



An Analysis of the Impact of the Internet on Coastal Management

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The role of the Internet in coastal management practice is analyzed through the Internet's communication and information access capacity. Primary and secondary impacts of the Internet in coastal management are assessed. A broad research framework is employed, including background on the development and spread of the Internet worldwide; analysis of emerging literature on the societal impact of the Internet; limited existing research on the use of the Internet by environmental management professionals generally and coastal managers in particular; and personal experience of the authors in the development of coastal management Internet sites. This analytical framework is supplemented by the first survey of integrated coastal management (ICM) Internet websites by www.coastalmanagement.com and a case study of the Internet Center for Coastal Management (ICCM) Internet-based communication platform based at the University of Washington. The survey of ICM websites found a total of 77 websites worldwide, with a dominance of sites in English located in the developed world. Assessment of the first year of operation of the ICCM project to facilitate discussion between coastal management practitioners and students in the United States and the Philippines demonstrates the enormous potential of the Internet as a communications tool in coastal management and also reveals the many practical technological and cultural constraints of using the Internet, especially in working on a project between the developed and developing world. Three groups of scenarios of the future use of the Internet in coastal management with decreasing levels of forecast certainty, namely, "probable," and "possible," and "potential for" are presented and discussed. Finally, the potential for the Internet to fundamentally transform the practice of coastal management is analyzed. It is concluded that while such a potential exists, there remain significant research questions requiring further analysis before the full transformative potential, and the possible impacts of such a transformation on coastal management, can be fully assessed. This article aims to provide a benchmark against which such future assessments can be made.

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Introduction

The Internet is an integral part of the professional lives of many of today's coastal managers. The ability to communicate almost instantly with colleagues around the world through e-mail and find information via the World Wide Web has provided a new dimension to the current practice of coastal management.

It is remarkable to consider that adoption of the Internet by coastal managers has occurred in only a very short time. Outside the university and military sectors, the Internet has only been accessible since the mid-1990s. Its impact is described by some as "the most revolutionary invention of the past 40 years" (Hollands, 1999).

This article aims to analyze this phenomenon by addressing the following questions: What factors have caused such a rapid and widespread adoption of the Internet by coastal managers? What is the Internet currently used for in coastal management, and by whom? What are the constraints and opportunities presented by the Internet for both professional coastal managers and, more broadly, those who use the coast for recreation and to earn a living?

The Internet is changing extremely quickly. Thus, this article was deliberately written intensively over the five-month period of January to May 2000. As a result, it can be considered a "snapshot" of the state of the Internet, its technology, and its impacts on coastal management over this period. The expectation of the authors is that future papers analyzing the interaction between coastal management practice and the Internet will be able to use this article as a benchmark that, in turn, updates an initial analysis of the issue in coastal management by Green (1995) and the more generic summary of the use of the Internet in environmental management by Sabharwal and Nicholson (1997).

Our approach to the writing of this article is eloquently summarized by Graham (1999):

The scale and speed at which . . . the Internet . . . has entered ordinary life in almost all its aspects is very striking. But, despite its popularity and the rate at which it has spread, it is still very new, too new in fact to allow much in the way of retrospective reflection on its nature and impacts. Even so, its importance can hardly be denied and consequently the impulse to try to think about what it is and what it may mean for culture, law and politics is very great. Anyone who undertakes to write in a reflective vein, however, must accept that both the technology and its use are sure to alter considerably even while such reflection is taking place. (p. 1)

To follow Graham's lead, we have followed our impulse to analyze and reflect on the current role of the Internet in coastal management and scrutinize how the Internet may affect coastal management in the immediate future. In doing so a case study from the United States and Philippines is used to illustrate one use of the Internet in coastal management.

While the authors of this article are deeply involved in the adoption of Internet technologies in coastal management, we do not consider ourselves technophiles. Neither do we consider ourselves luddites. Rather, our personal views, and hence our approach to this article, is to take "critical realism" view (Graham, 1999), which attempts to provide a considered, analytical view of the interaction of coastal management and the Internet. Taking a middle ground between a wildly optimistic view of the Internet and those with more pessimistic attitudes requires "that we are not swayed by technological innovation for no better reason than it is innovatory, and that at the same time we remain open to its actual character and possible advantage" (Graham, 1999, p. 15).

It is worth reflecting on the potential for the analysis presented here to become somewhat self-fulfilling. Both authors, and many readers of this article, are actively involved in shaping the online world of coastal managers. Consequently, there is a possibility, albeit one impossible to gauge the magnitude of, that the analysis presented here becomes a personalized view of how the Internet could develop within the practice

of coastal management. As a result, statements could be made here about the future of the Internet in coastal management that we can, to a greater or lesser extent, become involved in shaping. Although this issue is one that affects any researcher actively involved in a professional sphere, it is potentially one of greater importance to those involved in the Internet, as outlined by Jones (1999):

As we write we are shaping the future of the Internet, shaping our ideas about it, and forming popular opinion. Much of what is written points to a personal perspective on the future of the Internet, based on how an individual thinks it will evolve. . . . Our expressions of history and the Internet can only be personal and are valuable only when personalized. This limiting and frustrating result is driven by the personalized nature of the Internet's design. (p. xx)

The context within which this article is written is the overall sociological one, including cultural aspects of recent technological change in general and of the Internet in particular, combined with the evolution of coastal zone management practice. Thus, the aim of this article is to merge these two streams of endeavor into a meaningful analysis of the present and possible future interaction of coastal management and the Internet.

The background to the development and use of the Internet is outlined. Next, the current status of how the Internet is used in coastal management is described and analyzed using a case study. Finally, the possible future directions of the role of the Internet in coastal management are analyzed by drawing on historical development, personal experience, and the overall scenarios of Internet technology development projected by the computer industry.

The Internet Defined

Before examining the use of the Internet and its implications for coastal management, it is worthwhile defining the Internet and its various components. Definitions of the Internet are almost as diverse as the Internet itself. Nevertheless, the most widely adopted definition is that used by the Internet Society: "The Internet is a global network of networks enabling computers of all kinds to directly and transparently communicate and share services throughout much of the world."¹

There are two important components of the Internet Society's definition. First, the Internet is a network of computers linked through a common set of communication standards, known as Internet protocols. A computer linked to the Internet in this way is termed an Internet host. Open Internet standards allow a multitude of different types of computers to communicate with each other that would not normally be allowed to do so because of different computing standards. Second, the Internet is a powerful communication tool, allowing the broadcast and sharing of a wide variety of information media all over the world to the users connected to Internet hosts.

This article does not distinguish between the underlying standards of the Internet, which are widely known as "Internet protocols," and the types of communication media and communities that use these protocols unless there is a specific need to do so. Consequently, this article uses the generic term "Internet" for both the underlying Internet protocols and the media shared using these protocols.

The Growth in Internet Use

Statistics on Global Internet Use

The Internet was originally conceived in the United States during the 1960s as a way of reducing the impact of attack by foreign powers on its computer networks by distributing

computer resources around the United States (Cailliau, 1995). Use of Internet technologies then spread to the research and academic communities to share text and data, becoming widespread in the 1980s. However, it was not until the early 1990s that the first use of a common language to show graphical content on the Internet was developed. The first commercial applications to show pictures and graphics together with text on the Internet were launched in 1993 (Hobbes, 1999). The early adoption of the Internet was nothing short of phenomenal, with 50 million users within four years; by contrast, it took 70 years from the time of its invention for the telephone to reach the same number of users (Budde, 1999).

For the purposes of coastal management, the Internet has been used by coastal management professionals in defense, academic, and research communities for many years. As a communication tool for coastal managers in government, for nongovernment professionals, and for broader coastal user community, the Internet has existed effectively since the mid-1990s (Green, 1995).

Measuring the size and usership of the Internet has proved very difficult because of its fundamental "distributed" nature. To overcome these difficulties, two broad techniques for measuring Internet use, and hence its growth, are used: Internet hosts and Internet users.

Internet hosts are computers connected to the Internet. The number of Internet hosts is a useful indicator in itself. Parallels can also be drawn to the number of individuals, usually termed Internet users, or simply users, that are connected to the Internet through each Internet host computer. However, using the number of Internet hosts to estimate users is broadly viewed as unreliable.² Instead, direct surveys are conducted to determine the extent of Internet use. Such surveys are generally carried out either by market survey companies, many of which specialize in Internet surveys, or by national government statistical bodies. For example, in Australia, the Australian Bureau of Statistics has carried out surveys of Internet use every quarter since February 1998 (Australian Bureau of Statistics, 2000).

Recent statistics on global Internet hosts estimate 64.8 million³ as of December 1999 (Figure 1⁴), which grew from 159,000 only 10 years before (October 1989). Importantly, rates of Internet host growth shown in Figure 1 are thought to be slowing slightly.⁵ Although, this rate of growth is slowing, it still continues at a very rapid annual growth ratio of approximately 1.5 and will yield an estimated 146 million Internet hosts by January 2002.

Estimates of the number of current Internet users vary greatly, depending on the assumptions used. One "educated guess" as of February 2000 is 275 million⁶ Internet users worldwide, up from 201 million in September 1999.

The Growth of Internet Devices

In parallel with the continued rapid growth of Internet hosts, outlined above, is the projected increase in the use of Internet devices. An Internet device is any piece of electronic equipment that is able to connect to the Internet, including personal computers, handheld computers, telephones with in-built web browsers, Internet televisions, and computer games consoles. In the near future there are likely to be a myriad of additional Internet devices, such as household items (fridges, microwaves), devices imbedded into cars, boats, toys, and so on. It is forecasted that new Internet-capable electronics will outsell traditional computers in the United States by 2002, inducing a "seismic shift" in the Internet (International Data Corporation, 1999).

While much of the growth in Internet devices, including mobile phones, will be in developed countries, much of the potential increase to a predicted 1 billion mobile Internet

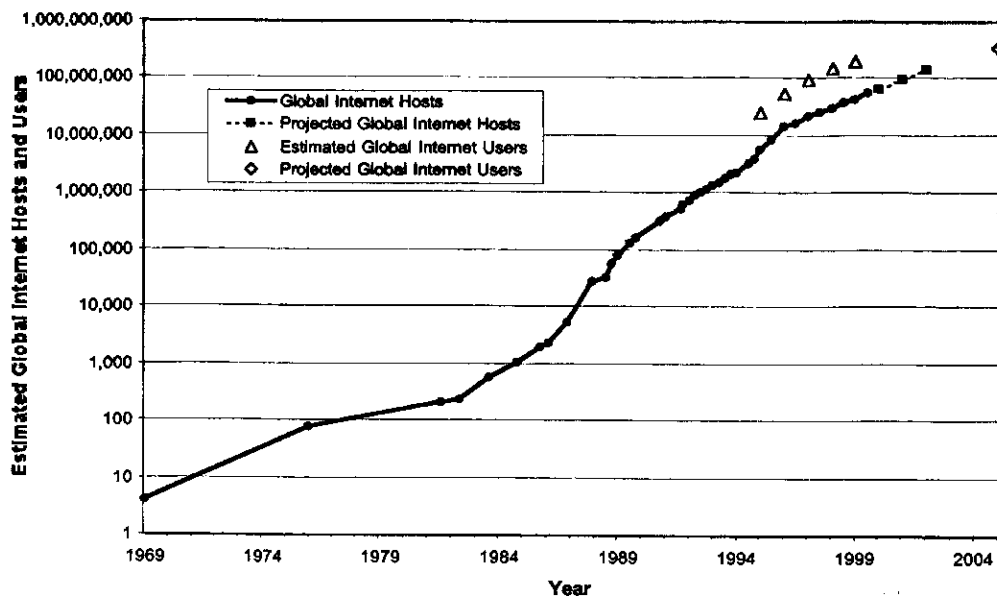


Figure 1. Global growth in Internet host computers.

access devices in use around the world by 2004 will be in developing countries (*Woolridge, 1999*). A key reason for this growth is the potential for “leapfrogging” in developing countries by accessing to the Internet not through fixed telephone lines, but directly through mobile phone networks. This issue is discussed further below.

English: The Internet's Lingua Franca

English has become the effective lingua franca of the Internet. English has quickly become established as the dominant language of the Internet fueled by the dominance of English as the language of choice for global business, many computer standards and programming languages being written in English, and its widespread use as a second language (*Gupta, 1997*).

The most widely quoted estimated figures for the breakdown of the online population by language (native speakers) as of February 2000 are 54% English speakers and 46% non-English speakers.⁷ The majority of non-English speakers speak Japanese, Spanish, Chinese, German, French, Korean, Italian, and Dutch.⁸ The proportions of English and non-English native speakers using the Internet is thought to be changing rapidly (*Figure 2*). In 1996, it was estimated that 80% of the then 50 million Internet users spoke English as their native language; by 2000–2001 this is predicted to be less than 50%, decreasing to 33% (of 747 million Internet users) in 2005 (*Figure 2⁹*). However, despite the gradual decline in the number of English-native-speaking Internet users, it remains to be seen if this will result in the decline of English as the lingua franca of the Internet. The current dominance of English in current websites on integrated coastal management is outlined and analyzed later in this article.

It could be argued that English has also become the global lingua franca of coastal management, or at least the language of choice for exchanging information on global coastal management practice. If this is the case, then there may be parallels to be drawn between the increased use of English in coastal management generally and its use on the Internet. However, to the authors' knowledge, there have been no studies of the change

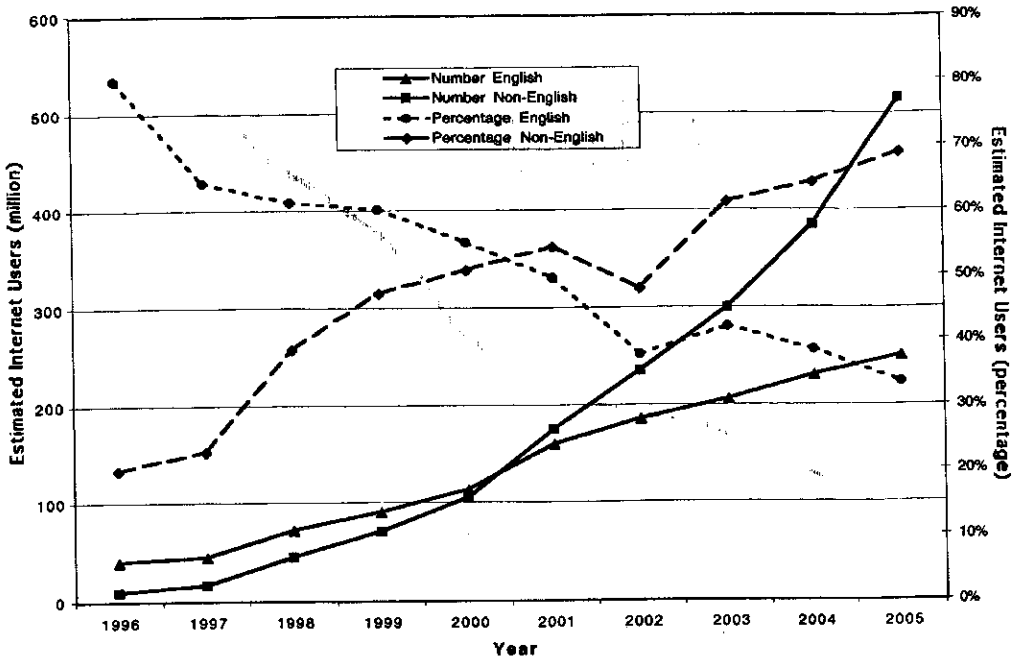


Figure 2. Estimated growth of English and non-English Internet users (native speakers), 1995–2004.

in use of English in coastal management over time, hence there is currently no quantitative means to assess the growth or otherwise of English in global coastal management practice.

The Digital Divide

The adoption of the Internet in both the developed and developing world is far from uniform. While the Internet now exists in the majority of the world's nations, its extensive use remains a developed world phenomenon. The gap between those with ready access to information technology (including the Internet) and those without it is widely termed the "digital divide." The digital divide occurs both within and between nations. Developed countries with relatively uniform telecommunications infrastructure such as the United States face an increasing digital divide due to factors related to economic prosperity, age, gender, and race. These factors also apply to the differences in access to the Internet among developed nations but is widest between developed and developing countries. It is estimated that the ratio of Internet traffic between the developed and developing world is 1:26 (Roche & Blaine, 1997). For example, less than 1% of the world's Internet traffic goes to Africa, with most of that going to southern Africa (Mushin, 2000). However, there are current development projects attempting to increase the reach of the Internet in the developing world. For example, the Acacia project of the International Development or Research Centre is working to bring the Internet to remote areas of Africa.¹⁰

The implications of the digital divide for creating societal divisions both within developed nations and between the developed and developing world are becoming increasingly important. In the United States, the importance of access to personal computers and the Internet "are increasingly critical to economic success and personal advancement"

(National Telecommunications & Information Administration, 1999, p. xv). The implications of continuing to be part of the Internet "have nots" is also being recognized as critical for the economic development of developing countries (Davison et al., 1999). Contemporary Information and Communication Technologies (ICTs) are recognized as simultaneously a curse and a blessing to developing nations. In 1997, an estimated 84% of global expenditure on ICTs occurred in North America, Western Europe and Japan conferring an enormous competitive advantages to developed nations. This comparative superiority threatens to perpetuate the imbalances that characterize north-south relationships.¹¹

There are also cultural differences in the acceptance of Internet and computing technologies, which is increasingly being factored into information technology adoption in the developing world (Al-Abdul-Gader, 1999; Harries & Davison, 1999; Hassall & Dista, 1999). There is an expanding analysis of the use of the Internet in developing nations within the broader context of technological appropriateness, following concepts of intermediate technologies developed especially for a developing nation's particular circumstances (Loh, Marshall, & Meadow, 1998). Such analysis has an interesting duopoly, linked to the notion of developing countries seeking their own most appropriate way to use the Internet, which seeks to be both "low tech" and "high tech" (Loh, Marshall, & Meadows, 1998). The high tech route can move rapidly to the adoption of the latest technology without having to consider adapting older technologies as in developed nations, simply because they were never adopted in the developing world. Such leapfrogging is evident in the developing world; the most widely cited example is the move straight to satellite-based wireless communication systems (Davison et al., 1999).

However, the awareness of social, cultural, and equity issues in the spread of the Internet is viewed by some as unique in that "for the first time in the history of capitalism the people are ahead of institutionalized inequality" (Stoecker, 1999, p. 2). Thus, in the United States, the growing digital divide is being tackled through a range of policy initiatives focused on providing multiple community points of access to the Internet,¹² together with a broad range of community, corporate, and government initiatives.¹³ Such an awareness bodes well for the consideration of digital divide issues in coastal management. Nonetheless, others (for example, Evervett, 1998) maintain that lack of access to the Internet by marginalized people remains a formidable barrier.

The Current Status of the Internet in Coastal Management

The Internet is used in coastal management both as a tool for gaining access to information and as a communication media (Table 1).

The Internet has unlocked an incredibly wide range of coastal management information. Information held by organizations and individuals and previously difficult to obtain is increasingly accessible through the Internet because the common technology of Internet protocols allows most computers to be connected to the Internet. Thus information held in government mainframe computers, the personal computers of individuals and small organizations such as the nongovernment sector, as well as information from the private sector can be accessed. The Internet could allow all computerized information on every aspect of a coastal management program to become accessible, including all fundamental scientific datasets underlying management outcomes, public consultation programs including all public submissions, and the political and bureaucratic decision-making processes shaping a management program. Of course, this theoretical accessibility to such information is rightly moderated by issues of security, privacy and economic issues (Smith, 2000). As such, the information currently accessible to coastal managers is less than the theoretical maximum, for reasons stated, but also for the

Table 1
Current use of the Internet in coastal management

Information access	Communication
<ul style="list-style-type: none"> • File transfer protocol (FTP) or websites of government, private sector, and community databases • Websites of spatial data through Internet geographic information systems (GIS) • Websites of reports and papers • Websites of educational materials • Websites of coastal program information including regulations, legislation, and policies • Websites of examples of best coastal management practice 	<ul style="list-style-type: none"> • E-mail • Bulletin boards • E-mail listservers • Internet chat • Datacasting • Video on demand • Closed virtual communities • Websites seeking to engage communities in program development and visioning

Note: For a glossary of Internet terminology, see <http://www.whatis.com>

current limitations of Internet technologies and the ability of governments and other organizations to invest in the computer and communication systems required to make information accessible.

It is useful to divide the information available for use in coastal management through the Internet into two categories: metadata and data.

Metadata is "data about data" (Bowker & Star, 1999). Information about coastal programs, policies, initiatives, and scientific data can be thought of as metadata. The Internet provides lists of available information that can be obtained through other means, such as a policy document or through requests for scientific data to be obtained on compact disc or other data storage media. Metadata listings, also called directories or atlases, have proved to be a very powerful use of the Internet in coastal management. Simply knowing what information is available about a certain subject area in coastal management, such as policy development, or a particular section of coastline has proved to be very valuable. For example, the Australian Coastal Atlas provides a means of searching a meta-database, using text searches or using an Internet geographic information system (GIS) (Martin et al., 2000).¹⁴ The results of the search can then allow users to contact the custodians of datasets requesting access to "raw data."

There is also a practical aspect to focusing on metadata on the Internet in that the majority of connection speeds to the Internet, especially in the developing world, are not fast enough to allow the download of large raw datasets. Thus, the coastal management data and information currently available directly through the Internet tends to focus on written reports, policies and other textual information which can be easily viewed through web browsers, or can be downloaded quickly due to small file sizes. Commonly, a website about a state or provincial coastal program will provide information about the purpose of the program including lists of issues to be addressed (including digital photographs), hypertext links to which agencies are involved, copies of promotional material or coastal management plans for download and contact details of program managers for further information requests. Such information-oriented websites can also include communication aspects of the coastal program, such as a bulletin board or requests for e-mail feedback on the program.

Coastal management is largely about communication (Kay & Alder, 1999). Therefore, it is logical to expect a significant impact from the rapid introduction of a com-

munication tool like the Internet. As shown in Table 1, there is a range of communication technologies currently used in coastal management. These technologies allow coastal managers to communicate with other professionals individually through e-mail, Internet chat, and, increasingly, video. Such one-to-one communication can be thought of as essentially an extension of telephone and fax communication. Perhaps the greatest advantage of one-to-one Internet communication is the ability to send data intact, rather than converting electronic data to paper, as with the fax machine. Consequently, coastal managers can e-mail research papers, digital photographs, video clips, and so forth to each other intact, allowing editing and then retransmittal. This article, for example, was written in this way.

A group of specialized Internet technologies (bulletin boards, e-mail newsgroups, and closed virtual communities) allows one-to-many and many-to-one group communication (Armstrong & Hagel, 1996). These technologies are extremely flexible, allowing an individual to communicate through e-mail to a predefined list of subscribers (newsgroups) or to enter a group discussion on particular topics (bulletin board). Such discussions can be moderated through automatic filtering or by restricting access to discussions in order to stimulate open communication between participants (closed virtual communities). One such closed virtual community is used as a case study in this article.

Such Internet technologies allow communication in ways previously unavailable to coastal managers, unless through personal contact at conferences and workshops, by the formation of specialist interest groups on the Internet. Such groups are loosely termed virtual communities by virtue of their existence on the Internet only (in "cyberspace"). Virtual communities are defined by Rheingold (1993) as "social aggregations that emerge from the Net when enough people carry on . . . public discussions long enough, with sufficient human feeling, to form webs of personal relationships in cyberspace" (p. 5). Thus, coastal management practitioners, students, and users can gain access to and discuss issues with like-minded professionals through specialized Internet discussion systems very quickly. Coastal managers can enter into specialized discussions on topics from aquaculture to zoning as well as general topics of coastal zone management. This enables questions on coastal management issues to be posed by an individual working in one part of the world and to whom the issue is new, and responses to be offered from professionals in other parts of the world to whom the same problem is commonplace. Both authors have used this ability to ask very specific questions relating to the development of coastal management policy and to gain useful responses from managers who have recently worked on similar policy issues elsewhere. An innovative example of Internet-based feedback on a coastal management visioning exercise was the U.S. National Ocean Service in its Internet Town Meeting on America's Coastal Future (Bookman, 2000).¹⁵

In some cases, virtual communities are extensions of actual real-life communities. For example, the Coastal Volunteering initiative in the United States includes a bulletin board for its members to share experiences and ideas.¹⁶

The lead author has been tracking the development of both communication- and information-based coastal management Internet sites since April 1996 through the development and maintenance of a website called www.coastalmanagement.com, which is actively maintained by this article's lead author. Once new coastal management websites are developed, they are either detected by the lead author through regular Internet searches, or the information is submitted by the site's developer or by an independent coastal professional who has found the new site to be useful. While these mechanisms are not foolproof, they have proved in practice to be an effective method of tracking the development of new coastal management websites.

As research for this article, the websites listed on www.coastalmanagement.com were surveyed and classified during March 2000. Websites were classified as to whether or not they described integrated coastal management (ICM) programs. An ICM website is interpreted to describe a coastal management program that brings together disparate elements in an attempt to holistically manage coastal resources. In this sense, an ICM program encompasses a broad constituency of coastal programs with varying degrees of integration, following the meaning of integration used by Cicin-Sain (1993) and adopted by Kay and Alder (1999). Thus, coastal programs that aim to coordinate, bring together, harmonize, and reduce fragmentation are deemed to be integrated programs (with clearly different degrees of integration).

Websites that meet this test of integration include

- government coastal program sites that outline national, regional/provincial, or local government attempts to better coordinate their efforts in coastal management;
- supernational (international) organizations with programs to promote and/or fund integrated coastal programs among its members, be they national or subnational or communities;
- nongovernment organizations working on local or community-based coastal management; and
- industry or trade groups with programs to promote and/or fund integrated coastal programs among its members.¹⁷

In addition to the above criteria, there are some further practical considerations. Only one website for a particular level of government is tagged as ICM. Although it may be argued that a government can develop more than one program that promotes ICM, by definition there must always be one website that is the "peak" integrator, bringing together all other ICM websites within a particular level of government. So, for governments with active ICM programs, most notably the U.S. federal government, only one site is tagged as ICM. The exception to this rule is where two levels of government are working with each other or with the community on a defined geographic area (such as San Francisco Bay Program¹⁸ in the United States or the Great Barrier Reef Marine Park Authority in Australia).¹⁹ The results of this survey are shown in Table 2.

The total of 77 ICM websites found in the March 2000 survey may be compared with the 1993 survey of coastal programs by Sorensen (1993). Sorensen found a total of 142 ICM programs, with a relatively even distribution around the world, with the exception of Africa. In contrast, the current survey of ICM websites shows a strong bias toward the developed world. These findings concur with the overall global use of the Internet as outlined above.

Sorensen is currently undertaking a major review of global ICM programs as part of the Baseline 2000 (B2K) project in preparation for the September 2000 Coastal Zone Canada conference (Sorensen, personal communication, May 2000). Initial results from the B2K project show a greater number of ICM programs than the 1993 survey with preliminary results as of May 2000 revealing approximately 330 ICM programs worldwide (Sorensen, personal communication). However, it is important to note that the definition of an ICM program used by Sorensen is more inclusive than that used in this article (Sorensen, personal communication). The B2K project is considering extending its work to an Internet-based survey methodology, which has the potential for integrating the results of ICM websites presented in this article.

In addition to ICM websites at www.coastalmanagement.com, a plethora of Internet sites on conferences, discussion areas, and information sources, universities, consultancies and especially individual sectors within coastal management are given. The range of these sites is shown by the International Coastal Management Index (ICMI), compiled

Table 2
Survey of integrated coastal management websites
by region and language, March 2000

	Number of Integrated Coastal Management (ICM) websites					Total
	English	Spanish	Japanese	Dual English/ non-English	Multiple language	
Africa	2					2
Middle East & North Africa						0
East Asia & the Pacific	2		1			3
Scandinavia & North Atlantic						0
European Union	10	2		1		13
Europe & Central Asia	6					6
North America	31			1		32
Latin America & the Caribbean	8					8
Australasia	10					10
Global	1				2	3
Total	70	2	1	2	2	77

Note. Methodology and results at www.coastalmanagement.com including download of raw data. The geographical divisions are based on World Bank regions.

for the National Oceanographic and Atmospheric Administration's Coastal Services Center. The ICMI was developed in 1996 by the University of Massachusetts, Boston to provide a thorough listing of coastal program Internet sites and sites relevant to individual sectors within coastal management, such as fisheries, tourism, and ports. The ICMI is not actively developed, but rather the approximately 1,200 links to sites established in 1996 are maintained. Consequently, it is difficult to determine the number of Internet sites that currently relate to either integrated coastal management, as outlined above, or a particular sector within coastal management. As such, the figure of 1,200 sites can be thought of as a minimum number of Web sites that provide either a communication or information provision role in coastal management.

To our knowledge, there are no statistics on the number of Internet users among coastal management professionals or those involved in coastal management. As such, it is currently impossible to estimate the actual or potential number of Internet users involved in coastal management around the world. However, in our experience, it is rare that coastal managers in the developed world cannot be connected by e-mail, either directly or through a group e-mail account within an individual's organization. This level of Internet use is not, again from our personal experience available in the developing world. However, the use of e-mail by coastal managers in the developing world appears to be widespread and increasing, especially with the expansion of free e-mail services that can be accessed from anywhere in the world through a standard web browser. For example, approximately equal numbers of recent subscribers to the icoast e-mail newsletter managed by Robert Kay through www.coastalmanagment.com come from developing and developed countries.

Analyzing the Impacts of the Internet on Coastal Management

Technological advances are, in a sense, self-undermining and this inevitably lends them a measure of transience. That is to say, the technological advances in one era generate the ideas and tendencies which come to replace them in the next. (Graham, 1999, p. 14)

The current Internet communication and information resources available in coastal management were outlined in the previous section. Have these Internet resources influenced coastal managers and/or the practice of coastal management? And if so, how can such changes be analyzed to determine if such changes already occurred, or may be imminent?

The impacts of the Internet on coastal management are analyzed from two perspectives. The first perspective results from an examination of the rapidly growing literature that analyzes the influence of the Internet on society at large, which is itself an extension of studies examining the societal impact of computer technologies in general. The second is the personal experience of the authors as coastal management practitioners involved both in the overall field of coastal management and specifically in the use of the Internet in coastal management. Where possible, literature is used that links the Internet with natural resource management, and specifically with coastal or ocean management. However, given the dearth of specific Internet coastal management literature, it is important to stress the essentially personalized nature of this second frame of analysis.

The results of the analysis are divided into two groups: the primary impacts of the Internet on the practice of coastal management and coastal management professionals, and the potential secondary impacts on the management of coastal resources as a result of the economic and societal changes brought about by the "new economy" stimulated by the Internet (Table 3).

To date the Internet has been the stimulus for immense social and economic changes in the developed world. These changes have been likened to a "seismic shift" (International Data Corporation, 1999) and described as a third revolution following from the first agricultural and the second industrial revolutions. This so-called third revolution has been termed the "Internet revolution." Some of the literature which describes that such an Internet revolution has, and is, taking place has some self-serving element, written by those who have much to gain from such a revolution (for example, Gates, 1996, 1999). However, there have also been a number of considered works from those both forecasting and observing of the changes being brought about by the Internet (Negroponte, 1995; Graham,

Table 3
Primary and secondary impacts of the Internet on coastal management

Primary impacts	Secondary impacts
<ul style="list-style-type: none"> • Heightened ability to communicate with individual peers • Heightened ability to communicate with peer groups • New ways to interact with stakeholders in the development of plans and policies • Improved access to data and information on coastal programs, tools, & techniques • Improved ability to monitor coastal processes in real time 	<ul style="list-style-type: none"> • Changes to the "new" global economy • Telecommuting and lifestyle choices • Urban design and the "information city"

1999; Jones, 1999). The result has been that analyses of the Internet in society over the past five years or so are now becoming relatively mature, as summarized by Jones (1999):

For all the newness and hoopla associated with the Internet, much of the narrative surrounding it is quite predictable. . . . The hype about the Internet, whether accurate or not, is tellingly like that which accompanied the introduction of earlier media technologies. It is possible to go so far as to say that technology itself (and the uses to which it is put) is less predictable than the hopes and promises for it that we harbor. (p. 1)

The potential and the realities of the Internet in coastal management are explored both through the following case study and in more general terms later in this article.

Case Study: The Internet Center for Coastal Management

An internet-based communication platform named the Internet Center for Coastal Management (ICCM) was developed in early 1999 at the University of Washington.²⁰ The impetus for development of this platform was to encourage improved communication and exchange of information among a defined community of people with a shared interest in coastal management. The site allows for the exchange of any type of digital files, threaded discussion links organized by topics, and the creation of links to other websites. These functions are organized in a user-friendly manner that acts like an interactive webpage and does not require prior knowledge of any programming language. In a sense, the ICCM is set up to function as an online meeting room where individuals with a common interest come together to undertake collaborative work. The intention is not to serve as a means for broad information dissemination, but rather to focus on the creation of an online peer group. Therefore, the ICCM is a password-protected site where membership is possible if someone has an interest in coastal management, particularly in Southeast Asia. Users have commented that the design of the interactive site is impressive and powerful. An example page from the ICCM is shown in Figure 3.

While this Internet-based collaboration has been evolving, the second author has been evaluating its effectiveness to facilitate useful communication and information exchange. Before and after individual and focus group interviews, participatory observation, and discourse analysis have been utilized (Patton, 1990) to collect information on participant expectations and their experience with using the ICCM. Thus far, the ICCM has been a limited success and has begun to reveal many challenges for such efforts. The most important challenges encountered generally fall into the categories of (1) defining common interests, (2) cultural/linguistic barriers, and (3) technological limitations.

In January 1999, the second author visited the Philippines to identify potential partners, to give training in the use of the ICCM, to solicit input into how the ICCM should be used, and to conduct baseline interviews. From January to March 1999, employees from the Coastal Resources Management Project—Philippines (a USAID-support coastal management project) (Courtney & White, 2000), employees from the Haribon Foundation (a large Filipino environmental nongovernmental organization), students from Silliman University (Philippines), and students from the University of Washington expressed interest in participating and were given the opportunity to use the ICCM. Thirty-one participants joined the ICCM. All participants had some degree of interest and understanding of coastal management.

Results of Early Attempts at Online Collaboration

Beginning in February 1999, a dialogue focused on coastal management was planned to begin. Areas of work were established based on users' responses to an online survey

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Envoy Discussions

START Documents Reference Team

ACTIONS

New Discussion

By Category

VIEWS

By Date

> By Category

By Author

TOOLS

Maps

Help

Search

previous | next | expand | collapse

- ▶ Current Topics and News Events
- ▶ Fellowships and Funding for CM
- ▶ Introductions
- ▼ Philippines National Policy
 - ▶ EO Document 29.03.2000 Roy Olsen De Leon
 - ▶ READ FIRST 10.03.2000 Patrick Christie
- ▶ Restoration
- ▶ Social/political factors

previous | next | expand | collapse

Figure 3. On-screen image of the discussion section of the ICCM. Note the expandable menu structure on the right-hand side of the image. Here the "Philippines National Policy" discussion topic is open, showing two postings.

(e.g., community-based coastal management, coral reefs, enterprise development, international frameworks, legal frameworks, protected areas, etc.). It was decided that the collaborative process should be as participatory and self-defining as possible. As a first activity, ICCM participants were asked to respond to introductory questions intended to help members learn about one another, their interests, and their backgrounds. During a two-month experience, there was limited dialogue about certain issues. For example, there was some discussion about who founded the concept of community-based marine-protected areas in the Philippines and about the enabling legislation in the Philippines with regards to coastal management. Most postings were initiated after a University of Washington student posed a question. The threads of discussion never went beyond five postings on any one topic. Some exchanges contained thoughtful and thought-provoking information.

University of Washington student: I'm working on a paper addressing the social and political factors affecting community-based resource management (CBRM) in the Philippines and would like some help focusing my efforts. Here's the question: What are the three most important social or political factors affecting CBRM at the national level? At the local level? Why?"

CRMP employee: In response to your question about the most important social or political factor affecting CBRM, here are a few ideas:

National level: The relative importance that national government puts on local decision making and decentralization has tremendous impact on the support and resources available to local government and communities in CBRM. In the Philippines, there is a strong trend towards decentralization to municipal and barangay level government. . .

Local level: The single most important factor affecting CBRM at the local level is the degree of economic development, the variety of economic alternatives available to resource users, and resource-dependent people. . .

Silliman University faculty: The relative successes in the Philippine coastal zone in the late 1980s and early 1990s are due largely to a strong emphasis on CB management in line with the bottom-up model of CM. With the passage of the Local Government Code of 1991, greater importance is placed on stakeholder collective participation in the implementation and planning.

Other postings were announcements of relevant information such as requests for proposals, fellowships, and other online services.

As the founder of the site and as a teacher at the University of Washington, the second author made numerous efforts to encourage participation on the ICCM. This was done through e-mail correspondence with ICCM users. Additionally, the second author attempted to facilitate the online discussion and to follow up with face-to-face meetings with participants.

In March the experience was temporarily stopped, due to the term ending at the University of Washington and lack of activity on the site. It was clear that the use of the site needed to be evaluated. In April and May interviews were conducted with School of Marine Affairs (SMA) students. In May 1999, the second author returned to the Philippines to conduct follow-up interviews. The results of these interviews and the observations of the exchange indicate that the first use of the ICCM was a mixed experience. The evaluation focused on three main areas of inquiry: (1) Did the ICCM facilitate two-way communication? (2) Does the ICCM help participants reach educational and professional goals? and (3) Does the ICCM facilitate education about coastal ecology, social processes, and resource management? Each of these research questions are addressed in turn below.

Did the ICCM Facilitate Two-Way Communication? This question can be approached on a number of levels. There is the higher-level question of whether the Internet can serve as a tool that allows for balanced and useful exchange of information between

people from different contexts. The ability of the Internet to serve as a conduit for two-way communication between the people from developed and developing countries and as a source of useful information or linkages to others within a global peer group has become a topic of increasing controversy. Some (Koenig, 1999) are quite optimistic that the Internet will allow those from the South, in this case scientists, to access valuable resources and somehow help to catapult them into parity with the North. Others maintain that it is overly romantic and simplistic to assume that the voices and ideas of marginalized individuals will find expression through the Internet (Everett, 1998). These skeptics maintain that social divisions and unfair interests are played out through the Internet. Undeniably, there has clearly been a technological divide that mirrors existing social divisions (Walton, 1999). There are no clear directions as to the role of the Internet in social development, and the sheer newness of the media prevents us from being able to address these wider issues at present.

However, at a more fundamental level is the issue as to whether the ICCM allowed for or facilitated meaningful communication among a small group of initial participants.

Faculty member, Silliman University: The exchange is a bit slow and minimal. . . . The questions raised were very specific. Once you got the answer, people didn't go on.

In summary, there was very limited two-way communication on the ICCM during that two-month period. As mentioned, no participants came forth to express an interest in utilizing the tool beyond limited discussion. No data or text were exchanged or coauthored. Nor were many people willing to make links to other websites. A posted text written by SMA students that reviewed the published literature concerning coastal management issues in the Philippines did not spur any commentary, although it was solicited.

The most common explanations by the users themselves for this lack of two-way communication were that the types of questions asked did not lead to ongoing dialogue, that site access was a problem, and that the interface needed design improvement. Generally, the questions posed were not about controversial subjects that might spur discussion. Rather they were focused on collecting information about a particular coastal management practice or to solicit opinions on noncontroversial subjects. In addition, the fact that discussion on the ICCM is asynchronous (meaning it is not instantaneous like a "chat room") may have contributed to waning enthusiasm. On occasion, individuals, especially those with slow Internet connections, had difficulty in navigating the ICCM to find new postings. Furthermore, unstable Internet connections and the lack of bandwidth in the Philippines so greatly slowed the loading of the ICCM (even though it has mainly a text interface), which was hosted in Seattle, that individuals were discouraged. During peak use periods, data transference rates for Silliman University (which has its own server connected to regular commercial phone lines) are as low as 300 bits/second and occasionally go below 100 bits/second. Silliman students felt that access to the computers and Internet connections was the main barrier to use of the ICCM. Silliman students and Coastal Resources Management Project (CRMP) staff members share Internet accounts and computers, so their use of the ICCM displaces other users. Access to the Internet in the developing world has been identified as an important barrier by other researchers (Everett, 1998).

While each of these expressed factors may inhibit the use of the ICCM, what may also discourage two-way communication is the distinction between U.S. and Filipino communication and educational styles. As part of their educational experience, U.S. graduate students are encouraged to ask questions and state their opinions. This is not the norm in Filipino education. For example, the voluminous, rapid, and sometimes discourteous discourse on e-mail listservs that are mainly used by Westerners is a clear indication that communication styles around the world are quite distinct (Harrison & Huntington, 2000).

Generally, Filipino students tend to defer to the opinions of perceived experts to a greater degree than U.S. students. Also, during interviews, some Filipino students also expressed uneasiness with their level of knowledge with regards to coastal management. They felt somewhat intimidated by the presence of other students and so-called experts who they felt were more knowledgeable. These dynamics are grounded in both cultural and educational norms and are, therefore, unlikely to change in the immediate future. Of course, there are interesting issues associated with the globalization of educational and cultural norms, in part stimulated by the Internet and other technologies (Castells et al., 1999). It is interesting to speculate regarding the impact of such phenomena over the longer term, but that is beyond the scope of this article.

In the future, it may be necessary to use more direct facilitation methods and to have more structured exchanges (e.g., linking students to co-author term papers). It is unclear, however, whether this will work in a multicultural context, nor would it be appropriate for a group of practitioners or experts that would rather use the Internet in a less-structured manner. In addition, access to computers with Internet capability that does not compete with other uses is essential. Finally, organizing group, synchronized activities (e.g., chat sessions) may encourage individuals to participate and may offer a degree of anonymity, although the deliberate use of anonymity in chat may bring with it problems of attributing facts, trusting opinions expressed, etc. These barriers will take time to work around, and the next ICCM mediated exchange, which is currently beginning, will take them into consideration.

Does the ICCM Help Participants Reach Educational and Professional Goals? While the discussion threads were short, some of the information exchange was quite useful, especially for the University of Washington students who were willing to solicit information and were using the information to write a term paper on the status of coastal management in the Philippines. University of Washington students commented that while they were somewhat disappointed with the lack of a dynamic dialogue, they were pleased to have the opportunity for direct contact with coastal management practitioners.

SMA student: I like the ICCM. It's a point of access to experts. . . . I think it has a ton of potential. I was able to fill gaps, able to get info on judicial decisions in the Philippines.

Haribon staff: What is good about this ICCM program is that it gives people the opportunity to express themselves. . . . Gives me confidence in my work and opinions.

The potential for access to others with similar interests is one of the greatest potential uses for the Internet. Virtual communities dedicated to education are being spontaneously formed around the globe by individuals and groups seeking those with a like mind. A number of programs are underway that effectively use the Internet for distance learning opportunities (Harasim et al., 1998). "Learning circles" are an example of how linking young students has allowed them to cross cultural boundaries and work on joint tasks.²¹

The ICCM has the potential to support the formation of mentoring relationships between experts and students of coastal management. Such relationships, which approximate apprenticeships, have been identified as critical to effective learning (Lave & Wenger, 1991). The initial experience with the ICCM indicates that there is potential for the formation of such relations but that they will require nurturing and innovation.

Does the ICCM Facilitate Education about Coastal Ecology, Social Processes, and Resource Management? Coastal management is an applied problem-solving activity. It is multidisciplinary by nature and tends to be context specific. Since coastal management

involves managing interactions among humans, institutions, and physical environments, there are few clearly defined answers to complex problems. Yet, over time, through a process of trial and error, a degree of understanding about coastal processes, problems, and solutions has been developed by practitioners, researchers, and resource users. In other words, our learning about coastal management is socially constructed and context specific.

One way that individuals have learned about coastal management has been through formal course work, perhaps at a university. There, they may have interacted with experts and coastal users in the field. The manner in which knowledge and understanding is developed about a particular topic is a complex one, and one that is increasingly impacted by such technologies as the Internet.

We have seen that learning requires the transformation of information into knowledge and knowledge into wisdom. These activities are enabled by and mediated by three things: cognitive processes that add to and alter mental models (of students); the influence on these processes of the context in which knowledge is constructed and used; and social influences that enable and mediate the knowledge construction process. In one way or another, universities have always provided support for these three activities. . . . The advent of the Information Superhighway has changed all this. It has made it possible for students to receive information. . . . But because the Web provides just information, not instruction or any other support for learning, it is completely incapable on its own of supporting knowledge construction, of providing a context for learning and of providing the kind of learning community that universities have always nurtured. This means that whenever the Web is used in our courses, for whatever reason, we must deliberately add back to the learning experience these three kinds of support that we have traditionally provided as a matter of course. Without this, our use of the Web is bound to fail. (Winn, 1997)

The clear message is that while the use of the Internet for educational purposes provides certain opportunities, it also requires careful and attentive facilitation.

The use of the ICCM allowed some individuals to learn about coastal management in a different context than that with which they are familiar. Through this technological tool, University of Washington students were successful in gaining a greater, albeit modest, understanding of coastal management in the Philippines. The interactive nature of the ICCM and other software interfaces now allows one to create an educational context that approximates face-to-face interaction. Nonetheless, the social dynamics of discourse and the level of shared interest in a subject will still determine the ability for unconstrained exchange of information.

In fact, that each participating institution had varying inclinations toward practical and academic activities made it difficult to define a common activity that would interest all parties equally. Joint decision making was especially challenging since only one person serially met with each institution.

During interviews, Filipino participants expressed an interest in spreading the network of participants to include other Filipinos and other Southeast Asians. For the Asian participants in the ICCM, the medium may provide opportunities to explore their common experience and challenges, an understanding of which has been hampered historically by cost, among other factors. For the U.S. participants, it provides access to up-to-date information as well as a valuable lesson in cross-cultural efforts—namely, that they take time and trust to develop.

Recent Efforts. Based on the first experience with the ICCM, certain actions were taken to improve its utility. Features were added to the ICCM interface to allow for easier navigation. Bandwidth is a perennial problem, so e-mail listservs were established to allow for rapid discussion of certain topics. Finally, and perhaps most importantly,

efforts have been taken to establish closer interpersonal links between the institutions. A program of joint face-to-face planning was established. A program of internships and faculty/practitioner exchanges was also established that was intended to initiate a dialogue that could be continued over the Internet.

In an attempt to redirect the ICCM onto a more tangible, focused activity, the CRMP, one of the partnering organizations, has decided to use the ICCM as a tool for the review of national-level coastal management policies. In preparation, 97 participants were joined to the ICCM—U.S., Australian, and Philippine governmental, nongovernment, and academic institutions. A CRMP staff member contacted each of these individuals and asked if they were interested in participating. Recently, an executive order that may be signed by the President of the Philippines to define a national coastal management policy has been posted on the site. Provocative review questions were posed to the participants by e-mail. The CRMP hoped to use this process as a way of soliciting input into such project activities. Despite the potential importance of this issue, only four brief postings were made over the course of two months. Some of the following reasons were offered for the lack of postings.

CRMP employee: I see it a little bit like the stock market craze over dot.com companies that are starting to go under. Expectations were high for these companies because people did not really understand their true potential or lack of because of little experience. Our ICCM experience to date is that e-mail has become so pervasive that I can hardly wait to turn off my computer and move on to other things. People in the Philippines, I notice, that have the luxury of time and access to the computer use the Internet but those of us who are too overloaded with e-mail and everything else, do not. This happens to be true for many of the people in the ICCM loop because they are all busy and engaged people often attending all-day workshops and the like. Filipino field workers, for example, can hardly even send an e-mail let alone open, navigate, and contribute to the ICCM site. This is partly because the culture here is much more face to face for things of substance. Administrative things are being done through e-mail but not substantive discussions, at least not on our project, and we are way ahead of many in using this technology. . . . It is hard to get written comments from anyone even in the traditional manner of writing comments on the report except for a few people who can do this easily. . . . I think that learning this through your ICCM experiment is very valuable. We need to consider the underlying values of people in adopting technology. I feel that fast development of certain technologies by those with good minds and deep pockets has almost totally forgotten where much of the world is coming from and how it operates. Anyway, this is all a learning experience.

Silliman University faculty: Concerning the ICCM, I have just discussed with my students about the ICCM topics, especially the executive order—the difficulty they have encountered in giving their views. They said that for them to comment on the executive order will require to do an in-depth study of the different institutions and the implications. Otherwise they end up just saying it is a good executive order, go for it, or it is a futile exercise. For example, they have to read the Fisheries Code, the Local Government Code, the AFMA, and check on the implications of the executive order on existing. I guess people are currently just too busy to visit the site and could only e-mail. E-mail still is the best/quickest avenue to inform people and solicit some information.

In addition, the discussion of such critical national policy issues in a public forum by foreigners may not be perceived as appropriate by some individuals.

A second, separate ICCM-Education site has been established to allow for more closely linked and facilitated activities to take place between students at the University of Washington and Silliman University. The first activity in May 2000 was a modest one involving the exchange and review of term papers concerning coastal management in their respective countries. Silliman faculty felt that a forum with a limited number of participants who are all students would encourage participation as there would be less concerns with experts viewing postings. In addition, students would be motivated to participate as there are academic incentives at work.

Finally, an online chat discussion with Marc Hershman (Director, School of Marine Affairs, University of Washington) and Alan White (Director, Philippine Coastal Resource Management Project) as resource people willing to respond to questions from University of Washington and Silliman University students was attempted. This was a notable success with multiple (31) postings from students over a 90-minute period. The fluidity and rapidity of the medium seemed to encourage participation. Furthermore, chat is a very popular mode of communication among Filipino youth. One limitation of this means of communication is that the questions and comments tended to be quite brief (up to four sentences) and the resource persons had little time to prepare thoughtful responses.

Based on these results, the planned expansion of the ICCM to include other South-east Asian countries as collaborators has been put on hold. Considering increased language barriers and the lack of long-term working relations between institutions (unlike in the Philippines where there are relatively tight linkages), the second author is currently reevaluating, in consultations with ICCM participants, the future of the ICCM.

The Future of the Internet in Coastal Management

The potential for the Internet as a transforming technology for coastal management is the central theme of this article. In this sense, the Internet is distinguished from other technologies used in coastal zone management, for example, the wave buoy or the use of computer-mediated conflict resolution, useful as each of these are. Transforming is used here to outline significant changes to the social, economic, and cultural practices of coastal managers and users of coastal resources. This contrasts with the notion of the Internet being "tacked on" to existing coastal zone management practice, acting merely as an appendage, rather than facilitating transformation of the field.

What, then, would support, or detract from, the notion of the Internet becoming a technology which will transform coastal zone management? Graham (1999), in questioning the transformative role of the Internet on society at large, suggested two factors in which technologies combined to trigger the agricultural and industrial revolutions in Europe, namely:

- provision of hitherto unimagined ways of fulfilling recurrent human needs; and
- bringing in their wake large-scale alterations of social and cultural life.

Graham argued that fulfilling human needs is fundamentally about increasing power, and thus choice. With the abundance of choice on the World Wide Web, freedom is immense, and so it can be argued that power resides with individual Interned users, thereby increasing their personal autonomy. Thus, Graham argued that this criterion is fulfilled, and so the Internet can be thought of as transforming technology. The second criterion, Graham argued, also has the potential to be fulfilled through the global nature of the Internet, allowing transnations to become less important and allowing "the reconfiguration of human communities in line with individually chosen grounds" (p. 38), potentially reducing the power of the state and its various institutions as the dominant force in social life.

Graham's optimistic analysis is shared by many observers of the "Internet revolution" (e.g., Rheingold, 1993; Negroponete, 1995). In contrast to such optimistic views are those that focus on the marginalizing effect of such technology and the innumerable cultural and technological barriers that stand in the way of transformation through this technology (e.g., Harries & Davison, 1999; Hassall & Dista, 1999). In addition, Graham (1999) appeared to assume that current decision-making processes and vested interests will effectively relinquish control. It appears unlikely that this will be the case.

A recurring theme in the literature on technological change and its societal impact is that of unintended consequences; that the introduction of a technology, such as the railroad, telegraph, or electric light, caused far-reaching impacts not imagined by their inventors. The notion of unintended consequences is amplified by literary connections to Frankenstein and to Dr. Faust's bargain with the devil (Tenner, 1997). Clearly, the very nature of unexpected consequence belies analysis of what such consequences may be. However, it is the concept that there are likely to be such consequences that is important here. This suggests that the monitoring of the implications of the Internet on coastal management is critical to allow those impacts that were projected to be compared with those that were not, thus allowing more informed future recasts to be made.

Perhaps it is the transformative potential of the Internet in coastal management that should be the research focus. The potential for the Internet to contribute positively to coastal management is enormous; the risk of negative and marginalizing impacts is very real. To further complicate the issue is the potential for unintended consequences (both positive and negative) of the Internet in coastal management. The challenge for coastal management appears to be one of balancing the positive implications of the Internet with potentially negative impacts. In doing so, a mechanism for tracking and considering the unintended consequences of the Internet in coastal management (both positive and negative) requires development.

To help consider the future development of the Internet in the practice of coastal management some future scenarios are presented. The aim is both to stimulate discussion and, crucially, for future researchers to be able to track the evolution of the Internet in coastal management. The term *scenario*, rather than *prediction*, is used deliberately in the same sense that climate researchers use scenarios to present the potential future impacts of greenhouse-gas-induced climate change (IPCC, 1998). In this sense, scenario means a particular "combination of uncertainties" rather than hard and fast forecasts. These scenarios are presented in Table 4 with three decreasing levels of projective certainty, namely, probable, possible, and potential for. These scenarios are presented with

Table 4

Three scenarios of the future use of the Internet in coastal management

Probable

- Continued development of virtual communities of coastal managers and user groups.
- Increased access to government data and information underpinning coastal programs.
- Increased global benchmarking of coastal programs and initiatives.

Possible

- A wired coastline of environmental sensors providing real-time data provision to managers and coastal users.
- Virtual expert work teams composed of developing and developed world practitioners able to address specific coastal management issues.
- Heightened digital divide between developed and developing nations, reduced development activity, and so increased natural resource degradation in the developing world.

Potential for

- Creation of a coastal management "mono culture" of English-dominated, developed world perspectives through the capture of Internet sites.
 - The early dominance of English to continue, possibly through the duplication of non-English language websites into English in an attempt to reach the widest possible Internet audiences.
 - Cheaper and more widespread monitoring technology becoming connected to the Internet, providing a vast array of data on coastal zones to be obtained and analyzed in real time.
-

the usual caveats of attempting to analyze the future, especially given the rapid speed of change of the Internet, unintended consequences, and the potential for self-fulfilling prophecies.

Key Research Questions and Conclusions

Key Research Questions

There are some key research questions which, if answered, could substantially improve our understanding of how the role of the Internet in coastal management develops. Perhaps the most important of these questions are:

- What is the influence of increased use of the Internet on the collection and sharing of data related to coastal management?
- What is the effect of the establishment of virtual communities interested in specific coastal management issues on the overall practice of coastal management?
- What role will the Internet play in enabling two-way interaction between coastal managers and coastal users?
- Will the Internet shift power to coastal users through increased ability to interact with like-minded users and through heightened access to information?
- Will the current dominance of English on coastal management websites continue? If so, what are the implications of continued use of English in non-English-speaking countries?
- Will technological leapfrogging occur in developing countries, enabling them to increase Internet use to the same or greater level than in the developed world?
- Will heightened access to information on coastal program outcomes around the world lead to a coastal management monoculture devoid of cultural and social diversity?
- What Internet communication technologies are most appropriate for different contexts and tasks?

Conclusions

The use of the Internet as a mainstream tool in coastal management is in its infancy. This article has attempted to draw together the current status of the Internet in coastal management, and in doing so to draw on the very rapid historical development of Internet technologies. Given the nascent condition of the Internet in coastal management, there remains a great deal of uncertainty as to how this field will develop. However, this development is likely to become increasingly important in the practice of coastal management, and could become a transformative technology.

The use of the Internet is becoming an everyday part of the lives of many coastal managers and is an important part of many coastal programs and initiatives, mainly in the developed world. While case study evidence and some limited research findings have been presented, there remains no empirical evidence of the full impact of the Internet on the practice of coastal management early in the 21st century. In the absence of such data, the potential of the Internet in coastal management was analyzed from an essentially personal perspective, supplemented by literature on overall technological and societal trends associated with the spread of the Internet.

It appears very likely that the Internet will change coastal management practice and the way in which coastal managers interact with each other and their stakeholder communities. The exact nature of such alterations and the speed with which they will take place are very difficult, if not impossible, to monitor and forecast, especially given the paucity of data on the evolution of the use of the Internet in coastal management. Indeed, one of the key research issues in analyzing the possible futures of the Internet in coastal management is the ability of coastal managers and information technology specialists to combine to actually shape the future. As recently summarized by de Bono in thinking about the new millennium, "you can only analyze the past but you can shape

the future" (de Bono, 1999). It is hoped that this article has gone some way in contributing to both these goals, through stimulating a dialogue among the coastal management profession about the positive contribution that the Internet can bring to promoting the sustainable development of coastal resources and the communities they support.

Notes

1. See <http://info.isoc.org/internet/> (March 2000).
2. "The art of estimating how many are online throughout the world is an inexact one at best. Surveys abound, using all sorts of measurement parameters. However, from observing many of the published surveys over the last two years, here is an 'educated guess' as to how many are online worldwide as of September 1999," http://www.nua.ie/surveys/how_many_online/index.html (December 1999).
3. See <http://www.mids.org/mn/908/stats.html> (December 1999).
4. Composite graph using the adjusted host counting technique of Network Wizards (www.nw.com) used by the Internet Software Consortium (www.isc.org) and Matrix Information Data Services (MIDS) (<http://www.matrix.net>). Internet Host projections for 2000–2002 are based on the MINDS extrapolation from Network Wizards' 1998–1999 host data yielding an annual growth rate for 1998–1999 of 1.515674.
5. As compared to 1997–1999 Internet host growth rates, <http://www.infoworld.com/cgi-bin/displayStory.pl?./features/990510mids.htm> (May 10, 1999).
6. http://www.nua.ie/surveys/how_many_online/index.html The breakdown of these figures is in millions: Africa—2.46; Asia/Pacific—54.90; Europe—71.99; Middle East—1.29; Canada & USA—136.06; South America—8.79.
7. <http://euromktg.com/globstats/> (December 1999).
8. English, 54%; Japanese, 7.1%; Spanish, 6.2%; Chinese, 5.4%; German, 5.0%; French, 3.9%; Korean, 3.8%; Italian, 3.5%; Dutch, 2.2%; Other, 8.9% (<http://euromktg.com/globstats/>)
9. <http://euromktg.com/globstats/evol.html> (December 1999).
10. <http://www.idrc.ca/ACACIA/> (February 2000).
11. <http://www.unimas.my/fit/roger/EJISDC/Charter.html> (January 2000).
12. Speeches on U.S. digital divide policies listed at <http://www.digitaldivide.gov/speeches.htm> (March 2000).
13. List of such initiatives in the United States is given at <http://www.digitaldividenetwork.org/initiatives.adp> (February 2000).
14. See http://www.environment.gov.au/marine/coastal_atlas/index.html (January 2000).
15. See <http://coast2025.nos.noaa.gov/>
16. See <http://volunteer.nos.noaa.gov/> (January 2000).
17. Websites that do not meet the criteria include education programs teaching or promoting ICM, research programs on ICM, ICM consultancy companies, and sites describing individual sectors within ICM (such as fisheries, conservation, oil & gas, ports).
18. <http://h2o.usgs.gov/public/wid/html/sfb.html> (December 1999).
19. <http://www.gbrmpa.gov.au/> (December 1999).
20. See <http://sma-svr1.sma.washington.edu/iccm/> for details (March 2000).
21. http://www.learn.org/projects/project_learning.html (March 2000).

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