrebicek, J. and Kubasek, M. (2004). "EnviWeb and Environmental Web Services: Case Study of an Environmental Web Portal", *Environmental Online Communication.* Ed. A. Scharl. London: Springer, 21-24.

[19] Hung, W.-H. and McQueen, R.J. (2004). "Developing an Evaluation Instrument for e-Commerce Web Sites from the First-Time Buyer's Viewpoint", *Electronic Journal of Information Systems Evaluation*, 7(1), 31-42.

[20] Isenmann, R. (2004). "Internet-Based Sustainability Reporting", *International Journal of Environment and Sustainable Development*, 3(2), 145-167.

[21] Karatzas, K. et al. (2004). "Environmental Information Systems and the Concept of Environmental Informatics", *Environmental Online Communication.* Ed. A. Scharl. London: Springer, 3-9.

[22] Kelle, U. and Laurie, H. (1995). "Computer Use in Qualitative Research and Issues of Validity", *Computer-Aided Qualitative Data Analysis. Theory, Methods and Practice.* Ed. U. Kelle. London: Sage, 19-28.

[23] Kim, J., Lee, J., Han, K., and Lee, M. (2002). "Businesses as Buildings: Metrics for the Architectural Quality of Internet Businesses", *Information Systems Research*, 13(3), 239-254.

[24] Kleinrock, L. (2004). "The Internet Rules of Engagement: Then and Now", *Technology in Society*, 26, 193-207.

[25] Kunst, M. and Witlox, N. (1993). "Communication and the Environment", *Communication Research Trends*, 13(1), 1-31.

[26] Lee, T.E., Chen, J.Q., and Zhang, R. (2001). "Utilizing the Internet as a Competitive Tool for Non-Profit Organizations", *The Journal of Computer Information Systems*, 41(3), 26-31.

[27] Lii, Y.-s., Lim, H.J., and Tseng, D.L.P. (2004). "The Effects of Web Operational Factors on Marketing Performance", *Journal of American Academy of Business*, 5(1/2), 486-494.

[28] Madeja, N. and Schoder, D. (2003). "Designed for Success – Empirical Evidence on Features of Corporate Web Pages", *36th Hawaii International Conference on System Sciences*. Los Alamitos: IEEE Computer Society.

[29] Mayfield, C., Joliat, M., and Cowan, D. (2001). "The Roles of Community Networks in Environmental Monitoring and Environmental Informatics", *Advances in Environmental Research*, 5, 385-393.

[30] Palmer, J.W. (2002). "Web Site Usability, Design, and Performance Metrics", *Information Systems Research*, 13(2), 151-167.

[31] Palmer, J.W. and Griffith, D.A. (1998). "An Emerging Model of Web Site Design for Marketing", *Communications of the ACM*, 41(3), 44-51.

[32] Pillmann, W. (2000). "Environmental Communication Systems Analysis of Environmentally Related Information Flows as a Basis for the Popularization of the Framework for Sustainable Development", *Computer Science for Environmental Protection 2000*, Vol. II, Eds. A.B. Cremers and K. Greve. Marburg: Metropolis, 1-14. http://enviroinfo.isep.at/Umweltinformatik2000.htm.

[33] Pohl, I. (2004). "Usability Evaluation of an Environmental Web Site and Its Support of the Organization's Mission and Goals", *Environmental Online Communication*. Ed. A. Scharl. London: Springer, 53-62.

[34] Pollach, I., Treiblmaier, H., and Floh, A. (2004). "Online Fundraising for Environmental Nonprofit Organizations", *38th Hawaii International Conference on System Sciences*. Los Alamitos: IEEE Computer Society.

[35] Potelle, H. and Rouet, J.-F. (2003). "Effects of Content Representation and Readers' Prior Knowledge on the Comprehension of Hypertext", *International Journal of Human-Computer Studies*, 58(3), 327-345.

[36] Robbins, S.S. and Stylianou, A.C. (2003). "Global Corporate Web Sites: An Empirical Investigation of Content and Design", *Information & Management*, 40, 205-212.

[37] Rose, G.M., Meuter, M.L., and Curran, J.L. (2005). "On-line Waiting: The Role of Download Time and Other Important Predictors on Attitude toward E-retailers", *Psychology & Marketing*, 22(2), 127-151.

[38] Scharl, A., Pollach, I., Pieber, M., and Treiblmaier, H. (2004). "Environmental Investment Sites: Sector Analysis and Development of GreenMoney.at", *Environmental Online Communication*. Ed. A. Scharl. London: Springer, 161-172.

[39] Strodthoff, G.G., Hawkins, R.P., and Schoenfeld, A.C. (1985). "Media Roles in a Social Movement: A Model of Ideology Diffusion", *Journal of Communication*, 35(2), 134-153.

[40] Taylor, M., Kent, M.L., and White, W.J. (2001). "How Activist Organizations are Using the Internet to Build Relationships", *Public Relations Review*, 27, 263-284.

[41] Tuckman, H.P., Chatterjee, P., and Muha, D. (2004). "Nonprofit Websites: Prevalence, Usage and Commercial Activity", *Journal of Nonprofit & Public Sector Marketing*, 12(1), 49-67.

[42] United Nations (1992). *Rio Declaration on Environment and Development*, http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm/.

[43] van Iwaarden, J., van der Wiele, T., Ball, L., and Millen, R. (2003). "Applying SERVQUAL to Web Sites: An Exploratory Study", *The International Journal of Quality & Reliability Management*, 20(8/9), 919-935.

[44] W3C (1999). *Web Content Accessibility Guidelines 1.0*, http://www.w3.org/TR/1999/WAI-WEBCONTENT-19990505/.

[45] Waite, K. and Harrison, T. (2002). "Consumer Expectations of Online Information Provided by Bank Websites", *Journal of Financial Services Marketing*, 6(4), 309-322.

[46] *WebXACT*, http://webxact.watchfire.com

[47] Wenham, K., Stephens, D., and Hardy, R. (2003). "The Marketing Effectiveness of UK Environmental Charity Websites Compared to Best Practice", *International Journal of Nonprofit and Voluntary Sector Marketing*, 8(3), 213-223.

[48] World Bank (2003). *World Development Report 2003 – Sustainable Development in a Dynamic World: Transforming Institutions, Growth, and Quality of Life*. http://www-wds.worldbank.org/.

[49] *Yahoo*, http://www.yahoo.com.