Using the Internet for Natural Resource Research: Results from an Online User Survey

Yu-Fai Leung*

ABSTRACT

Using the Internet as a research tool has become a common practice among natural resource and other professionals. However, we know little about how natural resource professionals utilize the Internet and how they perceive the impact of the Internet on their research endeavors. The objective of this exploratory study was to address these questions by means of an online user survey posted on the Internet in the form of a World Wide Web (WWW) home page; 279 valid responses were collected from a variety of institutional affiliations and natural resource subdisciplines. Most respondents spent less than 1 h each day online, and they used email and the WWW most often. The impact of the Internet on research activities was recognized among the respondents, while two specific aspects of research activity were perceived to be more affected—literature search/acquisition and research collaboration. Important issues concerning the use of the Internet in natural resource research, as well as the utility and limitations of Internet surveys, are discussed.

In the past few years, the Internet has experienced an exponential growth in popularity and significance. Recent estimates of worldwide Internet users range from 23.5 to 26.4 million, while the number of Internet hosts (sites with specific network address) doubled in 1 yr to 12.8 million in July 1996 (Kantor and Neubarth, 1996). The Internet, particularly its versatile World Wide Web (WWW) component, offers unprecedented promise in this information age thanks to its exceptional qualities such as its enormous information base, its ability to transcend time and space, hypertext linkages and hypermedia capabilities, instantaneous response, platform independence, and dynamic and decentralized structure (Leung, 1997). The Internet seems to have unlimited possibilities for academic research as more research-related information is accessible in a more organized manner, and as more powerful Internet tools are developed (Brody, 1996; Butler, 1996; Taubes, 1996a).

The impact of the Internet is felt in the collective natural resource field, with educational, research, and extension efforts undergoing electronic transformations. Here are some examples:

1. Electronic mail (email) is routinely used for communicating and collaborating with colleagues (Rose, 1994)
2. Classroom instructors increasingly take advantage of Internet’s multimedia capabilities (Logan, 1996)
3. Most natural resource schools and agencies have set up their WWW home pages to provide institutional and research information (Leung, 1995–1997)
4. More data sets and publications are available or downloadable from WWW or FTP sites (Green and Sommer, 1995)
5. More educational materials and technical reports are delivered electronically to the public (Megalos and Payne, 1996)
6. More national parks or otherwise protected areas have made their maps, regulations, and other visitor information available online (Freimund and Queen, 1996)


Although more online information is available, and supposedly more natural resource researchers and students are relying on the Internet for their communication and information needs, we know little about: (i) what Internet tools they use; (ii) how much time they invest in exploring (surfing) the Net; and (iii) how they perceive the impact of the Internet on their research activities. This study attempted to answer these questions by means of an online user survey.

RESEARCH METHODS

This exploratory study utilized the Internet as a data-gathering tool by posting a survey on a popular WWW site that provides natural resource information and collecting the responses. One major advantage for conducting Internet surveys is that they can easily reach target populations and solicit responses around the clock and around the globe at minimal cost. Survey instruments in WWW format, such as pull-down menus and clickable buttons, are user-friendly, therefore facilitating the response process (Schonland and Williams, 1996). Internet surveys, however, suffer from significant limitations such as self-selection and sampling bias (Georgia Tech GVU Center, 1996; Harris, 1996). Respondents self-select themselves when they decide to participate in such surveys by filling out the online questionnaire. The sample obtained is nonrandom, restricting the external validity or generalizability of such surveys. Finally, it is difficult, if not impossible, to assess the nonresponse bias and the accuracy of information provided by the respondents.

Recognizing these limitations, this survey sought to gather use information and opinions from a convenient sample of natural resource researchers, professionals, and students. A WWW home page comprising a questionnaire was online from 20 April to 19 August of 1996 (Fig. 1). This questionnaire was titled “Natural Resources Research on the Internet: A User Survey,” and was linked from the Natural Resources Research Information Pages (NRRIPS)—a com-

Department of Forestry, Virginia Polytechnic Inst. and State Univ., Blacksburg, VA 24061-0324. Received 30 Jan. 1997. *Corresponding author (yfleung@vt.edu).


Abbreviations: WWW, World Wide Web; NRRIPS, Natural Resources Research Information Pages; OCLC, Online Computer Library Center; FTP, file transfer protocol.
A comprehensive collection of pointers to natural resource information (Leung, 1995–1997). More than 25,000 hits were recorded for the NRRIPS home page from its inception in May 1995 to June 1996. The NRRIPS is accessible from major Internet catalogs such as Yahoo, Online Computer Library Center (OCLC)’s Database of Internet Resources (NetFirst), WWW Virtual Libraries (Forestry, Biosciences), and from search engines such as Lycos, Webcrawler, and InfoSeek. The survey was therefore able to reach most users who utilize the Internet for natural resource information. To recruit more participants, this survey was also advertised on various Usenet newsgroups related to ecology and natural resources.

Patrons of the NRRIPS were invited to visit the questionnaire home page (Fig. 1), and those who agreed to participate were asked the following questions:

1. How much time do you typically spend on the Internet for research purposes each day?
2. Which two types of the Internet (e.g., WWW, email, FTP) do you use most and second most often?
3. To what extent has the Internet changed the way you perform your research activities? Five aspects of research activity were assessed in this question: literature search and acquisition, funding search and acquisition, research collaboration, result dissemination, and scientific publishing. A 4-point impact rating scale was adopted: 1 = minimal; 2 = somewhat; 3 = quite; 4 = very much. An option for no comments was provided.
4. Rate the overall significance of the Internet’s role in research activities. A similar 4-point rating scale was adopted: 1 = minimally significant; 2 = somewhat significant; 3 = quite significant; 4 = very significant. An option for no comments was provided.

5. Provide affiliation and primary research area.
6. Open-ended comments.

We hypothesized the following:

Hypothesis (a). The WWW and email would be the most popular Internet tools.
Hypothesis (b). The impact of the Internet on different aspects of research activity would not be uniform.
Hypothesis (c). Respondents with different institutional affiliations would perceive the impact of the Internet differently.

Responses gathered during the sampling period were coded and analyzed. The country of residence of the respondents was determined by the domain part of their email addresses (i.e., XXX.edu indicates a U.S. institution address; XXX.au indicates an Australian address). The non-randomness and small size of the sample precluded any meaningful use of inferential statistics. Quantitative results will therefore be presented with caution, augmented by open comments provided by the respondents.

RESULTS AND DISCUSSION

Use Characteristics

A total of 279 valid responses (with reasonably completed answers) were collected during the 4-mo sampling period. The total number of hits on the NRRIPS home page for the same period was 2255, yielding an estimated response rate of 12.4%. The respondents were located in 26 different countries around the world, with 38% came from Canada or the USA. Their profiles are presented in Table 1. Fifty-one percent of the respondents were affiliated with academic institutions (34% were students and 17% were faculty members). Practitioners in government agencies made up another 17%. The top four primary research areas that were reported most frequently were recreation/tourism (18%), forestry (17%), natural resources—general (15%), and environmental protection—general (14%).

By far the most dominant Internet tools used by the respondents were email and the WWW.

Table 1. Profile of survey respondents.

<table>
<thead>
<tr>
<th>Profile</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affiliation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academic institutions: students</td>
<td>96</td>
<td>34.4</td>
</tr>
<tr>
<td>Government agencies</td>
<td>48</td>
<td>17.2</td>
</tr>
<tr>
<td>Academic institutions: faculty</td>
<td>47</td>
<td>16.8</td>
</tr>
<tr>
<td>Commercial organizations</td>
<td>36</td>
<td>12.9</td>
</tr>
<tr>
<td>Nonprofit organizations</td>
<td>14</td>
<td>5.0</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>14</td>
<td>5.0</td>
</tr>
<tr>
<td>Unknown</td>
<td>24</td>
<td>8.6</td>
</tr>
<tr>
<td>Total</td>
<td>279</td>
<td>100</td>
</tr>
<tr>
<td>Primary Research Area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recreation/tourism</td>
<td>50</td>
<td>17.9</td>
</tr>
<tr>
<td>Forestry</td>
<td>48</td>
<td>17.2</td>
</tr>
<tr>
<td>Natural resources—general</td>
<td>43</td>
<td>15.4</td>
</tr>
<tr>
<td>Environmental protection—general</td>
<td>40</td>
<td>14.3</td>
</tr>
<tr>
<td>Wildlife resources</td>
<td>16</td>
<td>5.7</td>
</tr>
<tr>
<td>Water resources</td>
<td>12</td>
<td>4.3</td>
</tr>
<tr>
<td>Protected areas/parks</td>
<td>13</td>
<td>4.7</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>19</td>
<td>6.8</td>
</tr>
<tr>
<td>Unknown</td>
<td>38</td>
<td>13.6</td>
</tr>
<tr>
<td>Total</td>
<td>279</td>
<td>100</td>
</tr>
</tbody>
</table>
ports Hypothesis (a). Most respondents reported that they use either the WWW (60%) or email (36%) most often. Only about 25% of the respondents reported that they frequently (most or second most often) use Internet tools other than email and the WWW. These other Internet tools were Gopher (text-based hierarchical system), FTP (file transfer protocol), Telnet (remote login), and Usenet (newsgroups).

The majority of respondents (67%) typically spend <1 h each day on the Internet, whereas 24% of the respondents spend 1 to 2 h. Only 9% of the respondents reported that they spend >2 h online each day. No noticeable differences in time spent online were found among different user groups (institutional affiliations).

**Perceived Impact**

Results of impact ratings are summarized in Fig. 2. The respondents were not overly enthusiastic about the impact of the Internet on their research endeavors, as the majority of impact ratings fell between 2.0 and 3.0 (somewhat to quite). Rating patterns for different user groups were similar except for result dissemination. For instance, regardless of the respondent’s affiliation, the impact of the Internet on literature search and research collaboration, as well as the overall significance, was rated higher than that of funding search and scientific publishing. These findings support Hypothesis (b) and partially support Hypothesis (c).

More than 50% of the respondents felt that the Internet has quite or very much changed the way they search and acquire research literature. The mean impact rating was 2.5, which varied from an average of 2.3 for the student respondents to an average of 2.8 for the respondents in government agencies or in commercial organizations (Fig. 2). When the Internet was considered as a tool for research funding searches and acquisition, 47% of the faculty respondents and 38% of the agency respondents perceived only minimal impact, although more respondents in commercial and nonprofit organizations felt the Internet was somewhat significant. The mean impact rating was only 1.6, which varied from an average of 1.3 for agency researchers to an average of 1.7 for professionals in nonprofit organizations.

The global accessibility of the Internet provides great potential for collaborative research. Thirty percent of the respondents in commercial organizations and 43% in nonprofit organizations perceived the Internet has quite or very much changed the way they perform collaborative research activities. The mean impact ratings varied from an average of 2.3 for the respondents in commercial organizations to an average of 2.5 for the respondents who were faculty members or were affiliated with nonprofit organizations.

Greater differences in perceived impact were found on two aspects of research activity: dissemination of research results and scientific publishing. For result dissemination over the Internet, 36% of the respondents in nonprofit organizations perceived a very significant impact, while only 11% of the faculty respondents and 13% of the agency respondents reported the same rating. The mean impact rating was 2.2, which ranged from an average of 2.0 for the student respondents to an average of 3.0 for the respondents in nonprofit organizations (Fig. 2).

Similarly to result dissemination, 64% of the respondents in nonprofit organizations perceived that the Internet has somewhat to very much changed the way they pursue scientific publishing, while only 32% of the faculty respondents and 33% of the respondents in commercial organizations felt the same way. The mean impact rating for scientific publishing was 1.8, which varied from an average of 1.6 for

---

Fig. 2. Mean individual impact and overall significance ratings of the Internet for natural resource research.
the faculty and agency respondents to an average of 2.1 for the respondents in nonprofit organizations.

For the overall evaluation, most respondents perceived the Internet to have a somewhat significant to quite significant role to play in research activities. However, the percentage of very much significance rating varied from 25% among the student respondents, to 21% among the respondents in nonprofit organizations, to only 13% among the faculty respondents. The mean overall significance rating was 2.8, with a range from an average of 2.5 for the respondents in government agencies to an average of 2.9 for the respondents who were students or were affiliated with commercial organizations.

Respondents’ Comments

The current use situation and perceptions of the Internet for research activities can be understood from qualitative comments made by the respondents. The potentials of the Internet were recognized by many respondents who believed that the Internet has a lot to offer. Many praised the benefits of the Internet’s global and round-the-clock access to researchers, particularly those who are located in remote areas and foreign countries. Some respondents were particularly pleased with the email system as it defines a whole new meaning of communication and research collaboration in a borderless and instantaneous sense. The utility of the Internet beyond a huge passive information archive was also demonstrated by the respondents. One example was that mailing lists, Usenet newsgroups, and other forms of Internet discussion forums can be used for gauging public opinion promptly and inexpensively.

Some respondents, however, shared their frustrated experiences in using the Internet as a research tool. Usual complaints included scarce availability of quality databases and full-text papers, difficulties in searching specific and latest information, junk and superficial material, and imprecise search capabilities. Reservations among faculty members on using the Internet as a research tool were noted by one student:

I have found that many of my professors do not like to accept information off the WWW. They feel the information is unreliable because you never know exactly where the data is coming from.

Survey Implications

The results of this exploratory study suggest that the WWW and email are the most commonly used Internet tools for the survey respondents. The dominance of the WWW is partly due to the fact that most tasks performed by other Internet tools can also be implemented in the user-friendly WWW environment. Ease of use, speed of communication, and versatile utilities may also explain the popularity of email among the respondents. For instance, having an email account usually means that you can send and receive messages, deliver and receive documents or files, obtain research news, and participate in discussion forums in the form of electronic mailing lists.

Using the Internet for research may save a great deal of time and cost associated with communicating with colleagues or with travel, but it may also consume your time without accomplishing any goals. This is particularly true for information searches through poorly designed and maintained WWW home pages and search engines (Harris, 1996; Leung, 1997). It should be expected that as search engines and Internet catalogs of higher quality become available, the time needed to spend online to locate and acquire research materials would be reduced, although the ever-growing information base and proliferating graphic-laden WWW home pages might counteract with this trend.

Literature search and research collaboration were the two aspects of research activity that were perceived to be more impacted by the Internet. This perception is supported by a recent study that reported that faculty members who used computer mediated communication were more academically productive partly due to facilitated collaborative work (Cohen, 1996). In addition to literature search and communication, the Internet can greatly facilitate delivery of research and technical materials to target audience and the public. This is particularly important to nonprofit organizations that have limited budgets and widespread audiences.

The Internet was perceived to have less impact on research funding searches and scientific publishing. So far the Internet seems to be mostly helpful for locating funding opportunities, but applicants usually need to do additional work to secure funding. Academic communities recognize, value, and reward the well-established printed scholarly publications much more than online publications. As Taubes (1996b) observed, ‘the best authors’ are still hesitant to submit their work to online publications. This might explain why many faculty and agency respondents in this survey thought that the Internet had only a marginal impact on this aspect of research.

CONCLUSIONS

This study attempted to address some important issues related to the use and perceptions of the Internet for natural resource research. It also demonstrated the possibility and utility of the Internet as an active data-collecting instrument. However, significant limitations on the validity of this survey must be recognized before general conclusions can be drawn. It is likely that this survey reached only those individuals who were interested in natural resource information, had access to and knew how to use a WWW browser (e.g., Netscape), came across the NRRIPS, and were willing to participate. We do not know how Internet nonusers perceive the impact of the Internet, we do not know how well the results of this survey represent the natural resource community, and, above all, we do not know to what extent the Internet can be used as a survey instrument and platform. Methodological studies are necessary to establish the proper design, validity, and utility of such surveys. More comprehensive user surveys are also needed.

Despite the limitations, this paper has revealed several issues that should be of interest to the natural resource community: (i) the impact of the Internet for research appears to be felt; (ii) some aspects of research activity seem to be more impacted by the Internet; (iii) if the Internet is to be used consistently and efficiently as knowledge and data archives, search and indexing capabilities must be improved, and the validity and reliability of the information
retrieved from the Internet must be known. Some faculty and agency researchers are still skeptical about the utility of the Internet and the quality of online information. Such a resistance can greatly affect their willingness to perform scholarly activities on the Internet, especially those activities that are critical in evaluating their performance such as scientific publishing. This would in turn hinder the growth of quality research materials on the Internet. These and other issues need to be recognized and addressed by the natural resource community if we are to fully reap the benefits of the Internet.

ACKNOWLEDGMENTS

The author thanks Dr. Jeffrey L. Marion, Dr. R. Bruce Hull, and two anonymous reviewers for their helpful comments on the manuscript.

REFERENCES
