

INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps. Each original is also photographed in one exposure and is included in reduced form at the back of the book.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.

UMI

**A Bell & Howell Information Company
300 North Zeeb Road, Ann Arbor MI 48106-1346 USA
313/761-4700 800/521-0600**

.

ABSTRACT

**Title of Dissertation: ELECTRONIC JOURNALS AS INNOVATIONS:
 A STUDY OF AUTHOR AND EDITOR EARLY
 ADOPTERS**

Karla Lynn Hahn, Doctor of Philosophy, 1999

**Dissertation directed by: Professor Marilyn Domas White
 College of Library and Information Services**

Electronic publishing holds the potential to alter scientific communication radically, although this transition is only in its earliest stages. Because of this, the current moment presents an opportunity to study the process of transformation as it unfolds from the viewpoints of early participants. This study investigated three research questions about how authors, editors, and readers of two electronic journals serving the ecology community viewed the development of electronic journals; how authors arrived at the decision to become involved in electronic publishing; and how social structures influenced the decision process. A qualitative approach was used to address these questions and to develop emergent themes. Three conceptual foundations grounded the project: Rogers' paradigm of diffusion of innovations, existing models of scientific communication, and the sociology of science. Data were gathered from interviews and supporting

documents. The two journals, while both relatively new and serving the same discipline, adopted somewhat different approaches to electronic publishing: one employed an electronic-only format and the second offered simultaneous print and electronic publication. These are currently the two main approaches to developing electronic journals.

The main findings of the study are (1) eight elements characterizing informants' perceptions of electronic publishing, (2) an open systems model of the journal selection decision, (3) the discovery of the key role of editors as opinion leaders, and (4) the importance of three emergent themes for understanding the development of an electronic publishing system. The eight elements characterizing perceptions of electronic journals are accessibility, interaction, interconnection, usability, acceleration, quality filtering, online discussion, and cost effectiveness. These characteristics emphasize the role of journals within the sphere of scientists' work rather than focusing on specific technologies. The model of the journal selection decision explains the various factors and the actors who use and influence the factors. The main entities within the model are authors, editors, manuscripts, and journals. The key social connections within the system are between authors and editors. The three emergent themes provide key factors for the success of electronic publishing: (1) greater integration and (2) better time management and acceleration of processes

**ELECTRONIC JOURNALS AS INNOVATIONS:
A STUDY OF AUTHOR AND EDITOR EARLY ADOPTERS**

by

Karla Lynn Hahn

**Dissertation submitted to the Faculty of the Graduate School of the
University of Maryland, College Park in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
1999**

Advisory Committee:

**Professor Marilyn D. White, Chair/Advisor
Professor Eileen G. Abels
Professor Fred D. Davis
Professor Delia Neuman
Dr. Natalie A. Schoch**

UMI Number: 9926786

UMI Microform 9926786
Copyright 1999, by UMI Company. All rights reserved.

**This microform edition is protected against unauthorized
copying under Title 17, United States Code.**

UMI
300 North Zeeb Road
Ann Arbor, MI 48103

DEDICATION

This dissertation is dedicated to the memory of Jenrose Weldon who showed me what it means to persist in following your dreams.

ACKNOWLEDGEMENTS

I am indebted to many friends, colleagues, and advisors who supported me through this project. Particular thanks are due to Marilyn White, my advisor. Her advice, support, and encouragement are greatly appreciated. I also owe special thanks to Delia Neuman for her critical assistance in the development and implementation of my methodology. I am also indebted to the generosity of my informants. All contributed significant time to the study, and many were exceptionally generous in their contributions of additional information sources and contacts. Finally I want to recognize the special contribution of my husband, Saul, whose loving support has assisted with every phase of this endeavor.

This research was partially supported by an ISI Doctoral Dissertation Scholarship Award.

TABLE OF CONTENTS

DEDICATION	ii
ACKNOWLEDGEMENTS	iii
LIST OF TABLES	vi
LIST OF FIGURES	viii
Chapter 1: Introduction.....	1
Chapter 2: Conceptual Foundations	9
Review of Electronic Publishing Research	10
Diffusion of Innovations	18
Scientific Communication.....	28
Philosophy and Sociology of Science.....	38
Chapter 3: Methods	44
Informants	53
Interview Protocols	60
Data Analysis.....	61
Chapter 4: Findings Based on the Initial Research Questions.....	66
Characterizing the Innovation	66
Comparison with the Innovation Cluster Analysis.....	84
The Publication Decision	90
Journal Selection Decision Elements.....	91
Patterns Among Authors	108
Role of Social Relationships	114
Characterizing the Research Community.....	114
Patterns of Interconnectedness	116
The Special Role of Editors	118
Chapter 5: Emergent Themes.....	122
Integration	123
Integration of Published Research Artifacts.....	123
Integration of the Ecology Research Community.....	129
Integration of Ecology and Applied Research Communities.....	135
Time	139
Individuals and Time Management	140
The Arena of the Research Project	145

Timing Issues and the Progress of the Community's Research Agenda.....	150
Timing Issues Relating to Interactions of the Research and Applied Communities.....	154
Peer Review.....	157
Chapter 6: Conclusions.....	178
Summary of Findings:.....	178
Diffusion Theory.....	182
Formative Effects of the Model.....	182
Applying the Model to the Research Questions.....	183
Additional Observations Grounded in the Diffusion Paradigm.....	188
Scientific Communication and the Sociology of Science.....	190
Tailoring of Electronic Functions to Community Needs.....	191
The Journal Selection Process Model.....	194
Changing the Scholarly Communication Process.....	198
Potential Applications and Future Directions.....	206
Implications for Electronic Journal Development.....	206
Potential directions for future research.....	208
Some speculations.....	209
Potential Criticisms.....	212
End Notes.....	217
Appendix A.....	219
Interview Protocol for Authors.....	219
Interview Protocol for Editors.....	222
Interview Protocol for E-journal readers.....	226
Appendix B.....	229
Coding.....	229
References.....	238

LIST OF TABLES

1	Innovation Cluster Members from Hahn and Schoch (1997).....	23
2	Comparison of the Study's Journals.....	47
3	Purposes/Questions/Methods Matrix.....	48
4	Informant Identifiers and Roles Discussed	59
5	Summary of Electronic Journal Characteristics Discussion Among Authors Primarily Affiliated with Journal E	76
6	Summary of Electronic Journal Characteristics Discussion Among Authors Primarily Affiliated with Journal P.....	77
7	Summary of Electronic Journal Characteristics Discussion Among Editors and Publishing Staff	78
8	Summary of Electronic Journal Characteristics Discussion Among Readers	79
9	Number of Informants Mentioning Electronic Publishing Dimensions by Informant Role.....	93
10	Number of Informants Mentioning Each Decision Element by Group.....	92
11	Matrix of Referent Mentions by Informants	117
12	Dimensions of Integration within Electronic Publishing.....	124
13	Time and Timing Issues Affecting the Scientific Publishing System.....	141
14	Ecologists' Three-tiered Model of Journal System Structure.....	163
15	Mapping of Themes and Findings for Research Questions 1 and 2.....	172
16	Comparison of Ecologists' and Psychologists' Journal System Structuring.....	197

B1 Open Codes Developed during Data Collection.....	231
B2 Axial Coding Related to the Study’s Foreshadowing Questions.....	235
B3 Axial Codes for Emergent Themes.....	238

LIST OF FIGURES

1	Model of Journal Selection Process.....	112
2	Modernized Garvey/Griffith Model (from Hurd 1996b).....	203
3	No-journal Model (from Hurd 1996b).....	204
4	Unvetted Model (from Hurd 1996b)	205
5	Collaboratory Model (from Hurd 1996b)	206

Chapter 1: Introduction

Although electronic journals have been technologically feasible for many years, the recent development and widespread adoption of the World Wide Web have greatly accelerated the appearance of both new all-electronic journals and electronic counterparts of existing print journals. There has been much speculation regarding the ultimate effects of the widespread use of electronic distribution of scholarly research as well as many attempts to advocate for various possible scenarios; however, very little is truly known about even the current success of existing electronic publications.

In 1997, a survey revealed that 24% of the journals in Science Citation Index were available online with smaller percentages available for social science and humanities journals (Branin & Case, 1998). Clearly, the present interval is one of transition from print to online distribution. This transition is occurring within a scholarly communication system that is currently under considerable strain. Much has been written about the concurrent increase in the volume of scholarly output and the cost of journal subscriptions in the science and technology arena. Tenopir & King (1997) presented perhaps the most data-rich and consequently disturbing report of the situation; they documented changes from 1975 to 1995. During this period the number of titles increased from 4,175 to 6,771. The average cost per title increased from \$39 to \$284 (well above the inflation rate for the period). Beyond documenting the changes in cost and

quantity; however, these authors also demonstrated the effects on scientists' reading behavior and use of journals. Tenopir and King found that scientists were reading slightly more articles but subscribing to far fewer journals personally. Scholars were supporting the reduced access to personal subscriptions with increased readings of library subscriptions. At the same time libraries were subscribing to somewhat fewer journals.

In general, the library community has long been aware of this uncomfortable tension among decreasing resources, increasing costs, and increasing demand. Discussion of the extent of the so-called serials crisis is widespread within the library literature. Carr, Buchanan, Adkins-Heljesen, Mettile, and Sorensen (1997) presented perhaps one of the most complete descriptions in print of a situation that has become common among American research libraries. Using the situation at the University of Kansas Library as a touchstone, they described a common scenario among American university libraries in which materials budgets are unable to keep pace with spiraling serials price increases. The typical results are reductions in the numbers of serials and monographs purchased and increasing reliance on interlibrary loan.

What has been perhaps more recently acknowledged within the library community and academia generally is the key role of scientists as the producers of the content and consumers of the published products in the development of the current publication system (Association of Research Libraries, Association of American Universities, & Pew Higher Education Roundtable, 1998; Bachrach et

al., 1998; Branin & Case, 1998). Increasingly arguments are being made that the crisis in scholarly publishing is not merely a library problem but rather a problem for the scientific community as a whole. Articles, news items, and letters to the editor relating to these issues have begun to appear regularly in Science and American Scientist (the membership publications of the American Association for the Advancement of Science [AAAS] and Sigma Xi respectively). That the two prominent American scientific organizations with memberships cutting across all scientific disciplines are sponsoring discussion of the issue demonstrates the general concern felt by the scientific community.

Against this backdrop of crisis in the current print-based communication system, the emergence of electronic journals not only offers more cost-efficient ways of distributing scholarly research but also promises new and more effective ways of distributing the results of scholarly research and increasing the rate of advance of the scientific enterprise. Even before the advent of the World Wide Web, the potential of electronic publishing became evident (Borman, 1993) and experiments were developed to test a range of mechanisms for creating and distributing digital publications. Psycoloquy was an early attempt to use the Internet and electronic mail to distribute and display a scholarly journal (Harnad, 1990). The Online Journal of Current Clinical Trials was started in 1992 and used the Internet for distribution and proprietary client software for display and searching (Keyhani, 1993). Elsevier's TULIP Project included a number of variations on electronic distribution and display (Borghuis et al., 1996). These and

other projects showed that developing effective technologies for creating and distributing digital publications posed many unforeseen challenges. These challenges were not limited to the development of the technology but also arose from the current organization of the distribution process for print publications and from the culture of scholarly communication. However, despite the challenges illuminated by the early projects, they succeeded in making the potential benefits of electronic publishing more tangible to publishers, libraries, and scholars.

This environment of dissatisfaction with traditional scholarly publishing systems overlaid with excitement about the potential of currently emerging electronic publishing systems suggests that a study of the development of electronic publications has significance as an object of research. While electronic publications are currently being developed to serve nearly all scientific communities, several research communities have a longer history than others. For example, the physics community has long been experimenting with various systems for distributing both reviewed and unreviewed research reports (Hurd, 1996a). In addition, different communities clearly have different interests in developing particular features of electronic publications. This is evidenced by a current wide degree of variation in the form of electronic journals.

Because the current situation is dynamic and electronic publications highly variable, a qualitative case study provides an appropriate starting point for developing an understanding of the emergence of electronic publications. Qualitative methods are also appropriate for capturing the views of scientists

actively involved in the publishing system. Much has been written by publishers and librarians representing the views of their interest groups, but very little is known of the views of the people who produce and consume the content of the publishing system. A case study approach based within a single scientific community is also appropriate because electronic publications are frequently developed within a research community to meet particular needs perceived by that community.

The research project reported here does not rely on retrospective interpretation of events relating to the development of electronic journals. An earlier pilot study of the Online Journal of Current Clinical Trials demonstrated the difficulties of investigating electronic journal development that had occurred several years in the past, in particular, prior to the widespread adoption of the World Wide Web. The report of the TULIP project also highlighted the difficulties of applying results learned in a pre-Web distribution environment to the current environment, where it seems inevitable that any successful electronic journal development will rely heavily on the World Wide Web (Borghuis et al., 1996). In light of these considerations, the research focuses on journals two that have recently developed in the field of ecology.

Three initial research questions were developed to serve as a starting focus to the research project. These three research questions illustrate the main the concerns of the study:

1. How do the authors and editors working closely with an electronic journal perceive electronic journals?
2. What is the decision process that authors are using to decide to publish in an electronic journal?
3. How do social factors influence the adoption decision?

To some extent these questions are based in diffusion theory as described by (Rogers, 1995). The first question addresses one facet of the issue of what electronic publishing as an innovation is. The intent of the project was not to determine the objective reality of electronic journals or even of a particular electronic journal but to explore the perceived nature of the innovation from the viewpoint of at least one group of people whose views are important -- authors and editors within the research community. In this case the views of the first people to use the innovation provide appropriate objects of study since these adopters made some kind of commitment to the innovation and had some direct experience with it.

The second question is based on an idea from diffusion research: the adoption decision process is a key subprocess in the diffusion of an innovation. For authors, an initial question was whether the adoption process might roughly correspond to the decision to publish an article in an electronic journal. In the world of paper publishing little attention has been focused on this activity. Thus a foreshadowing question was what does this process look like? Another was, what are the stages of the process and what factors influence the author's decision?

Since the focus of interest was electronic publishing, it was important to ask how the characteristics of a particular electronic journal influence the decision. Also, it was not clear how closely the author's publishing decision process mapped to the diffusion model's adoption decision process.

The third research question is based on the recognition that it is unlikely that an author's decision to publish in an electronic journal would be based strictly on the advantages or disadvantages of the distribution medium. Science is generally a social enterprise and diffusion is influenced by social factors. Thus at the outset of the study it was reasonable to expect that social factors played a role in authors' decision processes. Editors were likely to be one focus of social ties and others might exist between authors. As a result it was important to seek information on social structures that were affecting the decision process, to identify their nature and their roles in publishing decisions.

While the three research questions have roots in diffusion theory as a conceptual foundation, the utility of the questions does not depend on the applicability of diffusion theory to the development of electronic journals. Rather diffusion theory served as a research tradition that suggested some useful points of inquiry when looking at a new technology such as electronic publishing.

The research project was envisioned as exploratory and formative at the outset -- hence the appropriateness of qualitative approaches. However, because the study uses a qualitative approach, an expectation existed at the outset that the project would generate some emergent findings as well as answers to the research

questions. Together the emergent findings and the answers to the research questions form the body of the research results reported here.

Chapter 2: Conceptual Foundations

Although a significant literature has already developed around electronic publishing this literature is largely descriptive or even speculative rather than empirical. Kling and Lamb (1996) have even published an analysis of the utopian character of writings on the topic. In order to construct an understanding of how electronic publishing is described in the published literature, it is useful to review some particularly significant portions of the extant literature to assess what is known and where gaps are evident. As the review shows, the development of electronic publishing is generally poorly understood. To further support the study, conceptual foundations were drawn from three areas: diffusion theory, scientific communication, and the sociology of science. Diffusion theory offers a paradigm for understanding the process by which a group of people come to adopt any new technology. Electronic publishing, as a new technology, was expected to fit within many of the frameworks offered by the paradigm. Past studies of scientific communication have successfully provided models for understanding informal communication and formal communication via the print-based publishing system. This body of work was expected to provide a point of comparison for the study's findings. The sociology of science has frequently provided a context for studying scientific communication, the norms of science, and the reward structure motivating scientific research and publishing. These issues seemed likely to be affecting the situation I was studying.

Review of Electronic Publishing Research

The prominence of the topic of electronic publishing is suggested by the existence of a regularly updated bibliography, maintained by Charles Bailey (Bailey, 1998). A review of some key developments in the history of electronic publishing, particularly electronic publishing in the science and technology arena, provides a context for the current research. The extent of formal research on electronic publishing in general will also be developed.

A common genre within the electronic publishing literature is the narrative account describing the development process for various electronic publications or electronic publishing projects. Some early publications and publishing projects have been particularly influential and deserve special mention. Psycology was developed initially as an ASCII based, e-mail distributed psychology journal. It is one of the oldest and, according to Harter (1998), most successful electronic journals. The vision of this publication as a mechanism for developing a new type of scientific discourse -- scholarly skywriting, characterized by rapid exchanges of brief articles -- provided a compelling picture of formal scholarly communication transformed by the use of networks (Harnad, 1990, 1992, 1995). Psycology, as its title suggests, originated within the psychology community as a new, electronic-only publication. A quite different vision of electronic journals was explored by the Online Journal of Current Clinical Trials (OJCCT), another influential early electronic-only scholarly journal (Borman, 1993; Keyhani, 1993). OJCCT was first released in 1992 and was aimed at a broad biomedical audience

interested in rapid release of reports of clinical trials. OJCCT surmounted the limitations of ASCII text distribution by using a proprietary client-server search interface. Both Psychology and OJCCT tried to demonstrate the power of creating journals free from limitations imposed by the traditions of paper-based publishing.

A somewhat different line of experimentation, however, evolved in the form of attempts to develop and distribute electronic versions of existing paper-based scientific journals. Elsevier's TULIP Project (described by Borghuis et al., 1996) was a five-year collaboration between nine libraries and a large commercial publisher. Elsevier supplied each library with electronic content of a core group of its materials science journals, and the libraries then developed local storage and distribution systems employing a variety of technologies and interface designs. The Red Sage Project was a similar library/publisher collaboration to develop a local system for a library to provide its users with access to electronic versions of a publisher's journals. In this case Springer Verlag partnered with the University of California, San Francisco, in a project focusing on Springer's molecular biology journals (Lucier & Badger, 1994). At roughly the same time, Project ELVYN in Great Britain explored options for distributing electronic versions of existing physics journals via a partnership of the Institute of Physics and seven British libraries (Knight & McKnight, 1995; Rowland, McKnight, Meadows, & Such, 1996). Because these projects focused on creating electronic versions of

existing paper journals, the main challenges they addressed were determining how best to create page surrogates and how to create an effective distribution system.

Currently, some of the highest-profile projects to provide electronic versions of existing print journals include HighWire Press, the Open Journal Project, Institute of Physics Publishing, and Science On-Line. These projects share an emphasis on creating linkages among articles. HighWire Press moved rapidly to partner with scientific association publishers to develop a collection of electronic versions of science journals, mainly in the life sciences and biomedicine (Newman, 1997; Wilkinson, Dennis, & Rosen, 1997; Young, 1997). The Open Journal Project focused on linkage creation and explored a variety of techniques for creating linkages (Woodward, 1998). The Open Journal Project has developed three journals, one each in biology, cognitive science, and computer science. Linkages were largely generated computationally but included not only citation links but also definitional and other types of links (Hitchcock et al., 1998). The Institute of Physics' publishing project has its roots in project ELVYN (Easton, 1997; Singleton, 1997) but currently provides a much-evolved model of an electronic journal collection. The current system is in some ways similar to HighWire Press and The Open Journal Project in including a variety of article formats, links, and integrated access to database records (Dixon, 1998). Science On-Line is a HighWire Press journal but deserves special mention both because of its early initiation and relatively advanced state of development and because of its unique place as an organ of scientific communication. Beginning in 1996, Science

On-Line began offering individual subscribers access to articles in multiple formats, extensive cross linkage to other HighWire journals, links to PubMed (Bloom, 1996), and added electronic resources unavailable to readers of the print version of the journal (Bloom, 1997). This article enhancement, which has grown to include some publication of electronic-only articles, made Science On-Line an early example of a true hybrid print and electronic journal. Peek, Pomerantz, and Paling (1998) provide a current review of significant electronic journal collections including these and many others.

A third line of exploration of electronic distribution of scientific research reports grew from an informally developed system of preprint distribution based at Los Alamos. In 1991 Paul Ginsparg released an Internet-based preprint distribution system for the high energy physics research community. The archive grew rapidly to serve a wide range of fields in physics and mathematics (Ginsparg, 1994). The enthusiastic adoption of the pre-print server system caught the attention of physics associations. One result was that the American Physical Society developed this foundation into a seamless transfer system for at least part of the physics literature, making articles available in electronic form from preprint to published work (Kelly, 1997). The system included numerous linkages but culminated in an archiving system designed to make articles available indefinitely (Thomas, 1998). The success of this system garnered a great deal of attention (see Glanz, 1996; Taubes, 1996a, 1996b, 1996c) but observers have noted that the physics community may be rather unique in its low article rejection rates and

resulting ability to take advantage of preprint distribution (Publishing, perishing, 1998).

Electronic storage and distribution of older print publications has also been explored. The CORE project was an early collaboration between the American Chemical Society and Cornell University to build an archive containing a critical mass of older literature in Chemistry (Entlich, 1995). Like the contemporary electronic journal development projects, the CORE project focused on developing technological solutions to page reproduction and user interface design. The JSTOR project, funded by a coalition of libraries, focused on many similar issues but used the World Wide Web as the basis for its interface and distribution system. JSTOR also took a different approach to archive development by focusing on a core of journal titles cutting across disciplines. JSTOR also developed early support by assembling a consortium of libraries whose membership rapidly totaled more than two hundred (Guthrie & Lougee, 1997). JSTOR has concentrated on developing a viable economic model for archiving a core of the scholarly literature (Bowen, 1995; Guthrie, 1997). The high level of support the project garnered from libraries and publishers suggests that this approach can be successful.

How can the influence of these early experiments be measured? Harter (1998) presented one attempt to look at the impact of electronic publishing. He used bibliometric techniques, although, as he pointed out himself, these are of very limited utility for assessing the impact of electronic versions of journals

published in both paper and electronic versions since the format of the cited work cannot be determined. He found a modest impact in bibliometric terms for a handful of the early electronic-only journals, particularly Psychology and OJCT. In assessing the development of electronic versions of print journals, one crude yardstick is the rate of development of such electronic versions. In 1998, Ketcham-Van Orsdel and Born found that roughly 30% of the titles monitored by Science Citation Index had electronic versions. This compares to roughly 25% of Science Citation Index titles in 1997 (Branin & Case, 1998).

While accounts of development projects make up a significant proportion of the literature on electronic publishing, a few formal research projects have been undertaken to examine various questions with regard to electronic publications. Some studies of use exist. The TULIP, ELVYN, and CORE projects included usage study components. The TULIP Project included reports from each participating library on a variety of aspects of the systems each developed (Borghuis et al., 1996). Generally, libraries reported quite low usage of systems making it difficult to draw conclusions about how system features enhanced electronic publications in relation to their print counterparts (Borghuis et al., 1996; Entlich, 1995; Rowland et al., 1996). Stewart (1996) looked at how users of the CORE system wanted the interaction to work for them. Users explicitly compared use of electronic versions of journals to usage of the paper versions of journals. These usage studies tended to focus on distribution and interface design

issues. Content-related issues were largely ignored, although concerns were expressed that a critical mass of content might have been lacking.

In addition to research by publishers and librarians focusing on early models of electronic publishing, other investigators have laid at least a modest foundation for research looking at somewhat broader issues. Some investigations of the adoption of many of the requisite network technologies by scientists and technologists now exist (Abels, Liebscher, & Denman, 1996; Bishop, 1994; Budd & Connaway, 1997; Kaminer, 1997; Kaminer & Braunstein, 1998; Lazinger, Barllan, & Peritz, 1997; Liebscher, Abels, & Denman, 1997). Taken as a group, these studies document that, while only a few years ago adoption of network-based communications technologies was not widespread, more recently even at many small institutions relatively high rates of adoption of requisite technology for electronic publishing have already occurred within the scientific and technical community. Schauder (1994) provided a different snapshot of faculty use of conventional journal resources and then extant electronic resources by scientists in the UK.

Olsen (1993) presented the results of a very early user study. Based on her conversations with potential users she suggested many electronic journal features desired by academic scientists and discussed the barriers currently existing to effective use of electronic publications. Bishop presented an interesting qualitative analysis of her personal experiences attempting to use a small set of early electronic journals, focusing particularly on the many barriers extant

journals presented to new users (Bishop, 1995). Tenopir (1995) argued that not just readers of electronic publications but also authors of documents being published need to be incorporated into electronic publishing research. Tenopir and King (1996) provided a somewhat general context for the use and generation of information resources in scientific research. Lancaster investigated the views of a different group of stakeholders in electronic publishing, academic administrators, whom he surveyed (Lancaster, 1995). He found that library directors and other university administrators were not sanguine about the prospects for the development of a network-based scholarly publishing system. Beyond these general foundations serving to contextualize electronic publishing broadly within scientific work, there is clearly room for contributions aimed at examining the ongoing processes and context of electronic publishing from the viewpoints of participants in the process.

Reviewing this body of literature highlights the rapid rate of change in what constitutes a state-of-the-art electronic journal and shows clearly that electronic publications remain in the earliest stages of development. It is also apparent that any research into electronic publishing is highly sensitive to issues of timing. While this literature can serve as a rich resource for contextualizing this research project, robust, broadly applicable conceptual frameworks are not yet available. Instead, in developing this research three conceptual frameworks drawn from other sources proved useful -- diffusion theory, scientific communication, and sociology of science.

Diffusion of Innovations

Diffusion theory provides a framework for looking at the development and adoption of something new within a social system. The diffusion paradigm that provides the conceptual underpinnings for this study is that of Rogers (1995). Rogers describes diffusion as “the process by which an innovation is communicated through certain channels over time among the members of a social system” (p. 5) While succinct, this definition highlights a number of key elements of the paradigm. It is important to understand diffusion as occurring within a social system. Rogers’ diffusion model explains diffusion as a process that is deeply influenced by the social system in which it is occurring. The social system bounds the innovation process; further, the system approach highlights the roles that are played by individuals within the system, the structure of the system, and system norms. It is also important to understand diffusion as a process rather than a single event or decision. Time is an important element. The process has stages and encompasses multiple individual communication and decision events. The systems approach and process perspective suggest that perceptions of the innovation vary among individuals and over time as diffusion occurs.

Even more pragmatically, Rogers’ classic diffusion structure offers a number of tools for investigating the development and acceptance of an innovation such as electronic publishing. The paradigm encompasses models for decision making, characterization of the innovation, and social roles influencing diffusion. Adoption of electronic publishing within a community conforms to

Rogers' description of a contingent adoption decision. While individuals must make personal decisions to adopt or reject electronic publications, for an electronic publication to truly succeed, it must be adopted roughly simultaneously by major segments of the community. Importantly, publishers, authors, editors, and readers must all adopt the innovation. While this may seem a superficial truism, as at least one author has pointed out (Tenopir, 1995), scientists in different roles have different and sometimes competing interests in scholarly publishing. An author's interest in a publication may be different from a reader's interest, and publishers often have additional competing interests. Thus scientists playing different roles in the scientific communication process may be expected to adopt somewhat different views of electronic publications. This expectation must of course be tempered somewhat by the recognition that any individual may play multiple roles. It is not clear whether perceptions of electronic publications can vary within the same individual depending on the role played. It is also important to note that, while many individual adoption decisions will be involved with the diffusion of electronic publishing, there are also institutions involved. Rogers' framework includes a prototype for an institutional adoption decision as well as one for individual decisions.

The adoption process for individuals potentially includes five stages. An individual may move through three stages before adopting or rejecting an innovation: awareness, persuasion, and a decision that may be either acceptance of the innovation or rejection. While awareness and the decision are the stages

which define the start and the end of a process and are fairly self-explanatory, the persuasion phase may be extended and may involve information gathering from a variety of sources including the media, conversations with peers or experts, trials of the innovation, or observations of others' use of the innovation. Following a positive decision to adopt an innovation, two more stages may occur: implementation and confirmation. Implementation occurs as the adopter integrates the innovation into his or her normal practices of working or living. Confirmation is a second decision point at which the adoption may ultimately be rejected. Within this model of a potential adopter's interaction with an innovation, use of the innovation can occur in a number of contexts. Use of an innovation may reflect a trial occurring in a persuasion phase or may reflect implementation of the adoption. Either way, subsequent rejection of the innovation may occur. Within the diffusion framework, what is in the user's head -- that is, the user's intentions -- defines the relationship with the innovation rather than personal interaction with the innovation.

The institutional adoption process Rogers describes is in many ways quite different from that used by individuals. Innovation adoption within an organization occurs in two broad phases: initiation and implementation. Initiation comprises two successive subprocesses: first, agenda-setting, in which there is a recognition of organizational problems which create the perception of a need for an innovation, and, second, matching, in which the innovation is fitted to a problem on the organization's agenda. An adoption decision defines the end of

the initiation phases and signals the commencement of the implementation phase. Implementation consists of three separate subprocesses: redefinition and restructuring, in which the innovation and organizational process are modified and potentially re-invented; clarifying, in which the innovation/organizational relationship is reconsidered and clarified; and routinizing, in which the innovation is completely incorporated into the organization's ongoing activities and loses its identity.

The diffusion paradigm also suggests a variety of ways to characterize innovations. One appealing concept is that of innovation clusters. Innovation clusters are described as a set of related technologies that in combination provide a functional innovation. In the agricultural arena that gave rise to the diffusion paradigm, integrated pest management (IPM) is an example of an innovation cluster. IPM is not a single technique or technology but rather a group of approaches to pest monitoring and management. Prescott and Van Slyke (1997) applied the diffusion paradigm to the Internet and suggested that the Internet was best characterized as an innovation cluster. In earlier work Hahn and Schoch described how the idea of the innovation cluster could assist in understanding and describing the current wide range of diversity in functionality electronic publications currently display (Hahn & Schoch, 1997). Electronic science and technology journals may include a variety of different technologies such as page images based on PDF, e-mail notification, various technologies to automate peer review, etc. Expanding the concept to that of a feature cluster, Hahn and Schoch

suggested that particular electronic publications display a variety of feature innovations clustering along six main dimensions: publishing roles (who acts as publisher); distribution (how the content of the publication is made available to readers); document structure (the content of the documents and its organization within the document); research validation (how the validation function is incorporated into the publishing process); sale and pricing; and storage (how long-term access to documents is provided and who has responsibility for this function). This feature cluster was developed by a content analysis of a snapshot of electronic publishing literature. The cluster is summarized in Table 1. The literature used for the project was created largely by publishers, editors, and librarians. Whether scientists involved with electronic publishing see the technology in this way will be explored in this study.

In his synthesis of diffusion research, Rogers also emphasized the importance of social roles and social ties in understanding the adoption of particular innovations. Diffusion research traditionally uses a community as an important unit of analysis. Often diffusion patterns are compared between communities to explore observations that diffusion patterns differ based on community-related variables. The diffusion paradigm also describes particular roles identified in previous studies of innovations that may be helpful in understanding developments in the ecology community. Diffusion research has identified roles such as innovator, opinion leader, and change agent. Innovators are often defined in innovation study by how early they adopt an innovation.

Table 1:

Innovation Cluster Members from Hahn and Schoch (1997)

Cluster Members	Description
<u>Publishing roles</u>	
Individuals as publishers	Individuals publish their own documents, distributing them directly to users without intermediaries.
Libraries as publishers	Libraries assume the traditional publishing role either for authors from their institutions or for a subject area.
Universities or subsidiary units as publishers	Universities assume a publishing role beyond that currently played by university presses, perhaps publishing all documents created by their faculty. Individual units such as departments or work groups may assume this function.
Non-profit national publishing system	Some national institution already playing some other role or an institution created specially assumes the responsibility for publishing scholarly works.
<u>Distribution and retrieval innovations</u>	
Elimination of the journal issue as a distribution format	The journal issue ceases to exist with the article as the new publishing unit that is distributed.
Electronic distribution	Articles or issues are distributed to purchasers, typically via e-mail. Initiation of distribution by the purchaser is not required.

Table 1 (cont.):

Cluster Members	Description
Electronic notification	Potential readers are notified of availability of new articles, either through a Table of Contents delivery or by some kind of profiling system (SDI for instance).
Individual retrieval as needed	Articles are stored remotely and users actively retrieve desired articles.
<u>Innovations in document structure</u>	
Electronic page images	Conventional page formatting is retained by the creation of page images. Text may not be stored as characters.
Electronic text	Character-based storage of text. Formatting information may or may not be included. This format generally loosens restrictions on document size.
Hypertext links to related resources	Embedded links point to related documents, data, data archives, or communications channels.
Internal hypertext links	Links within a document pointing to other portions of the same document.
Nonlinear document structure	Alternate structures could be developed to replace the conventional linear format (e.g. introduction, methods, results, analysis).
Multimedia - video, sound, high-quality images, three-dimensional images	Documents incorporate media into text documents.
Embedded software	Programs may be part of a publication allowing the reader to manipulate data or run simulations.

Table 1 (cont.):

Cluster Members	Description
Inclusion of raw data	Without stringent restrictions on article size, it may become possible to include raw data.
Embedded user comments	Reviewer or reader comments can be incorporated into the article content.
Author updating	Authors are able to incorporate more recent findings to articles as necessary.
<u>Innovations in the validation of research</u>	
<u>Pre-publication innovations</u>	
No peer review	Several authors have suggested that replacement of peer review by other validation methods.
Reviewer grading	Each reader evaluates information by individual standards.
Reviewer grading	Grades or scores generated by reviewers can be incorporated into the publication or control accept/reject decisions.
Consensus review	Some kind of broader scholarly community could be tapped beyond the traditional reviewer selection process now in place. Thus consensus of a community of peers could replace review by editors or their designates.
<u>Post-publication innovations</u>	
Reader review	Readers provide comments, grading, or usage information is used to validate research
Inclusion of usage data	Usage data is stored with a publication and made available to readers.

Table 1 (cont.):

Cluster Members	Description
Author revisions	Authors are allowed to revise work following publication
<u>Sale and pricing innovations</u>	
Article pricing/sale on demand	Articles become the unit that is bought and sold rather than annual subscriptions
Charges varying by type of use	Print charges, view charges, search charges, and download charges can be imposed on users of documents.
Electronic payment	Various types of electronic payment and/or microcharging could be implemented.
Sale of surrogate information	Various types of surrogates could be created and sold. For instance, a format designed for browsing could be priced separately from a format containing the entire article.
Licensing	Individuals or institutions purchase licenses rather than documents or subscriptions.
<u>Storage innovations</u>	
Publisher storage	Whoever assumes the publisher role (traditional publishers, individuals, institutions, libraries, or a national non-profit) also assumes responsibility for storage of articles.
Designated archive	Official repositories are established, perhaps organized by discipline or some other criteria, and these provide long-term storage of electronic publications.

Table 1 (cont.):

Cluster Members	Description
Library storage (individual initiative)	Libraries assume the responsibility for long-term storage of electronic publications.
Distributed cooperative archiving	A distributed cooperative archiving system is created. Archiving arrangements are unofficial as compared to the designated archive.

Notes. From Applying diffusion theory to electronic publishing: A conceptual framework for examining issues and outcomes (p. 7-8), by K. L. Hahn and N. A. Schoch, 1997. In C. Schwartz & M. Rorvig (Eds.) ASIS '97: Proceedings of the 60th ASIS annual meeting, Washington, DC, Nov. 1-6, 1997, Medford, NJ: Information Today, Inc. Copyright 1997 by American Society for Information Science. Reprinted with permission.

However, Rogers also offered conceptualizations of common characteristics that distinguish this group from later adopters of innovations. Innovators are described as venturesome, often controlling substantial financial resources, able to understand and apply complex technical knowledge. Innovators often function as gatekeepers, controlling the influx of new ideas into a community. Despite this function, innovators are not necessarily highly respected within their community. Opinion leaders, in contrast, are defined as highly respected community members able to influence others' perceptions of an innovation. They are characterized as individuals who tend to engage in more social participation than other community members; tend to be more cosmopolite; tend to have higher socioeconomic status; and, while not usually as innovative as innovators, tend to be more innovative than most community members, particularly if the community's norms favor change. The change agent role is one of advocate for an innovation attempting to influence the community to adopt the new technology.

The appeal of the diffusion paradigm within the context of this research project lies in the breadth of phenomena it addresses and the maturity of the paradigm. The paradigm is rooted in nearly sixty years of research in many fields and has been applied to a tremendous range of technologies.

Scientific Communication

Scientific communication research provides the second conceptual foundation for this research project. The search for pattern and process in scientific communication was a major approach to developing understanding of

scientific communication in the period prior to the widespread adoption of electronic communication technologies. Price pointed out that the scientific literature has been growing exponentially for at least several centuries (Price, 1961). He later noted that during the course of the 20th century the scientific literature has developed some unique trends reflecting changes in the underlying scientific culture (Price, 1986). Price documented that the scientific literature is big not only in the sense of its size, but also in the sense that the frequency of multiple authorship of papers is increasing and the average number of authors on multi-authored papers is increasing as well. He interpreted this as resulting from an increase in the number of scientists involved in any given research project. This increase is explained largely as a result of an increased dependence on expensive equipment and an increased specialization of scientists caused by high levels of financial support for the scientific enterprise in general in the post-war period.

While Price focused on large-scale patterns in the published literature, research by Garvey and Griffith with various co-authors used a different frame of reference, scientific communication, and as a result developed a picture explaining a generalized process of disseminating research results within the scientific community. This body of work provides the most detailed description of the mechanics of the scientific communication process available and will be discussed here at some length. Garvey and Griffith, with their collaborators, carried out a group of studies in the 60's and into the 70's initially studying the

psychology community and later expanding their research into several other scientific communities (American Psychological Association, 1963, 1965, 1969; Garvey, 1979; Garvey & Griffith, 1971; Garvey, Lin, & Nelson, 1970; Garvey, Tomita, & Woolf, 1974; Griffith & Miller, 1970; Griffith & Mullins, 1972; Lin, Garvey, & Nelson, 1970). According to the Garvey and Griffith model, initially results are presented informally to small groups of researchers, typically at invited seminars either within the researcher's home department or at another university or research facility. Over time, results are reported to larger groups, for instance at conferences; preprints and technical reports may be distributed; manuscripts are submitted; journal publication occurs (Garvey & Griffith, 1971).

This model highlighted the importance of informal mechanisms of dissemination in the overall distribution process. This finding widely bolstered the understanding of the importance of prepublication reports, both for distribution and for review and refinement of research results prior to publication. The Garvey and Griffith work identified and explained the key role played by professional conferences in the development and dissemination of research results. Garvey and Griffith also found that the scientist/author essentially ceases active dissemination using informal methods once the research report is accepted for formal publication.

Both Garvey and Griffith elaborated various aspects of the model over time. Garvey, Tomita, and Woolf (1974) described stages in the research process and their relationship to communication patterns. Garvey et al. also investigated

variations in information needs associated with research stages. This work offered some broad comparisons of variations in communication patterns between social and physical scientists and between basic and applied scientists. The authors found that information needs and corresponding communication patterns did differ between the groups. Social scientists tended to use local colleagues and books more frequently than physical scientists while physical scientists made more use of meeting presentations and technical reports. Basic scientists tended to make more use of both formal and informal communication channels from the model when compared to applied scientists. Garvey, Lin, and Nelson (1970) focused even more explicitly on differences in communication patterns between communities of social and physical scientists. This work emphasized timing variations and reported that social scientists experienced greater lags between manuscript submission and article publication when compared to physical scientists. These lags were explained by different characteristics of the communication system. Garvey et al. concluded that these differences demonstrate differences in the effectiveness of the communication systems:

We conclude from our findings that the current system of prepublication dissemination for the social sciences is not as effective as for the physical sciences. Not only do a larger proportion of physical scientists make prepublication reports; they make them more frequently, and to more different kinds of audiences as well. And, they accomplish this prepublication dissemination within a shorter period of time. We are

currently examining the structure of the informal network associated with prepublication dissemination to determine whether there are qualitative differences in these networks between the physical and the social sciences. (p.71)

This quotation demonstrates a problem with the Garvey and Griffith approach: a tendency to assume that communication network structure alone explains the observed functioning of the publishing system. Garvey and Griffith generally ignored other factors that structure publishing systems, such as economic factors. This quote also suggests a tendency to assume that more communication activity and faster communication are universally desirable. There also was some tendency in Garvey's work to leave unexamined the question of what factors might be underlying and driving the observed communication network structure. Griffith and Miller (1970) started to examine this question in a study of five research areas in psychology. They reported a variety of communication structures within different communities and observed that the communities with high levels of informal communication ties tended to have professional associations, a need for expensive equipment available at only a few locations, and the presence of "a senior researcher and teacher who trained a major proportion of all the active researchers in this field" (p.129). Griffith and Miller also noted that community size varied and implied that this might be an important factor. These associated factors provide some intriguing suggestions as to how variations in communication may develop but leave unexplored how they relate to

needs of the research communities and the nature of research each community undertakes.

In addition to informal communication and communication network structure, Garvey and Griffith consistently emphasized manuscript rejection and publishing lags in their work. In a few instances this led them to offer some conceptualization of authors' decision processes. Garvey et al. (1970) offered a brief discussion of their observations regarding author selection of journals. They found journal audience, speed of publication, and editorial policy were the factors authors reported in their decision making process. Failure to match the subject matter of the article and subject approach of the journal was also reported as a common cause of manuscript rejection, implying that this was also a factor authors took into account. Garvey and Griffith also made use of a generalized model of the structure of the scientific journal system. Garvey and Griffith (1971) provided a three-tiered model for psychology in which

... there is apparently a hierarchy of journals to which authors submit their manuscripts. At the top are the most prestigious, with high rejection rates and long publication lags. These publish the core of the discipline's literature. At the next level, the journals are usually less prestigious, have lower rejection rates, and are less central to the literature in the field. At the lower level, the journals share few of the characteristics of the main or core journals and may be unrefereed. (p. 47)

This hierarchy is not explained but referenced in the work of Garvey et al. (1970)

as well.

While the research tradition initiated largely by the work of Garvey and Griffith focused on the author's role as the producer of research reports, other researchers have focused on other portions of the process of creating and disseminating research results. Several studies have examined the manuscript review process common among conventional scientific journals, particularly peer-reviewed journals (Dirk, 1996; Weller, 1996).

Another fruitful vein of research into scientific communication focused on communication networks and explored the concept of invisible colleges, a term coined by Price (1963). Garvey and Griffith's work on communication network structure fits into this tradition to some degree, but other researchers have greatly expanded the development of this avenue of investigation. In early work with life scientists, Mullins used a snowball sampling technique to develop a sociometric network which served as the basis for exploring informal communication (Mullins, 1968). He found that informal communication structure and social network structures only loosely corresponded to discipline structures. Crawford, in an influential study of sleep researchers, described a structure of networks focused around sociometrically central researchers located in a few research centers and comprising a small subset of the total community of active researchers (Crawford, 1971). This structure is similar to that Griffith found among the most integrated subfields of psychology (Griffith & Miller, 1970). Crane's research into the structure of the field of rural sociology (Crane, 1969; Crane, 1972)

explored the viability of the notion that within most fields of scientific research a small in-group of researchers function as a powerful elite, exchanging research reports and ideas informally well in advance of their publication in print. Crane discovered a central group of highly productive, interconnected researchers within rural sociology, each of whom functioned as a node connecting many peripheral members. Cronin (1982) provided an insightful synthesis of this early work with succeeding work on the sociology of science. He suggested that, although the concept of the invisible college had led to many helpful insights into the mechanisms of scientific communication within research fields, the widespread existence of invisible colleges effectively controlling the direction of research and the channels of communication remained in doubt. Another of Cronin's observations is of particular interest within the context of the current study, grounded as it is in a particular field within the life sciences: Cronin observed that a number of studies of scientific communication have described somewhat variable patterns of social organization with relation to communication structures among fields.

Research investigating the mapping of social structure for informal communication has continued in the interval since the formative work of the late 60's and early 70's. Lievrouw, Rogers, Lowe, and Nadel (1987) looked at researchers studying lipid metabolism using a combination of traditional network analysis techniques like those used by Crane and Crawford, but including factor analysis and qualitative analysis. This approach highlighted the relative

contributions made by the complementary techniques and emphasized interpreting the communication structure of the scientists' communication networks separately from exploring the intellectual structure of research field itself.

Other researchers have subsequently investigated the idea of describing the intellectual structure of a research field, typically utilizing a combination of bibliometric and interview techniques. The work of Cronin and Overfelt (1994) and McCain (1986a, 1986b, 1989) exemplifies this approach and demonstrates its applicability to many research areas, at least within the life sciences. The work of researchers concerned with invisible colleges and the intellectual structure of research fields has demonstrated that scientific research fields typically show a complex and somewhat variable communication structure linked with but not identical to a likewise complex but interpretable intellectual structure. This picture has yet to be generally reexamined in light of the impact of network-based communication technologies. Yet researchers have not been unaware of the potential for new communications technology to develop a new system of communication creating a need for new models (Zhang, 1998). Many of the researchers who have begun to explore such questions are the same individuals who developed earlier communication models. Lievrouw and Carley (1991) offered some early insights along these lines. However, the work of Crawford, Hurd, and Weller provides perhaps the most in depth consideration of the potential impacts of networked communications technologies on scientific communication (Crawford, Hurd, & Weller, 1996). These researchers selected

three areas of advanced use of network technologies and used them as case studies: high energy physics, the human genome project, and space science. Hurd (1996b) looked at how network technologies had already impacted the process of scientific work and communication and used Garvey and Griffith's model as a point of reference. Based on the developments in networked communication she saw, she developed a number of potential modifications of Garvey and Griffith's model that might reflect new and stable systems for dissemination of scientific research results. These models include what Hurd called a "modernized Garvey/Griffith model" which basically incorporates network-based versions of traditional channels described by Garvey and Griffith. For instance, printed conference proceedings are replaced by electronic proceedings; e-mail replaces letters, telephone calls, and face-to-face discussions. A few new elements were added in the form of preprint archives and databases of data sets. More radical process alterations were presented by Hurd's no-journal model, unvetted model, and collaboratory model. The no-journal model retains electronic conference reports but substitutes databases of reviewed articles and digital libraries for a conventional organization of articles within journals. The unvetted model lacks not only conventional journals but also conventional peer review. In this system, the main mechanism for dissemination is via submission to a server. Review occurs in the form of contributed and linked commentary potentially followed by author revision. The collaboratory model focuses as much on data deposit as on research reporting. This model incorporates validation and annotation functions

for the databank and research reports play a less central role in the research process than as represented in other models.

As Hurd demonstrated, scientific communication theories provide a useful conceptual foundation for research into electronic publishing because of the relatively good understanding they provide of the existing print based system. This system is a natural frame of reference for considering any changes resulting from the development of electronic publishing.

Philosophy and Sociology of Science

The philosophy and sociology of science provides the third conceptual foundation for this research. If studies of scientific communication are correct in the assumption that scientific communication is an integral process in the advancement of science, communication studies should be viewed within at least the outlines of a broader framework provided by the sociology of science. The sociology of science has repeatedly offered other researchers such an interpretive framework for any study of scientific communication. The relevance of the sociology of science for communication studies within the sciences is widely recognized. Near the time that interest in scientific communication began to increase under the influence of work by Price and the American Psychological Association studies, Menzel identified five themes from sociology with implications for scientific communication research (Menzel, 1966). This work played a formative role in shaping subsequent research and is worth elaborating here. Menzel argued that scientific communication acts occur within a system of

communication. Therefore, he argued, "It is necessary to look upon any one arrangement, institution, facility, or policy for scientific and professional communication as a component of the total system of scientific communication for a profession.... it is necessary to be comprehensive with regard to the varied functions served by the science information system." (p. 59). His second theme is that multiple channels may interact to deliver a message effectively. "Any given transaction between a scientist as a receiver of information and the channel that brings him that information usually has a history behind it and a future ahead of it...." (p. 59). His third theme is that informal communication plays a crucial role within the communication system of science. The fourth theme is that scientists can be considered publics. Menzel suggested "These publics, can, for example, be described in terms of size, in terms of turnover, and in terms of the interaction that exists within them....and in terms of the norms that they have created with regard to exposure to various channels...." (p. 61). With regard to how scientists use information, Menzel suggested, among other reasons "they want this information to help with very specific activities - activities that form very essential parts of their professional roles and therefore of their lives." (p. 61). Menzel's fifth theme is that multiple functions are supported by scientific information systems. He argues, "it is rather important to draw qualitative distinctions between the several kinds of things that the science information systems are called upon to perform...." (p. 61). In discussing this theme he observed that "Most of the great innovations have been instituted under the guiding themes of speed, efficiency,

and comprehensiveness.” (p. 61). While Menzel was not referring to electronic publishing, this remark is as aptly applied to the current developments in that arena as to earlier developments in the scientific communication system. Further, Menzel asked an equally prescient question “Can policies designed to satisfy some of these requirements really work to the detriment of others?” (p. 61). That Menzel’s themes were taken to heart by the research community is evident in the emphasis on informal communication mechanisms, a system-wide approach to studies of publishing, and an interest in identifying multiple communication channels. Less attention has been paid to his observation that scientists constitute multiple publics that may be somewhat dissimilar in their characteristics. Likewise, the ideas that there are multiple functions of the science information system and that the functions have complex interactions were also less influential.

As formative as Menzel’s work was, he was not the first to establish connections between scientific communication and the study of science as a social system. Merton is frequently credited with first building the link with his work beginning in the 1940’s (Griffith, 1989). Merton posited four norms controlling science as a social activity: universalism, communism, disinterestedness, and organized skepticism (Merton, 1942). Another major contribution was the development of the Matthew Effect (Merton, 1968) which was built in large part on work by Zuckerman with Nobel laureates (Zuckerman, 1967). This was an argument that scientists who are highly visible and control more resources tend to be better connected and receive more information and acknowledgement or

rewards than their less visible or less resource-rich peers (i.e. to them that have more, more shall be given). The Matthew effect is but one example of the important role Merton played by calling attention to the reward system of science, including its impact on the communication system (Merton, 1973). The work of S. Cole and J. R. Cole follows in this tradition. They described the structure of the reward system within physics demonstrating the importance of published work of recognized quality for the receipt of scientific rewards (Cole & Cole, 1967, 1968). They showed that it was the quality not the quantity of published work that generated recognition.

While Merton focused on the social structures that advance scientific development, Kuhn (1970) attempted to answer the question of how scientific knowledge cumulates. Kuhn's ideas have also been formative and are widely cited. Kuhn argued that in scientific disciplines knowledge advances in two alternating modes. Periods of normal science -- when research focuses on refining, validating, testing, and extending dominant paradigms that are widely accepted -- alternate with periods of upheaval and disagreement -- when a dominant paradigm is upset by a competing and incompatible new approach. The dominant paradigm is subsequently displaced rapidly as the new paradigm becomes widely accepted and structures a succeeding period of normal science (Kuhn, 1970). Kuhn argued that scientific knowledge thus cumulates relatively slowly during the periods of normal science while during periods of paradigm shift and revolution, scientific knowledge advances much more rapidly. Crane's

work is but one example of a popular practice of utilizing Kuhn's concept of paradigm shifts to explain communication patterns. Crane (1972) used paradigm shifts as a central concept underpinning her search for evidence to validate the existence of invisible colleges. Some of this rhetoric of revolution has been applied to the context of electronic publishing (see Keys, 1995, and Schaffner, 1994, who adopted competing views regarding the current mode). Griffith argued that, in fact, the significant features of Kuhn's work had largely been missed or misinterpreted and suggested that it might be more useful for interpreting past events than understanding current developments (Griffith, 1989). At the moment, it is not clear how Kuhn's model of scientific advance applies to the current shifts underway in communication media.

Mulkay offered an alternative framework to Merton's norms of science and Kuhn's paradigm shifts (Mulkay, 1979, 1991). Mulkay described his interest as the sociology of knowledge. He argued cogently that previous investigators had assumed that the sociology of science could not address the fundamental knowledge claims of science (because of their presumed objective reality) but instead limited themselves to studying the social conditions which influence the acquisition and cummulation of scientific knowledge. Mulkay argued conversely that there are many reasons to question the assumption of objective reality and proposed instead that sociology could effectively address all aspects of the development, construction, dissemination, and fate of knowledge claims because they are inextricably intertwined within a social context. Gilbert and Mulkay

(1984) and Mulkay (1991) demonstrated the utility of this approach in analyzing scientific discourse to investigate new questions of how scientists' knowledge claims are evaluated and rewards assigned. This work showed that the scientists' social context pervaded the entire research process with significant impacts for the manner in which new knowledge was developed.

The value of the sociology of science as a conceptual foundation lies in its ability to provide an idealized structure for understanding scientific work while also highlighting that in many ways scientific work deviates from idealized structures. In particular the areas of sociology of science which focus on the role of the communication system and the scientific reward system are especially pertinent to the research questions and design for this study..

Taken together, diffusion theory, scientific communication theory, and the sociology of science complement each other as bases for investigating questions regarding electronic publishing. Diffusion theory draws on a wide range of resources to explain a process common to all human communities exploring new technologies, while scientific communication theory and the sociology of science draw on previously developed knowledge about the workings of scientific communities. Scientific communication theory addresses many of the specific roles played by formal scientific publishing, while the sociology of science provides a more general backdrop against which to explore factors influencing the perceptions and decisions of scientists.

Chapter 3: Methods

A group of qualitative approaches to research design, data gathering, and data analysis provided the basic methodology for the research project. A qualitative approach was necessitated by several factors. Research into electronic journals and their effects on scientific communication is at the earliest stage. Existing electronic journals are not widely used and are quite variable in the technologies that they incorporate into the publishing process. Little formal theory other than the broad diffusion model is available. This makes it not merely difficult to frame testable hypotheses (other than very broad ones such as the diffusion paradigm does or does not apply) but probably undesirable. Qualitative investigation can provide rich data that are particularly useful in understanding human perceptions and human behavior. Qualitative approaches also offer a flexibility that is valuable for exploring new areas of research where theoretical frameworks are sparse or non-existent. In addition, qualitative research is typically heuristic and inductive, allowing important research questions and answers to emerge throughout the research process, not only at the beginning of the research project. As a result, research questions are often developed at the outset of a project but emergent questions are typically incorporated in a study's findings.

Other arguments for a qualitative approach also exist. At the outset of the project, one expectation was that authors from electronic journals might be at a

variety of stages in the diffusion process ranging from persuasion through decision, implementation, and confirmation. Some evidence also suggested that electronic journals represent feature clusters rather than a uniform innovation (Hahn & Schoch, 1997). Therefore, it seemed inappropriate to simply lump one or more groups of adopters together to achieve large numbers by aggregation and then sample. Even if this type of approach was desirable, large numbers of adopters of individual journals simply do not yet exist to support quantitative analysis.

A key feature of qualitative research approaches is that they are heuristic. Findings from early in the research process shape the ongoing research process. While there is a clear starting point for the research process and general research questions are developed, there is the expectation that new questions may emerge and that some aspects of the initial questions may prove uninteresting. This pattern of integrated data gathering, data analysis, and ultimately theory development is particularly attractive in researching a new development such as electronic publishing.

Because innovations diffuse within communities, communities represent an important unit of study. During the early development of the project the scientific community of ecology was in the process of starting two prominent new journals, one electronic-only and one to be published simultaneously in print and electronic forms. An earlier pilot study for the project which focused on the Online Journal of Current Clinical Trials (OJCCT) had already suggested that new

journals face special problems that established journals do not and that new electronic journals could more appropriately be compared to new print journals rather than to established print journals. To my knowledge this near simultaneous development of two new journals in one field, each representing one of the two dominant mechanisms of electronic publishing, is unique. The OJCCT pilot study also demonstrated some of the problems of studying electronic journal development retrospectively. Studying a community more recently involved in electronic journal development, such as the ecology community was then doing, was appealing.

Consequently these two ecology journals became the focus of data collection. Journal E is an electronic-only journal published by an established scientific society and initiated publication mid-year in 1997. Journal P is produced by an established commercial publisher of scientific journals and initiated publication early in 1998. Journal P's publisher has recently established simultaneous electronic publishing of versions of all of its print journals including Journal P. Both journals were launched by publishers experienced in publishing paper forms of scientific journals, suggesting at the outset of the research that both represented serious efforts to develop and support the titles. The two journals are compared and contrasted in Table 2.

A questions/methods matrix was developed at the outset of the research project using techniques described by Maxwell (1996) and Miles and Huberman (1994). Table 3 illustrates the foreshadowing questions, methods, and evidence

Table 2:

Comparison of the Study's Journals

	Journal P	Journal E
Publisher	Established commercial publisher	Established professional society
Publisher experience	Publishes other ecology journals and many journals in other science, technology, and medical fields	Publishes several other ecology journals
Publishing mode	Simultaneous paper and electronic	Electronic only
Electronic publishing format	PDFs of pages	HTML, embedded commentary
Subject focus	Emerging subdiscipline of ecology	Emerging subdiscipline of ecology
Submission formats	Paper required.	All submissions must be in electronic form: standard word processor files plus electronic files of any images, simulations, etc.
Review process	Single-blind review	Double-blind review
Date of first issue	July 1997	January 1998

Table 3:

Purposes/Questions/Methods Matrix

Research Question: What does electronic publishing mean to scientist authors and editors?

<u>Foreshadowing Question</u>	<u>Why</u>	<u>Kind of data needed</u>	<u>Sources of data</u>	<u>Potential analysis techniques</u>
What characteristics define the technology for scientists?	<p>Allows description of the technology from the viewpoint of first people to work closely with the technology.</p> <p>Allows comparisons between journals.</p> <p>Allows comparisons with published models.</p>	<p>Descriptions of the technology by scientists involved with it</p> <p>Comparative data organized by journal.</p>	Interviews of authors and editors	Content analysis, Constant comparative method
How do e-journal characteristics compare to paper journal characteristics?	Allows me to determine if differences exist which are important to authors.	<p>Descriptions of e-journal characteristics</p> <p>Descriptions of paper journal characteristics</p> <p>Discussion of perceived differences</p>	Interviews with authors and editors, literature review.	Content analysis, constant comparative method, grounded theory development, search for disconfirming evidence.

Table 3 (cont.):

Research Question(cont.): What does electronic publishing mean to scientist authors and editors?				
<u>Foreshadowing Question</u>	<u>Why</u>	<u>Kind of data needed</u>	<u>Sources of data</u>	<u>Potential analysis techniques</u>
What dimensions of publishing are affected by current e-journal models?	Allows testing of ideas about e-journals being innovation clusters.	Characteristics of e-journals organized by publishing dimensions	Literature on publishing dimensions E-journal characteristics from previous analyses.	Content analysis, grounded theory development, search for disconfirming evidence.
Research Question: How do authors decide to publish in an electronic journal				
49 What is the decision process that authors use in deciding to publish in an electronic journal?	This is a central process in the author's publishing decision. This is where I expect to see the impact of the electronic nature of the medium This process seems analogous to the adoption decision process	Descriptions of the author's decision process. Focus on sequence, events, actors, objects, influences, outcomes.	Author interviews	Content analysis, grounded theory development, search for disconfirming evidence

Table 3 (cont.):

Research Question (cont.): How do authors decide to publish in an electronic journal

<u>Foreshadowing Question</u>	<u>Why</u>	<u>Kind of data needed</u>	<u>Sources of data</u>	<u>Potential analysis techniques</u>
What are the variables that affect the outcome of the decision?	To explain variability in outcome of decision processes.	Descriptions of the author's decision process.	Author interviews	Content analysis, constant comparative analysis
	To identify factors that influence individual paths through process.	Discussion of factors perceived to be influencing the process.		
How do the electronic characteristics of the journal influence the process?	To understand the impact of the electronic nature of the journal.	Descriptions of the author's decision process.	Author interviews	Content analysis, grounded theory development, search for disconfirming evidence.
		Discussions of electronic characteristics and their impact on the decision process.		

Table 3 (cont.):

Research Question: What role do social ties and structures play in the decisions of author scientists in selecting an electronic journal?

<u>Foreshadowing Question</u>	<u>Why</u>	<u>Kind of data needed</u>	<u>Sources of data</u>	<u>Potential analysis techniques</u>
What social relationships are influential to the author's publishing decision?	To test the idea that social structures can influence the publishing decision. To determine the nature of influential relationships.	Identification of influential relationships Identification of type of relationships	Author interviews Editor reports in interviews	Content analysis, constant comparative method
What influence do prior relationships have on the publishing decision?	To test the idea the previous relations between scientists can influence the publishing decision. To determine how these previous relations shape the publishing decision.	Identification of preexisting social relationships Descriptions of how relationships influence the publishing decision.	Author interviews Editor interviews Literature searching of co-authorships	Content analysis, grounded theory development, search for disconfirming evidence
How does a relationship between author and editor develop?	To understand the editor's role in the author's decision process.	Descriptions of the development of author/editor relationships	Author interviews Editor interviews	Content analysis, grounded theory development, search for disconfirming evidence

Table 3 (cont.):

Research Question: What role do social ties and structures play in the decisions of author scientists in selecting an electronic journal?				
<u>Foreshadowing Question</u>	<u>Why</u>	<u>Kind of data needed</u>	<u>Sources of data</u>	<u>Potential analysis techniques</u>
What is the editor's role in influencing the publishing decision?	To test idea that editor has an important role in an author's publishing decision.	Description of the editor's role in the publishing process.	Author interviews Editor interviews	Content analysis, grounded theory development, search for disconfirming evidence
	To explore the idea that the editor can act as a change agent	Discussion of the editor's role in the author's decision process.	Literature reports	
How important are social relations relative to journal characteristics in the author's publishing decision process?	To allow consideration of alternative explanations beyond e-journal characteristics in determining publishing decisions.	Descriptions of the decision process Discussions of the importance of various factors on the decision process	Author interviews Editor interviews	Content analysis, grounded theory development, search for disconfirming evidence.

for all three research questions. This figure shows foreshadowing questions for each of the research question and presents the kinds of data that would be gathered, the corresponding sources of data, and the general form that analysis would take for the data gathered. The matrix was used to determine the questions used in the interview protocols for authors and editors. The matrix documents the starting point of the research process. It does not include questions that emerged in the course of the research. Not all of the matrix questions were ultimately addressed in the analysis phase of the study. Only the most interesting and relevant questions were pursued. Also some additional analytic techniques were applied as the analysis unfolded.

Informants

The journal editors and authors of articles published by the two journals were the sources of the main body of the data collected for the project. These scientists represent key stakeholders in the process of journal development. Griffith argued cogently that one of the key findings of his APA-funded research into the scientific communication process was that journal article authors are the key drivers of the communication process (Griffith, 1989). Tenopir (1995) also emphasized the importance of authors in the development of electronic publishing. Together authors and editors control the content of any publication. Without content, electronic publications can offer only attractive facades which fail to support the real work of the scientific community. Interviews of authors and editors captured two vantage points on the publication process. Thus it made

sense to focus especially on authors and editors during this formative investigation of journal development.

Three other groups of informants, however, were included in the study as well. At the end of an interview all editors and some authors were asked to identify publisher staff members who were particularly involved in the process of developing the journals. As publisher staff were identified, they were included as additional study participants. Interview protocols were developed for the publisher interviews on an individual basis, depending on the role that emerged for each staff member. This approach was developed because informal discussions with publishing staff working with other electronic journals suggested that publisher staff play quite variable roles in electronic journal development. This, in fact, proved to be the case. The two journals were completely dissimilar in the organization of their publishing staffs, reflecting the very different natures of the organizations sponsoring the publications. The commercial publisher had only one staff member on whose authority and activities the journal was developed. Other staff provided specialized support functions. The association publisher distributed responsibility for the development of Journal E very broadly. Various boards and committees recommended support of the journal at different times in its development and the startup, and subsequent development of the journal itself was handled as a team process. However, in all cases the interview protocols largely resemble those used for editor interviews.

Journal readers are obviously very important to the establishment of any new journal, but this group was excluded from the study initially out of a concern that actual readers might prove impossible to identify. It was also unclear what would constitute a reasonable definition of readership with regard to a new journal. It is well documented that scientists normally do not read journals cover to cover but rather frequently browse some journals regularly looking for articles of interest. With a new journal, regular browsing is a problematic concept, since one or two issues may not suffice to enable a potential reader to judge the ultimate utility of a journal. As data from authors and editors accumulated, however, the decision was made to attempt to identify a small group of self-identified readers of electronic journals to provide an alternate source of information about new electronic journals.

A small set of contextualizing interviews with informants from outside the ecology community who were involved in electronic publishing in various ways were carried out as well. These interviews were not key to the research project, and some of the interviews were not transcribed or coded. These interviews were pursued because contact with other communities helped to maintain a broader perspective as my involvement with the ecology community grew. These interviews included authors, editors, and publishing staff from other scientific communities and played a minor role in the development of the research process I describe here. Some of these informants assisted in pilot testing the interview protocols, while others were interviewed as the informants made themselves

known to the investigator after hearing about the research project. The five informants in this group represent the fields of chemistry, engineering, and physics and thus provide something of a counterpoint to developments in the ecology community.

Selection of interviewees was based to some extent on convenience. Due to the prohibitive costs of interviewing informants overseas, only authors and editors living in North America were included in the study. All publishing staff and reader volunteers resided in North America. Twenty-seven informants associated with either Journal P or Journal E provided the main body of interviews, supplemented by five contextualizing interviews.

In total, three of the four main editors of the two journals were interviewed. Journal P has two co-editors. One editor for Journal P was out of the country for the period of the research study, although the editor was contacted via e-mail to determine availability for the interview. Journal E has an editor-in-chief and a managing editor. The managing editor for Journal E played a formative role in journal development and thus was included in the study with the editor-in-chief. Journal P also has a managing editor, but this staff person functions as support staff and has no formative role in Journal P's development and thus was not included in the study.

Fifteen authors from the two journals were interviewed, seven from Journal E and eight from Journal P. This number was chosen as a cut off after author interviews ceased to yield new categories in the preliminary analysis

described below. Authors were identified as issues of the journals were released. Authorship of the journals overlapped with editorial board membership of both journals. One author from Journal P made some comments based on his experience as a reader of Journal E.

Three publishing staff were interviewed, two for Journal E and one for Journal P. In addition, one of the author informants for Journal P also has a publisher role for Journal E. The interview protocol for this informant included additional questions regarding the publisher role for Journal E. One of the readers also had a minor publishing role for Journal E. Again additional questions regarding the publisher role were included. Thus, while there were three publisher informants, five informants provided information from a publisher's viewpoint.

After interviewing many author, editor, and publisher informants, a decision was made to attempt to identify some readers who could be interviewed to gain some insight into the alternative perspective of the reader. To identify potential reader informants a request for volunteer informants was sent out on the listserv list, Ecolog-L, which a number of author informants had mentioned carried core discussions for the field. The call for volunteer informants indicated that the researcher was particularly interested in readers of Journal E or Journal P. I received four responses from readers of Journal E and another response from a reader of journals not included in this study. The four volunteers were interviewed along with another informant who was known from personal sources to be a reader, for a total of five reader informants. In addition, one of the authors for

Journal P had read Journal E and several of the Journal E authors were also regular readers of Journal E. Thus on several occasions author informants revealed perceptions based on experiences as readers of electronic journals as well as perceptions based on their experiences as authors. This should not be surprising given the nature of scientific publishing in which the same individuals may perform author, reader, reviewer, and even editorial or publisher tasks.

All informants were contacted initially either by letter, by e-mail, or in a small number of cases by telephone. All informants were interviewed by telephone, and all interviews were tape-recorded. Tape recordings were made either by taping speaker-phone conversations or using a telephone recording controller connected into the telephone line. All interviews began with an untaped discussion of confidentiality, and recording began only after permission was granted by the informant. All interviews, except for some contextualizing interviews, were transcribed. Most interviews were transcribed within one week of the interview. The longest interval between interview and transcription was 21 days.

In this report informants are identified by a letter-number combination (e.g., C2 or B1). This convention is used to provide anonymity. The individual codes were assigned after interviews and data analysis were completed. Table 4 lists informant identifiers for all authors, publishing staff, editors, and readers interviewed. Secondary as well as primary roles are indicated.

Table 4

Informant Identifiers and Roles Discussed

Informant	Role
A1	Author (Journal E)
B1	Publishing staff (Journal E)
D1	Editor (Journal E)
F1	*Author (Journal E), Publishing staff (Journal E)
G1	Publishing staff (Journal P)
H1	Author (Journal P)
I1	*Publisher staff (Journal E), Reader (Journal E)
J1	Author (Journal E)
K1	Author (Journal E)
L1	Author (Journal P)
M1	Author (Journal P)
O1	Author (Journal P)
Q1	Editor (Journal P)
R1	*Author (Journal P), Reader (Journal E)
S1	Editor (Journal E)
T1	Author (Journal P)
U1	Author (Journal P)
V1	*Author (Journal P), Publishing staff (Journal E)
W1	Author (Journal E)
X1	Reader (Journal E)
Y1	Author (Journal E)
Z1	Reader (Journal E)
A2	Reader (Journal E)
B2	Reader (Journal E)
C2	Reader (Journal E)
D2	Author (Journal E)

Note: * indicates primary interview role. Journal E affiliates: A1, B1, D1, Fr, I1, J1, K1, R1, S1, V1, W1, X1, Y1, Z1, A2, B2, C2, D2. Journal P affiliates: G1, H1, L1, M1, O1, Q1, R1, T1, U1, V1. Authors: A1, F1, H1, J1, K1, L1, M1, O1, R1, T1, U1, V1, W1, Y1, D2. Editors: D1, Q1, S1. Publishing Staff: B1, F1, G1, I1, V1. Readers: I1, R1, X1, Z1, A2, B2, C2

Interview Protocols

The interview protocols developed for the study were directly related to the questions/methods matrix developed for this study. The mechanics of this approach to research design are described by Maxwell (1996), although the structure of this type of matrix is also described by Miles and Huberman (1994). There is not a one-to-one correspondence between the foreshadowing questions and the interview questions. The general approach to the interviews was to provide informants with an opportunity to relate their individual experiences with a journal and discuss their views on electronic publishing more broadly. During the interview process informant responses were monitored for mentions of social relationship and used probes to follow up on any mentions of interpersonal relations influencing views, processes, actions, etc. The protocols in Appendix A illustrate the general line of questioning and discussion. Additional questions and discussion often developed in the course of interviews, and the protocols themselves were modified slightly as the study progressed when changes were believed to further the broader aims of the study. In general, the changes were largely in the order in which questions were asked. The other major modification was required for the interviews of authors of Journal P. It rapidly became obvious that these authors were generally not aware that an electronic version of the journal existed. Thus questions relating to electronic journals were reframed into a more general context and an attempt was made to determine whether the authors had in fact actually ever looked at an electronic journal. The way in which the

issue of Journal P having an electronic version was raised was also altered to create a smooth transition from discussions of the journal selection decision to the electronic publishing discussion.

Data Analysis

The main approach to analysis generally was a detailed content analysis using the constant comparative method (Strauss & Corbin, 1998a), structured initially by the research and questions and, as the analysis progressed, by emergent questions supplementing the research questions. In the constant comparative method categories are developed heuristically through repeated analysis of the body of text under consideration. The text is revisited repeatedly as categories emerge throughout the analysis. Text is typically coded for the categories developed, and these categories become the main focus of analysis. Content can be analyzed from several viewpoints, with different categorizations of the same text resulting. The transcripts of interviews, documents provided by interviewees, published or other public documents gathered by the researcher, and results of literature searching of interviewees' and authors' publications provided the main content analyzed. Grounded theory development typically follows on this type of analysis, and models of process or explanatory theory are developed based on the content analysis results. In this way theory is developed that is emergent from the findings of data analysis rather than from the imposition of theory developed externally from outside the research project. Grounded theory can then be compared to theory derived from other sources.

The program QSR NUD*IST was used to assist in the data analysis. NUD*IST is designed to assist qualitative researchers by supporting an index-based approach to document management, coding, and retrieving (Richards & Richards, 1998). Raw text of documents such as interviews and text from the journals themselves were incorporated into an electronic project corpus; the software was used to assist with coding, category development, analysis, and theory development. Typically the procedure was to import the transcripts of interviews into NUD*IST shortly after transcription was completed and then make an initial coding of the transcript. This initial open coding helped to review the effectiveness of the protocol and in some instances suggested additional probes for subsequent interviews. The initial coding also generated a number of new categories and new questions of interest. In several instances earlier interviews were subsequently recoded for categories developed in response to a later interview while data collection was continuing.

An initial coding scheme used for the first interview was developed based on my conceptual foundations, the research questions, and the questions/methods matrix. For instance, the initial scheme included codes for the main research questions, innovation cluster members, the journals, informants' roles, adoption decision stages, etc. An open coding process was used to expand this initial coding scheme (Strauss & Corbin, 1990). The expanded open coding set developed rapidly during the first ten or so interviews. After the first 11 interviews, the coding scheme included 131 categories, many arranged in

hierarchies, some of which formed the basis for later axial coding. After 23 interviews the coding scheme included 168 categories; many of the new additions were housekeeping categories for functions such as keeping track of informants. At the end of the data collection phase, the coding scheme included 176 categories. The coding scheme underwent a further phase of redevelopment with the development of axial coding structures (Strauss & Corbin, 1998b) during the phase of intensive data analysis that followed after data collection. One set of emergent axial codes developed and significant reorganization and consolidation of codes took place. This manipulation of the coding system illustrates the typical processes of the constant comparative method as text was reanalyzed and recoded as the coding system developed (Strauss & Corbin, 1990). Appendix B provides a listing of open and axial codes developed during the project.

Memoing was another technique used throughout the research process, particularly to assist in data analysis. In general, the approach to memoing was based closely on the techniques described by Miles and Huberman (1994). Memos were created to assist in developing and documenting various ideas that arose from the process of coding and analyzing data. Early in the research process memos assisted in developing the research questions and exploring the conceptual foundations for the project. After data collection began, memos were used to document and explore concerns about the research design and about data collection. For instance, a memo was written on the effects of using telephone as opposed to face-to-face interviews. Both during the data collection phase of the

project, during preliminary data analysis, and following the main data collection phase, while performing final data analysis, memoing was used extensively to describe patterns emerging from the data. For example, a memo was developed early in the process discussing the factors that authors and editors manipulated in managing the journal selection process that authors engage in when choosing a venue for a particular manuscript. This idea was revisited in later memos. Somewhat late in the initial data collection phase a memo was developed outlining emergent themes such as time, integration, and peer review.

As data collection drew to a close and more effort was focused on data analysis, a number of conceptual displays were created to assist in condensing the data and clarifying thinking about emerging theory. Concept maps of the type described by Miles and Huberman (1994) were developed to assist in exploring the author decision process. Several matrices were developed and elaborated to assist in this analysis and also in the analysis of electronic publishing features and the analysis of social relationships.

As data analysis continued, several other techniques were employed to test the degree to which the evidence in the data supported the ideas and explanations being developed. In particular, checks for representativeness were made and disconfirming evidence and outliers were sought. In some instances the development of the matrices assisted in these processes. Especially when examining informants' characterizations of electronic publications, the technique of weighting evidence was used. Miles and Huberman discuss all of these

techniques as ways to test and confirm findings from qualitative research projects (Miles & Huberman, 1994). Checking for representativeness means identifying patterns and then revisiting cases to verify how consistently the cases support the pattern or explanation being developed. Disconfirming evidence is evidence that contradicts emerging interpretations. Outliers are individuals or cases that do not fit into emerging patterns or models. Weighting evidence is technique in which content is evaluated for the intensity and context in which an observation is made. When analyzing the characterization of electronic publishing, for example, how long the feature was discussed was noted as well as whether the informant viewed the feature in a positive or negative light, and how emphatically the speaker argued the advantages or disadvantages of the feature.

A member check was a final method used to check the accuracy of the project findings. This technique is described in Guba (1981) and Lincoln and Guba (1982); at the end of a study data and interpretations are shared with selected informants. Drafts of an abstract and the findings chapter of this report were sent to twelve informants including authors, editors, and publishing staff. Informants affiliated with both Journal P and Journal E were included. Two informants were abroad and did not receive the materials. Six interviewees offered responses. All six agreed that the findings were essentially accurate. Four respondents offered minor suggestions that have been incorporated into this report.

Chapter 4: Findings Based on the Initial Research Questions

The three main research questions indicate the focus at the outset of the study. The research questions were:

1. How do the authors and editors working closely with an electronic journal perceive electronic journals?
2. What is the decision process that authors are using to decide to publish in an electronic journal?
3. How do social factors influence the adoption decision?

The process of exploring these questions led to a number of emergent questions and themes that are described later, in Chapter 5. This chapter discusses findings about how the ecologists viewed electronic publications and publishing, how authors decided to place articles in new publications and how the social organization of the ecologists influenced the publication process.

Characterizing the Innovation

In structuring this study a major interest was how working scientists involved in electronic publishing view electronic publications and electronic publishing. To assist in understanding their views, interviewees were encouraged to describe their personal experiences with electronic publications, to discuss their concerns, and to offer their visions of how electronic publications might look and function in the near future. Most discussion of previous experiences with electronic publications focused on Journal E and on Science Online. None of the

informants had personal experience using the electronic version of Journal P, unexpectedly. Several of them were aware of its existence but were unable to access it.

Reviewing informants' comments about electronic publications revealed that this group of active scientists viewed electronic publications through a somewhat different lens than that revealed by analysis of published statements of publishers and librarians (Hahn & Schoch, 1997). Informants repeatedly discussed eight functions that they saw as integral to electronic publications, either as they exist now or might soon exist given current technological capabilities. The concepts informants described are accessibility, interaction, interconnection, usability, acceleration, quality filtering, online discussion, and cost effectiveness. These characteristics, rather than describing specific technological enhancements per se, represent more general expectations or concerns about how electronic publications can enhance either scientific communication or the application of published information to scientists' work. The functions were often discussed as providing either benefits or drawbacks, and frequently participants discussed a function as having both positive and negative aspects.

Accessibility.

Accessibility refers to the number of people who have access to electronic publications, the characteristics of this group, and the effort and resources needed to read an electronic publication. Accessibility differs from usability in that

accessibility refers to developing the opportunity to read a publication while usability is more concerned with the effort involved in interacting with a publication. Accessibility is controlled both by technology and by characteristics of the publication system. Informants described concerns both with personal access and community access. Some dimensions of accessibility include physical access to needed technology, such as networks; others include the need for particular skills or knowledge as a prerequisite for access. T1 expressed some accessibility concerns in this way:

On the other hand, not everybody has access to the Internet. I don't know if we're just talking about the U.S. in general; if we are talking about the U.S., then it's fine probably to have the papers on-line only. But for other countries, I don't think that everybody has this advanced technology to get them, to get to the electronic versions. And then the paper, just traditional versions of journals may be beneficial, because then at least you can get it at the big library; you can have access to those papers.

Another author, A2, described his perceptions about the accessibility problems that may develop with electronic publications.

Well, mostly that particularly here on the West Coast where I am now, the connect speed is very slow. I think that's a major stumbling block. They [publishers of Journal E] have provided mirror sites in other countries so that people in South America, for example, can access it. That's a huge advantage in that it's very cheap to replicate the entire journal and then

give people access who probably wouldn't have access to a lot of journals - as long as they have access to the Internet. But people are impatient and they won't spend a lot of time on a slow link, so one of my concerns is the speed of downloading the information is too slow right now.

Interaction.

Interaction refers to new capabilities electronic journals offer readers to interact with published information. Often, discussion of interactive functionality was framed in terms of interactive models of various sorts, embedded programs, or multimedia. This interest in software-based interactive capabilities reflects a desire to interact in new ways, not so much with an author's text but with the author's constructs or data. Within the ecology community, data often describe various states or features of the natural world but can also encompass models and formula which describe natural systems or processes. R1, an author from Journal P, looked forward to electronic publications with such functionality:

You could put together dynamic graphs for the viewer or the reader can actually go in; in a sense it's like a mini Java in the web page. You can actually play around with different parameters and see for yourself just how the results came from or maybe get different results for yourself. You certainly can't do that in paper. Well, again I think that you're going to have things like interactive programs within the paper itself. You'll actually be able to manipulate data sets graphically and see what happens if you play around with various variables.

Interconnection.

Informants saw the ability to connect explicitly to information resources of various kinds as a powerful functionality provided by electronic publications.

Interconnection describes connections among related publications, among publications and supporting information sources, and among versions of the same publication. A1 (from Journal E) described the power of interconnecting electronic resources in this way:

What I would like to see is very high quality indexing so that everything is easily searched and particularly hyperlinked - the papers. For example, this is becoming available now electronically in databases. You go to the references, this person cited this paper and go directly to that paper. That might be the most important structure we could give. Being able to follow lines of thought, of criticism immediately without having to go and spend days or weeks at the library recovering references that comment on this paper; things citing forward, things citing backward - that to me would be the most important.

Usability.

Usability issues were discussed regularly within both positive and negative frameworks for electronic publishing. Many ecologists recognized that electronic publications require scientists to modify their habitual practices for managing published information flows. Informants discussed how electronic publications might make reading and applying published information easier or

harder. D2's comments, grounded in her experience as a reader of Journal E, provide an example of a discussion of the negative aspects of usability:

I think that because of the nature of the medium, it's going to be hard for this journal to focus too much on very heavy data analyses. Just because tables and equations and things like that don't come over too well. For example, I was just wanting to print out a paper from the same journal yesterday, in fact, and it was one that turned out to be rather theoretical. Each of the equations - in order to get the equation up on the screen - you have to click on the little symbol for it. And there are hundreds of equations in the paper. I got so tired after a while. And I thought "Uuhn." You know, "Do I really want to bother with this?"

Usability applies to more than the ease of direct interaction with a particular publication but more broadly encompasses the ease of integrating electronic publications into a variety of information seeking and information use activities. To some extent, usability concerns apply to the development of an electronic publication system rather than to the development of specific publications. One of the editors expressed his concerns this way:

The electronic is certainly convenient if you want to log on and print off a particular article. It's very much easier to do that than it is to go track it down by the card catalog and go downstairs to the library or to a different building, so I think it's a real plus there but it still has some downsides to it as well.

Acceleration.

Acceleration references the current print system and the built-in lag between author submission and reader access to a published version of an article. Electronic publication processes were widely expected to reduce the lag between author creation and reader access. W2, an author from Journal E, expressed fairly typical expectations of how electronic publishing will speed up information transfer:

In an electronic format the reviews and the processes of peer review and editing and publication goes a lot faster. That means that the data doesn't have to be three years old by the time it finally gets published. Pertinent data can get in there a little faster.

Quality filtering.

Quality filtering describes a sub-process of publishing that typically generates implicit or explicit cues to a work's quality. These cues are used by readers to assist in managing their information seeking and information use activities. Electronic publication was expected to alter the existing system of quality cues, requiring scientist readers to adapt their systems of information management.

Informants frequently contrasted the ways that traditional print publications provide quality filtering with concerns about how electronic publishing could destroy the system and overwhelm readers. L1, an author with Journal P, described some cues that are helpful in identifying quality in the

current publishing system and described how these cues are unavailable for electronic publications. This author also made a distinction between the innate value of the peer review process and the value of the cues that indicate the application of peer review.

The credibility of the peer review system is kind of a precious icon of science. And there's no reason to believe that an electronic journal should have any less of a critical peer review process involved with it. So in that sense there's really no difference. On the other hand, the costs involved in publishing a glossy journal have always been the hurdle that allows you to assess legitimacy in various ways. So you know that when you've got this glossy journal from Springer, you know this is the big time. Whereas any person of whatever motivation can create a web site and create a journal that is ostensibly peer reviewed, but there you don't have the cachet of the printed, glossy publication to give you another signal about legitimacy. The only way you would have on the electronic form to judge legitimacy is to assess the affiliation of the site or whoever is producing it, where they're from and what they're doing and have some assessment of the peer review process that they describe (if they do describe it) and who the reviewers are. So there is that one aspect of the capital costs of producing a paper journal that is removed when you produce something on the Internet.

Other sorts of quality cues were mentioned besides the substantiality of the

journal. The membership of the editorial board, the sponsorship of an association, the identity of the editor, and simply previous experience with a journal were additional cues.

Online discussion.

Online discussion refers to community-generated interaction incorporated into the publication system. This could take the form of comments, author/reader dialogue, reader/reader dialogue, author/author discussion, or some combination of these. D2, an author and a reader of electronic publications, offered this understanding of online discussion:

One thing that I hope will happen is that we do get more kinds of conversational, quick turnaround, kinds of exchanges of ideas happening. It seems to me that would be very valuable, because that's one of the things that you really can't do in a print journal very well at all. If somebody writes a reply to a paper and then the authors reply to the reply, you know, that kind of thing.

Cost effectiveness.

Many of my informants expected electronic publishing to affect the cost structure of scientific publishing. Most of these discussions were quite vague about how publishing would become more cost effective with an electronic system, but the expectation was expressed. K1 discussed this expectation in the typically general terms:

So I guess I don't think of it [electronic publishing], in a lot of ways, as being that different or serving that different a purpose as traditional journals - other than that it's going to be faster, it's going to be more convenient, it's probably going to be cheaper.

Much of the ecologists' characterization of electronic publications was grounded in either discussion of the existing print publishing system or in consideration of scientists' existing personal practices for managing information seeking and information use. Acceleration, for instance, refers to an anticipated reduction in the amount of time between author submission of a manuscript and reader access to the final form of the published manuscript. Usability, accessibility, and quality filtering are likewise grounded in concerns relating to how electronic publications may enable scientists to find and use information more effectively or may require them to develop new behaviors for carrying out these activities. Online discussion, interaction, and interconnection, in contrast, describe entirely new functions that can be developed by an electronic publishing system to enhance the existing publishing system.

Although these eight features or characteristics of electronic publishing emerged as particularly salient to the group, most of the characteristics were not necessarily viewed as benefits or improvements. Tables 5, 6, 7, and 8 display a rough description of the intensity and tone of informants' discussion of the electronic journal features. Acceleration is the only feature that was uniformly

Table 5:

Summary of Electronic Journal Characteristics Discussion Among Authors Primarily Affiliated with Journal E

Informant	F1		J1		K1		W1		Y1		A2		D2	
	J	G	J	G	J	G	J	G	J	G	J	G	J	G
Interaction	+	-		5+					+			N, -		
Usability			-			+			+	-		+		1, 2+
Accessibility	3+			+					‡			‡, 21		N, -, 2+
Cost effectiveness	2+		N	-		+								
Interconnection	+	2+					+			+			2‡	2+
Acceleration	+			2+	‡	+	‡		+		N		2+	†
Online discussion	+, -		2-		3‡, -		+		-		N	-	2N	
Quality filtering							+		N				+	-

Notes. Symbols in columns labeled J indicate discussion was about a specific journal. Symbols in columns labeled G indicate discussion was of electronic publishing generally. + Informant expresses positive attitude with regard to feature, ‡ Informant expresses strongly positive attitude with regard to feature, † Informant provides lengthy discussion of positive aspects of feature, - Informant expresses negative attitude with regard to feature, — Informant provides lengthy discussion of negative aspects of feature, † Informant expresses strongly negative attitude with regard to feature, N Informant's attitude toward feature is unclear or neutral. Symbols in red indicate that discussion described features of Journal E. Symbols in blue indicate that discussion described features of Journal P. Symbols in black indicate discussion described features of other electronic journals or potential electronic journals.

Table 6:

Summary of Electronic Journal Characteristics Discussion Among Authors Primarily Affiliated with Journal P

Informant	H1		L1		M1		O1		R1		T1		U1	
	J	G	J	G	J	G	J	G	J	G	J	G	J	G
Interaction						+							3+	
Usability				2N					+				-	+, ‡
Accessibility									+					+
Cost effectiveness									+, -				2-	—
Interconnection													2+	‡
Acceleration													‡	+
Online discussion														+
Quality filtering														+, -

Notes. Symbols in columns labeled J indicate discussion was about a specific journal. Symbols in columns labeled G indicate discussion was of electronic publishing generally. + Informant expresses positive attitude with regard to feature, ‡ Informant expresses strongly positive attitude with regard to feature, † Informant provides lengthy discussion of positive aspects of feature, - Informant expresses negative attitude with regard to feature, — Informant provides lengthy discussion of negative aspects of feature, † Informant expresses strongly negative attitude with regard to feature, N Informant's attitude toward feature is unclear or neutral. Symbols in red indicate that discussion described features of Journal E. Symbols in blue indicate that discussion described features of Journal P. Symbols in black indicate discussion described features of other electronic journals or potential electronic journals.

Table 7:

Summary of Electronic Journal Characteristics Discussion Among Editors and Publishing Staff

Informant	B1		D1		G1		I1		Q1		S1		V1	
	J	G	J	G	J	G	J	G	J	G	J	G	J	G
Interaction					+		+	+			+, ‡	‡		
Usability		+	-, ‡		+						+, -			
Accessibility	2‡		2+, -				+							
Cost effectiveness		+	N											+
Interconnection	+		‡		2+		+	+		+	+	+	+	+
Acceleration	+		2+				3+							
Online discussion	3‡, -		N, -				N				†			+
Quality filtering		+, -	N	-										

Notes. V1 appears in this table because of the informant's joint affiliation with journal E publishing. Symbols in columns labeled J indicate discussion was about a specific journal. Symbols in columns labeled G indicate discussion was of electronic publishing generally. Red labels indicate informant interviewed for affiliation with Journal E. Blue labels indicate informant was interviewed for affiliation with Journal P. + Informant expresses positive attitude with regard to feature, ‡ Informant expresses strongly positive attitude with regard to feature, † Informant provides lengthy discussion of positive aspects of feature, - Informant expresses negative attitude with regard to feature, — Informant provides lengthy discussion of negative aspects of feature, † Informant expresses strongly negative attitude with regard to feature, N Informant's attitude toward feature is unclear or neutral. Symbols in red indicate that discussion described features of Journal E. Symbols in blue indicate that discussion described features of Journal P. Symbols in black indicate discussion described features of other electronic journals or potential electronic journals.

Table 8:

Summary of Electronic Journal Characteristics Discussion Among Readers

Informant	X1		Z1		A2		B2		C2	
	J	G	J	G	J	G	J	G	J	G
Interaction										
Usability	+		+		+, ‡		+			
Accessibility			2+							+
Cost effectiveness			+		2‡, +					
Interconnection	+						+			
Acceleration	+		+		+		+			+
Online discussion							+			‡
Quality filtering										N

Notes. Symbols in columns labeled J indicate discussion was about a specific journal. Symbols in columns labeled G indicate discussion was of electronic publishing generally. + Informant expresses positive attitude with regard to feature, ‡ Informant expresses strongly positive attitude with regard to feature, † Informant provides lengthy discussion of positive aspects of feature, - Informant expresses negative attitude with regard to feature, — Informant provides lengthy discussion of negative aspects of feature, † Informant expresses strongly negative attitude with regard to feature, N Informant's attitude toward feature is unclear or neutral. Symbols in red indicate that discussion described features of Journal E. Symbols in blue indicate that discussion described features of Journal P. Symbols in black indicate discussion described features of other electronic journals or potential electronic journals.

discussed in positive terms. Interaction and interconnection were largely viewed as positive developments, with only one informant in each case describing a potential downside. Usability, accessibility, online discussion, and quality filtering are areas in which several informants expressed concerns that these features could create problems in addition to offering benefits. Concerns that electronic publications will require a learning curve or simply be less efficient than paper publications were expressed regularly. Informants, as a group, were time constrained and not especially enthusiastic about changes in publishing which, even for a short time, would require them to spend more time retrieving or reading articles. Informants were also concerned that new behaviors would need to be developed for monitoring the literature. For instance, while most informants liked being able to obtain articles at their workspace, several commented that they rely on regular library browsing and the arrival of new issues by mail as part of their current awareness activities. In contrast to these rather passive modes of monitoring new publications, electronic publications might require them to develop and maintain an active schedule of visiting electronic publications. Author D2 from Journal P expressed the concern this way, based on experiences with Journal E:

I have found that I tend to not read it if it doesn't come in and sit on my desk. You've got to make a point to go visit the site. Once you make that decision to sit down, then it's pretty easy, but there's not that -maybe we're conditioned to deal with mail and hard copy things and they sit on a

stack and eventually you keep looking at it and finally you've got a minute and you pick it up. Whereas now, I have minute, I'm not necessarily thinking "Oh, I need to go visit the [Journal E] site and see what's there." And I know they've talked about, they may have done it, but I haven't gotten one recently, is e-mail reminders from the journal that this new issue is out there, it's been updated. The fact that it's updated continuously makes that kind of difficult. So that's perhaps a drawback.

Relying on computer equipment to provide publications was worrisome for several reasons. There was some fear that segments of the scientific community could be cut off from access to the literature if they were unable to afford computers, lacked network access, or lacked the skills or motivation to use computers. This concern was generally expressed on behalf of scientists in less developed countries. Online discussion might appear to be difficult to dislike, but many informants felt that those scientists who had the greatest expertise to contribute might be the least likely to participate. Their lack of participation could have several impacts. Online discussion might simply never develop. Several informants feared the prospect of a flood of low-quality or even offensive contributions. Authors particularly were concerned about being subjected to time-consuming, unrewarding requests or comments. Editors and publishers were generally more positive in their comments.

Quality filtering is the only feature of electronic publishing that most typically was cast as a concern. This feature, in fact, is the only one which

multiple informants featured in extended discussions of expected negative impacts. The scientists who expressed these concerns generally extrapolated even faster growth of the published literature as a result of electronic publishing. Authors and publishers, in several cases, were concerned that not only would there be more low-quality literature, but, as a result, good-quality literature would be harder to discern.

It is important to point out that personal experiences with Journal E provided much of the context for discussion of these features. Only the publisher staff person from Journal P had worked with the electronic version of Journal P, and only a few of authors associated with Journal P were even aware that it had an electronic version when they were interviewed. In analyzing the data, discussions of electronic publishing grounded in the context of Journal E were distinguished from discussions clearly based either on other experiences or more general interests or concerns. As Tables 5-8 indicate, all of the features were mentioned in both contexts and all but one feature were discussed extensively in both contexts. However, the feature of online discussion was almost exclusively discussed within the context of its instantiation in Journal E; only two exceptions among sixteen informants occurred. Further, this feature was mentioned by only one affiliate of Journal P, although all but one affiliate of Journal E discussed it. Journal E was experimenting with two styles of online discussion. One was a system supporting reader commentary and author response. The other was a form of private symposium that is summarized and, in its concluding stages, opened for

public commentary and contribution. This suggests that, in the case of this one feature, Journal E seemed to be playing a particularly influential role in shaping ecologists' views of electronic publishing.

Very few patterns were found between informants affiliated with the two journals or among the author, publisher, editor, and reader groups. The editor and publisher groups are quite small and generally seemed to reflect similar interests and viewpoints. It appears they can be effectively considered as a single publisher/editor group in their characterization of electronic publishing. Multiple informants in the author and editor/publisher groups discussed each of the features. Readers discussed all of the features except interaction. This is interesting because interaction was generally frequently mentioned (by ten informants) and, with one exception, mentioned with enthusiasm. Several informants mentioned it multiple times. There are several possible explanations for this pattern: first, very few existing examples of opportunities for new types of interaction between readers and publications are available; second, the reader group for the study is very small.

The other main pattern in comparing affiliates between Journal E and Journal P is that the Journal E affiliates tended to discuss many more characteristics and discuss them more frequently within each interview. For instance, authors from Journal E mentioned 5.6 characteristics on average while authors affiliated with Journal P mentioned 3.1 characteristics on average. This is not surprising considering the greater depth of experience with electronic

publishing and electronic publications that Journal E authors possess. However, these data imply that first-hand experience with electronic publishing tends to create a greater understanding of the potential functionality of electronic publications. Journal E informants generally offered more detailed discussions of electronic journal characteristics and tended to show a greater depth of understanding of both positive and negative aspects of the electronic journal characteristics.

Comparison with the Innovation Cluster Analysis

Prior to developing the emergent characteristics of electronic publications, data were coded for mentions of the innovation cluster members identified in previous research (Hahn & Schoch, 1997, listed in Table 1). That research organized cluster members into six dimensions: publishing roles (who acts as publisher); distribution (how the content of the publication is made available to readers); document structure (the content of the documents and its organization within the document); research validation (how the validation function is incorporated into the publishing process); sale and pricing, and storage (how long-term access to documents is provided and who has responsibility for this function). All cluster members were coded when they appeared in informants' remarks, but most cluster members were never coded for at all. Analyzing the pattern of mentions at the dimension level, only two of the dimensions were coded fairly regularly (distribution and retrieval functions and document structure), while the remaining four were mentioned as infrequently as once.

Table 9 indicates the dimensions and cluster members informants discussed during interviews. It is important to recall that the innovation cluster members were selected in part as representing innovations, that is, new functions of electronic publications -- carryovers of existing features of the print system were ignored. As Table 9 indicates, many informants discussed peer review or problems with pricing of scholarly publications. However, they tended to ground their concerns in the current publishing system rather than offering descriptions of observed, expected, or even potential changes. This occurred despite several questions asking informants to imagine electronic publications advanced beyond their current state.

Clearly the features described by the ecologists in this study do not map strongly to the innovation cluster features. The innovative features that were emphasized relate mainly to the dimensions of distribution and retrieval and document structure. There was little or no discussion of innovations in publishing roles, new techniques for validation of research, sale and pricing, or storage. This apparent disparity is more understandable, however, when the differences in approach between the two studies are considered. The innovation cluster analysis of published literature used content created by professionals who were quite knowledgeable about the details of the current publishing process. It also emphasized new technologies with regard to publishing. Thus there was an emphasis among the cluster members on new technologies and on issues and

Table 9:

Number of Informants Mentioning Electronic Publishing Dimensions by

Informant Role

	Authors	Editors	Publishing Staff	Readers
<u>Publishing role</u>				
Individuals as publishers			1	
<u>Distribution and retrieval</u>				
Electronic distribution	3	2		1
Electronic notification	1	1		
Retrieval as needed	3	1		
Immediate publication		1	2	2
Searching	1			
<u>Document structure</u>				
Electronic page images			1	1
Electronic text	2	1	2	
Hypertext links	9	2	3	2
Internal hypertext	1	1		1
Nonlinear document structure	2			
Multimedia	6	1		1
Embedded software	5	1		
Inclusion of raw data	6		2	2
Embedded reader comments	5		1	1
<u>Validation of research</u>				
No peer review	2			
Automation of review		1		
Reader review	1			
<u>Sale and pricing</u>				
Author funding			1	
<u>Storage</u>				
Distributed cooperative archiving				

concerns most relevant to publishers and librarians (the main producers of the content that was analyzed). In contrast, this study focused on the users, in one sense or another, of electronic publications. This group is much less interested in technologies, preferring to focus on functionalities. The emergent characteristics tend to be quite general, that is less specific or concrete when compared to the innovation cluster features. When discussing validation processes for Journal E, even authors who have been through the process talked about it in quite general terms and emphasized the time component rather than the nature of the validation process. Consider these comments from two authors publishing in Journal E describing how it is different from traditional paper journals:

Y1:

It's a lot more accessible being on the Internet. You decide when you're going to read it. I think there is a whole, from what I understand it, a different kind of peer review process that makes the whole cycle of getting things published a little faster.

W1:

It has two things that I liked about it, or that I enjoy. One is that in an electronic format the reviews and the processes of peer review and editing and publication goes [sic] a lot faster. That means that the data doesn't have to be three years old by the time it finally gets published. Pertinent data can get in there a little faster.

In fact, Journal E had automated much of the mechanics of the review process and

employed a double-blind review. Most journals use single-blind review processes. Also, Journal E published extensive information on its peer review process in the instructions to authors, which several Journal E authors indicated they had read.

However, there is more difference than simply level of specificity. The literature-based innovation cluster members reflect a system-based view of publishing in which technologies offer various ways to redesign certain dimensions of the publishing systems while various technological capabilities add specific features to the system. Informants' discussions of electronic publications tended to be grounded in their own work needs. System features, thus, were largely of interest only as they impacted on the effectiveness and efficiency of scientific work.

It would be incorrect to imply that the ecologists were not aware of scientific publishing as a system; rather, their main interest in the publishing system lay in how it helped them to do their work more productively. While there is relatively little correspondence between the two groups at the level of the cluster members, at the level of the cluster dimensions there is far greater congruence than appears on the surface. Coding interviews for cluster members tends to hide this congruence, but it is clearer if the main publishing dimensions are compared directly with the electronic journal characteristics from this study. While there is not a direct, one-to-one correspondence many elements are related. Accessibility, for instance, is related to the distribution and retrieval dimension and the document structure dimension relates to interaction and interconnection.

These were the two dimensions that were most frequently mentioned. This similarity of emphasis between the two study groups is not surprising, considering that my informants' perceptions were grounded quite heavily in the current state of electronic publishing. These are two of the four main dimensions in which Journal E was innovating. Journal E placed extensive demands on authors in terms of the formatting required for manuscripts. Several authors noted that this was burdensome and this reaction may explain in part the emphasis on document-structure features.

Quality filtering relates to the research validation dimension, although informants emphasized the benefits of the current system rather than discussion innovations within this arena. The sale and pricing dimension corresponds to the cost-effectiveness characteristic. The storage dimension does not correspond to a characteristic, but informants discussed concerns relating to storage and archiving issues albeit largely without suggesting innovations. This interpretation explains the observation that, while my informants expressed many concerns about long-term storage and archiving of electronic publications, they did not usually offer any potential or foreseeable solutions. Often concerns were expressed and then concluded with a statement like R1's (an author from Journal P):

The only one [concern] I can think of is one of permanence. Is it as likely that an electronic journal like that will be as accessible 100 years from now as it is something in print is likely to be on the shelf? I'm not too concerned about that but that's the one thing that comes to mind. I think

there are enough ways to archive that kind of material right now and I suspect that there will be additional ways developed in the future to archive stuff like that. The problem isn't of real concern.

In the mind of this scientist, the dilemma of archiving was clearly one that would be solved by others. The scientist did not feel obligated to devise solutions.

The one dimension that was truly missing from this study is that of publisher role. This is not particularly surprising however, given the focus on the study on authors and editors. Thus, examining the views of working scientists yields a somewhat different picture of electronic publishing than was revealed by content analyzing a segment of the published literature. However, the two pictures do suggest some underlying similarities in the structuring of electronic publishing as an innovation.

The Publication Decision

My second research question was, What is the decision process that authors are using to decide to publish in an electronic journal? Content recruitment has been a persistent problem for new electronic journals (Taubes, 1996b). This is probably the case for new journals of any type. Certainly, the concern was expressed in the context of both journals in this study. All of my author informants provided extensive descriptions of their interests and concerns in choosing to publish in either Journal E or Journal P. Most authors also offered comparisons of their journal selection decision and previous journal selection decisions. Editors in turn discussed their concerns with and strategies for

recruiting contributors. Publishers described strategies for achieving general acceptance of the journals. These discussions allowed the development of a set of common decision elements influencing an author's decision and to construct a model for the decision process.

Journal Selection Decision Elements

Based on authors', publishers', and editors' representations of their understanding of the authors' journal selection process, a set of decision elements emerged.

These elements interact in a process that authors, publishers, and editors described as attempting to match articles and journals. Each actor in the publication process has varying control over several, but usually not all, of the elements. Also, not all elements come into play in each situation. Taken together, however, there remain a limited set of elements with which all the actors are familiar and for which they try to account to the best of their ability. The elements, based on the content analysis, are article quality, personal obligations, turn-around time, review process, audience size, audience character, niche, special features, and journal prestige. Table 10 lists the decision elements and the number of informants mentioning each element.

Article quality.

Participants in the publishing enterprise, from authors to editors to readers, make subjective judgments of the quality of an article. Authors were often quite open about their judgments of how the article placed in Journal E or Journal P compared to others they had written or planned to write. Also, the author's

Table 10:

Number of Informants Mentioning Each Decision Element by Group

	<u>Authors</u>		<u>Editors and Publishers</u>	
	Journal E	Journal P	Journal E	Journal P
	N=7	N=6	N=4	N=2
Article quality	2	5	3	1
Audience character	6	3	3	2
Audience size	4	3	2	0
Journal prestige	7	6	3	2
Niche	6	6	3	1
Personal obligation	5	4	1	0
Review process	4	3	1	1
Special features	7	2	3	0
Turn-around time	5	5	3	1

judgment of article quality can change during the writing process. Participants recognized that the judgments are necessarily subjective and that individuals' judgments of article quality did not always agree. For instance, several authors expressed the opinion that editors had underrated the quality of particular articles.

Author O1, who published in Journal P, spoke quite extensively about how his perceptions of article quality influenced the journal selection process. His comments reflect a confident assessment of the particular article being discussed:

We thought it was a pretty good paper, and it came down to either sending it to Ecology - which Ecology, in our field, is probably the top journal aside from Science and Nature. So we thought it was good work but we thought our research was probably a little too biogeochemical for a really broad ecological audience and thus it would be more appropriate for a journal in ecosystems..... We kind of had talked about it. [The co-author] and I had talked about the journal as we went along - where we would submit it - but not until the paper really was almost done did we have a full sense of how good the work came out.

Another author, M1, who also published in Journal P, offered an equally frank, if less flattering assessment of his article.

I didn't feel that it was a paper that would get into Ecology, for example, but this type of journal it partially.... This paper has theoretical value to it, but it's not - I don't know how to say it without saying it too badly - It's not a bad paper, but it's not a paper that is of the quality that a set of reviewers

for Ecology, for example, would recommend it for publication. There's some speculation in there.

Both authors' statements illustrate a common shorthand for describing an article's quality: an assessment of which journals might be likely to accept the article, assuming the subject matter to be appropriate. Authors did use terms such as "a good paper" but the ecologists often described a sort of yardstick on which Science and Nature marked the highest levels of article quality, Ecology marked a lower level, and other journals marked even lower levels.

Personal obligations.

Many informants expressed a sense that some community members felt obligated to contribute work to a journal because of personal ties, professional commitments, or some combination of both. Often the sense of obligation arose out of being a member of a journal's editorial board or from receiving an invitation to write from a respected colleague or former mentor. A1 described how a personal relationship influenced his decision to submit an article to Journal E:

It turned out that the senior editor, [name omitted], was a former mentor of mine, on one of my thesis committees at [University], and he's also on the science board where I was working at the [an ecology research center] and basically he just asked me if I had anything that I would like to submit. Since they were getting the journal started, they sought particular articles. So actually it was an invited submission.

Turn-around time.

Informants commonly mentioned time constraints. In some cases concerns about the amount of time passing between acceptance of an article for publication and its distribution in published form were an important consideration. The length of this period is a characteristic of a particular journal and can vary considerably between journals. One advantage new journals typically have over established journals is that there are unlikely to be backlogs of articles awaiting publication and thus the turn-around time is minimized. Although the label turn-around time tends to reflect the viewpoint of the authors, it is clearly intimately related to the idea of a publishing backlog, which was a label more commonly used by an editor or publisher staff member. T1, an author from Journal P, described the impact of this consideration on her publication decision process:

I had the manuscript and I was thinking where to submit and this new journal came up and I heard that they may publish it very quickly. And that was one of the motivations for me, too. It would be published probably quicker than any other one. Because it was a new one, they don't have a line of papers waiting for reviews yet.

Review process.

Each journal has a standard manner in which the review process is conducted which includes the selection of reviewers, handling of correspondence, copy editing, sending of page proofs, etc. In some instances, the editor plays a role in shaping this process. As the earlier quotes about article quality suggest, the

review process involves a certain judgement of quality. It also consumes a certain amount of time, affecting the turn-around time. There are also other characteristics and benefits from the process that can prove of minor importance in the journal selection process.

Author D2, who does interdisciplinary work frequently, described how her experiences with past review processes caused her to give this factor extra consideration in her journal selection decisions and encouraged her to submit her paper to Journal E:

I've had some experience in the difficulties of publishing interdisciplinary papers. It's always hard because, even if the journal you're sending the interdisciplinary paper to is interested in interdisciplinary kinds of things, there's always the problem that reviewers are probably in the discipline. So a reviewer who either feels that you've done a superficial job with their discipline - which is often the case if you're doing something of an interdisciplinary nature - you can get a rough ride from them. And sometimes they don't understand what you've done, so you can also have problems there. So it can be quite hard to be sure that you're going to be getting useful peer review. I would guess that people who write interdisciplinary papers probably find it takes twice as long on the average, to get a paper out than going head to head with people who are just firmly within a discipline and kind of always chugging out papers that match a formula. So I sort of knew what to expect and I was pleased to see

that somebody was pleased to look at a paper that wasn't squarely within one discipline or another and in this case it turned out to be easier than my past experiences have been.

Audience size and audience character.

Authors often considered a journal's audience in the decision process. This assessment was particularly challenging in the case of new journals such as Journal E and Journal P. Many authors, nevertheless, expressed some estimation of the nature of the audience, in both size and character. Some individuals seemed more concerned with the absolute size of a journal's audience than the actual composition of the audience. Again, D2 provided a particularly articulate expression of the concern with audience size in her discussion of her journal selection process:

And, of course, the other thought was - it's not clear to me what the readership of [Journal E] is, yet. Whether it's more widely available to people than a print journal would be? I'm not sure about that. Certainly it's easier to get at than having to go over to the library, but I don't know how many people know about it. So that's a very good question. That's certainly something that crossed my mind - how is my readership going to be in this particular situation? But I guess I was counting on the possibility of sending papers out to folks that might not have heard about it but might be interested anyway. So that's another aspect of it.

Authors were also interested in characteristics of the audience unrelated to its size. For instance the audience may be composed largely of academic readers or policy makers. Y1 described his hopes for the type of audience Journal E might reach:

Well, the general perception of the audience who's reading it now is that they're either biologists or ecologists, just looking at the nature of the article. Which isn't a natural audience for us per se, but I was interested in the chance to get exposure to them because there is this incredible gulf between the economic side and the more scientific, biological, ecology side.

Niche.

The niche concept describes in general terms the topical focus of a journal. It is somewhat broader than just the subject area covered. The niche might also include concepts of style, such as openness to taking review papers, ideas papers, etc. Sometimes the audience was used as a kind of shorthand for describing a journal's niche. This is not surprising, since there is a close relationship between a journal's topic and its readers' research interests. L1 used this shorthand to describe the niches of several prominent ecology journals that were not in the study:

If you want to communicate to a general audience of ecosystem ecologists as opposed to communicating within a more narrow range of aquatic ecosystem ecologists, you decide to publish in Ecology, which is a general

journal. So that decision was made a while ago, that we wanted to publish our result in Ecology as opposed to Limnology and Oceanography because Ecology was the journal where examples of the type of experiment we had performed had been published including a major paper of exactly the same type by [editor of Journal P] in the 1980's that I was a co-author on.

Although it sounds initially as if L1 is using the audience as the decision criterion, the comment about the type of paper published reveals that this is a sort of shorthand for the topical focus of each journal. The editors of the two journals had a strong sense of the niche of each.

S1

I don't think it should be a very big journal. Papers in a traditional journal - there will be many, many papers but each paper typically speaking to a small audience. I'd like to see [Journal E] be a slim journal with every article having a much broader range of interest. That too defines a different niche in ecology, in addition to the other things I mentioned, and yet not in any sense a policy journal like Environment, for example, that's a policy journal. This is not a policy journal. This is a pre policy journal, if you wish. There's the foundations from which policy can emerge.

Q1

Well, it covers an area that has never had its own journal. Ecosystems science has always been published in a variety of different journals. There has never been one that just focused on the dynamics of ecosystems and

we're using ecosystems to include broad scales which has typically been labeled as landscapes as well. So I see that as one big plus. The second is that I think that there is tremendous opportunity for better integration of what is considered traditional ecosystems science and traditional landscape level research. We don't have a very good understanding of how large areas function when you consider the spatial dynamics in particular. And I think that having a journal in which that integration is explicitly acceptable and laid out as an important priority is a big plus. S1's comments particularly illustrate the idea that the niche concept includes more than just a topical focus, although the topical focus clearly is an important component of the niche concept.

Special features.

Many journals offer unique functions that are not commonly offered by peer publications. Obviously, special features can cover electronic functions but can also include a special type of paper not normally accepted in research oriented journals. All authors from Journal E discussed the effect of the electronic character of the journal on their decision processes. Typically the electronic nature of the publication was of interest to the authors, sometimes out of general curiosity but often due to the opportunities to capture reader feedback. Y1 expressed his interest in this way:

I had been told that there would be some sort of interaction. There's a forum of some sort that people can post questions and comments on the

papers, and that was another one that was of interest to me in going ahead with this. So people could comment and I could have a look at those comments and see where that was going.

However, often the electronic character of Journal E impacted the decision process somewhat indirectly, via authors' expectations that turn-around would be faster or the audience would be broader. D2 expressed her interests in these terms:

Well, I think my expectation was - part of it was I just did this out of curiosity to see what was involved with putting a paper in an electronic journal. I hadn't done it before. I was hoping it would go faster than in a print journal, and it did. I was hoping that the ease of access to the journal would give the paper wide readership, and as I mentioned, I'm not sure whether that hope is going to be borne out or not. We'll just have to see.

Journal prestige.

Many of my informants used the term prestige to describe a community sense of a journal's quality and ability to confer this expectation of quality to the article published in it. The judgment of prestige is subjective and can change over time. Informants claimed that their judgments of prestige were influenced by the general quality of papers published, stature of authors publishing work in the journal, and the stature of the editors. U1, who published in Journal P, expressed the effect of prestige on his decision in this way:

And for the other [major factor], again a journal that's peer reviewed and has some level of stature is again more highly thought of and the work is

considered more valuable in terms of our reward process. So my perception that [Journal P] would be one of those high-stature journals was certainly a factor.

My decisions usually relate to, number one, what journal does this paper fit - in terms of their goals and aims and readership - and second is what is the prestigious or most highly esteemed journal of that list, whatever it might be, and that's usually where I start.

While the concept of a match between article quality and journal prestige is important, my informants tended to emphasize journal prestige as shorthand for a range of desirable journal features. Editors seemed to wish to optimize the prestige of the journal they controlled, while authors wanted to place their articles in journals with the highest prestige possible. Clearly, in this instance all of my informants were involved with journals with no real track record. Nevertheless, a certain prestige level was anticipated at the outset of publication or was expected to develop shortly in the future. H1 presented a justification of his decision to publish some work in Journal P based in large part on his confidence in one of the journal's editors.

I guess there were a number of reasons. I certainly respect the [editor] of the journal, both as a friend, and also I think [the editor is] a tremendously competent person who will make sure that the journal is successful and that it would be a good place to publish. I know [the editor] was soliciting a lot of other people whom I respect to contribute articles. So it seemed to

make sense that this would be a good place to have an article, to put some work I wanted to have out.

When a decision is made to submit a manuscript to a particular journal, which factors have the most weight depends on the situation: time factors, the content at hand, historical factors, personal relationships, etc. Editors and publishers, however, try to maximize a journal's perceived prestige (in the eyes of authors and readers), while authors try to maximize the perceived quality of an article by the ultimate audience. Invariably, the situation is never cut and dried or seen as dependent on a single element.

The complexity of the interaction of various factors is revealed by this extended explanation of the decision process offered by D2 from Journal E:

I basically had already written the manuscript, because my paper was one that there weren't too many different ways of writing the manuscript. Basically, it was a lot of cognitive psychology being written for applied ecologists. So it wasn't like I could say, "All right, I'm going to write this paper really differently for this journal or that journal." It was going to be basically the same paper no matter what I did. And my choice was whether to send it to Ecological Applications, which is a very, kind of high-powered, often rather technical, journal - which would have been appropriate because a lot of the papers that I was discussing in my paper had actually come out in Ecological Applications earlier. But, I just had a feeling that it might get a rough ride at Ecological Applications because it

wasn't really ecology that I was talking about - I was talking about [another related discipline]. So, as soon as I got wind of the orientation of [Journal E], that seemed much better. And then I had a little e-mail exchange with the editor, [name omitted], and he said it was "just the kind of paper we're looking for." So it seemed like an obvious one to put it. I think that it doesn't have the prestige of some of the more established journals; and if I were real concerned about prestige, then I might have thought twice about it. But to me it seemed that having a response from an editor saying, "Your paper sounds like the sort of thing we're really interested in," it just seemed like the publication process would be smoother with that sort of positive orientation. So that's why I went for it. And, of course, the other thought was - it's not clear to me what the readership of [Journal E] is, yet. Whether it's more widely available to people that a print journal would be? I'm not sure about that. Certainly it's easier to get at than having to go over to the library, but I don't know how many people know about it. So that's a very good question. That's certainly something that crossed my mind - how is my readership going to be in this particular situation. But I guess I was counting on the possibility of sending papers out to folks that might not have heard about it but might be interested anyway. So that's another aspect of it.

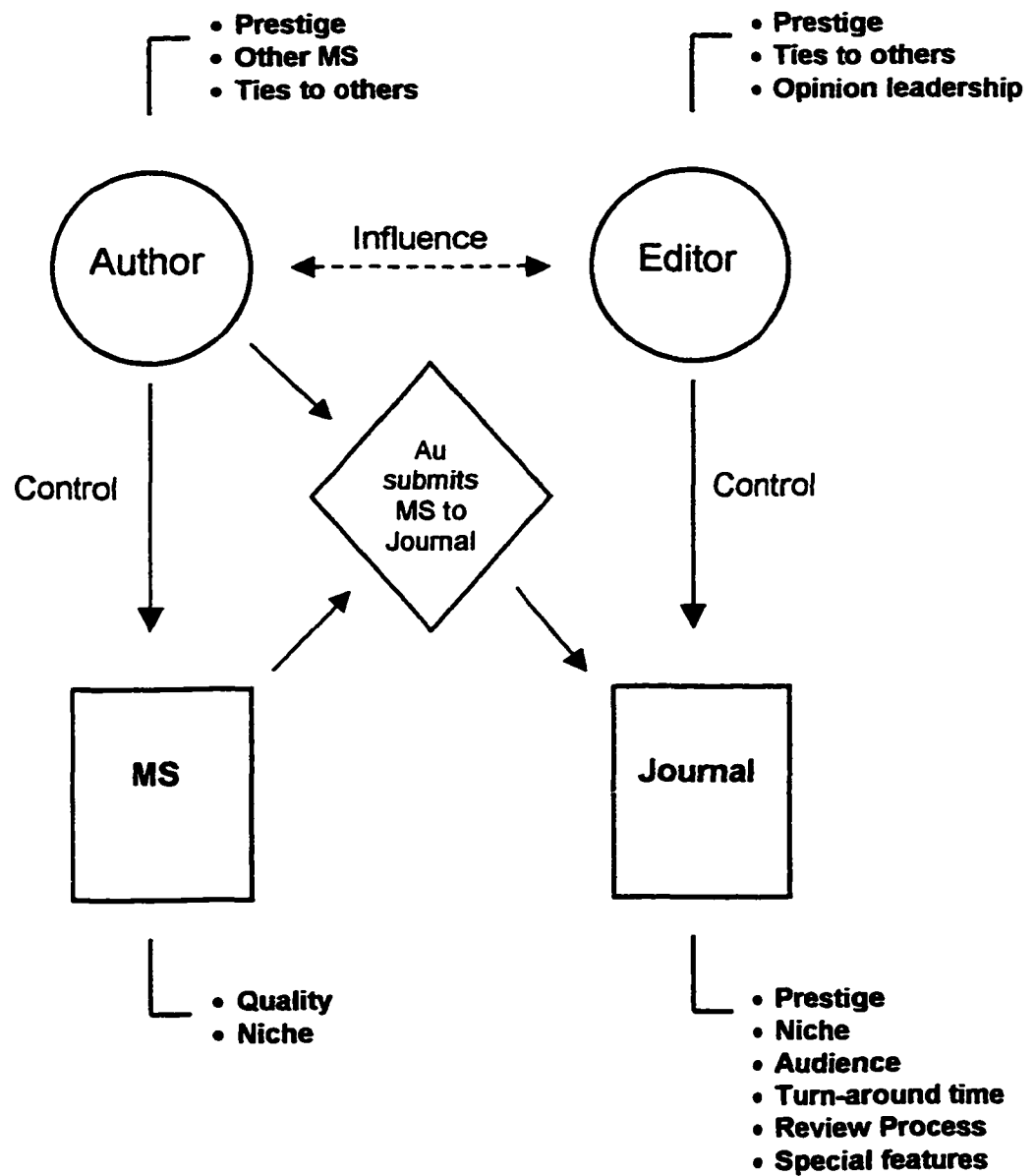
Model of the Journal Selection Process

To capture the complexity of the interaction of the stakeholders and various decision elements, a working model was developed based on informants' discussions describing the relationships among the elements, the stakeholders, and key components of the decision process. Figure 1 presents this model. The entities included are the stakeholders (authors and editors); the manuscript; and the journal. Publishers are not directly represented in the model because they have little ability to influence the elements beyond the startup of the journal. No one actor controls all of the elements, although all the actors seem to be quite well aware of them, in general. The dotted line running between the author and editor represents that this influence is weak relative to the author's control of a manuscript and the editor's control of the journal. Manuscripts may have multiple authors and journals may have multiple editors, of course, but the situation is simplified in the model for the sake of clarity.

Authors often spoke of a matching process between a manuscript and a journal. The factors that determine the strength of the match, however, are the decision elements. The decision elements generally correspond to the factors attached to the various entities. For instance, authors and editors may have personal obligations. A manuscript has a level of quality. The journal entity has a level of prestige, an audience, a niche, a review process, a turn-around time, and may possess special features. Authors obviously control the subject of a

Figure 1:

Model of Journal Selection Process



manuscript and to some extent the quality. Through attempts to optimize a journal's prestige and express a sense of a journal's mission, editors can act to shape community perceptions of many of the elements and may directly control others, such as the review process. In general, actors are aware of each other's roles and concerns. For instance, while authors may have greater control of some elements they are aware of editors' general ability to influence these or other relevant elements. Thus, no portion of the model is hidden from the stakeholders.

The model captures the complexity of the interactions that result in the selection of a journal in a way that simply listing the elements cannot. It is still somewhat incomplete, however, as a model of the world in which authors and editors interact to generate manuscript submissions to journals. Each of the elements has been generalized to some extent. The audience is not represented as actors. Both authors and editors are aware of the audience of readers, but most contact is hidden from their direct observation, a fact that both groups of informants frequently noted. Also, there are likely interactions between elements that are not well accounted for here. For instance, as mentioned earlier, the niche of the journal and the character of the audience are related. Often the kind of people expected to read the journal was used as a kind of shorthand for the subject focus of the journal. Therefore this model should be regarded as an open systems model of the type described by Covi and Kling (1996) in their discussion of digital libraries. The model's elements exist within an unbounded system in which

additional environmental factors come into play to influence the system described.

Patterns Among Authors

Comparing patterns of decision elements between authors of the two journals, I could observe only one strong pattern despite the fact that none of the authors from Journal P knew the journal had an electronic version at the time they selected it. In almost all instances the authors, editors, and publishers of both journals described the same decision elements. The authors from Journal E tended to mention more elements than the authors of the electronic/print journal, but only one pattern of differing emphasis in the elements mentioned occurred. Not surprisingly, the single exception was the discussion of special features. Journal E, as an electronic-only journal, offered a number of special features unique to the world of ecology journals. It should not be surprising that these were discussed frequently by the authors choosing that journal. It may be that the Journal E authors mentioned more elements because they took into account more elements in an attempt to counteract some of the uncertainty created by the electronic special features. However, the group of interviewees is very small in both cases and thus the rather weak evidence may not adequately support such a conclusion. What is clear, however, is that the electronic character of the journal was a factor in the decision process for Journal E authors. The electronic version of Journal P was not a factor for authors since none of them knew of the electronic version at the time of their journal selection decision.

Although other differences between the authors of the two journals were not apparent, an interesting pattern did emerge from analysis of the comments of the authors as a group regarding the considerations motivating submission to a new journal when established journals were available. In considering the selection decision model, it should be remembered that informants were largely describing decisions to submit articles to new journals. All of the author informants were asked explicitly how the decision to submit the article under discussion compared to other decisions to submit manuscripts to other journals. In fact, several authors had previously submitted the manuscripts under discussion to other journals and most had at least considered submitting their manuscripts to another journal (generally a more established journal). Informants' comments suggested that the elements described in the model are the same for most scientific journals, at least within the field of ecology. Informants did tend to emphasize the advantages of faster turn-around time in some instances, and this seemed to be a major advantage offered by new journals relative to established journals. In some cases personal obligation was also mentioned as playing a significant role. It was clear that editors and publishers at least occasionally leveraged personal influence to encourage submission of articles. This study is not structured to demonstrate that this is more common for new journals, but it seems reasonable to expect that new journals more commonly leverage personal obligation for article recruitment. However, editors of both journals reported that they were receiving numerous unsolicited manuscripts. Informants typically reported that they expected the new

journal to lack prestige relative to more established journals. However, authors generally believed that decreased turn-around time, fulfillment of personal obligations to editors or others affiliated with the journal, the audience character, or some other elements, alone or in combination, compensated for the uncertainty regarding a new journal's prestige. Answers to this question did not differ generally between authors from Journal P and authors from Journal E. A few authors from Journal E expressed curiosity about the effects of the electronic features but argued that they had little impact on the decision process.

In addition to the basic elements of the decision model, informants mentioned two additional concerns about the selection decision related to ongoing access. These concerns were mentioned in the context of the decision to submit a manuscript to a new journal and were described as concerns rather than as factors influencing the decision. The two concerns regarded archival permanence and potential lack of coverage of the journal in secondary sources. If a journal is not included in secondary sources, the extended audience is denied intellectual access. These concerns applied to both new journals, not simply to Journal E. However, the concern with archival permanence was mentioned more frequently for Journal E, and concerns related specifically to the electronic format were quite common.

Coverage in secondary sources is related to the ultimate audience for the journal and for the papers within the journal. Author 13, from Journal P, described the concern with coverage in secondary sources by stating,

One concern is that I'm not sure the journal is indexed under Current Contents. For example, I've gotten one request for a reprint. You know, somebody that I hadn't already indicated I'd written a paper from. So I'm not sure how information about, you know, whether it will be cited in some of these indexes or not. That would be a concern. I expect that it will. Whether it is now, I don't know. But if it takes quite a while to get indexed, then that's a problem because obviously it's not going to be disseminated very widely. The work is not going to be very widely accessible if it's not indexed in some of the common places. But I don't know what the status of that is. But that would be a concern.

Journal E explicitly addressed this concern within the published call for papers by stating "The journal is read by almost 5,000 ecologists and resource managers worldwide, and is more readily available than print journals in many countries. It is abstracted by BIOSIS."¹

While informants were quite frank in discussing their concerns regarding publishing in new journals, it should be remember that, as a group, they had decided that the benefits outweighed the risks. The main assets new journals seemed to offer potential contributors were faster-turnaround time, audiences of unusual composition, and an opportunity to satisfy personal obligations. At least in some cases, these proved adequate to compensate for what authors recognized as an element of risk associated with publishing in a relatively unknown venue. In addition, many informants reported a shortage of venues for manuscripts in

ecological specialties. The high rejection rates of even some specialized journals seem to support this perception.

In concluding discussion of patterns among authors' journal selection processes, it is important to address the issue of deciding to publish in a new paper journal compared to deciding to publish in a new electronic journal. Authors from Journal P did not know they were deciding to publish in an electronic journal. They described the same decision elements and offered the same justifications for publishing in a new journal as the authors from Journal E, who could have no illusions about the electronic character of the journal. The one decision element not considered by authors from Journal P was the electronic character of the journal itself. However, generally, the authors from Journal E downplayed the electronic character of the journal when describing their decision process, citing the character of the editor, the expectation of fast turn-around, the audience and features as more attractive. In fact, none of the papers published in Journal E were dependent on the electronic functionalities the journal offered. All could have been published in a paper journal if the authors had wished to place them in traditional venues. Except for the author of an extended comment published in Journal E, all of authors, indeed, reported considering placing their manuscripts in other paper-based journals. This suggests that very few authors, at least in the ecology community, are currently prepared to generate manuscripts designed to leverage truly novel functionalities of electronic publications. Journal

E, at least, is competing directly with paper-based publications and gaining very little leverage in attracting manuscripts from having an electronic-only format.

It is likewise important to explore the relationship between the journal selection process and the innovation decision process. The model suggested here is a static representation of an open system rather than a time-bounded decision process sequenced by stages. The development of the decision elements was pursued because this structure seemed a richer representation of the data and a more accurate reflection of the content of those data. The structure of the data is doubtless somewhat of a consequence of the interview technique used. A sequential decision process could perhaps be developed using an interview protocol that focused more on the timing of decision-making elements. Another alternative might be to follow informants over time as a selection decision is made. At the outset of the study, however, the possible correspondence between the journal selection decision involving an electronic journal and the adoption decision process was an anticipated subject of investigation. It was suspected that a decision to publish in an electronic journal, or a journal with an electronic version, might reflect a decision to adopt electronic publishing. Because of this concern, authors were asked "how committed you feel to electronic publishing." A range of answers were found. Some authors claimed to be long standing supporters of electronic publishing while others expressed less than a sense of full commitment to electronic publishing even though they had published in electronic journals. None of the Journal P authors were making a decision to publish in a

journal with an electronic component, although several of them described themselves as committed to electronic publishing. Comments from Journal E authors revealed that they felt they were experimenting with electronic publishing and in some cases were not completely pleased with the results of the experiment. Although it is tempting to interpret these results from the Journal E authors as reflecting trials with electronic publishing or as responses reflecting the confirmation stage in the adoption decision (Rogers, 1995), in retrospect the techniques of this study do not seem sufficiently robust to support a claim to have resolved this question.

Role of Social Relationships

My third research question was, How do social factors influence the adoption decision? Some answers to this question are interwoven into my discussions of my second research question. Personal obligation clearly plays a significant role in many journal selection decisions, at least in the case of new journals. The effects of personal relationships in this context are developed further below. In addition, I elaborate other evidence of the effects of social structures, relationships, and roles influencing perceptions of electronic publishing and the development of electronic publications.

Characterizing the Research Community

At the outset of this study I wanted to examine a single research community. Several observations support the claim that both journals serve a cohesive group of working scientists. One editor of each journal has published an

article in the other journal studied. Several authors are on the editorial boards for the other journal in the study. Several informants spontaneously mentioned awareness of one journal while they were being interviewed about the other.

While this continuity of community is gratifying, it did add some complexity to interpreting informants' statements, since a few informants play multiple roles within the journals. While this could be seen as a hindrance to research, this multiplicity of roles within the research community is doubtless common beyond the context of this study. There is likely to be frequent crossover between the editor and author roles, the publisher and author roles (for association leaders at least), and the author and reader roles.

It is also important to clarify that, while an attempt was made to explore social connections among informants, particularly as they influenced decision-making, the study did not encompass an effort to identify all relationships among informants. This was partly from confidentiality concerns: informants typically were not told who was being contacted other than by general category. If they asked, authors were told that editors were being interviewed and vice versa. It was clear in a couple of cases that informants had mentioned my study to each other and thus probably knew that I had spoken to specific individuals. Also, since some informants were asked to suggest other people who should be interviewed, those informants could infer that their suggestions were followed. However, the idea of presenting informants with a list of names largely composed of informants and probably revealing the journals being investigated was unappealing. The data,

as a result, suggest particularly salient social connections rather than a comprehensive picture of social relations such as might result from sociometric network studies like those of Crane (1969) or Crawford (1971).

Patterns of Interconnectedness

Table 11 records explicit mentions of prominent or influential individuals within the community of ecologists studied. The salient relationships that were revealed in the course of the study relate particularly to two types of decisions: decisions by authors to submit papers to particular journals and decisions by readers to investigate particular journals. Table 11 also documents occasions in which authors noted that an article was written in response to an invitation received from an editor.

Two significant patterns are apparent from this data: the relative absence of mentions of author/author influence and the important role of author/editor influence. With one exception, the authors mentioned were mentioned for their secondary roles as publishing staff affiliates with Journal E. None of the authors mentioned other authors in the course of the interviews. Instead, editors received by far the most mentions, particularly within the context of influencing decision processes. Most informants mentioned editors as influential in some publication-related decision process. Some of this might be attributable to a flurry of invitations from editors to authors; and while these occur particularly frequently for Journal P, not many of the author/editor links are attributable to this source. Readers also tended to mention editors as influential in the decision to monitor

Table 11:

Matrix of Referent Mentions by Informants

Referents:	Authors			Publisher staff			Editors		
	F1	J1	V1	B1	I1	G1	S1	D1	Q1
Informants:									
<u>Authors</u>									
A1							XR		
F1				X			?	X	
J1							XR		
K1							-		
W1							-		X
Y1							XR		
D2							X		
H1									XR
L1							X		X
M1									
O1									-
R1							X		
T1									-
U1									XR
V1							X	X	X
<u>Pub. Staff</u>									
B1	X		X				X	X	
I1	X						?	X	
G1									
<u>Editors</u>									
S1		X		X				X	
D1			X	X			X		
Q1			X						
<u>Readers</u>									
X1					X				
A2							X		
C2									
Z1							-	-	
B2							X	-	

Notes. Red labels indicate informant interviewed for affiliation with Journal E. Blue labels indicate informant was interviewed for affiliation with Journal P. Not all mentions were in the context of the journal of affiliation. X informant personally knows referent, - informant knows referent by reputation, ? not clear how informant knows referent, R referent requested article from informant.

publications. Publishing staff were also mentioned regularly for Journal E. This journal, as an association publication, had many more individuals playing influential roles in the development of the publication. Some readers did mention authors from both inside and outside the study population as important in the decision to read a particular journal.

The Special Role of Editors

Editors clearly play a powerful role in structuring the relationships of authors and readers with journals. The editors of both journals were almost universally mentioned as influential by the authors submitting to their journals. While these mentions sometimes revealed explicit requests for a manuscript, they also included mentions of collegial relationships, personal friendships, and expressions of respect. Most of the readers also mentioned the editors as influential. Many of my informants claimed to know one or more of the editors and respect them. This respect gave authors confidence that the journal would ultimately be respected, that manuscripts would receive careful review, and that people would pay attention to the journal. D2 expressed this confidence in the ability of an editor to attract readership:

Also, because I know the editor and several of the other authors who contribute to this journal, I had a pretty good feeling of who the kind of core readership would be.

This confidence in the ability of editors to attract readers seems justified based on my discussions with readers. A2 commented that he read Journal E

because, “I knew the guy’s name that was editing it, or starting it up, and am not usually disappointed in reading anything he’s been involved in.” Other readers supported this judgment.

In the case of both journals, the editors were selected following the decision to develop the journals. According to publishing staff, these ecologists were selected in large part for their prominence within the research area and their ability to lend influence to the journal. All four editors fit Rogers description of opinion leaders. Rogers (1995) defined opinion leadership as

the degree to which an individual is able to influence other individuals’ attitudes or overt behavior informally in a desired way with relative frequency. This informal leadership is not a function of the individual’s formal position or status in the system. Opinion leadership is earned and maintained by the individual’s technical competence, social accessibility, and conformity to the system’s norms. (p. 27)

As opinion leaders, these editors were able to offer publishers the ability to promote a new journal by attracting both authors and readers. In the case of a new electronic publication, the importance of the support of opinion leaders increases. In the cases of both Journal P and Journal E, the editors selected seemed to be effectively encouraging the adoption of the two new publications.

To summarize, social relations proved to play an important role, particularly in understanding decision-making processes such as the journal-selection decision and the decision to read a particular journal. Unexpectedly, the

editor role proved to be especially important. The diffusion paradigm offers a useful tool for interpreting this finding by suggesting that the importance of the editor role may be derived in part from the opinion leadership exercised by the editors in the study.

The three research questions provided a useful framework for interpreting three key research findings. The first finding is a set of perceived core electronic journal functions: accessibility, interaction, interconnection, usability, acceleration, quality filtering, online discussion, and cost effectiveness. These functions are strongly tied to the ongoing work of ecologists rather than reflecting particular technologies. They are understood as offering potential benefits but also incorporate many concerns regarding potential reductions in the effectiveness of the formal publishing system.

The second finding is a model describing the journal-selection process. This model relates the key stakeholders, authors and editors, with the appropriate decision elements. The decision elements are article quality, personal obligations, turn-around time, review process, audience size, audience character, niche, special features, and journal prestige. All groups of informants displayed awareness of these decision elements. Authors typically used a subset of the decision elements to mediate an optimal match between manuscript and journal. There was little difference between the decision elements used by authors publishing in an electronic-only journal and authors believing they were publishing in a paper-only journal. Authors suggested that they found that faster turn-around time,

opportunity to fulfill personal obligations, and the audience character outweighed concerns regarding journal prestige and general uncertainty.

The effect of social relations on decision processes is the third finding based on the research questions. The journals clearly served a single research community and author/editor relations were the key social relationships that emerged from the interviews. Publishers actively recruited opinion leaders from within the community to serve as editors. This role enabled the editors to positively influence authors' submission decisions and readers' decisions to peruse journals.

Chapter 5: Emergent Themes

While my interviews were successful in allowing me to answer my research questions, my analysis suggested a further major question -- what key relations between the scientific community and the publishing system are affected by electronic publishing? Three themes emerged from my informants' discussions of electronic publishing which describe such key relations. In the previous chapter, it was suggested that with regard to electronic publishing informants' perceptions of key innovation characteristics tended to differ from characteristics emphasized in the literature written by publishing staff and librarians. The ecologists were more focused on characteristics impacting their work as opposed to characteristics impacting the publishing system. This does not mean that the informants were unconcerned with the current publishing system. The themes identified show just the opposite.

These themes -- integration, time, and peer review -- emerged in the course of data analysis. In some cases the themes expand to a higher level relations that were discussed in the previous chapter as affecting individuals' relations with particular publications. The original research questions focused mainly on informants' views and experiences with particular journals but included a component broadening the discussion to scientific publications more generally. The themes emerged when data were analyzed to discover informants' views of the publishing system in the context of the community. The emergent themes

explain to some extent the ecologists' understandings of and concerns for the system more holistically.

Integration

Integration describes a function of the publishing system to create and maintain connections. These connections tie together information sources, community members with shared interests, research communities, and broader communities. *Integration has three basic characteristics: it is based on the creation of new connections; it allows the development of new activities or capabilities; and it improves the effectiveness of existing activities or capabilities by a magnitude beyond that offered by additive effects by allowing new modes of interaction.* To some extent integration weaves together several of the ecologists' characteristics discussed previously: interconnection, interaction, usability, accessibility, and online discussion; but it applies them over several scales. However, the theme includes additional components. Table 12 summarizes three dimensions of potential integration generated by an electronic publishing system. These dimensions -- the integration of research artifacts within the publishing system, the integration of a research community, and the integration of a research community with other communities applying research -- are further developed below.

Integration of Published Research Artifacts.

Previously the term interconnection has been used to refer to a specific functionality that electronic publications can provide to link individual

Table 12:

Dimensions of Integration within Electronic Publishing

Integration of research artifacts

Potential: Interconnections among articles, resulting in integration of published works, greater usability, better accountability, new effectiveness

Potential: Connection of data to the publishing system, creating opportunities for better use of data and development of new types of research.

Potential: Connection of other types of information constructs to the publishing system, generating more effective communication and opportunities to develop new areas of research

Fears: Information overload, leading to loss of author control.

Integration of the research community

Potential: Interconnection of researchers across space

Potential: Increased effectiveness of information exchange by reduction of time barriers

Potential: Added communication lines from readers to authors

Fears: Exclusion of some community members, information overload

Integration of research community and communities applying research

Potential: Greater accessibility of research to applications community

Potential: Increased feedback from applications community to research community

Fears: Misapplication of research

publications. This concept of integration resulting from linkages interweaving information sources to allow new modes of interaction was one of the most frequently mentioned innovative characteristics of electronic publications. Interactive interconnection can also form the basis for a higher-level improvement in the usability of the publishing system beyond a simple additive improvement in usability of particular publications. Several informants looked forward to interconnections that create an integrated publishing system in which researchers navigate quickly and efficiently among related resources. This integrated system would make information easier to evaluate and assimilate. The power of linking texts has been repeatedly advocated by various authors (Dixon, 1998; Hitchcock et al., 1997; Hitchcock et al., 1998; Holoviak & Seitter, 1997; Moret, 1997; Probets, Brailsford, Carr, & Hall, 1997). Early in the development of the World Wide Web Cronin and McKim (1996) also discussed how the Web particularly could play this integrative function, although they failed to fully explore specifically the potential for integrating scholarly publishing. However, the integrating potential of electronic publishing is broader than hypertext conceptions typically suggest. The ecologists suggested not merely integration of text but also integration of data and other information constructs into the publishing system.

The following quote from A1, an author affiliated with Journal E, illustrates a sense of the importance of interlinkages of text and then adds the

importance of integrating data. He saw these functions as the greatest potential advantages offered by an electronic publishing system:

What I would like to see is very high-quality indexing so that everything is easily searched and particularly hyperlinked - the papers. For example, this is becoming available now electronically in databases. You go to the references, this person cited this paper and go directly to that paper. That might be the most important structure we could give. Being able to follow lines of thought, of criticism immediately without having to go and spend days or weeks at the library recovering references that comment on this paper. Things citing forward, things citing backward - that to me would be the most important.

The other incredibly important thing is if we could get standardized means of publishing the data either with the paper or just as a publication, a different kind of publication, in itself. People providing data. That's starting to happen too. But I think that could be an enormously important extension of journals that they don't really do very much of now. Science is doing that now. They request you send things to their Web site. Extra, if you publish a genetic sequence, for example, you have to give them the sequence and they put it on [the site]. I would see that that's a sticky issue because people have concerns about the proprietary nature of data. I won't let somebody else use it. But that inhibits a lot of progress, and I would hope to see a lot more data being

made available with papers or maybe following a paper at some point. And electronic journals could really facilitate that because it's cheap. Instead of publishing reams of paper, which you can't possibly do now, provide giant data sets. But again it's a quality-of-information problem. That data set, you have to know that it's good data, and it's got good meta-data that describes what it is so you have confidence in what's there. That's a major job that maybe journals or maybe societies can start to pick up and maintain these databases of data sets. So I think those are the two things that I can think of to me as being the most important - creating a link from one paper to another so that you could immediately find out those papers that cite this paper.

K1, an author from Journal E, suggested that data integration can expand the abilities of the publishing system to support new types of research:

Ideally, journals will not just be places for your article but storehouses for your data. So it's going to allow people that want to do that to synthesize work, to reanalyze work in a larger context.

Electronic publishing systems were exciting to ecologists not merely as ways to make data accessible, but also as systems to integrate data in new ways to support new ways of communicating information, such as models. One informant affiliated with Journal E had published a model in a general science online journal (not in my study). He described his experiences in this way:

I had published a paper in [the general science journal] that was a more standard format and they said “It would be nice as a spin-off...” (this paper involved a lot of simulations) “to have something that would explore a lot of those issues.” So we had something where readers could actually not do simulations themselves but could see movies and things....

Later this informant (K1) also described his motivations and expectations:

If you asked me these questions about why I published that paper in [the general science online journal], I’d give you a different set of answers.

There we published a paper that we could not have published in a standard journal. The sorts of things we tried to do on it were things for which the electronic format was uniquely suited. And I think there, there’s an obvious reason for doing it. It’s going to change the kinds of ways we transfer information as opposed to a relatively standard paper, which the [Journal E] paper was, which just happens to be published electronically instead in hard-copy format.

In the case of this author, at least, the opportunity to integrate a simulation into a publication transformed the publishing experience.

While integration of text, data, and models and other types of information constructs clearly has transformative potential, the comments above also hint at some fears that were also commonly expressed. A1’s quote demonstrates a recognition that many authors may fear losing control of their data, and other informants mentioned information overload as another concern.

Integration of the Ecology Research Community.

Integration provides a unifying theme at the level of the community's research literature but provides a further unifying theme at another level, that of the research community. Publishing systems clearly have the ability to integrate research communities. The development of a new journal was frequently justified by my informants in large measure by the potential of a specialized journal to integrate and empower a group of researchers focusing on a topic of shared interest. Q1 described this expectation for Journal P:

Well, it covers an area that has never had its own journal. [The subfield of ecology] has always been published in a variety of different journals.[Description of the field omitted]. So I see that as one big plus. The second is that I think that there is tremendous opportunity for better integration of what is considered traditional [subfield A] and traditional [subfield B].... And I think that by having a journal in which that integration is explicitly acceptable and laid out as an important priority is a big plus. I think that it can actually help foster some of the areas that I think need to be developed better scientifically.

This integrating role of journals of the paper-based publishing system has been documented by other researchers (Price, 1961; Griffith & James, 1970). The development of an electronic publishing system offers even greater potential for integrating communities of ecological researchers with shared interests.

An electronic publishing system can integrate the research community across barriers of space. Several informants reported that electronic communications have already begun to have this effect, allowing collaboration among researchers on different continents, as this statement from X1, a reader of Journal E, illustrates:

I don't hesitate to contact a colleague overseas about something, because I'm pretty sure that if he reads his e-mail that I'll get an answer the next day. And for some of the projects I've been working recently, I've been communicating pretty regularly with people overseas.

Interviewer:

Would you work with them even if you didn't have the e-mail? Is it to the point where it's making something possible that wasn't possible.

X1:

I think so.

Similarly, an electronic publishing system allows simultaneous global access to published information.

Online discussion integrated into a publishing system also increases the potential for community integration by allowing the connection of research reports with commentary. Online discussion provides an example of how integration and time are related. Integration can occur not just because of technology links but also from the removal of time lags. Electronic publishing incorporating online discussion reduces the time required for electronic

communication and potentially allows a greater level of contact between author and reader members of the research community. It becomes much easier for community members who have never met to become engaged via shared research interests. Also, the paper-based publishing system is largely a one-way system for transferring information from author to reader. Online discussion offers new opportunities to connect readers to authors, offering a new level of connection among them. The excitement generated by these new connections was particularly evident in the comments of the author of an extended comment on an article in Journal E. K1 compared writing his extended response to an article in Journal E to an earlier experience writing a paper for submission to a paper-based journal:

You know the big difference to me was just that it was a much more... For the print article it was a fairly major endeavor. From the beginning of the project you're deciding. You know you're going to be publishing and it was just a big project. Maybe because it was a response more to [Journal E], it felt more informal; it felt much easier. It just didn't feel like a huge labor. It felt like I have an idea. I really enjoyed it more. I don't think it's nearly as significant as the paper that got published, the print paper, because that was actual data and results and all that. But I probably enjoyed it more just because you really felt like the response time was quick, there wasn't - you didn't labor over it for months and months. It was out. They come back quickly with a "here's what we need for it to be..." They were back within days saying, "This is going to be published, sent

out for review, here's what you need to do." In days I sent it back to them and in two weeks I had the reviews back. So it just didn't feel labored and it was actually kind of a joy to do that.

Interviewer:

Would spontaneous be a good adjective?

K1:

Absolutely. I feel like the decision to write the reply was made basically made sitting in front of the computer reading the first article. - Oh wow! - and just going. In a few hours you're basically done with it. And thinking if nothing comes of it, it was a good exercise just to write this. I just kind of enjoyed that. It clarified some of my thoughts about some of the things I think. So spontaneous is a good word.

The spontaneity expressed by K1 provides a contrast to the expectations expressed by several authors publishing in the more conventionally distributed Journal P. Several of these authors described awaiting reprint requests, letters, and e-mails from colleagues to give them a sense of the impact of their publications. For instance, U1 from Journal P described how he expected reprint requests to be a key indicator of the success of his article:

I will feel really good about it if the reprint requests start flowing in, which they have not yet.... Yeah, I feel good about it so far. Ask me in another month and, if I haven't gotten any requests, then I won't feel quite so good about it.

This quote suggests how the reprint-requesting system and similar types of techniques are important but imperfect methods for authors to hear from interested readers in a print-based system. As Lin, Garvey, and Nelson (1970) noted, face-to-face author/audience member discussions resulting from seminar and conference presentations are effective ways for authors to obtain formative feedback on their research before publication. Online discussion integrated into the publishing system is an alternative, post-publication way to enhance an author's opportunities for obtaining feedback from an article's audience.

It is worth mentioning that K1, the author of the electronic response from Journal E, repeatedly indicated that the ability to respond rapidly to a recent article was a major motivator in the decision to create the response article. By creating opportunities to harness creative energy generated by an encounter with a stimulating publication, electronic publishing offers the possibility of capturing ideas that might otherwise go unexpressed. Clearly this potential can have a negative side as well if the process generates mostly content of little or no value.

Even readers who do not respond can expect benefits from this type of integrated community communication. B2 compared his experience as a reader of Journal E to his experiences reading paper publications and effectively conveyed this combined impact of removing time lags and integrating comments into the publishing system:

Gosh, the differences. Well, I perceive them [paper and electronic publications] quite similarly with the exception that, when they ask for

opinions, which I believe [Journal E] has - they have kind of almost an online town meeting and it's where people's comments get posted over time as a response to an open-ended question that they ask. It's kind of interesting because it allows a very quick and well-documented way of getting some of the experts' responses. It doesn't have the lag time of a conventional journal, which probably for something like Ecology or Ecological Applications would be about two years between even acceptance and publishing.² And that's a disappointment. If I want to contact a professor, and I think this is part of a cutting edge of their research, I'm more likely to find they've been there, done that and moved on to something else by the time that I learn about what they do. And that's why I like an electronic journal. It allows me to see what the researchers are doing right now.

The excitement that these and other informants expressed when comparing experiences with electronic and paper publications demonstrates some of the potential of electronic publishing to alter the nature of community interaction.

Electronic publishing systems potentially also reduce limitations on the amount of content that can be incorporated into the system. Many informants expected electronic publishing systems to allow the development of new forms of publication. Several ecologists described how current ecology journals may require articles reporting results of experimental research to incorporate more experimental data. Alternatively, Journal E was experimenting with publishing

articles that are more synthetic in their approach and less data-intensive.

Additionally, online discussion may well tend to encourage more content that is critique, synthesis, reporting of observations, or reanalysis as opposed to the now typical introduction, methods, results, and conclusion paper. Potentially an electronic formal publishing system could integrate a wider range of publication styles than the current publishing system can support; many of these new styles could foster better exchange and consequently better integration.

While electronic publishing offers opportunities for greater community integration, some ecologists expressed concern that an electronic publishing system could weaken existing community ties by excluding some community members, particularly those unwilling or unable to develop sophisticated computer skills. The frequently voiced concern that community members are, or will be, excluded from accessing an electronic publishing system also suggests the potential power for community integration offered by an electronic publishing system.

Integration of Ecology and Applied Research Communities.

Integration can occur at a third level, the level of multiple communities that use basic ecology research; by linking the ecology community with the management and policy communities that apply ecology research. Journal E explicitly attempted to integrate the ecology research community with other communities that use ecological information. Several staff involved in the development of Journal E discussed this goal of integrating the scientific and

policy and management communities. It is clear that the broadened access provided by network distribution and the removal of subscription requirements made possible by electronic publishing were seen as key to enabling this integration.

My informants were also careful to explain why this type of integration is important to the ecology community. For instance, ecological information and research findings are used for policy making and management of natural resources. Many of the individuals working in the policy and management communities are trained as ecologists. Several of the self-identified readers and two authors were ecologists whose main responsibilities were for applied work rather than basic research. There was a general perception among my informants that the paper-based publishing system functions very poorly in transferring information between the research community and communities interested in applying ecological information. Reader and author informants from the policy-making and management communities also expressed frustration with the research community. Several of these informants expressed views that the research community is frequently out of touch with broader concerns. Y1 is one such self-described outsider who expressed his views this way:

I'm from a little bit different tradition. I'm not an academic. I frankly have very little patience with some of these excessive academic debates about minutiae, and always feeling you have to have an extreme position to get recognized somehow. Instead of everyone has their model, their way of

looking at things, let's kind of struggle together to get the right answer.

Because I certainly feel in this field that people are making progress.

Electronic publishing offers the potential to make it easier for non-researchers to obtain research reports in a timely and convenient manner. An online discussion function tied to research reports could integrate the research communities with communities applying their research by providing a means for non-researchers to present their viewpoints in an arena that is accessible in turn to the research community.

Not all of my informants were concerned with integrating research and policy communities. Some research ecologists were skeptical that such integration was achievable. Others were simply unconcerned. There is some evidence, however, which suggests that Journal E is successful in acting to integrate previously separated communities of researchers and the groups who apply the information generated by the research community. W1 was a federal employee whose main work was land management. However, he also chose to contribute some research of his own to Journal E:

I think to some extent it [electronic publishing] will democratize the process. I think to some extent, being on the non-research side or the non-academic side, I think to some extent paper journals are being dominated or captured by the academic side. I think with these electronic journals, especially the concept of [Journal E] you go through and publish a paper and they have a discussion and a comment side on it. It's not just left out

there - you know, this is the answer. This is what I put out there, even though it's been peer reviewed, people've looked at it, what do you think? And then people on my side of it, the managers or the users or the non-academic side, can say "Yeah, but..." I always love the academics. They love the theory of land - I'm a land manager by training and by practice - and the theories of land management. I've said, "Yeah, but did you ever think that the neighbors won't let you do that? or did you even think that yeah, that's really a great idea, but it costs so much and I have to run the thing with a budget." And being able to comment back and say "in theory you're right on, but in practice here's the problems" and be able to have a discussion and talk to people about those kind of issues.

S1 discussed the nature of the historic separation of the communication systems for academic communities and other communities that make use of scientific research and offered an engaging view of how an electronic publishing system could bridge these historic gaps:

The unique niche that I think the journal occupies is partly defined by the medium itself. That unique niche is to develop the bridges between the fundamental understandings of science, the fundamental understandings of people, and the fundamental understandings of policy. I emphasize fundamental. The journal - there are all sorts of things around that relate to efforts to articulate policy for particular issues, international, national, and regional - there is very little around that is focused on what the physicists

call applicable science. That is research and scholarship focused on underlying fundamentals that have great consequences in society. It is therefore a bridge that attempts to focus on integration - integration across disciplines; integration across role players in our society; integration of activities in research, policy, and practice. So, once you've talked about integration, you face the realization that there are historically separations between these communities. Separation between these communities means that there is a lack of understanding, understanding of scientists of policy, of citizens of science, business people of science and so on...

Integration provides a powerful concept for describing the potential ability of an electronic publishing system to improve the advance of research within the field, to allow the exploration of new research approaches, and to increase the effectiveness of transfer of research information to the communities that apply such information. The concept incorporates a synthesis of the previously discussed functions of interconnection and interactivity to improve accessibility and usability. By conceptualizing these as occurring across multiple dimensions or scales, integration ties together the levels of the community's body of published literature, the community's members, and the larger body of users of the community's research.

Time

Time and timing issues were another recurring theme in discussions of the development of an electronic publishing system. To some extent it is impossible

to distinguish timing and integration issues completely. Integration effects are frequently based in part on the reduction or removal of time constraints. However, timing issues are pervasive and operate in somewhat different arenas, which makes it worthwhile to discuss them separately. Almost all informants discussed issues of time and timing that were affecting themselves, their research projects, the work of the community, and the ultimate application of basic research. Indicators of time effects tended to appear in the contexts of characterizing electronic publishing and decision making. Table 13 offers a brief summary of these issues, which are discussed further below.

Individuals and Time Management

Most of the scientists described themselves as highly time-constrained or emphasized time constraints frequently when describing their activities. A few even described themselves as exceptional in their relative freedom from time concerns, which they perceived as generally pervasive within the research community. Most informants reported multiple demands on their time and managed multiple projects simultaneously. These issues can be generally categorized as time management concerns, which operate at the level of individual actions and behaviors. Time management seems to be key to realization of the hopes and, in a few cases, the fears, of my informants with regard to how electronic publishing will impact their work and the work of the community as a whole.

Table 13:

Time and Timing Issues Affecting the Scientific Publishing System

Arena	Time Effects
Individual work processes	Time management concerns constrain activities. Time allocated to interacting with the published literature competes with other activities.
Research process	Reducing the time allocated to the publishing cycles alters the timing of other parts of the system. Time saved on publishing can be applied to extend other research phases. Time saved on publishing can make new types of research possible or assist in preserving research resources. Time saved on publishing may make additional rewards realizable.
Community development	Publication lags are essentially lost time, holding back community progress. Time is required for assimilation of research results. Time is required for quality control activities.
Development of communities applying ecology research	If publishing consumes too much time, policy or management changes may occur too late to be effective.

Time management issues threaded the discussions of many of the electronic journal characteristics, particularly those involving usability, quality filtering, and online discussion. While most informants reported or expected significant benefits from the development of an electronic publishing system, there were also concerns that electronic publishing could negatively affect many time-related aspects of the scientific communication process. With time recognized as a generally precious resource, the ecologists described many practices aimed at minimizing the time demands of interacting with the published literature. For instance, many informants reported that they typically carried research articles around with them for reading in odd moments of free time. Not surprisingly, many of the usability concerns the ecologists ascribed to electronic publications were fears that these publications would require more time to use or would decrease scientists' freedom in managing their reading time -- for instance, by requiring them to read from a computer screen.

Notice the emphasis on time elements demonstrated in the following description by J1, who explained why he did not monitor Journal E, the journal in which he published an article:

I have to also tell you that I don't regularly go on and scan to see what's come out lately. I see that as a disadvantage, but other people probably do that. When a print version comes across my desk, it's very easy for me to spend literally two minutes looking at the table of contents, surveying the papers; and if there's something I want to read, I may make a copy of it to

take home, I may take the journal home. I probably have subscriptions to a couple dozen journals, so that's a very efficient way for me to do it. If I have to get onto the Web or go to the site to look up things, at the moment it's going to take me much longer and I find I don't do it.

Conversely, electronic publishing was also viewed as offering time-saving benefits during usability discussions. T1 published an article in Journal P but read electronic journals. Again, note the emphasis on time factors in her comment:

I think on one hand it is very convenient to have these electronic journals and actually I am going to use some of them. I just got e-mail that there is Climatic Research online and I can get some papers from there. It's very convenient. You save time from just going to the library and just getting it from the library.

Quality filtering was another function of electronic publishing that included some elements of time management. A less efficient quality filtering system for the published literature would demand that an ecologist devote more time to finding high-quality literature or endure a higher occurrence of time wasted reading low-quality information. Information overload problems are in large part time management problems. D1, an editor, described how he saw quality filtering as an asset for time management:

Peer review and editorial boards of good journals play a really important role, and it becomes more important with time as we are inundated with information. There is just so much out there that you could read. You need

some help in deciding how to spend your time when you're choosing what to read.

Online discussion was sometimes discounted as a viable function of electronic publishing because of the inhibiting effect of the time constraints on successful researchers. Y1, an author from Journal E who generally spoke quite positively about electronic publishing generally, expressed his cynicism about online discussion in these terms:

So far, I don't know. I haven't checked lately to see if there've been any comments on our paper. But the problem is, if someone has something worthwhile to write, as in a comment on a paper, especially in academia, I get a sense that they're not just going to do it for free, and sort of post. If they have an incentive, they'll want to maybe publish their own idea, or they're so busy they don't actually have time to sit down and structure. And the only people who do have time to sit down and put down their ideas and submit it to the journal as a comment on a paper are marginal enough people who have views that are not as useful, because they have time.

This concern that time constraints may limit participation in online discussion may or may not accurately predict the ultimate fate of online discussion. It does emphasize, however, that time limitations must be counterbalanced by alternative benefits if online discussion is to become an accepted function of electronic publishing.

With individual time constraints pervasive among ecologists, personal time management needs clearly influenced many perceptions of electronic journal functions such as usability, quality filtering, and online discussion. Other factors also came into play in shaping perceptions of these and the other characteristics, but the timing issues form a recurrent pattern within the arena of individual work practices.

The Arena of the Research Project

Time and timing issues appear within the structure of the research process as well. As discussed in the previous chapter, perhaps the most widely held perception regarding electronic publications is that they should reduce the time needed for publication of research results. Turn-around time was also a frequently mentioned decision element. Informants from all groups regularly expressed a general concern with the amount of time required by paper-based scientific communication. Publication lags of 12 to 18 months were generally reported by authors, editors, and publishers and were recognized by readers.³ Minimizing the time allocated within the research process to the publishing process was thus highlighted in many discussions. This section will focus on the research process as Garvey and Griffith (1971) described it. The process includes the development of the research project, the gathering of data, and the dissemination of results to the community. Concerns about the time required for recognition of publication to occur are also included here, since this seems to be an integral part of the dissemination of research. While acceleration and turn-around time focus on

shortening the publishing cycle, the interesting effects ecologists discussed tended to focus on impacts on the other portions of the cycle: selection of research projects and achievement of recognition and rewards for publishing research.

Several informants expressed dissatisfaction with the current research effectiveness of the community as a whole. These complaints were time -related in that they were concerns that research methodologies were unnecessarily limited to a handful of accepted quantitative techniques which favor projects that are limited in the scope of the time spans investigated and time required for data collection. To quote S1, an editor, who also published in both journals:

I thought that U. S., particularly, ecology was barren, narrow, and overly scholastic - that it was completely unaware of bodies of literature, of theory, example in practice. [It was] totally ignorant of these bodies of literature that identified so clearly that the ecology of the U.S. was the ecology of things you could put quadrats around or stuff into bags and had little to do with the larger issues of multiple-scale phenomena, approaches from statistical and scientific inference that were not the same as bench science. [It was] Naive, narrow, and scholastic in character, and it was a disservice to the science and a disservice to the policy issues concerned.

The main argument here is that ecology has become overly dependent on quick and dirty approaches that are not necessarily best suited to the nature of the questions being asked. This informant and several others expect the advent of electronic publishing to expand the community's opportunities to develop

alternative research approaches, in part by altering the timing of the publishing system.

While some ecologists believed the timing of the publication process is affecting the selection of research approaches and research techniques, the timing of the publication process was also seen by some as affecting availability of ecosystems for study. Because many of the subjects of ecologists' research are endangered by various human activities, the time scale of the research process may be too long to assist in preserving endangered ecosystems for study or other reasons. Reducing the time required by the publication process can have the benefit of assisting in preserving the objects of ecologists' studies. D2 expressed the concern eloquently:

If you're an ecologist, you're probably going to have to be thinking conservationist thoughts. It's so important - if people are going to have anything to study in twenty years, most people are realizing that they've got to have a kind of conservation orientation, even if that's not their primary interest. ...[There's a] sort of desperate feeling, too, that this is a really time-limited site that people have on their hands and things that we're working with are slipping away rather quickly.

At the other end of the research process, there seems to be a general recognition among ecologists that the time frame for achieving the rewards of the research process is limited. Thus the period required for publication affects the amount of time required for the research process. Also, as several of the

informants pointed out, ecological processes occur over a variety of time scales, many of which are longer than the time scale dictated by the academic reward system. In general, for any particular research project, the faster the communication process the greater the amount of time that can be devoted to data collection and also the greater the range of projects that can be considered. Conversely, time-savings could be applied to obtaining the rewards and recognition for publishing research results. Thus, reducing the time required for publication could conceivably offer several benefits. There is some evidence from the study that reductions in turn-around time can allow the publication of research that would not otherwise be considered publishable simply because of the amount of time that has passed since the research was performed. One author who published in Journal P explained that he favored the new journal because of its minimal turn around time. The following comments were offered in response to a probe of an earlier answer regarding the decision not to send the paper to the journal Ecology:

Well, the main drawback is that they probably wouldn't have accepted it unless I did two or three different revisions. I did [the research] a long time ago and I didn't want to do it again.

Interviewer:

It was time to get this out there?

A 8:

Not really time to get it out. I'd done this as part of my dissertation, two years prior and it was modeling [garbled] and the model had progressed beyond where it was then, so essentially it went somewhere where it wasn't going to be changed or it wasn't going to be published.

If the time scale of the reward system governs the time allotted to a research project, reducing publishing time could allow data collection to occur over a longer period of time. While this would not be especially desirable for many types of scientific research, for ecologists studying events occurring on seasonal, annual, or even longer time scales, the opportunity for a longer period of data collection can create opportunities for research that is not practical with a paper-based publishing system.

Finally, there was an additional timing-related wrinkle to publishing in a new journal. Because the journal is unknown, authors expect a longer time to elapse before receiving the full rewards of publishing in it. Author A1 had published work in Journal E and reported feeling some later regret about this selection decision because of this delay in achieving rewards:

I think in retrospect I would have tried it somewhere else in that my time horizon being a post doc is shorter than for people in other positions. You want the maximum short-term bang. I think that in the long run it will be an important journal. Like I say, had I the chance to do it over, I think I would send it somewhere else.

This quote illustrates the problems that can be created by delays in achieving recognition for published work, particularly for younger scientists trying to establish themselves. It also illustrates the influence of timing issues on publication decisions. These concerns about timing issues related to receiving recognition were woven into several discussions of turn-around time and review processes as decision elements.

Timing Issues and the Progress of the Community's Research Agenda

Timing issues related to accelerating publishing processes and minimizing turn-around times affect another arena, that of the development of the research community's agenda. As numerous researchers before have pointed out (e.g. Price, 1961, and Garvey, 1979), a scientific field's research progress is tied to the time scales of the publishing system. Accelerating the pace of individual research projects and the dissemination of individual findings can be expected to increase the general rate of progress in a research area, although the nature of this relationship may not be linear. Increasing the rate of community progress is doubtless the main community-level benefit expected from the acceleration characteristic of electronic publishing. Along with this expected benefit there is a similarly rooted concern that the community may lose access to the products of research over time. These two time-related elements structured many discussions of the impact of electronic publishing on the development of the ecology community's research.

While the benefits of more timely publication for accelerating the pace of community development are fairly obvious and have already been discussed, there are some basic concerns about unintended consequences of accelerating the pace of publishing. Changes in turn-around time could affect the ability of the community to catch mistakes. A reduced turn-around in publication time resulting in faster distribution could mean that mistakes are caught by the community more quickly post publication. Conversely, review could occur on such a short turn around cycle that mistakes are missed in the review process. R1, an author who published in Journal P, was concerned that electronic publishing could be too fast:

Results come out so fast. A person might publish or submit a paper and it's in press in a month and then suddenly you find some new data that completely changed the paper. With that fast turn around time, there's no way to make the corrections. So I think actually having a drawn-out process where paper's concerned to a certain extent can be a good thing. Of course, there are bad aspects. But it could be a sort of a double-edged sword -- it has both benefits and liability. But you'd definitely lose something, I think, if you completely went to paper and did everything electronically, especially with regard to speed.

Research communication is not completed merely by the release of a publication. Community members must read and interpret results as well if the results are to be effective in advancing the research agenda of the community. Timing issues come into play at the community level during discussions of the

electronic journal characteristics of access and usability. Restrictions on access or increased difficulty of use could increase the time required for the community to read and use a publication.

Many of the benefits of incorporating online discussion into the formal publishing system are related to improving the rate of advance of the research front. Several informants viewed online discussion as a way to speed communication compared to the conventional practice of letters to the editor. S1's interview suggested a more sophisticated view of the timing of communication and the impact of changing the pace of communication. His comments are not quoted directly because they could not be effectively edited to preserve confidentiality. However, S1 commented particularly on the relatively fast, but still asynchronous, nature of online discussion. His comments indicated he believes this asynchronously paced communication mode opens up new styles of interaction and enables new participants to engage in discussion. S1 was clearly envisioning an ongoing dialogue developing, with the intervals allowing participants to encode and interpret information more thoughtfully than is possible in face-to-face style discussions but more quickly and more sustainedly than exchanges in print media allow.

Another set of timing effects tied to the development of the community's research agendas is the preservation of access to research products over time. This concern is perhaps related in part to the long time frames over which ecological processes occur. Electronic publishing regularly aroused concerns relating to the

persistence of research results published electronically. For a community that uses information collected by previous generations of researchers, expressions of need for long-term access to the community's archival literature are not surprising. There seems to be a broad expectation within this community that data collected by the research community should be deposited and preserved for future community use. F1, an author and publishing affiliate of Journal E stated:

As a scientist you want to put yourself in a forum which a hundred years from now someone still can use your data, and I say this as someone who has mined eighty-year-old journals for data.

The integrative potential of data publishing has been discussed already; but archival issues are relevant to data publishing as well. Several informants -- editors, authors, and readers -- referred to a couple of ongoing projects to gather and archive community-generated research data, one sponsored by the main ecology society and the other by NSF. At least one of these archives will be tied to the publishing system. Archives aside, publications themselves were widely viewed as viable mechanisms for archiving research data for the community. Several informants besides F1 mentioned having personally used data published long ago and wanted their research results likewise to be available to serve as a resource for research over long time scales. Not surprisingly, these informants foresaw many problems for the research community if an electronic publishing system cannot provide the same level of access over time that has been achieved for paper-based publishing. Long-term community access was mentioned as a

concern associated generally with publishing in a new journal. Several authors publishing in Journal P expressed this concern even about the paper version of the journal. However, electronic publications were generally considered even more ambiguous in their potential for either long-term maintenance or thoughtless decay and loss. This concern tended to be emphasized more by informants associated with or discussing Journal E.

Timing issues again interwove discussions of several characteristics of electronic publishing. Within the arena of advancing the research agenda of the community, these issues emerged in discussions of acceleration, accessibility, usability, and online discussion. Concerns about preservation tie in to some extent to accessibility concerns, but the timing issues emerge more broadly as a general concern with electronic publications.

Timing Issues Relating to Interactions of the Research and Applied Communities

As mentioned previously in the discussion of the theme of integration, the activities of the ecology research community have broader interest and utility among related communities of policy makers and natural resource managers. The timing theme also influences the structure of the interaction among the ecology research community and the communities that apply ecological theory and research findings. Two of the readers interviewed and two of the authors from Journal E belong to these “application” communities. Informants generally agreed that information normally disseminates very slowly beyond the research community, in part because of the long time spans involved in publishing

information and making it accessible beyond the community of research specialists. By speeding up the publishing process through an electronic publishing system, informants expect to see interest increase in using current research findings beyond the scholarly community. C2, an environmental consultant, expressed this view particularly clearly:

Well, the journals in the field of ecology are primarily academically oriented toward academic issues for their own sake. But most ecologists are not that kind of ecologists. That only represents in today's world about 15% of ecologists. About 85% are practicing ecologists. They're doing something, they're getting paid for doing something in ecology. Whether it be for biological services or for some state fish and wildlife group or the Department of Defense or wherever they are, they're getting paid for practicing ecology - for inventorying and for managing and for remediation dealing with ecology. So there are not a whole lot of hard copy journals that deal with that sort of thing, or kind of keeping up on the regulations that sort of drive that sort of thing. And dealing with that whole area which is practicing ecology - it's something that is time oriented. You need to know about it straight away. You need to know what's going on. There are a lot of new reasons why things are done because of changing regulations or new regulations from Department of Interior or EPA or whoever it might be that drive the technology that are used in monitoring and so forth. The applications of GIS [Geographic

Information Systems] or GPS [Global Positioning Systems] to conservation. All kinds of things are happening that if you waited for a hard bound published copy, you're talking about a year after the article was first written before it gets peer reviewed and then it gets into the queue cycle for publication and finally gets out in hard copy. Whereas something out of Journal E can get out and be used, because you're dealing with the utilization of information, information can be put into practice much quicker.

The process of exploring the research questions showed that time-saving and the speeding up of various processes are particularly powerful factors in structuring many of the issues relating to electronic publishing. Threading through many discussions of electronic journal characteristics and decision elements, time management, time dependencies, preservation, and acceleration together provide a useful theme of time issues that assists in understanding how electronic publishing fits into the publishing system now and suggests some key issues that will need to be addressed as electronic publishing develops. These time elements operate within arenas ranging from the personal to the research community and the larger societies which use the community's research. Time and timing issues affect the nature of the research the community undertakes by affecting the productivity of individual scientists, the types of research projects that can be considered, the speed at which research results are communicated, the ability to receive rewards for research achievement, the character of formal communication

processes, and the manner in which the research community interacts within its boundaries and with those outside its boundaries.

Peer Review

Peer review is the usual control regulating authors' access to the publishing system and the rewards accruing from successful publication. In light of this key role, perhaps it is not surprising that, although peer review was not incorporated into the interview protocols, almost all of the informants discussed it to some extent. Peer review was a frequent topic in discussions of quality filtering and online discussion as electronic journal characteristics and during discussion of several decision elements including journal prestige, article quality, journal review processes, and turn-around time. Peer review thus provides a theme unifying several elements of electronic journal characteristics and the journal selection system. In addition, a model of the structure of the journal literature emerged that is helpful in explaining the functioning of the current journal system and many informants' views on the potential roles for electronic journals within the body of published literature.

Peer review was typically viewed as underpinning the quality control function of the publishing system. The ecologists made it quite clear, however, that peer review is a sophisticated system tied closely to individual publications. Thus peer review does not reflect a uniform standard of quality. Rather, the peer review process is tied to the context of particular publications, with review being more stringent in some cases than others. Review is not based simply on the

quality of the work under consideration but also incorporates a judgment of the appropriateness of the work for the publication in question. Although informants sometimes spoke as if peer review were synonymous with publication, most did make clear that even in a print-based formal communication model, not all publications are peer reviewed.

Peer review functions within a system of journals that vary not only in their quality but also in their subject focus, style, format and intended audience. Peer review therefore acts to mediate a match between an article and a journal based on many factors in addition to a standard of quality. The system provides cues to quality but embeds these cues within a system offering readers a number of other indicators that shape additional expectations readers might have about article content. The presence or absence of quality cues and other cues from the system also influences the recognition received by authors for their publications. Journal prestige in turn is related to quality but also incorporates other factors such as the size of audience.

All groups of informants frequently described a simplified model of journal publishing usually possessing three tiers. The model was often cited in the context of discussions of the journal selection process and also in the context of quality filtering and journal prestige. The model is summarized in Table 14 and described in detail here. Within the ecologists' model the top tier was exemplified by Science and Nature. Most scientists aspire to publish in one or both of these journals but recognize that most scientists' work never reaches the standards of

Table 14:

Ecologists' Three Tiered Model of Journal System Structure

Tier	Characteristics
General science journals	Greatest prestige Highest-quality articles High rejection rates Stringent review for quality, broad interest beyond discipline Broadest audience: includes scientists outside the discipline Exemplar: <u>Science</u>
Top discipline journals	Significant prestige High-quality articles High rejection rates Stringent review for quality, broad interest within discipline Broad audience within the discipline Exemplar: <u>Ecology</u>
Specialized journals	Variable prestige - can be as high as top discipline journals Variable quality of articles - can be as high as top discipline journals Variable but typically lower rejection rates Varying review stringency - focus may be match with journal niche Specialized focus - can be a research area or article type Narrower but more focused audience within discipline or in inter-disciplinary area Exemplar: <u>Conservation Biology</u>

quality and broad interest that these publications hold. At the second level, informants described the top publications of the broad discipline. Ecology was usually named by this community as exemplifying this tier. Ecological Applications and Conservation Biology were sometimes placed here but more usually at the next level. This second tier seems to be the level at which most ecologists hope to place their best work. In fact, some informants viewed placement of some work here as requisite for professional advancement. At the third level, a host of specialized publications are available. These works, while usually offering less prestige and validation than the top two tiers, provide a selection of venues often targeted to specific audiences with specialized interests within the discipline or may focus on particular formats - for instance, reviews. Both of the journals in this study were generally acknowledged to occupy this tier, which frequently encompasses a variety of subjectively estimated judgments of quality. Both Journal E and Journal P were regularly described by authors and editors as specialized but very high-quality publications occupying this level. When I asked author informants why they expected these journals, which are too new to have established a track record, to develop rapidly into high-quality, prestigious publications, they typically cited the quality of the editors and editorial boards along with the reputations of the publishers.

This three-tiered model of the existing journal system is highly generalized, as many of the ecologists who described it pointed out. The model, however, reflects a sophisticated structuring of the publishing system and reveals

that peer review is not simply a binary quality judgment of merits publication and does not merit publication. Editors also exercise a moderating role by setting expectations for reviewers and intervening in the review process on occasion if the results of the process are out of line with their vision of the journal.

The three-tiered model suggests a general relationship between quality and breadth of audience. To attract a large audience a journal may have to provide a consistently high level of quality. However, journals attracting only a focused audience can vary in quality and maintain at least subscribership, if not readership. Journal prestige may also tend to relate to size of audience. Again this relationship is not tight as journals with relatively small audiences may also have high prestige.

The interviews offered other evidence that ecologists recognize that published works vary widely in quality. Authors were often quite frank in reporting their assessments of the quality of their own works. Often the work that served as the main focus of our discussions was openly described as minor, of less interest or less significance than other work the author had done in the past or planned in the future. Conversely, in some instances authors suggested that a particular article turned out to be of higher quality than had been expected at the outset of the writing phase. For instance, O1's comments were revealing:

I guess when I go to submit something, a couple of things that factor in.

Number one are page charges - which [Journal P] doesn't have any page charges - the quality of the journal relative to how good I think the work is

- and like I said, I thought that this paper that we submitted was, I think it was some of the best work that we've done, which meant that there were probably about three or four journals that I would consider sending it to.

The structure of the journal system and the mediating role played by the peer review process thus clearly influenced the journal selection decision.

Another comment from O1 described the decision of himself and his co-author, illustrating how the system functions from the author's standpoint:

We thought it was a pretty good paper and it came down to either sending it to Ecology - which Ecology, in our field, is probably the top journal aside from Science and Nature. So we thought it was good work, but we thought our research was probably a little too biogeochemical for a really broad ecological audience and thus it would be more appropriate for a journal in ecosystems. And then secondly in the field of [Journal P]. I think we have very high hopes that [Journal P] is going to turn out to be a premier journal. I think there is real need for the journal. So we're quite... So we thought our paper was very good and we were very optimistic about the future of the journal, it's going to be the premier outlet for [research in the field covered by Journal P].

This quote reveals how the authors used the model of the journal system to identify a likely journal within the constraints of the type of manuscript they had in hand. This model alone is not sufficient to explain all aspects of the ecologists' publishing decisions. Other decision elements frequently came into play, as

shown by O1's first quote and as has been discussed variously above; however, the structuring of the journal system and mediating role of peer review are important parts of the picture.

Informants' discussion of a three-tiered structure within the publishing system sometimes led to a more extended discussion of how the existing formal publishing system offers scientist readers a number of cues for evaluating individual articles. Such discussions raised a number of questions regarding how an electronic publishing system can offer cues of similar utility. For instance, print publication in scientific journals does generally signal peer review. Exceptions are generally widely recognized, perhaps more easily because they are rare. D1 (Journal E) described the general filtering role of journals in this way:

It seems to me that journals are very important filters. Peer review and editorial boards of good journals play a really important role, and it becomes more important with time as we are inundated with information. There is just so much out there that you could read. You need some help in deciding how to spend your time when you're choosing what to read. I think that the highest-quality peer reviewed journals play that role. They are the filter that picks out articles which at least by conventional wisdom are the most valuable. Lots of scientists take advantage of that filter. They'll go first to articles that have the imprimatur of having been chosen for publication by the top journals. People pay enough attention that they cite the articles in those journals. So I think that this is going to continue

in the electronic realm but only if what it takes to produce journals in this way isn't wrecked by electronic distribution.

The application of these quality cues is mediated through the peer review system.

Two other informants independently described a recent occurrence of improper co-opting of the cues associated with Proceedings of the National Academy of Sciences (PNAS), a highly respected, broad-interest publication. II tells the story most clearly and also offers his interpretation of the significance of the fraud:

I think of this phony Science paper that was published by these people in Oregon. I assume you know this story.

Interviewer:

No, actually I haven't heard this story.

II:

Oh, it's really bad. They're being sued. Some "hey, let's not worry about global warming" folks started an institute, and they're well funded by the "hey, let's not have to pay for our pollution" folks in Oregon (I guess) and they started this institute called the something, something Study Institute and they sent out to thousands and thousands of scientists all over the country a reprint that is made in exactly the same type font, same style, same everything, as - no, I'm sorry - as a PNAS paper. In exactly the format and everything, but if you look in the corner it doesn't say PNAS. That's the only way you would know it wasn't from PNAS. Everything

else is the same. And it's a phony paper that claims that global warming is wrong, it's not happening, and it's certainly not due to CO₂ or anything else that industrial folks might be producing. And then they had a petition with it to sign to say you agree with this paper or something..... They got something like 20,000 signatures based on this phony article. So the point is that the authority of a journal like PNAS goes a long way towards making people listen. That's good. Obviously there's a bad side to it, but it takes a little test like that to show you how important it is in a way. So I hope that will somehow continue to be the case, where important work published electronically still has that imprimatur of professional societies that have done the right kind of peer review.

This petition was widely reported to the scientific community (for instance, Malakoff, 1998). This story emphasizes the power of the quality cues encoded in the journal structuring system in the world of paper publishing. Many of the informants believed that these cues and the controls that underlie them could be transferred intact to an electronic publishing system. L1, an author from Journal P, expressed his confidence in the potential for transfer:

The only thing that distinguishes science from other means of endeavor is peer review, and the credibility of the peer review system is kind of a precious icon of science. And there's no reason to believe that an electronic journal should have any less of a critical peer review process involved with it. So in that sense there's really no difference.

Conversely, several informants described a perception that many scientists currently view electronic publishing as incompatible with peer review. A few informants made statements suggesting that their mental framework for electronic publishing excluded peer review even though other parts of their conversation indicated that they knew of peer-reviewed electronic publications. H1's interview provides an example of this. He indicated early in the interview that he was aware that Journal P, the journal he published in, had an electronic version. However, later he stated:

Now, the electronic version has the advantage. If you're going to get it over the Internet, that certainly saves you the time of going down to the library. But on the other hand, I'm not quite as sure that all of the safeguards are there that are going to ensure that the articles are of the highest quality. I should hope so, of course, but I don't know.

Not surprisingly, the perception of lack of peer review was often seen as contributing to a view that electronic publications are of inherently lower quality relative to print publications. D2, who published in Journal E, describes his concerns with this perception:

Before I submitted the manuscript, I wasn't really familiar with electronic journals at all; and several people that I mentioned it to were saying, "Well, is that journal peer reviewed? Is it going to get you the same kind of [garbled] that you would get from a peer reviewed print journal?" I think because it seems to be well peer reviewed, and they advertise that

that's what they do, that shouldn't turn out to be a problem. But it could well be that as a kind of initial impression this may sound like a kind of second-class publication to people. And if you're really worried about status or trying to get tenure or something like that, it could be that some authors wouldn't want to go to an electronic journal until they've proven their worth and their commitment to quality.

Joint print/electronic publishing was recognized as potentially bridging this disjunction. Still, problems clearly remain for new journals trying to find a place in the publishing system. The problem for an author was described by K1, an author from Journal E:

I'm not sure what weight it has, to have a publication in an electronic journal at this point. I don't know. My sense is that it carries less weight than to have something in a print journal. I can't decide if that's because it's electronic or because most electronic journals are so new. Because I think print journals it's the same thing. I think if you publish in the first couple of volumes, nobody's heard of the journal. If you have a really good paper, are you going to send it to Ecology or send it to some journal that no one's ever heard of, because it just got started? So I'm not sure whether it's strictly because I think it's electronic it gets less weight or it's just simply that [Journal E], two issues out, doesn't carry that much weight yet.

Editors and publishers for both journals were aware of these problems and spent

significant portions of their interview sessions describing their aspirations for achieving prestige for their journals through attracting high-quality articles and prestigious contributors. Despite such efforts, one informant indicated he regretted his decision to publish in Journal E largely because of this perceived quality problem tied to peer review.⁴

Peer review plays multiple roles in the work lives of these ecologists; it is a mechanism for judging authors' work, but it can also provide a mechanism to improve the quality of an author's work. As several informants mentioned, useful comments may enable an author to improve the manuscript and enhance the likelihood that the research it reports is accepted in the best possible light.

The gateway function of peer review has been discussed at length here. As a gateway, successful navigation of peer review serves not merely as a quality certification but also as a mechanism by which prestige may be transferred to a publication and indirectly a body of work. However, discussions with informants suggested some additional, perhaps undesirable, functions of the peer review process. Peer review can function as a barrier to the attainment of prestige and successful dissemination of research results. While informants often expressed a judgment of their work's quality, that judgment was frequently at odds with those of a journal's reviewers and editors. Several authors revealed that the work published in Journal E or Journal P had previously been rejected by other journals. Most often the rejecting journals were described as second-tier journals, but one article published in Journal P had previously been rejected by Journal E.

Rejection must be a common experience for authors, given the 70-80% rejection rates regularly reported for competitive journals in ecology.⁵

Six authors discussed the experience of having a manuscript rejected. Four of them had published articles in the study journals that had previously been rejected by other journals. In some instances authors were relatively unconcerned by a rejection. In some cases, however, authors viewed rejection of an article as indicative of larger problems in the publishing system. V1 expressed such concerns, which were shared by other authors as well:

Well, I had a paper which actually, ironically, had been rejected by the electronic journal, Journal E, and it was rejected because... Oh, yeah, I had first sent it to Ecology. Both Ecology and Journal E rejected it because I think it was too - the study wasn't experimental. It was sort of a large-scale observational study. Because of that I wasn't able to in a way pin down the mechanisms involved in the things I found in the study. Also because it was at a multi-species level, I wasn't really going to be able to. But I think the patterns that I found were interesting. So, I sort of thought that Journal P, the point of Journal P as a journal, or one of the points of it is to look at the big picture and to see themes. In order to do that, I think you need to ask, what are the patterns out there, before you go into detail about mechanisms and individual species and so on. So I think a lot of the journals have gotten a bit bogged down in wanting particularly experimental stuff where detailed mechanisms are uncovered. Almost like

putting the cart before the horse in that you need to know what the patterns are before you know really what you're trying to explain. You need to know what the patterns are and then try to explain them, if you know what I'm saying. Instead of going straight for mechanisms, which I think is a bit of a problem in ecology in general. So that's kind of a long-winded explanation, but I did write a cover letter trying to explain that and I submitted it to Journal P.

In this case and others the peer review system was represented as enforcing barriers that limited the acceptance of certain types of research approaches.

There are other ways in which the demands of the peer review process are not an unmitigated good for the publishing system. The informants recognized that the process was time-consuming and labor intensive. The time required to accommodate peer review places limits on the ability of an electronic publishing system to accelerate publication. Also, the limited number of people willing and able to provide peer review and the constraints on their time suggest that the system, as it is currently structured, may not be able to cope with the amount of content that could potentially be made available through an electronic publishing system. In general, a demand to maintain peer review places significant limitations on the development of an electronic publishing system.

Operating within a recognized structuring of the journal literature, peer review provides two main functions. Peer review mediates the match between articles and journals. It provides a quality control system that is understood by

authors and readers. The system provides valuable cues to reader and assists authors in obtaining recognition for their work. The second function is an inevitable result of the first function. On occasion, peer review acts as a barrier to publishing and slows dissemination of research. Despite the recognized negative aspects of this final function, it is all the more striking that the informants were unanimous in their support for peer review and saw its role within the publishing system as nearly indispensable. Even an unreal but perceived association of electronic journals with the lack of peer review was a cause of concern for several authors publishing in Journal E.

The three themes identified in this chapter -- integration, time, and peer review -- represent emergent elements of the electronic journal characteristics and decision elements. Electronic publishing promises improvement of the research process. Key factors for the success the electronic publishing are greater integration and better time management and acceleration of processes maintained within a framework of effective community review. While these themes do not explain all of the research findings, together they provide an alternative and more synthetic structure than that developed in the previous chapter for interpreting ecologists' understanding of electronic publishing and its role in the communication process. Table 15 indicates some of the relationships between the findings related to the research questions and the emergent themes. In a few areas, the themes expanded into areas of the research process that were not directly

Table 15:

Mapping of Themes and Findings for Research Questions 1 and 2

	Integration	Time	Peer review
<u>E-journal characteristics</u>			
Interaction	New techniques for interaction with research reports could integrate research artifacts and integrate the research community by increasing the effectiveness of information exchange.	New styles of interaction could save researchers time or cost researchers time. More effective interactive capabilities could speed dissemination of research results	
Usability	Difficulty of use may be a barrier to dissemination and deter community integration and integration of multiple communities. Alternatively improved ease of use could increase the range of community members and communities making use of information and create greater integration.	Improved usability could save researchers' time while greater difficulty of use can cost time.	
Accessibility	Accessibility can act to facilitate or prevent use of information by community members or members of multiple communities. Improved accessibility could correspond to greater integration.	Improved accessibility can save researchers' time.	

Table 15 (cont.):

	Integration	Time	Peer review
Cost effectiveness			
Interconnection	Interconnection facilitates integration of research artifacts.	Interconnection can provide significant time-savings for researchers.	
Acceleration	Acceleration of the publishing process may support better integration of the research community or of the research and applied communities by allowing faster dissemination of information.	Acceleration of the publishing process can result in the use of alternative research processes; accelerate the progress of the research agenda of the community; speed the dissemination of information beyond the research community.	
Online discussion	Online discussion supports integration of the research community and integration of that community with communities applying ecology research.	Online discussion potentially can accelerate the research agenda of the community and speed the dissemination of information beyond the research community.	

Table 15 (cont.):

	Integration	Time	Peer review
Quality filtering	Quality filtering supports community level integration and the integration of multiple communities by creating a shared body of trusted information sources.	A quality filtering system saves individual scientists time in seeking and using published information; by minimizing the dissemination of false information both within the community and beyond the community it prevents loss of time.	Peer review plays a key role in the development of cues useful for quality filtering.
<u>Decision elements</u> Article quality			Judging article quality is a fundamental role of peer review; assessments of article quality affect author decisions on the positioning of articles within the publishing system.
Audience	By defining an audience, journals facilitate integration of the research community and potentially integration of the research community and communities applying that research.		Over time, the structuring of the publishing system results in the creation of a relatively stable audience.

Table 15 (cont.):

	Integration	Time	Peer review
Journal prestige	Community recognition of journal prestige assists in community integration by focusing and concentrating information exchange.	Journal prestige plays a key role in quality filtering and thus offers time-savings to researchers engaged in information seeking and use.	Journal prestige is a significant determinant of position within the publishing system.
Niche	Niche serve as a significant focus for community integration. Niche can focus on interdisciplinary exchange or exchange between research and applied communities.	Identification of niche can provide a tool that can be used for time management or can assist in focusing and accelerating a community-level research agenda.	Niche is a key component of the structuring of the publishing system and typically the match of article and journal nice is a function of the peer review process.
Personal obligation	The development of personal obligations can assist in the development of community integration or the integration of multiple communities.		
Review process	Participation in the review process can enhance community integration via the information exchanged by author and reviewer.	The actual structure of the review process can affect the time demanded of researcher participants.	The structure of the review process plays an important function in peer review.
Special features	Special features can be designed to assist integration at all levels.	Special features can be designed to minimize time issues in multiple arenas.	Peer review may or may not be involved in the implementation of special features.

Table 15 (cont.):

	Integration	Time	Peer review
Turn-around time		Minimizing turn-around time can accelerate the progress of the research agenda of the community; speed the dissemination of information beyond the research community.	The time required for peer review is a significant component of turn-around time.

considered in the initial framing of the study. They remain grounded however in previous work in scientific communication and the sociology of science.

Chapter 6: Conclusions

Summary of Findings:

The goal of this study was to explore ecologists' understanding of electronic publishing. Two sets of findings address this basic question. First, the findings include answers to the three original research questions:

1. How do the authors and editors working closely with an electronic journal perceive electronic journals?
2. What is the decision process that authors are using to decide to publish in an electronic journal?
3. How do social factors influence the adoption decision?

In addition, findings related to three themes that emerged from the data are presented: integration, time, and peer review that structured many aspects of ecologists' understanding of electronic journals and their role in the formal communication system.

First, it is worthwhile to review the findings related to the research questions. Ecologists characterized electronic publishing as different from paper-based publishing in terms of eight general characteristics: accessibility, interaction, interconnection, usability, acceleration, quality filtering, online discussion, and cost effectiveness. These characteristics emphasize the importance of journals as tools integrated into the ecologists' work system rather than focusing on technological capabilities per se. As such, the characteristics provide

a useful way to structure the majority of the ecologists' perceptions. Authors associated with Journal P were not aware of its electronic component at the time they decided to submit manuscripts for review. While as a group they recognized all electronic journal characteristics, individually this group tended to mention fewer characteristics per interview compared to authors who reported awareness of having published in an electronic journal.

The journal selection system involves authors, manuscripts, editors, and journal titles. These elements are developed into a descriptive open systems model (shown in Figure 1). Editors try to manage certain perceived characteristics of their journals including niche, turn-around time, prestige, and special features to attract a flow of articles from authors and to maximize average article quality. Authors try to optimize the match between their manuscript's quality and niche and the journal characteristics mentioned. Editors also use personal obligation to attract submissions, which authors acknowledge can influence their decisions.

The ecology community is relatively closely knit, with both journals clearly sharing a significant proportion of their audience of readers and pool of potential authors. Within this community at least, editors play a key role in journal development. They are opinion leaders within the community and are recruited by publishers because of their opinion-leader status. Editors appear able to leverage this leadership successfully to assist in overcoming the many obstacles faced by new journals. They do this in part by overt use of personal ties, but they also benefit indirectly from their high visibility within the community. Authors

and readers consciously monitor these leaders' professional activities and pay special attention to their projects.

The three emergent themes address important relations within the scientific publishing system which came up as areas of special concern for the development of electronic publications and an electronic publishing system. Integration has three basic characteristics. It is based on the creation of new connections; allows the development of new activities or capabilities; and improves the effectiveness of existing activities or capability by a magnitude beyond that offered by additive effects. Much of the potential of electronic publishing lies in integrating information resources, community members, and multiple communities with shared interests in ecological research.

Time and timing effects operate within several arenas. For individuals, time effects assume the form of time management activities and concerns. Timing issues also create key dependencies within the arena of the research process, with the result that changes in the publishing process affect the selection of research projects and approaches and also affect the rewards and recognition that can be generated from a research project. At the community level, timing concerns influence the rate of development of community research and relate to concerns with archiving the formal literature. Finally, timing effects structure the ability of the research community to transfer basic research results to the management and policy communities that apply the information.

Peer review mediates the structuring of the existing journal system. The system is understood by ecologists to consist of a rough hierarchy of high-prestige general science journals, high-prestige disciplinary journals, and specialized subdisciplinary and interdisciplinary journals of varying prestige. Table 14 elaborates the model. This structuring, mediated by the peer review system, offers important cues that affect how the literature is used and assimilated and influences the recognition that is awarded for research publishing. This structuring also influences journal selection decisions. Informants were unanimous in their support of the functions of the peer review system.

Together the three themes synthesize and explain many of the findings related to the research questions. The themes threaded many of the discussions of the characteristics of electronic journal characteristics and the journal selection process. Although the themes do not encompass all of the findings relating to electronic journal characteristics and journal selection, they highlight some important shared features and expand the findings of the project beyond these concerns to address issues such as the selection of research projects.

Considering these findings, some conclusions should be offered and it is important to revisit the study's conceptual foundations and consider how its findings fit into the frameworks that were expected to be helpful at the study's outset. Some potential applications and future direction for research in electronic publishing will also be discussed. Finally, some potential criticism of the study will be addressed.

Diffusion Theory

Rogers' paradigm of diffusion of innovations (Rogers, 1995) was formative in the development of research questions and in many instances informed development of grounded theory. However, this clearly was not a diffusion study. Therefore, it is worthwhile to clarify ways in which Rogers' ideas informed the work and also indicate areas where the model proved less helpful. Throughout the presentation of the study's research methods and findings areas where it proved possible to draw effectively on the theory of diffusion of innovations have been indicated. Now it will be useful to pull together many of these observations and draw some conclusions on the role of the paradigm within the study and the contributions of the study to the paradigm.

Formative Effects of the Model

The diffusion paradigm's greatest role in the study was in the developmental phases. Rogers' model was used as a general starting point to assist in framing the study, developing the research questions, and generating questions for the interview guides. The diffusion paradigm emphasizes adopters' perceptions of an innovation and of innovation characteristics. It also suggests that adopter characteristics, interpersonal relationships, community structure, and community norms have important influences on perceptions of innovations and the process of adoption.

The diffusion paradigm suggested that it would be fruitful to consider a single research community and identify important members of the community

within the context of the adoption system. In framing the study, therefore, a research community actively engaged in exploring electronic publishing was selected. Within that community, the project focused on the views of individuals playing a variety of roles within the publishing system: authors, editors, publishing staff, and readers. The diffusion paradigm also suggested that the decision to publish in an electronic journal might be a significant point in the adoption process. At the beginning of the analysis phase, while investigating the process of deciding to publish in an electronic journal, there was an expectation that the publishing decision might correspond to an adoption decision.

Understanding informants' perceptions of electronic journals might assist in explaining their decisions. As a consequence, the interview guide included questions to probe informants' perceptions of electronic journals and electronic publishing, the factors that influenced their decision to publish in the journals, and their sense of commitment to electronic publishing. While this is just one example of the diffusion paradigm uses, it forms the most obvious influence and illustrates how the model formed a jumping off point for the research project.

Applying the Model to the Research Questions

Although the diffusion model was quite influential, for the purposes of addressing the research questions the paradigm was limited in some important ways and helpful in others. It proved necessary to move outside the paradigm to some degree in the examination of electronic publishing characteristics; however, the findings can be related to Rogers' model of innovation characteristics. It also

was necessary to move outside of the paradigm to understand the relationship between the adoption decision and journal-selection process. The diffusion approach was fundamental to understanding the patterns of social relations which were found.

The diffusion paradigm offers several structures for characterizing innovations and innovation features. The characteristics described by the ecologists suggest that electronic publishing as a type of innovation does not match well in many ways with the classic innovation types Rogers described. It is neither a single technology nor completely a cluster of related technologies. It has a software component and a hardware component, but the way these are constructed by journal producers or experienced by journal users is highly variable. Publishing is a system composed of many individual publications, many of which are used in common by varying groups of scientists. While the diffusion model might treat a particular publication or publisher's collection as an innovation, it proved difficult to apply this approach to the publishing system. Ultimately, while Rogers' characterization structure is useful for comparing electronic publishing to other innovations, this research suggests that the available conceptualizations for characterizing the innovation of electronic publishing need further development.

In developing the characteristics of electronic publishing, a step back was taken deliberately from using another portion of the diffusion paradigm. Rogers offers five variables for characterizing innovations: relative advantage, trialability,

observability, complexity, and compatibility. The earlier content analysis of the literature on electronic publishing suggested that there might be other dimensions useful for characterizing electronic publishing (Hahn and Schoch 1997). Also because this was not a strict diffusion study, the perceptions of the innovation could be explored in a more open-ended way. In the setting of this study eight characteristics emerged as having particular salience to the ecologists. Some of these are related to Rogers' variables. For instance, some characteristics (such as acceleration, quality filtering, and cost effectiveness) reference the paper-based publishing system. This referencing is related to Rogers' variable of relative advantage and suggests that a study seeking to compare electronic and paper-based publishing more explicitly could capture more information using this dimension. Compatibility, likewise, can also be viewed as related to this referencing phenomenon. Other comments from informants suggest that they had consciously experimented with electronic publications (trialability). There seems little doubt that future research projects could be structured to capture information from informants describing their perceptions along these dimensions. However the formative purposes of this project were better served by the approaches chosen.

While the diffusion paradigm was useful in many ways, it proved underdeveloped in an important area that constrained its usefulness for understanding adoption of electronic publishing. Adoption of electronic publishing will clearly require what Rogers labeled a complex contingent decision

process. There is an important interplay between adoption decisions made by individuals and those made by organizations. Unfortunately, while Rogers offered two basic models, one for individual adoption decisions and one for corporate organization decisions, neither adequately describes the complex setting investigated.

Even considering the level of the individual adoption decision, the decision to publish in an electronic journal did not correspond well to a decision to accept electronic publishing. This may be in part because the informants played multiple roles in their use of electronic journals. Initially the decision to publish in an electronic journal was thought to perhaps reflect an individual decision to adopt electronic publishing. This relationship, in fact, does not seem to exist in such a simple form. For the ecologists publishing in Journal P, the decision to publish in a journal that has both paper and electronic forms was simply a decision to publish in a paper journal. The electronic counterpart played no role since the authors were unaware of it. However, some of these authors did consider themselves as supporters of electronic publishing (perhaps in other roles). The ecologists who made this publishing decision varied in their self-identification of adoption of electronic publishing. Even for individuals publishing in the electronic-only journal, the decision to publish in the journal did not seem to correspond to an adoption decision per se.

To study the adoption decision effectively, a research project will have to be structured to disentangle information regarding adoption in various arenas

structured by scientists' roles. Most authors are also readers, and some may be editors or developers. Adoption may be structured by the arena in which the scientist is operating. Perceptions of electronic publications may vary depending on the role, or the weighting of various features may vary with role. Decisions may thus occur at different times even for the same individual, depending on the arena in which the scientist is operating or the role the scientist is playing. Studying the interactions of multiple roles played by individuals would be quite challenging and might be better explored using techniques that are less dependent on self-reporting than those used for this study.

Analysis of social relationships revealed that author/editor relationships and reader/editor relationships were the main relationships mentioned. Drawing on Rogers' paradigm provided an explanation of this -- the editors function as opinion leaders within the research community. The diffusion paradigm thus provided an effective tool for understanding the findings for this third research question.

While the diffusion paradigm provides a point of comparison and occasional explanation for the findings of this study relating to the three original research questions, the paradigm has less to offer in understanding the emergent themes. The themes instead relate to the conceptual foundations of scholarly communication and the sociology of science and will be discussed further in those contexts.

Additional Observations Grounded in the Diffusion Paradigm

There are some other portions of the diffusion paradigm that do not relate directly to the questions and themes discussed so far, which nonetheless are worth considering in an analysis of electronic publishing. One such applicable concept from the diffusion paradigm is reinvention. In a way, electronic publishing is a system that incorporates multiple reinventions of the basic innovation of the electronic journal. To quote Rogers:

Recognition of the existence of re-invention brings into focus a different view of adoption behavior: Instead of simply accepting or rejecting an innovation as a fixed idea, potential adopters on many occasions are active participants in the adoption and diffusion process, struggling to give their own unique meaning to the innovation as it is applied in their local context. Adoption of an innovation is thus a process of social construction.

(p. 179)

However, as helpful as this idea is, re-invention is typically understood as a process controlled by the technology users. Within the electronic publishing arena, it is the publishers, not the authors or readers who control the re-invention process, at least at the level of individual journal titles.

Moving outside the diffusion paradigm and drawing on a different concept, it is worth suggesting that, as a category, electronic journals lack strictly identifying characteristics. Instead they form a category whose membership is defined by family resemblance. Bambrough (1971) explained family resemblance

as a set organizing function in the following way. He argued that, while people tend to look for some common feature that defines the members of a category, in fact many categories' members share varying subsets of a large class of features. Saying that electronic journals form a set organized by family resemblance means that electronic journals may incorporate varying subsets of a large class of features (technologies). At the outset of this research process a large set of potential features of electronic publications were identified. However, in discussing electronic publications with informants and continuing to monitor the literature, it seems there is no single or multiple set of features that electronic journals necessarily share. Perhaps the most widely recognized feature at the moment is distribution via the World Wide Web. However, historically this has been far from a necessary feature of electronic publishing, and many electronic publications are still distributed outside this framework. To come back to re-invention and the concept of the feature cluster, publisher re-invention of the electronic journal seems to be a useful model for understanding the development of the current variability in the development of an electronic publishing system, particularly if the journals are conceptualized as forming a category based on family resemblance in which the features are drawn from a cluster of related technologies.

There is a final diffusion-based observation that is worth exploring. Rogers emphasized that many consequences of innovations are unanticipated by innovation promoters and adopters. While the ecologists easily acknowledged this

problem of prediction, they still expressed many expectations of consequences of their individual innovation decisions and the ultimate adoption of electronic publishing community-wide (which was almost universally assumed). As part of the study's findings, these perceptions are interesting because, correct or incorrect, they are likely to inform many individual actions and decisions. For instance, many informants viewed the ultimate diffusion of electronic publishing as inevitable, even within the very near future. Also, many scenarios were offered about the likely effects of electronic publishing on related processes within scientific research such as peer review and quality filtering.

While the diffusion paradigm proved quite helpful in framing the research project, structuring data collection, and interpreting some of the data, limitations of the paradigm also emerged, providing opportunities for further development of the paradigm and opening the door to the application of other conceptual traditions.

Scientific Communication and the Sociology of Science

Studies of scientific communication have long been grounded within the larger body of work relating to the sociology of science. While it was helpful to consider these separately during the literature review, they are less separable in the process of analyzing the project's findings. Therefore, these areas be drawn on synthetically in discussing the conclusions below, although scientific communication bears most of the emphasis.

Tailoring of Electronic Functions to Community Needs

What ultimate shape electronic publications assume remains to be seen, but several lines of evidence suggest that different communities of scientists are working with electronic publications developing along somewhat divergent lines. For instance, the joint work of Crawford, Hurd, and Weller (1996) described and contrasted electronic publishing developments in the research communities of high energy physicists, genome researchers, and astrophysicists. Any casual survey of the literature and of the marketplace confirms this diversity. This should not be surprising, since work by Griffith and others has documented variations in the print-based communication system corresponding to the needs and structure of the discipline served (Garvey et al., 1970; Garvey et al., 1974; Hagstrom, 1970). For instance, some fields have historically relied more heavily on preprint distribution than others.

A second basic premise on which this work is grounded is that electronic journals -- and even more narrowly, electronic science journals -- do not share a consistent feature set. In fact, as print-on-paper journals present a somewhat diverse array of content and presentation styles, in the world of electronic publications there is even less consistency and perhaps less need of consistency for the rules of content, form, and feature. While it may be that over time there is convergence among the early forms of electronic journals, it is also possible that different forms reflect different needs in the communities being served and that flexibility will remain a hallmark of the genre. This last idea merits further

investigation. The ecology community, for instance, makes little use of pre-publication distribution of research and appears to be quite concerned with developing and using mechanisms to make data accessible community-wide. The community also has concerns with the dissemination of research information (including both data and theory) beyond the research community to communities applying research, such as resource management and policy-making communities. Finally, this community is quite involved in developing multivariate models of complex systems. All of these factors could be expected to affect the development of an electronic publishing system in terms of the features that are created and adopted and the types of structures that are developed to provide needed functionality.

Whatever system develops, to be effective it must meet the existing communication needs of the community and expand the functionality of the current system. This research suggests that rapid transfer, effective transmission, open access, research validation, quality filtering, and archiving are effective functions of the current formal publishing system. Scientists are anticipating that interactivity, interconnection, faster transmission, and broader accessibility will be enhanced functions in network-based publishing systems. Many of the concerns that are raised with regard to electronic publishing focus around retaining what are perceived as core functions at risk. Peer review and the quality filtering function were the areas of greatest concern. Archival functions and loss of access were significant but lesser concerns. Much of the excitement observed

focused on the ultimate promise of greater efficiency and effectiveness of communication. Particularly the time saving and integrating effects of network-based communication emerged as core to the success of electronic publishing.

Many authors present a very different vision of electronic publishing in which a single, universal publishing system develops -- serving the needs the entire scientific, technical, medical complex of our society. Often early experiments, particularly those of the physics community, have been seen as pointing the direction in which all scientific communities will go eventually (Ginsparg, 1997; Judson, 1994; Taubes, 1996b). Perhaps this vision is informed in part by an equally over-generalized model of the current, paper-based system. Such thinking obscures the current diversity in scholarly communication systems and, more dangerously, may create a tendency to undervalue the diversity of experimentation in electronic publishing and overlook the variation in community needs that underlies some of this diversity among the early electronic publications. If all scientific communities have the same needs, then any community can serve as proxy for any other, and a best design for an electronic publishing system exists. When the best design is discovered, it might be expected to replace all other models. However, if scientific communities have different needs, then electronic publishing systems may share many common features and interconnections but will work most effectively when grounded in the needs of the community of interest. This latter approach would result in a continuing diversity of electronic publishing systems. Clearly both of these approaches are themselves

over-generalizations. Even if a best design exists, it may not be adopted for cultural or other reasons. In a world of tailored communication systems, many designs may coexist, varying in some ways but sharing significant common features. In fact, it seems likely that, given the drive for open access and integration, publishing systems serving diverse communities, while differing in significant ways, would still share many core functionalities and allow significant integration of community publishing systems. The important argument here is that it is better to test for diversity than to assume uniformity, particularly when evidence is discovered suggesting diversity exists. This research has uncovered certain characteristics of a particular research community. Future research focusing on other scientific communities could assist in determining the degree to which ecologists' perceptions are shared by scientists in other communities.

The Journal Selection Process Model

There are few models of the journal selection process extant. Garvey, Lin, and Nelson (1970) identified audience, turn-around time, and editorial process as explicit factors in the decision process and implied that some sort of subject match and quality match between manuscript and article occurred. In a later publication, Garvey (1979) suggested that authors utilized journal prestige, a match between the subject of the journal and the subject of the manuscript, and turnaround time to select journals. He did not specify the way he identified these factors; they seem to have arisen from general observations made in the course of his research.

Many of the factors Garvey identified are similar to those identified in this research with ecologists. Personal obligation and special journal features are the two main factors that were identified that are missing from Garvey's discussions. Also, although Garvey offered extensive narrative description of a generalized process, his focus remained largely on manuscript rejection and publication lags. The relationship among factors is underdeveloped in comparison to the model described here. Also, he focused on the review process (really a peer review process rather than an editorial process, despite his labeling) and largely ignored roles of the editor beyond that of initial quality control and reviewer selection. The model from this study expands the role of editor within the journal selection process to that of manuscript recruiter, developer of journal prestige, shaper of subject focus, and audience attractor.

An important part of the author decision process described is the concept of journal prestige. This concept was associated with a widely held three-tiered model of the structure of journal prestige among ecology journals. Garvey and Griffith (1971) in their highly influential description of the scientific communication process, presented a three-tiered model of psychology journal structure which is different from the one observed here in several important ways. Garvey and Griffith reported:

In psychology, there is apparently a hierarchy of journals to which authors submit their manuscripts. At the top are the most prestigious, with high rejection rates and long publication lags. These publish the core of the

discipline's literature. At the next level, the journals are usually less prestigious, have lower rejection rates, and are less central to the literature in the field. At the lower level, the journals share few of the characteristics of the main or core journals and may be unrefereed. (p. 47)

The two models are summarized in Table 16. Although both models have three tiers, a close comparison of the models reveals that the tiers do not correspond directly. The highest-tier journals in Garvey and Griffith's construct are still focused on psychology. The highest tier of journals in the ecologists' construct are highly competitive general science journals (e.g. Science and Nature). The top tier of the Garvey and Griffith construct corresponds more closely to the second tier the ecologists describe. The ecologists' lowest tier appears to correspond mainly to Garvey and Griffith's second tier. Unfortunately, the lowest tier is quite poorly defined in the Garvey Griffith construct, making it difficult to determine whether the third tier in the ecologists' model incorporates both the second and third tiers in Garvey and Griffith's model or whether psychologists' lowest tier journals have no equivalent in the ecologists' publishing system.

These variations could be the result of one or more of several factors. Garvey and Griffith's research was carried out almost thirty years ago. Publishing system structure may have changed in the interval. Garvey and Griffith's research was carried out using different methodologies. It is possible that the use of similar methodologies would have produced at least somewhat more similar results. A third possibility is that the publishing systems of the two communities of

Table 16:

Comparison of Ecologists' and Psychologists' Journal System Structuring

	Psychologists' perceptions of their journal system. (Garvey and Griffith, 1971)	Ecologists' perceptions of their journal system
Level I	High prestige psychology journals Characterized by core disciplinary literature, high rejection rates, long publication lags	High prestige general science journals Characterized by disciplinary work of broadest interest, high rejection rates, short publication lags
Level II	Second tier psychology journals Characterized by less central disciplinary literature, lower rejection rates	High prestige, top tier ecology journals Characterized by core disciplinary literature, high rejection rates, long publication lags
Level III	Lowest tier psychology journals Characterized as possibly unrefereed.	Lower prestige, specialized ecology journals Characterized by specialized disciplinary literature, variable publication lags

researchers are genuinely different in their structuring. The communities that Garvey and Griffith typically refer to as physical scientists may differ from those they call social scientists. The social sciences may lack high prestige, general interest journals with fast turn-around and high rejection rates serving as the producers of the highest tier of published research reports. This study is not broad enough to support this hypothesis fully, but the evidence from ecologists is suggestive of this explanation.

Changing the Scholarly Communication Process

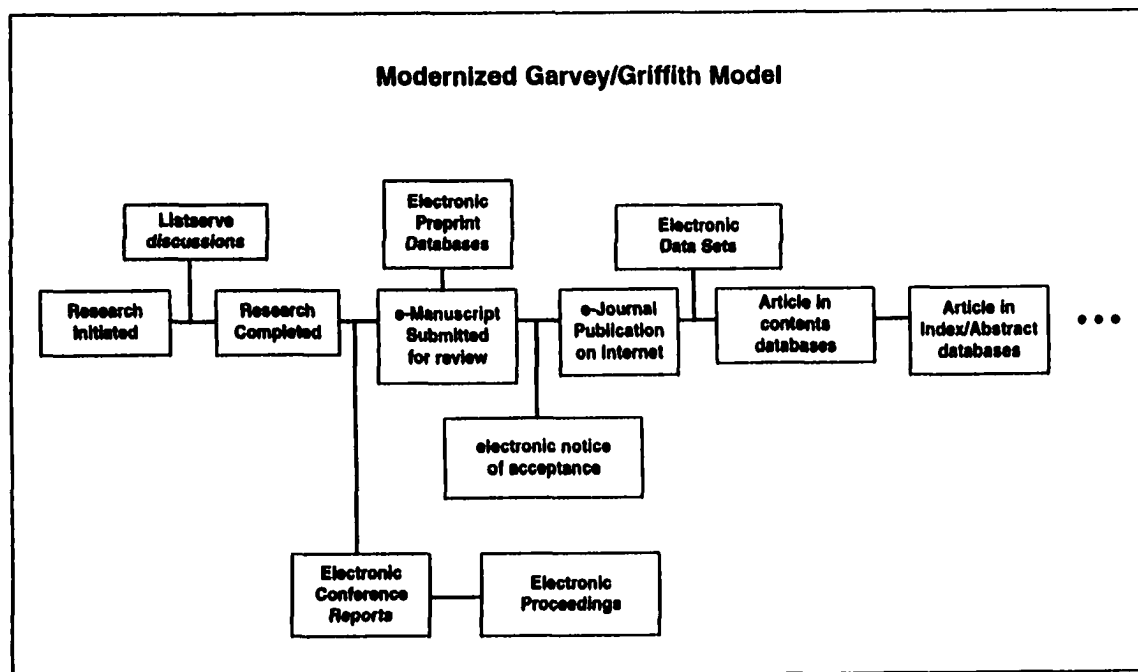
This project focused on a scientific community and identified some ways in which electronic communications are functioning within its formal scholarly communication system. Some key perceptions of electronic journal functions such as accessibility, interaction, interconnection, usability, acceleration, quality filtering, online discussion, and cost effectiveness were identified. Integration, alteration in time elements and a threat to peer review developed as emergent themes structuring much of the discussion of the development of an electronic publishing system. Other scholars have taken different approaches to understanding the functioning of electronic journals and other network-based communication structures. Perhaps the broadest view is that presented by Hurd, who began by considering the Garvey and Griffith model and then observed some patterns in the high energy physics community, the genome research community, and the astrophysics community (Hurd, 1996b). She then developed a series of models she believed could reflect developing models of formal communications

systems. Her process generated four models: a modernized Garvey/Griffith model, in which most of the former communications elements are retained but converted to electronic form; a no-journal model, in which formal research reports move from preprints through a review process, to a permanent electronic storage system in which journals as an organizing structure are eliminated; an unvetted model in which, again, journals disappear and pre-publication peer review is replaced by a peer commentary system; and a collaboratory model, in which the emphasis is shifted from publication servers to data deposition in databanks. The models are reproduced here in Figures 2-5.

Hurd did not specify whether she saw different scientific communities adopting different models with multiple models coexisting or whether she expected to see a single model dominate. In some ways the latter might be congruent with the observations she and her co-authors described for the three research communities their joint project examined (Crawford, Hurd, & Weller, 1996). Another reading of her scenarios would suggest that the modernized Garvey/Griffith model reflects a transitional stage in which technology is used merely to automate existing processes and that the other three models reflect stages in a radical re-engineering of the publication system and the use of technology to perform different work. Whether Hurd's models represent developmental stages or alternative endpoints for the scientific communication system, it is clear that the ecology community at the present moment is at the very earliest stages of the development of a new communication system.

Figure 2:

Modernized Garvey/Griffith Model (from Hurd 1996b)



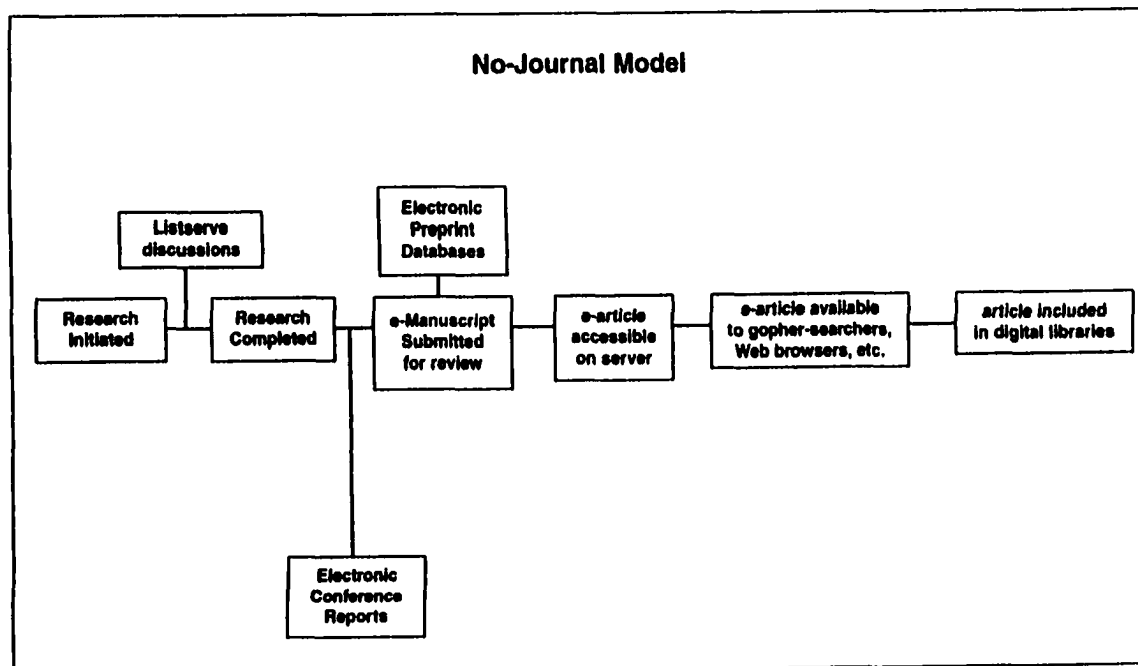
Note. From *Models of scientific communications systems* (p. 22), by J.M. Hurd, 1996, In S.Y. Crawford, J.M. Hurd, and A.C.

Weller. From print to electronic: the transformation of scientific communication, Medford, NJ: Information Today, Inc.

Copyright 1996 by American Society for Information Science. Reprinted with permission.

Figure 3:

No-journal Model (from Hurd 1996b)



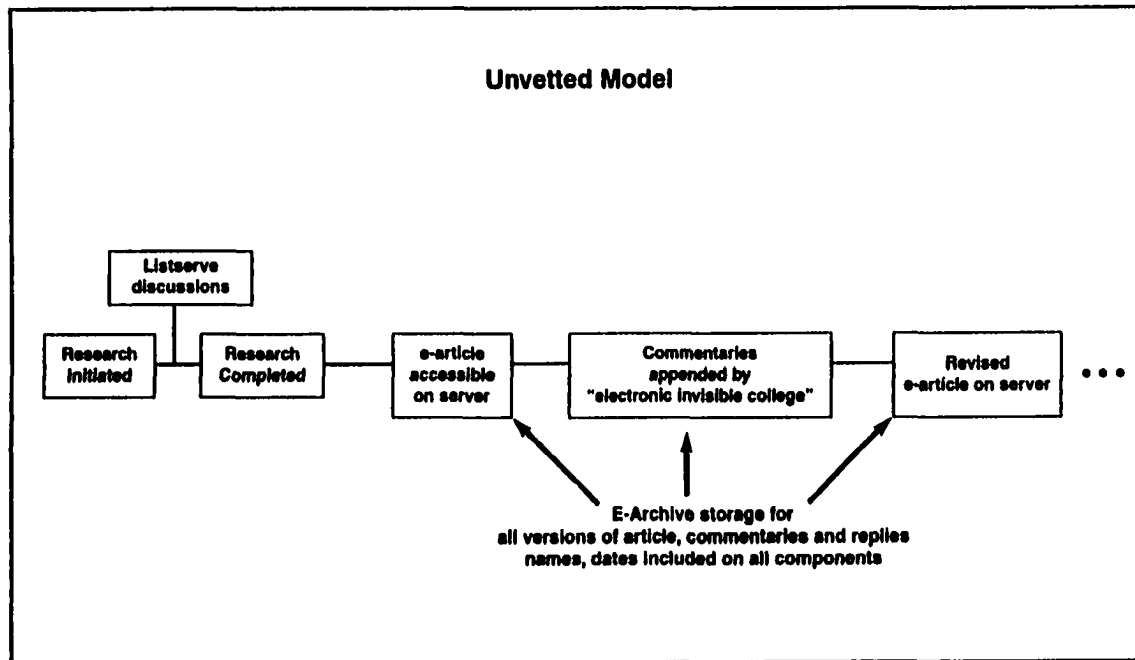
Note. From Models of scientific communications systems (p. 25), by J.M. Hurd, 1996, In S.Y. Crawford, J.M. Hurd, and A.C.

Weller. From print to electronic: the transformation of scientific communication, Medford, NJ: Information Today, Inc.

Copyright 1996 by American Society for Information Science. Reprinted with permission.

Figure 4:

Unvetted Model (from Hurd 1996b)

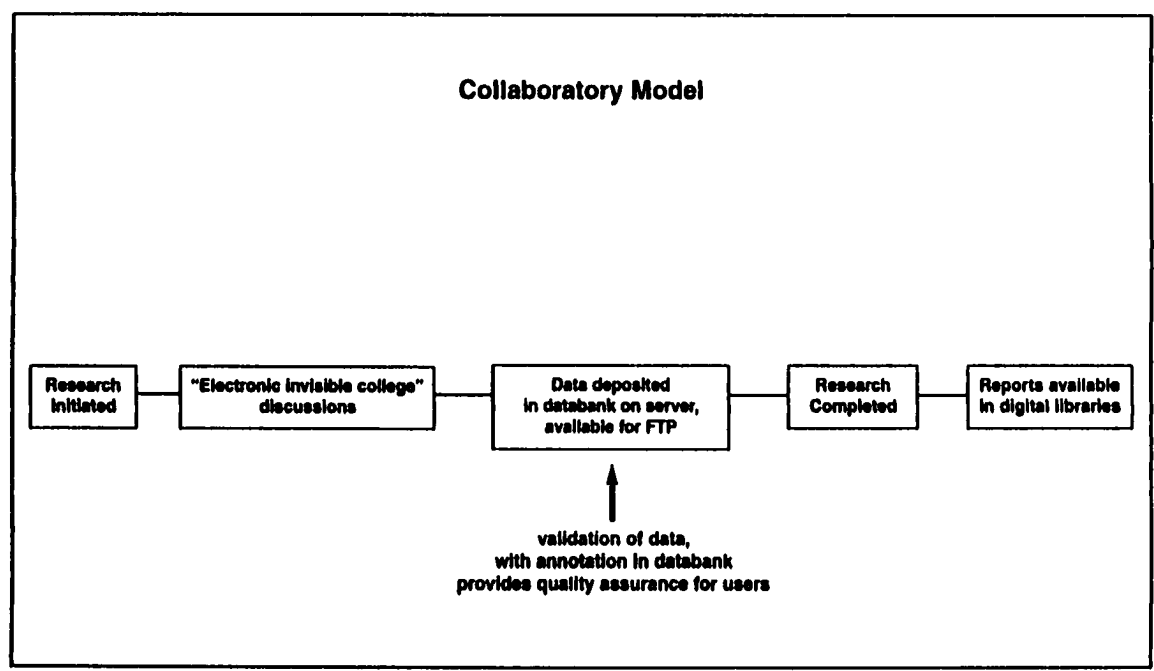


Note. From Models of scientific communications systems (p. 28), by J.M. Hurd, 1996, In S.Y. Crawford, J.M. Hurd, and A.C.

Weller. From print to electronic: the transformation of scientific communication, Medford, NJ: Information Today, Inc.

Copyright 1996 by American Society for Information Science. Reprinted with permission.

Figure 5:
Collaboratory Model (from Hurd 1996b)



Note. From Models of scientific communications systems (p. 30), by J.M. Hurd, 1996, In S.Y. Crawford, J.M. Hurd, and A.C. Weller. From print to electronic: the transformation of scientific communication, Medford, NJ: Information Today, Inc. Copyright 1996 by American Society for Information Science. Reprinted with permission.

The system that the ecologists described most closely conforms to the modernized Garvey/Griffith model. However, there are some patterns shared by Hurd's other models that this research calls into question. The no-journal, unvetted, and collaboratory models share the two key features. All three systems lack organizing structures for research reports; there are simply aggregations of articles on servers. Also, all three systems suggest the elimination of peer review. Hurd suggested that peer review might be replaced by reader review systems, such as comment systems, voting system, or reader tabulation systems. The emphasis the ecologists placed on the current peer review system which operates within a system of journals organizing articles suggests that these aspects of the publishing system may not be easy to replace. The quality filtering that ecologists rely on results directly from these structures suggesting that models lacking journals as organizing structures will need to replace this organizing function explicitly. Hurd recognized validation as the important function that peer review plays. The ecologists recognized validation as a function of peer review, but they clearly emphasized the quality structures mediated by the peer review process in their discussions about the role of journals. This observation does not need to imply that somehow this research community or others could not move beyond a modernized Garvey/Griffith model to some other model. Instead the suggestion is that other models need to support a quality filtering function that is lacking in the other models suggested by Hurd.

Hurd's models tend to focus on a transition of research information from inside the research process through a community presentation and review process to a permanent storage system. What this emphasis is less able to capture is the integrative aspects emerging from networking capabilities. Interestingly the models, in the order in which they are presented (modernized Garvey/Griffith, no-journal, unvetted, collaboratory) become flatter and more streamlined as multiple, somewhat redundant communication structures are eliminated (such as the conference report). It is not clear whether integration is being overlooked or simply subordinated to the time dimension implicit in the presentation. However, this study suggests that an important value of the transition to network-based electronic systems is the power of integrating the communication process. As discussed earlier, this integration includes not simply research reports but data as well. Only the collaboratory model incorporates data (accessible in databanks) into the formal communication system. Interest in data distribution may vary from one scientific community to another, but the concept of data integration seems to be important for this community and may be a key part of models with features besides those incorporated into the collaboratory model.

While Hurd's work suggests some interesting dimensions of potential development in an electronic publishing system, this project suggests that several important elements remain to be accounted for. To capture the transition that is under way at the current moment, new models of the publishing system are needed which incorporate the emerging integrative functions, reflect the effects of

changing time dependencies, and incorporate more of the sorting functions of the system.

Potential Applications and Future Directions

In addition to discussion the relationships between the study findings and other published research it is important to consider some of the broader implications of the study. Several findings have implications for electronic journal development. In addition, this section suggests several avenues for future research.

Implications for Electronic Journal Development

Much of this study has focused on user perceptions of electronic publications. Electronic journal developers could draw upon these observations to assist in making design decisions. For instance, eight characteristics of electronic publications were identified. These indicate what it is that ecologists value in the existing electronic publishing system. Developers should note that the scientists were less enamored of technologies than of functionalities. While, developers must select technologies to generate functionalities, they should keep in mind the values of the users they hope to serve. In addition, the discussions of electronic journal features revealed a number of fears regarding the development of electronic journals and the development of an electronic publishing system. Developers may also benefit from a better understanding of users' concerns with regard to electronic publications if they wish to minimize unanticipated negative effects of development decisions.

The conception of electronic publishing as a dynamic set of technological innovations sharing family resemblance and experiencing rapid re-invention has several implications for developers as well. This conception suggests that there will continue to be diverse experimentation and that electronic journals can continue to function effectively as a set with quite heterogeneous functionality.

Another facet of electronic journal development is often content recruitment, particularly if the journal is new. Discovering what influences authors' submission decisions formed a significant segment of the study. The model developed highlights several important concepts for journal developers. Clearly editors play a key role in the success of new journals in attracting content; however, the decision process is complex and multifaceted. The development of a "killer application" may be unlikely in the arena of electronic journal development as a result. However, new journals could draw on a number of factors to increase their chances of success in content recruitment. At the same time, publishers considering conversion from print to electronic form could draw upon the model to understand the functions that need to be transferred.

It could also be helpful to journal developers to gain a larger understanding of the role of individual publications within a broader publishing system. Many discussions regarding the development of an electronic publishing system have ignored the complexity of the functions of the current system. For instance, peer review's function in the process has often been oversimplified. Journal developers aspiring to create products which transform the publishing

system need to be aware of the richness of the current system and the depth of the connections between the system and scientists' work lives.

Most of these suggestions focus on the developers of individual electronic journals or electronic journal collections; however, other groups have an interest in the development of an electronic journal system, and many of the study's findings are applicable to related tasks. For instance, developers interested in building tools to assist scientists in using the electronic publishing system can also benefit from various of the study's findings, particularly those focusing electronic journal perceptions and the interactions between the publishing system and ecologists' work practices. Although it is not feasible to elaborate all of the potential applications of this project's findings, the set presented here suggests the general lines of opportunity.

Potential directions for future research

While many conclusions have been drawn, in many instances attention has been drawn to areas where this project provided insufficient information to effectively address emergent questions. Some examples of such areas include a community level model of a complex contingent decision process incorporating both individual and institutional adoption decisions. There are also some additional areas that seem to provide fertile ground for further research.

The community-level focus of this project restricted its scope to a single research community, ecologists. An obvious area for further investigation is comparative work grounded in different research communities. The chemistry and

physics communities have developed a number of electronic publications and could provide fertile ground for such comparative research.

Longitudinal study of the research community also seems a likely area for further understanding of the development of electronic publishing. Clearly the diffusion and development of electronic publishing is currently only in its very earliest stages. It is impossible to determine at this point the extent to which the conditions observed within the ecology community are controlled by the current stage of the diffusion process. Continued monitoring of the development of electronic publishing over time could answer this question and would doubtless yield a harvest of increased understanding of this important transformation of the scholarly communication system.

The techniques used for this project were influenced by the nature of the questions asked and various environmental constraints. Different questions could leverage different approaches and thus expand on the work presented here. For instance, this study focused on early adopters of electronic publications. Survey methodologies could collect data about perceptions of a larger sample of the community. This could be used to address questions about the generalizability of the findings to other adopter categories, including non-adopters.

Some speculations

Some further areas for potential research arise out of some rather speculative interpretations of the study's data. These observations are perhaps not absolutely supported by the evidence generated by this research but further

research may serve to substantiate them. This study did not attempt to explore whether some characteristics of electronic publishing were more attractive or more compelling than other characteristics. However, three characteristics were particularly frequently and positively mentioned: interaction, interconnection, and acceleration. If some functions were more attractive, then it would be to the advantage of developers to accelerate or accentuate these features in new electronic publications. At the same time, this study also did not explore whether some functionalities are more attractive to some groups than others. The data suggest that electronic journal readers may not see interactivity as an attractive feature while authors find it appealing. This anomaly seems difficult to understand or explain since the advantage to readers would seem to be greater than for authors. Further research may shed some light on this seeming incongruity.

It also proved impossible in this study to determine fully the potential attractions and deterrents of electronic-only publishing as a format. Most author informants from Journal E downplayed the attractions of electronic publishing and a few hinted that electronic publishing might discourage selection of the journal by manuscript authors. This finding suggests that electronic publications face a real barrier in attracting submissions. Further study of a group of authors that included people who considered but decided against an electronic publishing could be fruitful in resolving this question. At the same time, it should be recognized that the authors affiliated with Journal E had not developed documents

that leveraged electronic publishing by offering something that could not be incorporated into a print publication. A gap seems to exist between the recognized potential of electronic publishing and the current ability or motivation of authors to take real advantage of electronic publishing's potential.

Finally, the model of simultaneous print and electronic publishing was not well explored in this research. It happened that none of the authors from the early issues of the journal seemed to be aware of the electronic counterpart at the time of their publishing decision. Given the rather low level of excitement generated by electronic-only publishing among authors from Journal E, it seems likely that even if authors from Journal P had been aware of the electronic version, it would not have affected their decisions significantly. However, this is a hypothesis that is untested by this project and remains to be examined. Simultaneous print and electronic publication can result in a system where any potential advantages of electronic publishing are negated by the need to synchronize two versions of the same journal. A crucial challenge facing those interested in moving beyond current publishing models is breaking this seeming anachronism of electronic journals tied to the limits of paper-based publishing if not paper-based distribution. Sadly the anachronism seems to be limiting even journals like Journal E which has eliminated paper-based distribution but seems still to be constrained by paper-based construction of submissions.

Potential Criticisms

An appropriate final topic for discussion is the consideration of potential criticisms of the study. The criticisms discussed here obviously cannot include the full range of potential criticism. Therefore, comments will focus on criticisms relating to evaluation of the findings.

There are several common lines of criticism raised by studies using naturalistic methods of inquiry. In an extensive review of qualitative studies in information retrieval research Fidel argued that one hallmark of appropriate use of qualitative approaches is that the study is both case-based and holistic (Fidel, 1993). While the case-based approach may limit the generalizability of findings, it is appropriate for studying situations which are complex and uniquely situated. Fidel uses the term holistic to describe accounts of social actions which are both descriptive and detailed. The questions this project addresses are complex, as illustate findings illustrate, and attempts were made to include as rich a range of descriptive detail as possible. The problem of geographic separation between interviewer and informants created many limitations in the level of detail that could be incorporated into data collected. It was not practical to arrange face-to-face interviews and generally informants were interviewed only once (although all informants were engaged in at least two conversations with the interviewer as part of the interview scheduling process). While the lack of face-to-face interviewing is regrettable, informants offered a number of cues that they were comfortable with the interview process. Many informants made jokes and various humorous

remarks. Perhaps more telling, several informants revealed events that could be seen as casting themselves or their actions in an unflattering light. Six informants openly discussed having had papers rejected. Also, an informant revealed regretting his journal selection decision. As well, other informants were openly critical of various aspects of the journals they had publishing in or sponsored. All of these are evidence of good interviewer/interviewee rapport. As frustrating as it was to rely on phone conversations, this approach provided a much richer body of data than could be accumulated with a survey methodology.

Other evaluation criteria can also be applied to the study. Glazier (1992) focused on issues of reliability and validity as evaluation criteria. He suggested that reliability indicates the consistency of the results described and that validity is a measure of the accuracy of results. Guba and Lincoln have suggested four criteria: consistency (which corresponds to Glazier's reliability), truth value (which roughly corresponds to Glazier's validity), neutrality, and applicability (Guba, 1981; Guba & Lincoln, 1982). In earlier discussion of research methods, a number of techniques were mentioned which were incorporated into the data analysis procedures to maximize many of these qualities in the findings. The findings have been presented in such a way that, as much as possible, the nature of the evidence is apparent. Many supporting quotations, both from the interviews and from the published literature, have been included. Conflicting and inconsistent statements were mentioned where these are important for understanding the variability observed in the data. Instances where variability did

not appear have also been noted, for instance, when various subgroups of informants reported similar perceptions despite differing vantage points. During the analysis process conceptual saturation was sought. Interviewing stopped when analysis was not producing new concept codes. A member check was performed at the conclusion of the study to verify the accuracy of findings. These practices are largely aimed addressing concerns regarding consistency and truth value.

Neutrality is a more challenging issue to address. Throughout the course of the study several techniques were employed to encourage reflexivity. The main techniques were memoing and the use of contextualizing interviews. On several occasions memos were developed which aimed specifically at addressing concerns regarding neutrality. Several informants who were involved with electronic journals but outside of the study population were interviewed to gain perspectives from outside the community and to assist in monitoring the level of interviewer involvement with the research subjects. Informants were interviewed in a way that avoided interviewing a large group of people from one of the study's subgroups all within a short period of time. As interviewing progressed, interviews alternated (although not strictly) between members of various subgroups within the study population.

Evaluating the applicability of this research project to settings outside of those considered here is also challenging, and may be best judged by other researchers. This research is deeply grounded in a particular research community. Where possible, findings are integrated with related research. Since there have

proven to be a variety of areas where this is possible, some findings seem to have some generalizability, particularly those relating to the journal selection process and the role of electronic publishing in the formal scientific communication system. However, it will be important to compare this project's findings with future work using other approaches and to look at other research communities to achieve a better sense of the applicability of the findings to other settings.

Because this project draws heavily on the research approaches advocated by Strauss and Corbin (1998a), it is appropriate to consider some of the criteria they offer for evaluating the empirical grounding of a study. While some of their criteria can only be evaluated after time has passed, six of them are relevant now. Strauss and Corbin's criteria are 1) are concepts generated, 2) are the concepts systematically related, 3) are there many conceptual linkages, are the categories well developed, and do categories have conceptual density, 4) is variation built into the theory, 5) are the conditions under which variation can be found built into the study and explained, and 6) has process been taken into account (Strauss & Corbin, 1998, p. 270-271). Clearly this study generated many concepts which have been systematically related within a variety of contexts and incorporated into several models such as the journal selection process and the journal hierarchy. Variation has been discussed and process has been highlighted in several instances. Readers will have to judge for themselves as the adequacy of conceptual density.

While the evaluation criteria presented here are doubtless incomplete in some respects, they do provide a range of approaches for considering the effectiveness of the study in addressing the basic research questions, in contributing the literature of the field, and for pointing to interesting directions for future research.

End Notes

¹ Personal correspondence with publishing staff indicates that this readership figure is based on the number of individuals who have registered to be notified of new journal issues.

² Correspondence with publishing staff for these journals indicates that this publishing lag figure is too large. Publication lags for these journals are significantly shorter than this informant reported.

³This figure is similar to that reported by earlier studies of scientific journals. Lags of several months to more than a year were reported for scientific journals generally by Garvey (1979). Garvey and Griffith (1971) reported an average lag of nine months for psychology journals. This publishing lag has been offered as justification of a number of preprint systems, most notably that explored by the American Psychological Association in the 1960's (Piternick, 1989). With the advent of electronic publishing and the development of preprint archives among the physics community, a number of advocates for electronic publishing have advocated preprint publishing as a desirable step to minimize publishing lags (Publishing, perishing, 1998; Taubes, 1996). However, the community seems to do very little preprint distribution.

⁴It is difficult to understand how this perception of incompatibility of electronic publishing and peer review has developed. One clue is that there have been a number of prominent scientists who are advocates for electronic publishing

and who have simultaneously argued that peer review is unnecessary -- most notably Paul Ginsparg (1994, 1997). The news coverage of Ginsparg's views in Science (e.g. Taubes, 1996) is illustrative of the type of publicity these views have received within the scientific community. Ginsparg's electronic publication model is based more on a preprint model than on the current paper-based publishing system and thus does not incorporate peer review prior to release of research results to the scientific community. However Kling and Lamb (1995) also reported a similar observation from their study that "Scholars who do not work routinely with electronic texts often assume that they are deficient in some ways." (p. 265).

⁵ These rejection rates are congruent with those reported by other studies in other disciplines. Garvey (1979) reported that 4 out of 10 authors studied had their articles rejected by the first journal they submitted them to. Zuckerman and Merton (1971) reported rejection rates in the 70-80% range for a number of scientific publications. More recently Hargens (1988) reported similar rejection rates for several association journals in the social sciences. He reported lower rejection rates for prestigious journals published by scientific associations, but his study set included only one life sciences journal.

Appendix A

Interview Protocol for Authors

Introduction: We will be talking about your specific experiences publishing your article, about electronic publishing generally, and to some extent about your views on publishing generally.

1. How is [Journal] different from a conventional paper journal in your mind?

(Probe for specific characteristics, functions.)

1b. Some people have described electronic publishing and electronic journals as innovations - new technologies. Could you describe how you see [Journal] as innovative?

2. I'd like to talk some more about your views on electronic publishing in the context of your experiences with [Journal]. How did you find out about [Journal]?

(Probe for people who were involved and their relationship with author.)

3. What was the process you went through in deciding to publish in [Journal]?

(Probe into sequence, actions, actors, influences.)

(Probe into special effects of electronic characteristics.)

4. How did your decision to publish in [Journal] compare to your other publishing decisions?

(Probe into special effects of electronic characteristics.)
5. What do you think [Journal] offered to you as an author?

(Probe into special effects of electronic characteristics.)
6. How would you describe the audience for [Journal]?

(Probe into how the perception of the audience fit into the publishing decision.)

(Probe into what was attractive about this audience.)
7. What concerns did or do you have about publishing in [Journal]?

(Probe into special effects of electronic characteristics.)
8. What role did the electronic characteristics of [Journal] have in your decision to publish there?
9. What factors were influential in your decision to publish in [Journal]?

(Probe into human relationships and roles.)
10. Did you consider publishing this article elsewhere? Where?
11. How does your article in [Journal] fit into your ongoing research program?
12. How do you feel now about your decision to publish in [Journal]?

Now I'd like to talk more broadly about your views on electronic publishing generally and move beyond your experience with [Journal].

13. Imagine that two years have passed and that electronic journals have been significantly improved. What would these improved e-journals be like?

(Probe for how this improved communication tool is different from current electronic journals.)

14. What concerns do you have about electronic publishing of scientific research?

15. How do you see electronic journals fitting into the broader picture of scientific communication?

(Probe for views of how things might change in the future?)

16. Now that you've had at least one experience working with a journal that publishes electronically, would you describe yourself as committed to further electronic publishing, still making up your mind, or quite turned off?

Interview Protocol for Editors

Introduction: We will be talking about electronic publishing generally, your specific experiences working with [journal], and to some extent about your views on publishing generally.

1. How is [Journal] different from a conventional paper journal in your mind?

(Probe for specific characteristics, functions.)

1b. Some people have described electronic publishing and electronic journals as innovations - new technologies. Could you describe how you see [Journal] as innovative?

2. I'd like to talk some more about your views on electronic publishing in the context of your experiences with [Journal]. How did you become involved with [Journal]?

(Probe into special effects of electronic characteristics.)

2b. What was the process you went through in deciding to become the editor of [Journal]

(Probe into sequence, actions, actors, influences.)

(Probe into special effects of electronic characteristics.)

3. What do you think [Journal] offers to the field of ecology as an electronic journal?

(Probe for Journal P: what is different about the e-version relative to the paper version.)

4. What concerns did or do you have about [Journal] as an electronic journal?

(Probe for Journal P: what is different about the e-version relative to the paper version.)

5. How do you feel now about your decision to become the (co)-editor of [Journal]?

6. When you began working with this journal how did you envision your audience of readers?

(Probe for any written documents that may have been developed.)

- 6b. Has your understanding of [Journal]'s audience changed since the journal's inception?

(Probe into how this has changed and why.)

7. Have you had any other experiences with electronic publishing? (If yes, follow up with repeats of above questions as appropriate)

8. Now I would like to talk briefly about your work as an editor for [Journal]. What processes do you use to acquire manuscripts for [Journal]?

(Probe any mention of personal relationships prior to submission.)

(Probe any ways in which they use the electronic nature of the journal as a selling point.)

8b. Who of the authors were known to you before their submission of a manuscript for [Journal]?

(Probe how they used their relationships to encourage authors to submit papers.)

9. Have you had any other experiences editing a journal?

9b. How does your experience with [journal] compare to your experiences with other journals?

10. Now I'd like to move to a general discussion of electronic publishing beyond just your personal experiences with [Journal]. Imagine that two years have passed and that electronic journals have been significantly improved. What would these improved e-journals be like?

(Probe for how this improved communication tool is different from current electronic journals.)

11. What concerns do you have about electronic publishing of scientific research?

12. How do you see electronic journals fitting into the broader picture of scientific communication?

(Probe for views of how things might change in the future?)

Development of further interview contacts:

1. I will be interviewing several authors who have recently published with your journal as part of the study. Do you have any suggestions about who I might like to be sure to talk to or who I should talk to first?

2. I would also like to interview some of the staff involved on the publisher side who have been involved in the development of this journal. Can you suggest some people it would be helpful to talk to?

Request for supporting documentation

If there is any written documentation relating to the development of the journal that you could share, it would be helpful for me to get a copy of it. For instance, any kind of proposal or business plan would be very useful to me.

Interview Protocol for E-journal readers

Introduction: We will be talking about electronic publishing generally, your specific experiences working with [journal], and to some extent about your views on publishing generally.

1. Would you mind telling me a little about your work as an ecologist?
2. How did you find out about [Journal]?
3. How much have you used [Journal]?

(Probe for length of time)

4. How is [Journal] different from a conventional paper journal in your mind?

(Probe for specific characteristics, functions.)

- 1b. Some people have described electronic publishing and electronic journals as innovations - new technologies. Could you describe how you see [Journal] as innovative?

5. Why did you decide to read [Journal]

(Probe into special effects of electronic characteristics.)

(Probe into sequence, actions, actors, influences.)

(Probe into special effects of electronic characteristics.)

6. What do you think [Journal] offers to the field of ecology as an electronic journal?

(Probe for Journal P: what is different about the e-version relative to the paper version.)

7. What concerns did or do you have about [Journal] as an electronic journal?

(Probe for Journal P: what is different about the e-version relative to the paper version.)

8. What's your judgment now of the value of [Journal]?

(Probe: What other journals would you say are equivalent in value in some way?)

9. Who do you think the audience for [Journal] is?

(Has your understanding of [Journal]'s audience changed since the journal's inception?)

(Probe into how this has changed and why.)

10. Have you had any other experiences with electronic publishing? (If yes, follow up with repeats of above questions as appropriate)

11. Now I'd like to move to a general discussion of electronic publishing beyond just your personal experiences with [Journal]. Imagine that two years have passed and that electronic journals have been significantly improved. What would these improved e-journals be like?

(Probe for how this improved communication tool is different from current electronic journals.)

12. What concerns do you have about electronic publishing of scientific research?

13. How do you see electronic journals fitting into the broader picture of scientific communication?

(Probe for views of how things might change in the future?)

14. Now that you've had at least one experience working with a journal that publishes electronically, would you describe yourself as committed to further electronic publishing, still making up your mind, or quite turned off?

Appendix B

Coding

Codes and organizing schemes for codes were developed continually throughout the data collection and analysis phase of the research project. The approaches to coding used were based on the methodology described by Strauss and Corbin (1998). During most of the data collection phase, open coding dominated. Table B1 indicates the open codes and their definitions as they existed at the end of the project, the point of maximum development. The definitions were generally created at the time they were first used and thus are not necessarily parallel in their structure. Open codes were also developed for the electronic publishing dimensions and cluster members listed in Table 1. These are not repeated here, although Table 8 indicates the frequency of use for these codes. All codes were developed and maintained with the assistance of QSR NUD*IST, a software program designed to assist qualitative researchers in code development and maintenance (Richards and Richards, 1998).

Open coding is a creative, heuristic process. As the list of codes in Table B1 illustrates, not all codes prove equally useful. During later stages of analysis, some assume greater significance. Although some codes were initially developed as a small hierarchy, many were later organized or re-organized. Additionally many codes fell by wayside and played no role in later analysis.

Table B1:

Open Codes Developed during Data collection.

Codes with code structures indicated	Definition
Review process	Discussion of the process whereby manuscripts are selected for publication.
New J Probs	Discussion of problems relating to the startup of a new journal.
Submission attraction	Problems the journal has in attracting submissions of articles.
Readership	Problems in attracting sufficient readership to make the journal a going concern or from the author's viewpoint, the size of the audience.
Quality	Problems involved in assuring that a new journal provides a recognized standard of quality.
Coverage in secondary sources	Concerns about new journals not being covered in standard indexing and abstracting sources.
Financial uncertainty	Issues raised by the financial instability of a new publication.
Impermanence	Fear that the title will not persist - perhaps because it isn't economically viable.
E-journal probs	Discussion of e-journal problems
Credibility	Credibility problems associated with electronic publication
Insecurity	Concerns that electronic information is easily stolen or presented out of context.
Citation	Problems of indicating source identity when referring to an electronic publication.
Unstable technology	Problems with electronic publications created by the instability of associated technologies.
Novelty	Problems created by the newness of the journal.
Impermanence	Potential problems resulting from a higher than usual likelihood that the journal will fail and not be preserved.

Table B1 (cont.):

Codes with code structures indicated	Definition
Ease of use	Concerns about the ease if using electronic publications
Increased author visibility to public	Concerns that negative consequences could result from high visibility of authors in a networked environment.
Intangibility	Concerns that authors or readers are deterred by the lack of a tangible publication product.
Questionable peer review	Concerns that peer review practices are somehow not of good quality.
Accessibility	Concerns about ability to access electronic media. Includes access to networks, hardware, or software.
Cost issues	Concerns relating to the costs of an e-journal or the ability to charge for electronic publications.
Automation of review	Discussion of technologies that automate all or part of the work traditionally done by editors or reviewers.
Turn-around time	Discussion of the time between acceptance of a manuscript and final publication.
Audience discussion	Discussion of the perceived audience of the journal.
Quality filtering	Discussion of the concept that the publication process provides quality filtering.
Libraries	Discussion of Libraries.
Document type	Various types of documents.
Interview	Transcription of an interview.
Editorial	The work of a journal editor and published as an editorial.
Call for papers	Text produced by journal staff to encourage submission of further work.
Outlet shortage	Discussion of the situation in ecology that there are not enough venues for publication.

Table B1 (cont.):

Codes with code structures indicated	Definition
Journals	Various journals mentioned
Journal E	Informant associated with the Journal E
Journal P	Informant associated with the Journal P
Science Online	References to <u>Science Online</u>, the electronic version of the journal <u>Science</u>, published by AAAS.
JSTOR	References to the JSTOR project.
Role	Various informant roles.
Editor	Editor of a journal.
Author	Author of an article published in a journal. Does not have to be the first or only author.
Publisher	Non-editor publishing staff.
Reader	Self-identified reader of an electronic publication.
Commitment	Stated commitment to electronic publishing.
Committed	Informant statement that he/she feel committed to electronic publishing.
Not sure	Informant statement that he/she is still making up mind about electronic publishing.

Axial coding is a process in which key open codes are organized and developed further (Strauss & Corbin, 1998). Some preliminary development of axial coding is evident in the organization of the open codes in Table B1. Table B2 presents the development of axial coding relating to the three research questions of the study. Table B3 presents the development of axial codes for the emergent themes. It is worth noting that, while my texts were recoded for the emergent themes, the development of the analysis of the emergent themes also drew on some open coding that was not formally reorganized and integrated into the emergent coding structure. For instance, the analysis drew in part on a reexamination of codes such as interconnection, quality filtering, and quality filtering.

Table B2:

Axial Coding Related to the Study's Foreshadowing Questions

Coding structure	Definition
Research Questions	The three research questions.
E pub perceptions	What electronic publishing means to scientist author and editors in environmental science.
Defining characteristics	What characteristics define the technology for environmental scientists.
Monolithic	Perception that electronic journals represent a single, undifferentiated technology. "Electronic" is the defining feature rather than subfeatures.
Paper E-pub comparison	How e-journal characteristics compare to paper journal characteristics.
Little difference	Statements that electronic journals are really not that different from paper journals.
Interaction reader paper	Discussion of how the electronic medium can facilitate interaction of readers with the research report in new ways.
Ease of use	Discussion of the convenience to the reader added by electronic publishing. May be convenience or inconvenience (positive or negative effect).
Accessibility	Range of accessibility offered by electronic publications. May be positive (greater access) or negative (reduced access). Emphasis is on the number of people having access.
Cost recovery	Discussion of the need to develop new mechanisms to recover the costs of electronic journals.
Interconnection	Ability to interconnect resources. The focus is on the linkage. Interactivity between report and reader is not interconnection.

Table B2 (cont.):

Coding structure	Definition
Acceleration	Decrease in the time required for communicating research results to the community resulting from use of electronic media.
Online discussion	Ability of electronic publications to foster discussion of issues within the community.
Quality filtering	Discussion of how electronic publishing will affect the existing filtering process that current peer review structures, and the expense of paper publishing play.
Publication decisions	How authors decide to publish in an electronic journal.
Author decision process	The decision process authors use in deciding to publish in an electronic journal.
Variables for decision outcome	What variables affect the outcome of the journal selection decision.
Impact of e-characteristics	How electronic characteristics of the journal influence the process.
Optimization function variables	Variables which authors try to optimize on behalf of their articles and that editors and publishers try to optimize on behalf of their journals and readers.
Article quality	Subjective judgement of the quality of an article. Usually an individual's judgement of a particular article.
Turn-around time	Amount of time it takes between acceptance of an article for publication and its distribution in published form.
Audience character	Characteristics of the audience unrelated to its size.
Audience size	Numeric size of the audience (perhaps synonymous with readership) of a journal.

Table B2 (cont.):

Coding structure	Definition
Personal obligation	Sense that some community members feel obligated to contribute some work to a journal. The source of the obligation could be participation on an editorial board.
Special features	Unique functions offered by the journal that are not commonly offered by peer publications. Obviously this can cover electronic functions, but can include other things such as special types of articles.
Niche	Generally the topical focus of a journal. It is actually a little broader than just the subject area covered but also includes concepts of style.
Review process	The manner in which the review process is conducted - the selection of reviewers, handling of correspondence, copy editing, page proofs etc.
Journal prestige	Prestige possessed by a journal and to some extent conveyed to articles published there. The judgement of prestige is somewhat subjective and can change over time.
Social relations	What social relations influence the development and adoption of electronic publishing among environmental scientists.
Recruitment Members	Description of activity to recruit papers. Subcategories are codes for each study participant. (The subcategories are not repeated here but consist of the individuals listed in Table 3.)

Table B3:

Axial Codes for Emergent Themes

Codes	Definitions
Emergent	Definition: Series of nodes describing emergent themes from the research project.
Peer review	Discussions of peer review – processes, roles, effects, concerns etc.
Quality	Concerns about quality related to peer review.
Rejection	Mention of the rejection of a manuscript.
Time	Discussion of any time effects including time constraints, timing sensitivities, etc.
Distribution time	Time required to distribute a research project's results
Typical distribution time	Typical times for a journal.
Persistence	Persistence of information over time.
Integration	Discussion of the benefits, processes, or results of integrating people, objects, etc.
Information sources	The benefits of linking information sources. Includes code for hypertext from publishing dimensions.
Research community	Integration of the ecology community.
Multiple communities	Integration of the ecology community with other communities.
Value added	Discussion of ways in which publishing or electronic publishing adds value to research activities or scientific work.

References

- Abels, E. G., Liebscher, P., & Denman, D. W. (1996). Factors that influence the use of electronic networks by science and engineering faculty at small institutions. Part I. Queries. Journal of the American Society for Information Science, *47*(2), 146-158.
- American Psychological Association (1963). Reports of the American Psychological Association's Project on Scientific Information Exchange in Psychology (Vol. 1). Washington, DC: American Psychological Association.
- American Psychological Association (1965). Reports of the American Psychological Association's Project on Scientific Information Exchange in Psychology (Vol. 2). Washington, DC: American Psychological Association.
- American Psychological Association (1969). Reports of the American Psychological Association's Project on Scientific Information Exchange in Psychology (Vol. 3). Washington, DC: American Psychological Association.
- Association of Research Libraries, Association of American Universities, & Pew Higher Education Roundtable. (1998). To publish and perish. Policy Perspectives, *7*(4), 1-12.

- Bachrach, S., Berry, R. S., Blume, M., von Foerster, T., Fowler, A., Ginsparg, P., Heller, S., Kestner, N., Odlyzko, A., Okerson, A., Wigington, R., & Moffat, A. (1998). Intellectual property: Who should own scientific papers. Science, 281(5382), 1459-60.
- Bailey, C. (1998). Scholarly electronic publishing bibliography. Houston: University of Houston Libraries, <http://infolib.uh.edu/sepb/sepb.html>.
- Bambrough, R. (1971). Universals and family resemblances. In C. Landesman (Ed.), The problem of universals (pp. 119-130). New York: Basic Books.
- Bishop, A. P. (1994). The role of computer networks in aerospace engineering. Library Trends, 42(4), 694-729.
- Bishop, A. P. (1995). Scholarly journals on the net: a reader's assessment. Library Trends, 43(4), 544-70.
- Bloom, F. E. (1996). New online tools for scholars: 2. Science, 273(5282), 1637.
- Bloom, F. E. (1997). Spring preening. Science, 276(5314), 879.
- Borghuis, M., Brinckman, H., Fischer, A., Hunter, K., van der Loo, E., ter Mors, R., Mostert, P., & Zijlstra, J. (1996). Tulip final report : Elsevier Science.
- Borman, S. (1993). Advances in electronic publishing herald changes for scientists. Chemical and Engineering News, 71, 10-24.
- Bowen, W. G. (1995). JSTOR and the economics of scholarly communication : Council on Library Resources, <http://www.clir.org/econ/jstor.html>.
- Branin, J. J., & Case, M. (1998). Reforming scholarly publishing in the sciences: a librarian perspective. Notices of the AMS, 45(4), 475-86.

- Budd, J. M., & Connaway, L. S. (1997). University faculty and networked information: results of a survey. Journal of the American Society for Information Science, 48(9), 843-52.
- Carr, T. R., Buchanan, R. C., Adkins-Heljesen, D., Mettile, T. D., & Sorensen, J. (1997). The future of scientific communication in the earth sciences: The impact of the Internet. Computers and Geosciences, 23(5), 503-512.
- Cole, S., & Cole, J. R. (1967). Scientific output and recognition: A study in the operation of the reward system in science. American Sociological Review, 32(3), 377-90.
- Cole, S., & Cole, J. R. (1968). Visibility and the structural bases of awareness of scientific research. American Sociological Review, 33(3), 397-413.
- Covi, L., & Kling, R. (1996). Organizational dimensions of effective digital library use: closed rational and open natural systems models. Journal of the American Society for Information Science, 47(9), 672-689.
- Crane, D. (1969). Social structure in a group of scientists: a test of the "invisible college" hypothesis. American Sociological Review, 34(3).
- Crane, D. (1972). Invisible colleges: Diffusion of knowledge in scientific communities. Chicago: University of Chicago Press.
- Crawford, S. (1971). Informal communication among scientists in sleep research. Journal of the American Society for Information Science, 22(5).

- Crawford, S. Y., Hurd, J. M., & Weller, A. C. (1996). From print to electronic: The transformation of scientific communication. Medford, NJ: Information Today, Inc.
- Cronin, B. (1982). Invisible colleges and information transfer: a review and commentary with particular reference to the social sciences. Journal of Documentation, 38(3), 212-36.
- Cronin, B., & McKim, G. (1996). Science and scholarship on the World Wide Web: a North American perspective. Journal of Documentation, 52(2), 163-171.
- Cronin, B., & Overfelt, K. (1994). The scholar's courtesy: a survey of acknowledgement behaviour. Journal of Documentation, 50(3), 165-96.
- Dirk, L. (1996). From laboratory to scientific literature: the life and death of biomedical research results. Science Communication, 18(1), 3-28.
- Dixon, A. (1998). The wannabee culture: why no-one does what they used to do. Issues in Science and Technology Librarianship.
- Easton, C. (1997). Too many journals, in too many forms? Serials Review, 23(3), 64-68.
- Entlich, R. (1995). Electronic chemistry journals: elemental concerns. Serials Librarian, 25(3/4), 111-123.
- Fidel, R. (1993). Qualitative methods in information retrieval research. Library and Information Science Research, 15(3), 219-247.

- Garvey, W. D. (1979). Communication: the essence of science. Oxford: Pergamon Press.
- Garvey, W. D., & Griffith, B. C. (1971). Scientific communication: its role in the conduct of research and creation of knowledge. American Psychologist, 26(4): 349-362.
- Garvey, W. D., Lin, N., & Nelson, C. E. (1970). Some comparisons of communication activities in the physical and social sciences. In C. E. Nelson & D. K. Pollock (Eds.), Communication among scientists and engineers (pp. 61-84). Lexington, MA: D.C. Heath and Company.
- Garvey, W. D., Tomita, K., & Woolf, P. (1974). The dynamic scientific-information user. Information Storage and Retrieval, 10, 115-131.
- Gilbert, G. N., & Mulkay, M. (1984). Opening Pandora's box: A sociological analysis of scientists' discourse. New York: Cambridge University Press.
- Ginsparg, P. (1994). First steps towards electronic research communication. Computers in Physics, 8(4), 390-396.
- Ginsparg, P. (1997). Winners and losers in the global research village. Serials Librarian, 30(3/4), 83-95.
- Glanz, J. (1996). E-journal: delayed but still a force. Science, 273, 734.
- Glazier, J. D. (1992). Qualitative and nonqualitative research methodologies: thesis, antithesis, or synthesis? In J. D. Glazier & R. R. Powell (Eds.), Qualitative research in information management (pp. 201-214). Englewood, CO: Libraries Unlimited.

- Griffith, B. C. (1989). Understanding science: studies of communication and information. Communication Research, 16(5), 600-14.
- Griffith, B. C., & Miller, A. J. (1970). Networks of informal communication among scientifically productive scientists. In C. E. Nelson & D. K. Pollock (Eds.), Communication among scientists and engineers (pp. 125-140). Lexington, MA: D.C. Heath and Company.
- Griffith, B. C., & Mullins, N. C. (1972). Coherent social groups in scientific change. Science, 177(4053), 959-964.
- Guba, E. G. (1981). Criteria for assessing the trustworthiness of naturalistic inquiries. Educational Communication and Technology Journal, 29(2), 75-91.
- Guba, E. G., & Lincoln, Y. S. (1982). Epistemological and methodological bases of naturalistic inquiry. Educational Communication and Technology journal, 30(4), 233-252.
- Guthrie, K. M. (1997). JSTOR: the development of a cost-driven, value-based pricing model. Paper presented at the Scholarly Communication and Technology Conference, Emory University, <http://www.arl.org/scomm/scat/guthries.html>
- Guthrie, K. M., & Lougee, W. P. (1997). The JSTOR solution: accessing and preserving the past. Library Journal, 122(2), 42-45.
- Hagstrom, W. O. (1970). Factors related to the use of different modes of publishing research in four scientific fields. In C. E. Nelson & D. K.

Pollock (Eds.), Communication among scientists and engineers (pp. 85-124). Lexington, MA: D.C. Heath and Company.

Hahn, K., & Schoch, N. (1997). Applying diffusion theory to electronic publishing: A conceptual framework for examining issues and outcomes. In C. Schwartz & M. Rorvig (Eds.) ASIS '97: Proceedings of the 60th ASIS annual meeting, Washington, DC, Nov. 1-6, 1997 (pp. 5-13) Medford, NJ: Information Today, Inc.

Hargens, L. L. (1988). Scholarly consensus and journal rejection rates. American Sociological Review, 53(1), 139-151.

Harnad, S. (1990). Scholarly skywriting and the republication continuum of scientific inquiry. Psychological Science, 1(6), 342-344.

Harnad, S. (1992). Interactive publication: Extending the American Physical Society's discipline-specific model for electronic publishing. Serials Review, 18(1/2), 58-61.

Harnad, S. (1995). The postGutenberg galaxy: How to get there from here. The Information Society, 11(4), 285-291.

Harter, S. P. (1998). Scholarly communication and electronic journals: An impact study. Journal of the American Society for Information Science, 49(6), 507-516.

Hitchcock, S., Quek, F., Carr, L., Hall, W., Witbrock, A., & Tarr, I. (1997,). Linking everything to everything: journal publishing myth or reality? Paper presented at the ICC/IFIP Conference on Electronic Publishing '97:

New Models and Opportunities, Canterbury, UK,
<http://journals.ecs.soton.ac.uk/IFIP-ICCC97.html>.

Hitchcock, S., Quek, F., Carr, L., Hall, W., Witbrock, A., & Tarr, I. (1998).

Towards universal linking for electronic journals. Serials Review, 24(1),
21-33.

Holoviak, J., & Seitter, K. L. (1997). "Earth Interactions": Transcending the
limitations of the printed page. Journal of Electronic Publishing, 3(1),
<http://www.press.umich.edu/jep/03-01/EI.html>

Hurd, J. M. (1996a). High Energy Physics. In S. Y. Crawford, J. M. Hurd, & A.
C. Weller (Eds.), From print to electronic: the transformation of scientific
communication (pp. 65-76). Medford, NJ: Information Today, Inc.

Hurd, J. M. (1996b). Models of scientific communications systems. In S. Y.
Crawford, J. M. Hurd, & A. C. Weller (Eds.), From print to electronic: the
transformation of scientific communication (pp. 9-34). Medford, NJ:
Information Today, Inc.

Judson, H. F. (1994). Structural transformations of the sciences and the end of
peer review. JAMA, 272(2), 92-94.

Kaminer, N. (1997). Scholars and the use of the Internet. Library and Information
Science Research, 19(4), 329-345.

Kaminer, N., & Braunstein, Y. M. (1998). Bibliometric analysis of the impact of
Internet use on scholarly productivity. Journal of the American Society for
Information Science, 49(8), 720-730.

- Kelly, R. A. (1997). Digital archiving in the physics literature: author to archive and beyond - the American Physical Society. Serials Librarian, 30(3/4), 163-170.
- Ketcham-Van Orsdel, L., & Born, K. (1998). E-journals come of age: LJ's 38th Annual Periodical Price Survey. Library Journal, 123(7), 40-45.
- Keyhani, A. (1993). The Online Journal of Current Clinical Trials: an innovation in electronic journal publishing. Database, 16, 14-23.
- Keys, M. (1995). Beyond Gutenberg and gigabits: librarians and the emerging digital revolution. Resource Sharing and Information Networks, 10(1/2), 21-32.
- Kling, R., & Lamb, R. (1996). Analyzing alternative visions of electronic publishing. In R. P. Peek & G. B. Newby (Eds.), Scholarly publishing: The electronic frontier (pp. 3-15). Cambridge, MA: MIT Press.
- Knight, J., & McKnight, C. (1995). Project ELVYN: Implementing an electronic journal. Computer Communications, 18(6), 418-422.
- Kuhn, T. S. (1970). The structure of scientific revolutions. Chicago: University of Chicago Press.
- Lancaster, F. W. (1995). Attitudes in academia toward the feasibility and desirability of networked scholarly publishing. Library Trends, 43(4), 741-752.

- Lazinger, S. S., Barllan, J., & Peritz, B. C. (1997). Internet use by faculty members in various disciplines: a comparative case study. Journal of the American Society for Information Science, 48(6), 508-518.
- Liebscher, P., Abels, E. G., & Denman, D. W. (1997). Factors that influence the use of electronic networks by science and engineering faculty at small institutions. Part II: Preliminary use indicators. Journal of the American Society for Information Science, 48(6), 498-507.
- Lievrouw, L. A., & Carley, K. (1991). Changing patterns of communication among scientists in an era of "telescience". Technology in Society, 12, 457-477.
- Lievrouw, L. A., Rogers, E. M., Lowe, C. U., & Nadel, E. (1987). Triangulation as a research strategy for identifying invisible colleges among biomedical scientists. Social Networks, 9, 217-248.
- Lin, N., Garvey, W. D., & Nelson, C. E. (1970). A study of the communication structure of science. In C. E. Nelson & D. K. Pollock (Eds.), Communication among scientists and engineers (pp. 23-60). Lexington, MA: D. C. Heath and Company.
- Lucier, R. E., & Badger, R. C. (1994). Red Sage project. Serials Librarian, 24(3/4), 129-134.
- Malakoff, D. (1998). Climate change: Advocacy mailing draws fire. Science, 280(5361), 195.

- Maxwell, J. A. (1996). Qualitative research design: an interactive approach. Thousand Oaks, CA: Sage Publications, Inc.
- McCain, K. W. (1986a). Cocited author mapping as a valid representation of intellectual structure. Journal of the American Society for Information Science, 111-22.
- McCain, K. W. (1986b). The paper trails of scholarship: mapping the literature of genetics. Library Quarterly, 56(3), 258-71.
- McCain, K. W. (1989). Mapping authors in intellectual space: population genetics in the 1980's. Communication Research, 16(5), 667-681.
- Menzel, H. (1966). Scientific communication: five themes from social science research. American Psychologist, 21(11), 999-1004.
- Merton, R. K. (1942). Science and technology in a democratic order. Journal of Legal and Political Sociology, 1, 115-126.
- Merton, R. K. (1968). Matthew effect in science. Science, 159(3810), 56-63.
- Merton, R. K. (1973). Sociology of science: Theoretical and empirical investigations. Chicago: University of Chicago Press.
- Miles, M. B., & Huberman, A. M. (1994). Qualitative data analysis. Thousand Oaks, CA: Sage.
- Moret, B. M. E. (1997). Bridging the gap between theory and practice. Journal of Electronic Publishing, 3(1), <http://www.press.umich.edu/jep/03-01/JEA.html>

- Mulkay, M. (1979). Science and the sociology of knowledge. London: George Allen & Unwin.
- Mulkay, M. (1991). Sociology of science: A sociological pilgrimage. Bloomington, IN: Indiana University Press.
- Mullins, N. C. (1968). Distribution of social and cultural properties in informal communication networks among biological scientists. American Sociological Review, 33(5), 786-797.
- Newman, M. (1997). The HighWire Press at Stanford University: a review of current features. Issues in Science and Technology Librarianship.
- Olsen, J. (1993). Electronic journal literature: Implications for scholars. Westport, CT: Mecklermedia.
- Publishing, perishing, and peer review. (1998). Economist, 346(8052), 77-78.
- Peek, R., Pomerantz, J., & Paling, S. (1998). The traditional scholarly journal publishers legitimize the Web. Journal of the American Society for Information Science, 49(11), 983-989.
- Piternick, A. B. (1989). Attempts to find alternatives to the scientific journal: A brief review. Journal of Academic Librarianship, 15(5), 260-266.
- Prescott, M. B., & Van Slyke, C. (1997). Understanding the Internet as an innovation. Industrial Management and Data System, 97(3), 119-124.
- Price, D. J. (1961). Science since Babylon. New Haven: Yale University Press.
- Price, D. J. (1963). Little science, big science. New York: Columbia University Press.

- Price, D. J. (1986). Little science, big science... and beyond. New York: Columbia University Press.
- Probets, S., Brailsford, D. F., Carr, L., & Hall, W. (1997). Dynamic link inclusion in online PDF journals.
- Richards, T. J., & Richards, L. (1998). Using computers in qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), Collecting and Interpreting Qualitative Materials (pp. 211-245). Thousand Oaks, CA: Sage Publications.
- Rogers, E. M. (1995). Diffusion of innovations. (4th ed.). New York: The Free Press.
- Rowland, F., McKnight, C., Meadows, J., & Such, P. (1996). ELVYN: the delivery of an electronic version of a journal from the publisher to libraries. Journal of the American Society for Information Science, 47(9), 690-700.
- Schaffner, A. C. (1994). The future of scientific journals: lessons from the past. Information Technology and Libraries, 13, 239-247.
- Schauder, D. (1994). Electronic publishing of professional articles: attitudes of academics and implications for the scholarly communication industry. Journal of the American Association for Information Science, 45(2), 73-100.
- Singleton, A. (1997). Journals and the electronic programme of the Institute of Physics. Serials Librarian, 30(3/4), 149-61.

- Stewart, L. (1996). User acceptance of electronic journals: interviews with chemists at Cornell University. College and Research Libraries, 57(4), 339-349.
- Strauss, A., & Corbin, J. (1990). Coding procedures: open coding, Basics of qualitative research . Thousand Oaks, CA: Sage.
- Strauss, A., & Corbin, J. (1998a). Basics of qualitative research: Techniques and procedures for developing grounded theory. (2nd ed.). Thousand Oaks, CA: Sage Publications.
- Strauss, A., & Corbin, J. (1998b). Grounded theory methodology an overview. In N. K. Denzin & Y. S. Lincoln (Eds.), Strategies of qualitative inquiry (pp. 158-183). Thousand Oaks, CA: Sage Publishing.
- Taubes, G. (1996a). APS starts electronic preprint service. Science, 273(5273), 304.
- Taubes, G. (1996b). Electronic preprints point the way to 'author empowerment'. Science, 271, 767-768.
- Taubes, G. (1996c). Science journals go wired. Science, 271, 764-766.
- Tenopir, C. (1995). Authors and readers: the keys to success or failure for electronic publishing. Library Trends, 43(4), 571-591.
- Tenopir, C., & King, D. W. (1996). Electronic publishing: a study of functions and participants. In M. E. Williams (Ed.), Proceedings of the 17th National Online Meeting, New York, May 14-16, 1996, (pp. 375-384). New York: Information Today, Inc.

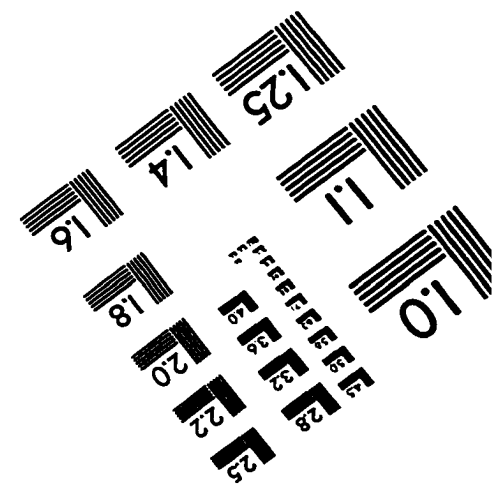
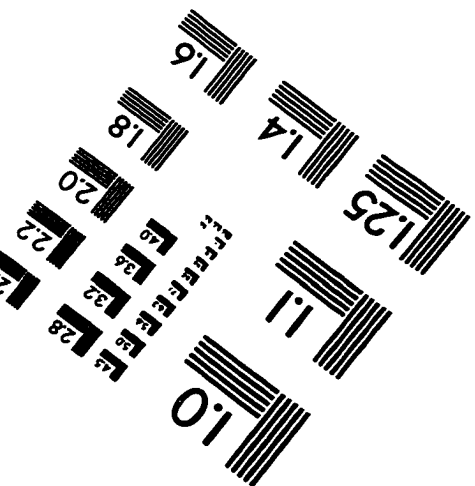
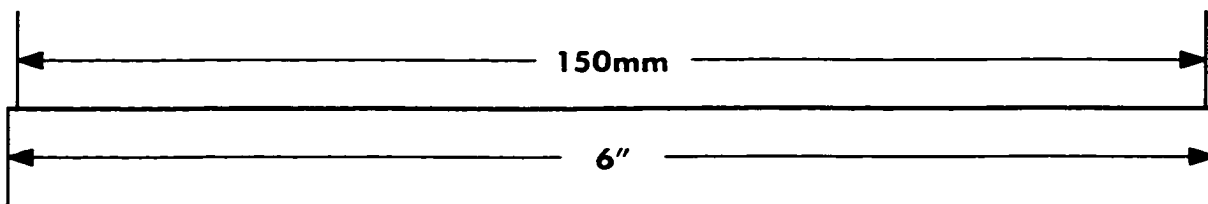
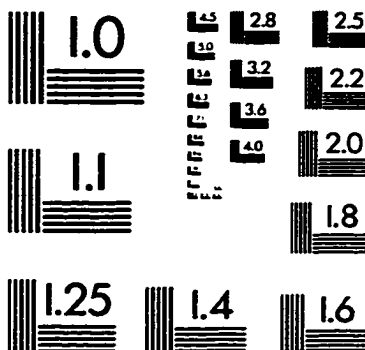
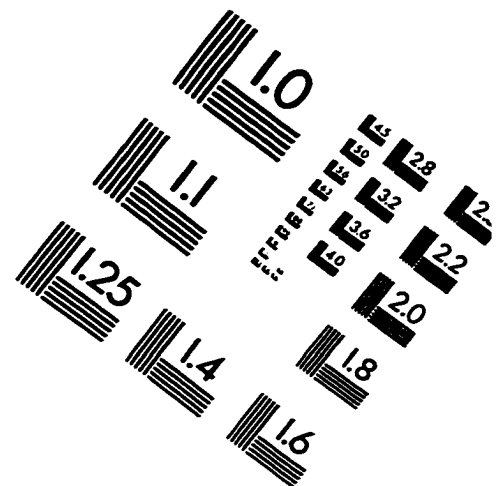
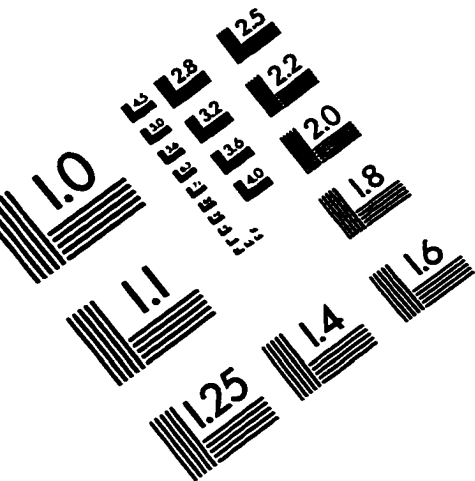
- Tenopir, C., & King, D. W. (1997). Trends in scientific scholarly journal publishing in the United States. Journal of Scholarly Publishing, 28(3), 135-170.
- Thomas, T. (1998). Archives in a new paradigm of scientific publishing: Physical Review Online Archives (PROLA). D-LIB.
<http://www.dlib.org/dlib/may98/05thomas.html>
- Weller, A. C. (1996). Editorial peer review: a comparison of authors publishing in two groups of U.S. medical journals. Bulletin of the Medical Library Association, 84(3), 359-366.
- Wilkinson, F. C., Dennis, N. K., & Rosen, B. (1997). Back to the future: at last librarians chart a new course in scholarly electronic publishing. Against the Grain: Linking Publishers, Vendors and Librarians, 9(5), 80-85.
- Woodward, H. (1998). Electronic serials: The UK Electronic Libraries (eLib) Programme. Serials Review, 24(1), 15-20.
- Young, J. R. (1997). Stanford-based HighWire Press transforms the publication of scientific journals. Chronicle of Higher Education, 43(36), A21-A22.
- Zhang, Y. (1998). The impact of Internet-based electronic resources on formal scholarly communication in the area of library and information science: A citation analysis. Journal of Information Science, 24(4), 241-254.
- Zuckerman, H. (1967). Nobel laureates in science: Patterns of productivity, collaboration, and authorship. American Sociological Review, 32(3), 391-403.

Zuckerman, H. A., & Merton, R. K. (1971). Patterns of evaluation in science:

Institutionalization, structure and functions of the referee system. Minerva,

2(1), 66-100.

IMAGE EVALUATION TEST TARGET (QA-3)



APPLIED IMAGE, Inc
1653 East Main Street
Rochester, NY 14609 USA
Phone: 716/482-0300
Fax: 716/288-5989

© 1993, Applied Image, Inc., All Rights Reserved