Environment and Planning B: Planning and Design 2001, volume 28, pages 865 – 887

DOI:10.1068/b2749t

The Gulf of Maine Environmental Information Exchange: participation, observation, conversation

Paul C Schroeder
Department of Spatial Information Science and Engineering, University of Maine, 5711 Boardman Hall Room 348, Orono, ME 04469-5711, USA; e-mail: schroedr@saturn.caps.maine.edu

Paul R Boudreau
Marine Environmental Sciences Division, Department of Fisheries and Oceans, Bedford Institute of Oceanography, PO Box 1006, Dartmouth, Nova Scotia, Canada, B2Y 4A2; e-mail: boudreaupr@mar.dfo-mpo.gc.ca

Chris E W Brehme, Andrew M Boyce
Island Institute, Rockland, ME 04841, USA; e-mail: cbrehme@islandinstitute.org, aboyce@islandinstitute.org

Alison J Evans
Integrated Coastal Planning Project, Faculty of Architecture and Planning, Dalhousie University, PO Box 1000, Halifax, Nova Scotia, Canada, B3J 2X4; e-mail: aevans@fox.nstn.ca

Aviva Rahmani
Ghost Nets, PO Box 692, Vinalhaven, ME 04863, USA; e-mail: ghostnet@foxislands.net
Received 17 June 2000; in revised form 15 March 2001

Abstract. In this paper we describe an attempt to create an inclusive and participatory information sharing network across a large geographic region, the Gulf of Maine. This network aims to contribute to the health of the region's human and natural environments through facilitating partnerships among individuals and organizations that are already working toward this goal. Initiated at a time when cooperation, public learning, and information sharing increasingly depend on digital information technologies, this effort represents a turn away from earlier attempts to create centralized data sharing systems toward a more people-centered and project-centered approach. After introducing the Gulf of Maine Environmental Information Exchange and its region, particular projects will be described, along with the on-line technologies that are being applied including those related to digital mapping. A description of the purposes of the Information Exchange follows, with details about a network organization which is being shaped based on principles that have emerged through participant interactions. Public participation GIS and the community-based fisheries management movement are presented as examples of participatory governance that have contributed to discussions within the Information Exchange. We conclude with a summary of the accomplishments of this network building process and the challenges its participants recognize at this time.

General introduction

In this paper we introduce a regional, cross-border effort that is working to realize the idea of a sustainable, distributed, and participatory information sharing network. This effort aims to make use of the growing potential of on-line communications and information management technologies especially needed owing to the large geographic extent of the region. In some ways this is a virtual, invisible organization, pursuing that elusive goal of overcoming the barriers of distance and time that are said to characterize the emerging information society. Though its motivating ideas are not unique, the process has uniquely captured the commitments of many of its participants.

The Gulf of Maine Environmental Information Exchange (GOMINFOEX) is an ongoing conversation, now in its third year, among individuals who are committed to the environmental, economic, and civic health of the Gulf of Maine region (see figure 1, over; web addresses for GOMINFOEX and other related networks and

programs are provided in table 1). It is an effort to increase awareness of social and natural environments across the region, and it attempts to foster a sense of regional citizenship that is compatible with deeply held local community values and concerns. The Information Exchange exists solely to provide a context within which individual efforts and projects already underway can proceed more effectively, can share expertise and results more openly, and can be discovered more easily by others who may want to know about their work. The effective and equitable sharing of information is seen as a primary means toward these goals. The overall objective of the Information Exchange is expressed in its vision statement:

> "To maximize the benefits to coastal communities of the Gulf of Maine from available environmental information" (GOMINFOEX, 1999).

Table 1. Projects participating in GOMINFOEX, and other regional networks.

Name of program or network	URL
Atlantic Coastal Action Program (Canada)	www.ns.ec.gc.ca/community/acap/index_e.html
Atlantic Coastal Zone Information Steering Committee	www.dal.ca/~mbutler/aczisc.htm
Bay of Fundy Ecosystem Partnership	www.auracom.com/~bofep/
Bay of Fundy Marine Resource Centre	www/bfmrc.ns.ca/
Bedford Institute of Oceanography	www.bio.gc.ca/
CEF Consultants Ltd	www.cefconsultants.ns.ca
Coastal Assessment and Data Synthesis System (NOAA/NOS)	cads.nos.noaa.gov/
Coastal Communities Network of Nova Scotia	www.coastalcommunities.ns.ca/
Coastal Network of the Gulf of Maine	fox.nstn.ca/~carp/CNet/
Cobscook Bay Resource Center	www.cobscook.org/
Common Coordinates	www.spatial.maine.edu/~schroedr/gom/comcoord.html
Conservation Council of New Brunswick	www.web.net/~ccnb/
East Coast of North America Strategic Assessment Project	seaserver.nos.noaa.gov/projects/ecnasap/ecnasap.html
Ecology Action Centre	www.chebucto.ns.ca/Environment/EAC/
Environmental Data and Information Management System (EDIMS)	ekman.unh.edu/edims/documents/GOM_Reference_Handbook/dimc/edims
FishResearch.Org	www.fishresearch.org/
Fisheries and Oceans (Canada) Maritimes Marine Environmental Science	www.mar.dfo-mpo.gc.ca/oceans/e/mesd-e.html
Fishermen and Scientists Research Society	www.fsrs.ns.ca
Fishers' Website	www.gfwa.org/~gfwa/fishers.htm
Fundy Forum	www.fundyforum.com
Geodata Alliance	www.geoall.net/
Ghost Nets	www.ghostnets.com/
Gloucester Fishermen's Wives Association	www.gfwa.org/
GOMINFOEX Participants Map	www.spatial.maine.edu/~schroedr/gom/participants.html
Grand Manan Whale and Seabird Research Station	personal.nbnet.nb.ca/gmwhale/
Gulf of Maine Aquarium Circuit Rider	www.gma.org/circuit_rider/
Gulf of Maine Biogeographical Information System (GMBIS)	kiefer4.usc.edu/gmbis/index.htm
Gulf of Maine Council on the Marine Environment	gulfofmaine.org/

The growth of on-line communications technologies inspires the possibility of devising regional knowledge sharing networks that are locally based, widely distributed and nonhierarchical. Most participants in the Information Exchange hold a long-term vision that such networks will serve to increase the capacities of local communities and projects without, at the same time, draining limited local resources away from them.

Most of the participants in GOMINFOEX are professional workers in governmental agencies, local nonprofit organizations, and educational or research institutions. Most have chosen to participate without any specific mandates or instructions from their home organizations. One organization, the Gulf of Maine Council on the Marine Environment, has had a unique role in fostering this process, but no organization is its institutional leader.

Name of program or network	URL
Gulf of Maine e-Atlas	atlas.islandinstitute.org/
Gulf of Maine Environmental Information Exchange (GOMINFOEX)	www.gominfoex.org
Gulf of Maine Ocean Observing System	www.gomoos.org/
Gulf of Maine Times	www.gulfofmaine.org/times/
Maine Coastal Program	www.state.me.us/spo/mcp/
Marine Invertebrate Diversity Initiative	www.fundyforum.com/MIDI/
Massachusetts Coastal Zone Management	www.state.ma.us/czm/
Massachusetts Ocean Resources Information System (MORIS)	www.state.ma.us/czm/MORISINT.HTM
MaineSeafood.org	www.maineseafood.org
New England Aquarium	www.neaq.org
New Hampshire Coastal Program	www.state.nh.us/coastal/
Northwest Atlantic Marine Alliance	www.namanet.org/
Pine Tree Folk School Help Net	www.mint.net/folkschool/helpnet/index.html
Regional Environmental Data and Information System (REDIMS)	oracle.er.usgs.gov/GoMaine/
Stellwagen Bank National Marine Sanctuary	www.sbnms.nos.noaa.gov
Task Force Atlantis	www.atlantisforce.org/
US Fish and Wildlife Service Gulf of Maine Coastal Program	gulfofmaine.fws.gov/
Woods Hole Oceanographic Institution	www.whoi.edu/
Programs and networks in other regions	
Biscayne Bay Partnership Initiative	www.ficus.usf.edu/orgs/bbpi/
CEONet (GeoConnections Canada)	ceonet.cgdi.gc.ca/
Chesapeake Bay Program	www.chesapeakebay.net
Ecological Monitoring and Assessment Network	www.cciw.ca/eman-temp/eman/atlantic.htm
Great Lakes Information Network	www.great-lakes.net
Gulf of Mexico Program	pelican.gmpo.gov/
National Geospatial Data Clearinghouse (US)	www.fgdc.gov/clearinghouse/
Land Cover Information for the Baltic Sea Drainage Basin (BALANS)	balans.satellus.se/
Southern Appalachian Man and the Biosphere Program	sunsite.utk.edu/samab/
Stockholm Challenge	www1.challenge.stockholm.se/new_tavlande_index.html
StreamNET	www.streamnet.org
Sustainable Community Indicators Program	www.crle.uoguelph.ca/indicators/

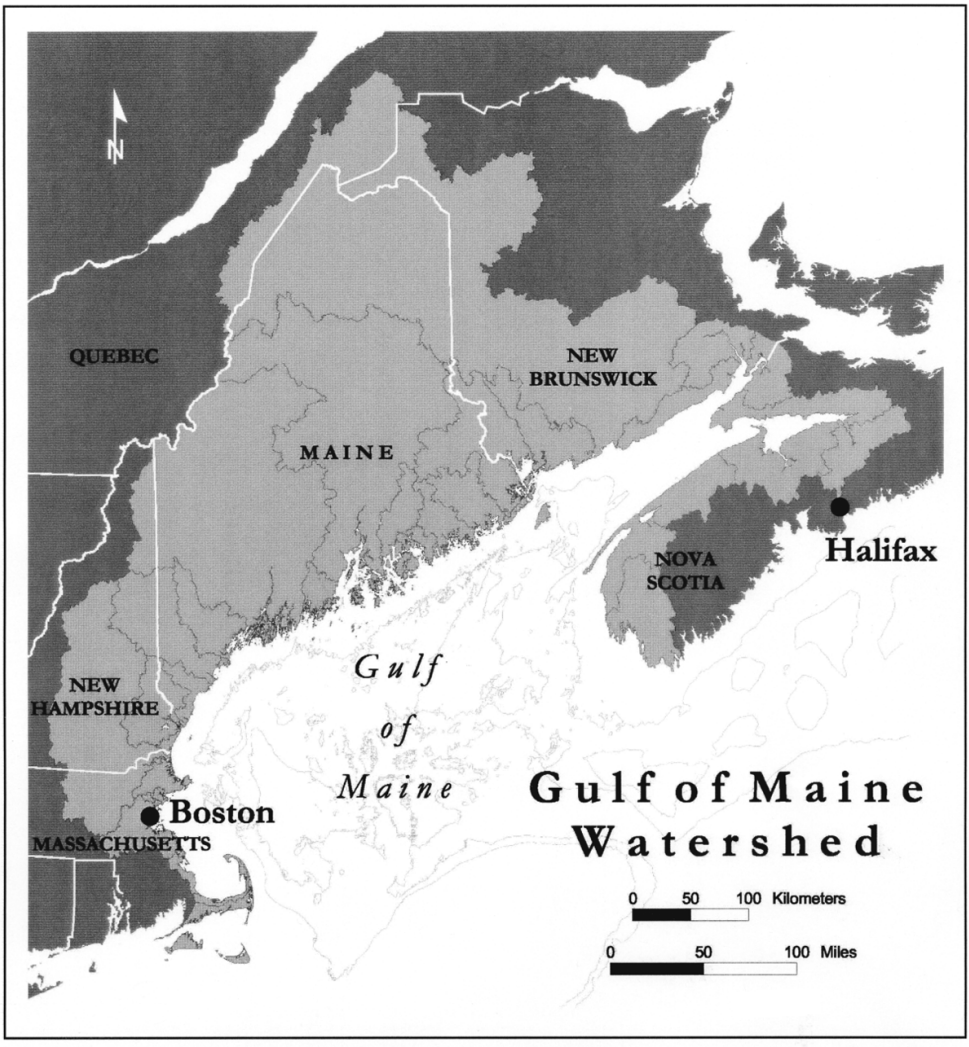

Figure 1. Gulf of Maine Watershed Region, by A M Boyce.

Those who participate in GOMINFOEX seem particularly motivated to reach out across the boundaries that they experience in their daily lives and work. Boundaries in many dimensions characterize GOMINFOEX, including the US–Canadian border. The coastal zone is a region in its own right which marks significant differences between marine and land-oriented interests, and very real differences in mission and worldview have been expressed among participants. Several sets of boundaries are often mentioned in discussing the goals and tasks of the effort. Participants seem particularly committed to learning to recognize the legitimacy of these political, physical, and philosophical boundaries while attempting to find ways to bridge them.

Participants have introduced many metaphors in attempting to describe this process. The importance of interactions between local and regional scales, and the focus on the welfare of parts as key to the success of the whole, have evoked descriptions in terms of holograms, fractals, and the creations of collage artist Robert Silvers. Coastal communities are seen as pieces of a jigsaw puzzle needing to be fit into a whole, and local communities of interest have been described as nests. Saxe's poem about the six

blind men and an elephant has been evoked on several occasions, though never risking direct quotation of its moral, in which the blind disputants "Rail on in utter ignorance, Of what each other mean, And prate about an Elephant, Not one of them has seen!" (Saxe, 1882). The technical character of much of the discussion reminds some of a virtual computer users' group. As a place for meeting partners, forming alliances, and forging agreements, this has been compared to a matchmaking service or to the personals columns in newspapers. It is also seen as a place, both virtual and face-to-face, that is a safe participant-defined public information space (Schroeder, 1997), a 'participant observatory', or as one version of the new agora that marks the commons vision of the information society (Felsenstein, 1993).

This wide range of metaphors reflects the absence of a clear mandate and also reflects both the creativity and the uncertainty of the process underway. That any organization may be conceived in terms of "networks of recurrent conversations" in ongoing support of "certain kinds of commitments" (Winograd and Flores, 1986, page 158) seems very appropriate as applied in the present case. Understanding the hardware of the Internet to be a 'network of networks' is now commonplace; crafting new social institutions in parallel forms is to attempt to build what Castells terms a network society (Castells, 1996; 1997; 1998). Castells might identify this as an effort to create "project identity" (1997, page 8), a community-building effort aiming to model in a particular information sharing network the practices that might be extended to the creation of a habitable information society as a whole. Other efforts at network building in the Gulf of Maine region have been explored by Evans and colleagues, who have suggested a version of the London transit map as an image of the organizational relations involved (Evans and Cavanagh, 1998; Evans et al, 1999; see figure 2).

Most who are involved see this as an attempt to increase a sense of community across the region as a whole. Above all, the Information Exchange seeks to foster wider awareness of the range of interests and efforts that are alive in the region, so

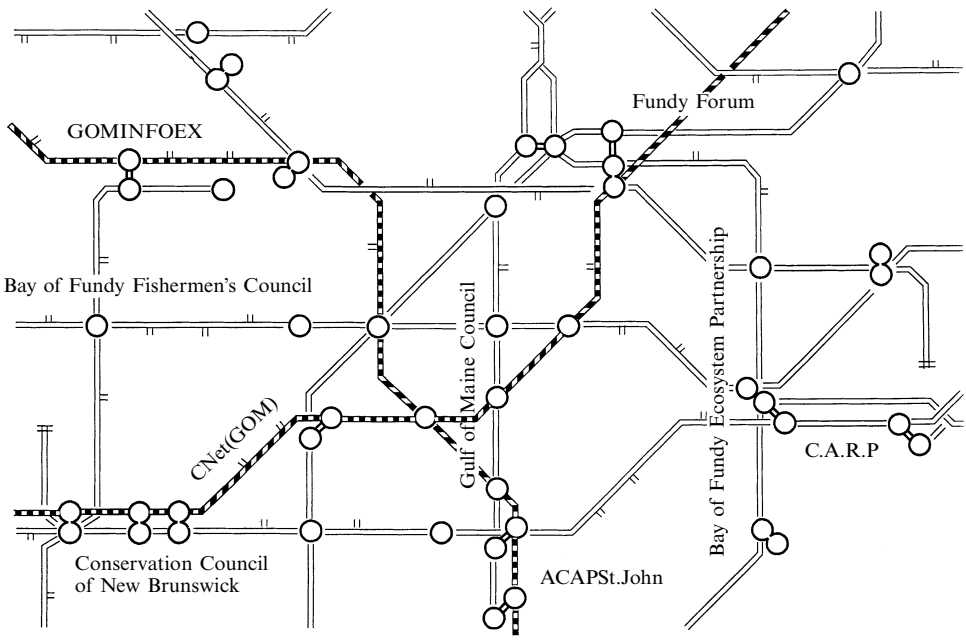

Figure 2. Networks in the Gulf of Maine/Bay of Fundy ecosystem (after London Transport map), by A J Evans.

that participants can take the needs and goals of others into consideration as they attempt better to achieve their own.

The Gulf of Maine region: geography and history

The marine region of the Gulf of Maine has been defined as the waters of the sea between Cape Cod, Massachusetts in the west and Cape Sable, Nova Scotia in the east (Bigelow and Schroeder, 1953, page 1), and includes the Bay of Fundy, world famous for its tides. Considered as a drainage basin, land areas surrounding Gulf of Maine are 70 000 square miles (180 000 km^2) in area. The region includes all or parts of five US states and Canadian provinces: Massachusetts, New Hampshire, Maine, New Brunswick, and Nova Scotia.

This region is at the eastern terminus of the longest and busiest international boundary in the world, 8890 km (Widdis, 1992). This boundary bisects the Gulf, and presents a major challenge in terms of the information sharing that is required for natural resource management. The Gulf generally is defined to include the vast and formerly bountiful fishing grounds of Georges Bank and Browns Bank, themselves bounded by the continental shelf, beyond which the bottom begins its dramatic descent into the Atlantic Ocean.

Although there has been some measure of self-awareness among residents of the region for at least the past 250 years, by far the most common self-identification is with its two nation-states. Social, economic, and political forces have both unified and divided the region. Until 1820, thirty years after the founding of the United States, Maine was a territory belonging to Massachusetts, and still strives to distinguish itself from that state. After the American Revolution, loyalists migrated north to Atlantic Canada, some of whom dismantled their homes in Castine, Maine and transported them by sea to found St Andrews, New Brunswick. The US–Canada boundary in the St Croix River region was contested for over 100 years (Morris, 1976, plates 16 and 17). A border dispute between the states of Maine and New Hampshire has recently been settled by the US Supreme Court.

In the early 19th century, when local transportation was by water, Halifax and Boston were linked much more closely than they are today. Overland shipping, at first predominantly via transcontinental railroad and now via trucking, has strengthened an east–west awareness that continues today in calls for more robust transcontinental highways links (Cody, 1998). The land-oriented view of the region, to be united by a new highway from Montreal through Maine to Moncton in the east, reflects an economic vision that is in step with the North American Free Trade Agreement's redefinition of economic and political relations. The goal of these efforts is to strengthen the overland links between the semidetached Atlantic provinces and Canada's continental and economic heartland (Courchene and Telmer, 1998). From the Canadian perspective, these complex forces interact in a "fragile but continuously evolving east–west society" that must always balance against "the very powerful north–south pull that connects American and Canadian border regions in many ways" (Widdis, 1992, page 48).

These forces may also enhance local identities for many who live here, especially those who live in rural coastal communities, who are linked to their neighbors by water and whose economies are tied to the sea. A map that was drawn to emphasize the natural landscape and that omits political boundaries entirely (Kelly, 1991) has been a significant instrument in raising awareness of the integrated natural resource setting of the region. The dominant features of this map are water, the land area drained by the region's many rivers, and the opening of the Gulf into the Atlantic Ocean. That the health of the Gulf and the health of the region are linked is increasingly recognized.

The collapse of the cod fishery off Newfoundland provided a wake-up call to Gulf citizens whose identity has been tied to the cod and other groundfish for centuries (Kurlansky, 1997). Those who live on and by the water, such as fisherman and community-based management advocate Marsden Brewer of Stonington, Maine, have begun to advance a transboundary perspective: "It's the same fishery. There's a boundary between our two countries, but it's one big ecosystem" (Molyneaux, 1999, page 5).

The local identities that closely link livelihoods to natural resources often are marked by closely guarded local boundaries that result from long histories of distrust. Today, against traditions of conflict, the region is experiencing an awareness of increasing economic interdependence. Its economy, especially of its many small coastal communities, depends on natural resources which are known to be at risk. Resource management innovations such as local lobster management zones, watershed-based restoration of Atlantic salmon habitat, and community-based fisheries management initiatives are being devised in reaction to perceived failures of existing governmental resource management regimes (Bay of Fundy Fisheries Council, 2000).

The effort to build the Information Exchange seeks to support these community-based resource management initiatives. Some of the principles that have been adopted in community-based fisheries management are being explored by the Information Exchange in its search for an appropriate organizational form. The growing importance of community-based approaches, accompanied by frequent discussion of issues of governance, reflects shifting notions of sovereignty, changing roles of governmental and private sectors, and the need to build effective political structures that will effectively mediate economic issues that are local and transnational at the same time.

Organizational background of the Information Exchange

The Gulf of Maine Environmental Information Exchange is an autonomous effort with roots in the Gulf of Maine Council on the Marine Environment. Although it is not directly funded by the Council, GOMINFOEX has benefitted from limited seed funding and, more importantly, from the participation of leading members of the council's Data and Information Management Committee (DIMC), who see this initiative as an opportunity to go beyond the council's data sharing efforts of the past. This section situates GOMINFOEX in terms of these previous and, in some cases, ongoing efforts, and also distinguishes it from other regional attempts to share environmental and natural resource data and information.

The Gulf of Maine Council on the Marine Environment has been in existence for over ten years, and is composed of provincial, state, federal, and private sector partners from the Gulf of Maine region. It has actively promoted public participation in planning and environmental decisionmaking through financial support to research projects, nongovernmental organizations (NGOs) in the region, and community groups. It confers several Visionary Awards annually to individuals who have made outstanding efforts in conservation and resource management in the region. The council's mission is "to maintain and enhance environmental quality in the Gulf of Maine and to allow for sustainable resource use by existing and future generations" (Gulf of Maine Council on the Marine Environment, no date). In addition to the DIMC, the council's standing committees are active in issues related to aquaculture, marine debris, water quality monitoring, and public education and outreach through a quarterly newspaper, the *Gulf of Maine Times*. These efforts attempt to balance science, resource management, information access, and citizen engagement.

The DIMC's efforts in its early years included support for innovative data sharing arrangements, including a Fundy/Gulf of Maine/Georges Bank (FMG) data integration effort, which sought to integrate diverse environmental information in a single

database built around a GIS (Ricketts, 1992). The preparation of a prototype strategy for the implementation of a Coastal Information Network was sponsored in 1992 (Arctic Sciences Ltd, 1992). The DIMC initiated a data and information coordination effort called Environmental Data and Information Management System (EDIMS), oriented towards the needs of resource managers (Brown and Garrison, 1993). The Regional Environmental Data and Information System (REDIMS) was developed by the Regional Association for Research in the Gulf of Maine (RARGOM) to support collaboration among scientific researchers. An extensive survey of resource managers and local government officials attempted to estimate the range of information needs and potential users of these and related systems (Schmidt, 1992).

These initiatives were conceived before the emergence of global access to distributed information via the World Wide Web. The early models of centralized data repositories could not be sustained within the limited resources available to the council, and performance expectation were judged unrealistically high given the state of available on-line technologies. These efforts stalled in the mid-1990s.

At the same time, the importance of community-based interests began to attain regional visibility through meetings such as Bridging the Gulf (1996), convened to learn "how community-based efforts can be enhanced through networking, sharing experiences and increasing skills and organizational capacity" (Widoff, 1996, page 4). Scientists as well as governmental resource managers began to see the need to build their approach to scientific information with the full cooperation of those who depend economically on the resources and local citizen groups (Percy et al, 1996).

A renewed sense emerged from this background that better coordination of information production, management, and access should be attempted, leading to the first Out of the Fog conference (in November 1998), subtitled Furthering the Establishment of an Electronic Environmental Information Exchange for the Gulf of Maine. This event, cosponsored by the council and the New England Aquarium, included agency and academic data providers along with local community, NGO, education, and fisheries industry users. A preconference survey asked, among other questions, "Why is the Gulf of Maine watershed important to you?" With "ecological value" the most frequent response was "because I live here" (Farrey et al, 1999, figure 11, page 39).

The Out of the Fog meeting featured presentations from large-scale federal and regional initiatives that were being considered as models for what could happen around the Gulf of Maine. These included Great Lakes Information Network (GLIN) in continent's heartland and StreamNet in the Pacific northwest. The data directory of Canada's Atlantic Coastal Zone Information Steering Committee (ACZISC) and the US Coastal Assessment and Data Synthesis project were presented as specific approaches to data identification, management, and sharing.

In addition to reports from representatives of these major initiatives in other regions, a summary of comparative research into these and similar initiatives was presented by John Evans (1997). In a subsequent report, that included a review of the EDIMS effort, Evans noted that there was a "lack of a clear shared goal among participants. Indeed, few in the region saw themselves as Gulf of Maine citizens, and the region's most obvious trans-boundary resource, the dwindling offshore fishery, was a federal issue, outside the purview of the Gulf of Maine Council" (1999, page 406). These presentations and observations and reports were the ground from which the GOMINFOEX discussions later grew.

Although the Out of the Fog proceedings emphasized existing large-scale, centralized, well-planned, and well-funded organizational models, the direction indicated in the meeting's recommendations was somewhat different. A tension between centralized

approaches and growing recognition of local responsibilities was reflected in this statement:

> "There was overwhelming consensus that access to and sharing of Gulf of Maine information and data should be maximized through linkages among local initiatives. Most participants supported the notion of centralized access ... to information. However, ultimate responsibility for compiling, posting and maintaining information and data should lie with respective interest groups. A large majority of participants stressed the need for a two-way exchange of information, adequate training for network users, and a bottoms-up approach to network development" (Farrey et al, 1999, page vii).

The task of devising this was delegated to a proposed Action Committee, which first met early in 1999 and whose discussions form the basis of the remaining sections of this paper.

The Action Committee of GOMINFOEX

Soon after the first Out of the Fog conference was held an invitation was extended for participation in the Action Committee. This voluntary, self-selected group has based its ongoing discussions on the recommendations of the conference. Although the region of concern for this process has been identified as the entire watershed drainage basin as well as the marine areas of the Gulf of Maine, primary focus has been on coastal communities in their relation to marine resources.

The diversity of people who would need to be involved in the long term led one Out of the Fog participant to declare, "... the key to the future success of information exchange in the Gulf of Maine is people; people, people, people. I cannot stress this enough" (Farrey et al, 1999, page 10). Developing GOMINFOEX through the Action Committee process has been a people-centered rather than data-driven approach to building an information sharing network. The Out of the Fog report named categories of people in the region who have a significant interest in the outcomes of this process. These include workers in governmental regulatory agencies, academic researchers, individuals active with NGOs, members of local community groups, educators, and people involved in commercial fisheries. The report specified the particular capacities and needs of each of these groups, including data collection and analysis, policy advocacy, the economics of access to fish stocks, and education for sustainable resource use.

The Action Committee's discussions began with a broadly defined mandate to create an information sharing network that would serve a variety of local and regional needs across several dimensions of interests. The goals of the effort and guidance on how to reach them were largely expressed in negative terms: no existing organization was likely to assume direct responsibility and leadership; the development of any form of centralized bureaucracy would not be considered; no substantial funding would likely be available toward effort. Those involved who had experienced earlier attempts to create centralized databases for the region insisted that some other approach would need to be taken.

One of the first Action Committee decisions was to remove the word 'electronic' from the suggested name for the effort, committing itself to crafting a network that would encompass all traditional media and forms of communication. The large geographic extent of the region clearly requires the appropriate application of on-line technologies, bringing these into coordination with existing media such as newspapers and face-to-face meetings. Early discussion also explored the relationships between geographic proximities and proximities of interests.

Early meetings also considered whether a well-managed set of links to web resources could accomplish the purpose of the proposed network. Creating and maintaining such sites was eventually recognized as a task of partner projects, not of GOMINFOEX itself. The creation of one links site, the Fishers' Web brought a distinction between 'projects of GOMINFOEX' and 'projects of partners and participants' into focus. In all cases, priority has been placed on partner projects, both as a strategy towards capacity building at local levels and because the Information Exchange has no resources with which to undertake projects of its own and no interest in establishing potentially competing activities.

Over time, the negative cast of initial requirements such as 'create no new bureaucracies' evolved into a positive strategy that aims toward linking existing resources through the creation of a mutual awareness and partnership building network. The goal now centers on creating a context in which projects already underway can achieve their established goals more effectively through a process of mutual discovery with others who have a direct interest in the success of each others' work.

This strategy of resource discovery and mutual reliance has been most evident in the distribution of on-line communications capacity across several organizations that already have this capacity in place. An on-line mailing list for Out of the Fog conference attendees was created by the New England Aquarium, documentation including meeting minutes and a list of action items is hosted by the Gulf of Maine Council's website, and discussion of issues related to information exchange was included in the regular schedule of on-line timed, moderated discussions sponsored by the Fundy Forum. Directory and contact information has been maintained within the Council's People Finder database, which allows editing of individual entries on-line. The decision to use existing resources also brought new attention to them through extending awareness about them to GOMINFOEX participants. Reliance on the resources of others has left a gap in terms of establishing an identity for the GOMINFOEX process itself. An initial attempt to link related projects to a common identity was to implement a 'silly word', or unique acronym, that local projects could make visible on their existing web pages or include as metadata tags that could be identified by search engines. This experiment served the function of a links page without requiring links maintenance. The 'silly word' eventually attained official acronym status for the project and was discontinued as a separate effort on its own.

Dozens of projects and ideas have been presented and discussed at Action Committee meetings. An Action Item List has become the basic working inventory of projects that have been brought to GOMINFOEX attention for advice or support in identifying appropriate partnerships. Adoption as an action item does not imply the availability of any material support. The Gulf of Maine Council's Supporting Action Matrix is in the process of being adapted as an additional on-line tool for tracking action items.

A central function that the Action Committee meetings serve is as a forum at which projects that are under development or are in the concept stage can be brought forward for discussion. Examples of these include: implementation of a 'sustainable community indicators' process in coastal communities; coordination of access to curriculum materials about marine-related topics in K-12 education; establishment of regional standards for sharing data from community based water quality monitoring programs; the establishment of a Gulf of Maine Marine Protected Areas (GOMMPAS) listserv; the development of three fisheries-related websites (Fishers' Web, FishResearch.org, and MainSeafood.org); and how best to advocate for policies toward more open and transparent access to governmental information. The overall GOMINFOEX effort was named a finalist in the year 2000 Stockholm Challenge.

Several projects have been under continuous discussion within GOMINFOEX toward the development of working collaborations and in terms of direct project implementation. These are described in the sections below.

Gulf of Maine e-Atlas

The e-Atlas was initiated by the Island Institute of Rockland, Maine as an alternative to producing a new edition of their existing printed environmental atlas, *From Cape Cod to the Bay of Fundy* (Conkling, 1995). The Institute's mission is to support the inhabited islands along Maine's coast (Platt, 1998). The e-Atlas, which aims to create a map-based public interface that provides interpretive information about the Gulf region, is in the midst of a three-year development process. Rooted in an existing book, the e-Atlas extends the metaphor of the book into the on-line environment. The project is implementing a web-based map server (ESRI's ArcIMS) with the goal of presenting real-time visualization of georeferenced data along with stories from the region, scientific reports, and descriptions of the region's projects of interest. As a place for stories, technical reports, project information, and maps, the interface intends to support interpretations which would not be possible through the presentation of maps alone.

While taking advantage of the dynamic abilities of an advanced technology, the e-Atlas aims to be accessible to the public as a new form of the familiar printed reference atlas, taking its place along with other components of integrated and distributed geolibraries (National Research Council, 1999). A similar proposal to base an on-line GIS on an existing printed atlas has been advanced in the Great Lakes region (Fuller et al, 1995; Wagemakers and Eddy, 1999). The public's familiarity with the structure and function of reference atlases, although taking advantage of the stability of the map metaphor, is taken as the foundation for designing their next transformation. Though the known analytical capacities of spatial technologies are sometimes thought to transcend the map metaphor, there is a risk in departing from known models when public learning is at stake.

The development of the e-Atlas depends on contributions from partners across the Gulf of Maine region and beyond, and identifying these partners is the basis of its participation in GOMINFOEX. It has the potential for being a space where ongoing data sharing and coordinated visualization can take place. It has implemented interactive display of data collected through the East Coast of North America Strategic Assessment Project (ECNASAP) and had tested an early version of the Spatial Planning and Analysis Tool, a utility for remote collaborative data entry and visualizations for on-line spatial databases being developed by the Special Projects Division of the US National Ocean Service (Aguirre and Parikh, 2001). It is also developing an on-line map interface for of the Gulf of Maine Council's People Finder database, and will house the project and participant maps as mentioned below.

Because access to the analysis of real-time data analysis through the Internet is now possible, the e-Atlas has the potential to address some of the distributed access and data management issues that have been major obstacles for regional information sharing efforts in past years. The project strives in a small way to bridge the technology/democracy tension that is described in the section on public participation GIS below.

Ghost Nets/the Cities and Oceans of If

Ghost Nets, a ten-year ecological art and environmental restoration project conducted by artist Aviva Rahmani, recently completed restoration of a former dump site on Vinalhaven Island, Maine to a working habitat including a salt marsh. Various disciplines including geology and bioengineering were applied to this restoration. Outcomes of this project include revisioning of urban landscapes in terms of environmental

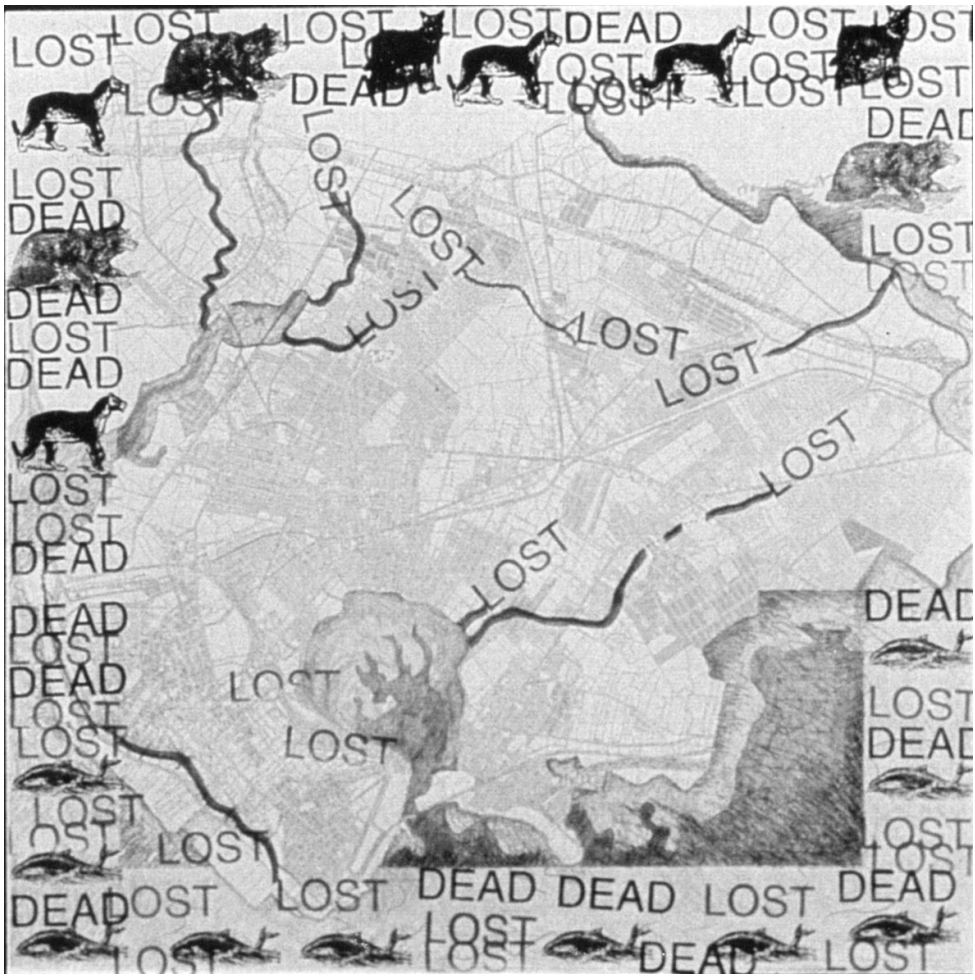

Figure 3. The City of If, Portland Re-Design Before, by Aviva Rahmani, 2000. 22″ × 22″, one of a sixteen-panel grid, colored pencil, ink stamps and markers on paper.

history, including presettlement waterways and indigenous migration routes. The visual arts are combined with digital mapping toward envisioning strategies for restoration. Through a series of urban residencies, "The Cities and Oceans of If", the artist has created sixteen speculative interpretive mapping panels that identify and suggest restoration of keystone habitat linkages. These images of the coast of Maine and the city of Portland hypothesize the replacement of existing human traffic corridors with large predator migration routes, moving humans to other transportation systems (see figure 3). The artist has sought collaboration through GOMINFOEX to apply scientific data to the creation of a series of arts installations that would invite public interaction and learning about the relations between natural habitat and patterns of human activity.

Common coordinates/participants map

These projects arose directly from discussions of the Action Committee, and intend to develop maps that track organizations and projects related to the Information Exchange. These participant maps are being implemented as GIS layers within the e-Atlas. Information about missions and regions of interest of particular projects will

be available through text and spatial query. Display of this geography of projects intends to help in building direct working partnership among projects, addressing a recognized problem of sustaining the GOMINFOEX initiative over the substantial distance across the coastline of the Gulf of Maine.

Nearly fifty individuals have registered on the current prototype participant map. Its next development will be in the form of a direct linkage between the Gulf of Maine Council's People Finder contacts database and the e-Atlas. To this will be added maps of the regions of interest and other organizational attribute information from projects that are partners within GOMINFOEX. To some extent, Canada's Ecological Monitoring and Assessment Network has implemented similar on-line maps of project locations that are specifically devoted to environmental monitoring projects, though these do not provide the spatial discovery of project regions of interest that are being developed through common coordinates. The need for a facility such as this was expressed by a respondent to a 1992 needs survey exploring information requirements of agencies in the Gulf region (Schmidt, 1992, appendix: survey responses):

> "I wish we had a GIS of people and their institutions and mission statements specialized for the Gulf of Maine bioregion. I wish this list were balanced for both public and private, secular and sacred institutions and their specialties. Only then can all tap into the same database of well-organized facts and communicate 'on the ground' with the same perspectives."

The second Out of the Fog conference

A second Out of the Fog conference (OOTF2) was held in late 2000, two years after the first. It was coordinated by the Action Committee and was made possible through funds received from the Gulf of Maine Council. Presentations at the conference focused on specific information sharing efforts as were discussed in workshops devoted to specific topics of concern chosen by those who attended: water quality monitoring, salt marsh restoration, aquaculture siting and development, and community-based fisheries management (CBFM). Several new directions for Action Committee efforts were suggested, including support for bathymetric GIS framework data development, the potential of developing a digital library, and the importance of informational support for CBFM efforts. Presentations included ongoing attempts to link distributed data sources based on developments underway in the Canadian Department of Fisheries and Oceans, Marine Fish Division's Virtual Data Centre.

In addition to these thematic concerns, specific recommendations were made regarding GOMINFOEX organizational development, including expression of the need for a more clearly defined organizational structure and the need for some form of dedicated staff for ongoing coordination. There is continuing discussion about the nature of participation in this process, whether some minimum definition of participation should be defined for certain organizational purposes, and how participants in this process differ from members, stakeholders, and representatives in other settings.

Including the first Out of the Fog conference in Boston, and a follow-up conference held two years later in Saint John, New Brunswick (OOTF2) there have been twelve opportunities for people to participate in the process. Participants numbered fifty five and fifty one at the conferences, with eleven persons attending both. The Action Committee met eight times from 1999 to March 2001, averaging twelve participants at each meeting. In addition, there were two events that took place exclusively on-line, a timed discussion sponsored by the Fundy Forum on the topic of information exchange in the Gulf region which had sixteen contributors (Fundy Forum, 2000), and forty-nine people who registered on-line for the Participants Map. In total, 134 different people have been involved; ninety-one participated in only one of the events;

thirteen participated in five or more; three have joined in all twelve events. The next section provides details about how these participants have framed organizational development in terms of goals and principles that have emerged from their ongoing discussions.

Purposes, principles, and network organizational development

Relying on guidance from the first Out of the Fog conference, the Action Committee has pursued these general goals: increase awareness about the region's natural and human environments; increase sharing of trusted information among scientists, resource managers, and those who depend on the resources economically, toward best management decisions on both sides of the international boundary; and, advance values of participation, self-representation, and regional citizenship. This constitutes a long-term capacity-building effort based on assumptions about the intrinsic value of increased information sharing, toward gradually increasing the "wisdom, willingness and wealth" that are prerequisites for effective resource management (Boudreau, 1999, page 29).

GOMINFOEX has become a community of interest that seeks the benefit of the whole through increasing mutual awareness of the goals, capacities, and needs of its constituent parts. All discussion has centered on the individual project level as the place where benefits of participation will be realized, and has relied on individuals who are committed to the success of particular projects as the source of direction, expertise, and value for the Information Exchange as a whole. The idea of a project-centered approach has been fundamental as the relationships among principles, goals, and organizational structure have evolved.

At the beginning there were no known models for the process underway or the results to be achieved. This self-directed process is not one of design, characterized by well-specified outcomes that are reached by applying rational methods to materials whose properties are well known. Instead, this is an example of what can be termed an "eolithic" process (Storm, 1953), requiring invention, constantly adjusting goals in terms of the possibilities of the present, and making use of materials found to be at hand. Decisions about what kind of organization would be needed, the specific technologies that would be applied, and the values and goals that would define the effort have been made with reference to one basic guiding question: how can this best proceed by using the people and resources that are available today? Recent discussions of organizational development have been framed by the six-part process of organizational design advanced by the Chaordic Alliance: purpose, principles, participants, organizational concepts, constitution, and practices (Chaordic Alliance, no date).

As a basis for the goals defined for this initiative, principles have emerged as informal standards expressed in the following terms: this is an inclusive process that is noncompetitive and builds trust; it will work toward more open and transparent public information policies; it strives to maximize the use of distributed knowledge; recognizing the unique mission of each partner and increasing the capacity of each project leads toward the welfare of all. Information sharing principles that are being considered in the draft document include: welcome everyone willing to contribute; identify and promote appropriate collaborations; promote participatory exchange of information; promote distributed actions; devise innovative solutions with appropriate technologies; build capacity to exchange information through education and communication. Participants are urged to be collaborative in efforts among partners, to be cooperative toward common goals, and to strive for nonduplication and best use of available resources. These points mirror the guidance extended in recommendations from the Out of the Fog conference: facilitate linkages will help groups and projects

overcome recognized limitations; make full advantage of existing resources; involve all participants in use and production of information; and do not be afraid to experiment. Within this framework of emergent principles, it is recognized that the purposes, principles, and organizational structures must evolve together.

In addition to the principles that have emerged autonomously from Action Committee discussions, participants have referred to other established principles from their own experience in other organizations. Examples include principles on the production and sharing of geospatial information as adopted by the GeoData Alliance (2000) and the Principles of Good Fisheries Management as adopted by community-based fisheries alliances in the Bay of Fundy region (Bay of Fundy Fisheries Council, 2000; Coastal Communities Network, 1997).

The concept of organizations as "networks of recurrent conversations" in ongoing support of "certain kinds of commitments" (Winograd and Flores, 1986, page 158) seems fitting for this attempt to build community through information sharing. Conversations among partners and commitments that have emerged through new partnerships are at the heart of the GOMINFOEX process. In her discussion of global NGO networks, Meyer states that "the information-sharing relationships among NGOs, or between NGOs and their target groups, may be of more interest than the particular information shared" (1997, page 1130). In the Information Exchange the focus on project-centered relationships rather than emphasis on specific technologies of data exchange reflects Meyer's insight that network relations have importance beyond the communication of specific data and facts that may traverse the networks.

Some participants have suggested that the broad range of views and conflicting values encompassed in the GOMINFOEX process are difficult to explain in their home organizations. This has led to adoption of a 'Statement of Neutrality of Process and Inclusiveness' that intends to explain the climate fostered by the organization:

> "GOMINFOEX seeks to benefit those who are interested in the welfare of the Gulf of Maine region through initiating and strengthening information sharing partnerships. While working toward this goal the Exchange seeks to establish processes and relations that are inclusive, trusted, neutral and nonpartisan in nature. GOMINFOEX recognizes but does not seek to reconcile the many different values, interests, approaches and goals of participating individuals and organizations. The Exchange does not authorize any particular organization or information source. Agreeing to participate in the GOMINFOEX process does not imply endorsement of any other partner's individual or organizational goals" (GOMINFOEX, 2001).

In this section we have attempted to show how the principles, goals, and organizational structures that have been discussed in the GOMINFOEX process have gone forward in close relation to each other. Acknowledgment of the many uncertainties and significant differences of opinion about the validity of facts in natural resource policy disputes, along with deep differences in values, is visualized in a 'cultural conflicts resolution matrix' presented by biologist David Lavigne (1955). This matrix has been introduced to the Action Committee in an attempt to clarify the facts versus values conflicts that recur in controversies surrounding fisheries management. An autonomous approach to managing these differences has emerged in the form of community-based fisheries alliances, discussed in the next section.

Community-based fisheries management

Concepts of governance are intrinsic to the process of information systems design. GOMINFOEX as a regional public information resource network aims to increase public knowledge and to support the decisions of natural resource managers. Attempting to value and make use of all relevant knowledge, from scientific research to local

fishing traditions, provides an occasion to reflect on governance at all scales, from home organization to international. In this section and the one that follows we describe distinct approaches toward rethinking governance. First, community-based fisheries management (CBFM) is presented as an attempt to increase participation and local authority in the use of marine resources, especially important in sustaining the economies of coastal communities. In the following section we describe an effort to democratize the specific technologies related to spatial information. People who are active in GOMINFOEX have identified themselves with each of these approaches.

In the management of fisheries there is a longstanding clash of interests among fishers, marine biologists, and others who claim to have a stake in setting marine resource policies (Acheson and Steneck, 1997; Dobbs, 2000). What Schön and Rein (1994, page 4) term "intractable policy controversies" erupt annually in new forms across the Gulf region, such as seen in the recent disputes over indigenous peoples' access rights to lobster grounds in Canada's maritime provinces. Such disputes often focus attention on the relative inadequacy of structures of governance concerning resource policies. A recent panel of CBFM advocates named issues of governance as an overriding concern for the region and the future health of its resources (Alden et al, 2000).

The belief that CBFM is an appropriate and viable alternative to customary top-down approaches has been expressed in several initiatives around the Gulf. The Bay of Fundy Fisheries Council is a leader in this effort, along with the Fundy Marine Resource Center, the Cobscook Bay Resource Center, the Cobscook Fisheries Alliance, and the Stonington (Maine) Fisheries Alliance. These groups have shared perspectives with each other in the adoption and application of CBFM principles, as documented in publications of the Coastal Communities Network of Nova Scotia (Coastal Communities Network, 1997) and in the Fundy Fisherman newspaper (Bay of Fundy Fisheries Council, 2000) and as advanced through summer institutes on community-based management held in the region (Recchia, 2000).

These emerging CBFM efforts have influenced GOMINFOEX and other networking organizations such as the Coastal Network of the Gulf of Maine (CNet) and the Bay of Fundy Ecosystem Partnership (BoFEP). All of these emphasize partnership-building, participatory research, and information collaboration (Evans et al, 1999).

In pursuing the goal of sustainable fisheries, community-based management efforts aim to bridge divisions that exist between scientific experts, practitioners, policymakers, and regulators. Each community has diverse needs in the areas of education, economic development, and environmental protection. Those who are willing to devote effort and take risks in meeting those needs should not be undermined by governance practices that perpetuate differences and diminish the potential for collaboration. One community's strategy toward advancing collaboration while recognizing diverse interests and values was described in these terms:

> "If your primary interest was economic benefit to the industry, you could be involved in some part of our overall effort where that is what you could focus on. And if you were much more concerned with the marine resource curriculum at the high school, you could focus in on that. I think it's important not to try to create a pressure cooker where we have to somehow force everybody to agree to the same thing" (comments of W Hopkins in Alden et al, 2000).

The emergence of CBFM, along with expressed needs to provide for the inclusion of diverse views that at times will manifest controversy and conflict, motivates what Innes calls communicative planning. Information itself, no matter how well-grounded, is often problematic in its uses by policymakers and policy advocates. Innes maintains that "formal information enters into public decisions in ways other than by decision

makers consciously employing the information as they weigh alternatives and make choices" (1998, page 53). Indeed, the customary rational model of planning, in which "problematic identification, analysis and alternatives, evaluation, choice and implementation" are often "so merged as to be indistinguishable" seldom fits the facts of planning and policymaking, since decisionmakers often "have ignored the implications" of their planners' findings (page 53).

The need to acknowledge the reality of policy controversies in crafting new approaches to governance was reflected in a paper that was circulated among GOMINFOEX participants, written by Jim Ellsworth who is a resident of the region. In it he suggests that the creation of environments for cooperative learning and mutual goal-setting based on the 'double-loop learning' model advanced by Argyris. Ellsworth states, "New collaborative forms of governance and citizen engagement are now in use and showing great promise. ... Champions of double-loop learning maintain that it is especially applicable in situations where issues are complex, where there are multiple perspectives, and where problems change as problem solving advances" (2000, page 8).

Inclusive, community-based approaches to problem setting and problem solving run against most prevailing top-down management practices. There is much support for the 'quasi-privatization' of natural resources through the establishment of certain forms of quota systems in fisheries (Molyneaux, 2000, pages 34–35), just as there are trends toward privatizing certain public information resources. Participatory and ecological approaches to resource management must in turn be supported by equally diverse 'information ecologies', a concept introduced to GOMINFOEX through discussion of a book on that theme (Nardi and O'Day, 1999). Although that book details technologies in limited institutional settings such as libraries and hospitals, its concern with systems of "people, practices, values, and technologies" in which "the spotlight is not on technology, but on human activities that are served by technology" is in line with the approach taken by the Information Exchange. Of particular importance in information ecologies are people who function as "keystone species", who work in important roles that fill the spaces between technologies as translators, facilitators, mediators, teachers (Nardi and O'Day, 1999, pages 53–54).

The contrast between private ownership assumptions and a commons approach to the management of natural and informational resources suggests that justice in governing the use of natural resources requires an open, inclusive, and just structure for the creation, management, and use of information. The Information Exchange is attempting to create an information neighborhood or safe information space which can grow parallel to community-based approaches to resource management. This return to an emphasis on communities is oriented toward values that are asserted by historian of science Stephen Toulmin to mark a departure from the dominant assumptions of modernism:

> "The 'modern' focus on the written, the universal, the general, and the timeless—which monopolized the work of most philosophers after 1630—is being broadened to include once again the oral, the particular, the local, and the timely" (1990, page 186).

Maps, spatial technologies, and public participation GIS

Mapping, especially through the use of geographical information systems (GIS), has been recognized as a core requirement in the development of Gulf-wide information systems for the past decade. The potential of GIS was mentioned in the first report that proposed establishing a data sharing system under Gulf of Maine Council sponsorship (Schmidt, 1992) and a GIS was proposed as the primary integrating feature of a coastal resource information system (Ricketts, 1992). The presentation of scientific data of region-wide scope is often accompanied by maps, for instance showing the locations

of monitoring buoys, the paths of data-gathering cruises, and visualizations of the locations of fish stocks and spawning events. These are increasingly being supplemented by the use of satellite remote sensing imagery and real-time monitoring of oceanographic conditions, the coordination of which is underway through the Gulf of Maine Ocean Observing System (GOMOOS). Mapping and GIS projects are underway in many coastal communities and local watersheds in the Bay of Fundy and Gulf of Maine, and are being used in some way in nearly all projects related to GOMINFOEX.

It is essential to recognize that GIS is "part of a political process and not solely a technical or computational problem" (Harris and Weiner, 1998, page 69). "Issues of surveillance, privacy, confidentiality, and individual rights are not overcome but intensified" and that "will be the prerogative of the communities themselves, not business or government" (page 74). GIS can no longer be viewed as an agency-held specialist-controlled stand-alone tool. However, this legacy colors all present implementations of GIS. Against this background the discussion of a possible public participation GIS (PPGIS) has begun, raising issues both of what a GIS may become, and what forms of participation may be facilitated through GIS. An overview of the PPGIS concept is presented in an issue of *Cartography and GIS* devoted to this theme (Obermeyer, 1998).

The principles that frame the mission of the GOMINFOEX closely parallel the criteria for the design of a GIS-2 that developed during discussions of GIS and society sponsored by the National Center for Geographic Information and Analysis (Harris and Weiner, 1996). As summarized by its leaders (Sheppard et al, 1999, page 811) these criteria include "equitable representation of diverse views, preserving contradiction, inconsistencies and disputes against premature resolution", the inclusion of participants in defining data standards and system goals, the integration of contributions from many sources and media within a single interface, and preservation of the history of any application's development.

The concept of a "participatory GIS" (Harris et al, 1995) has been elaborated by its originators in the notion of a PPGIS that "empowers communities" (Harris and Weiner, 1998, page 67). They are cautious regarding the relation between empowerment and GIS: any GIS as we know it also disempowers and marginalizes, and those who claim evidence for community empowerment often leave the concept of community undefined. It is their view that there has been "little evidence of a genuinely 'community-based' GIS" (Harris and Weiner, 1998, page 74) and they suggest that the concept will advance through "innovative partnerships between GIS users and grassroots community organizations" (page 72) in the form of a "community-integrated GIS" (page 74) that exhibits the following characteristics: it is likely to be agency-driven, but it is not top-down nor privileged toward conventional expert knowledge; it assumes that local knowledge is valuable and expert; it broadens the access base to digital spatial information technology and data; it incorporates socially differentiated multiple realities of landscape; it integrates GIS and multimedia; it explores the potential for more democratic spatial decisionmaking through greater community participation; and it assumes that spatial decisionmaking is conflict ridden and embedded in local politics.

The observation that initiatives such as the Information Exchange must address political frameworks and principles is detailed by Jordan and van Tuijl, who state that NGOs must begin to recognize the "questions of democratic quality, representation, participation and accountability" that their activities involve, and to recognize the controversial nature of asking these questions (Jordan and van Tuijl, 1998). The collaborative nature of the Information Exchange in its project definition and design adopts a principle of self-representation, often absent from standard data-based information systems. This principle clearly ties the Information Exchange to the PPGIS discussions.

The developing mission and structure of the Information Exchange reflect the criteria proposed for a GIS-2 and a community integrated GIS as outlined above. These dimensions could become indicators for evaluating aspects of the success of GOMINFOEX. Whether the Information Exchange actually achieves results that adequately reflect PPGIS/GIS-2 criteria will be judged only over time, and only by those who are involved in the process. A community of GIS practitioners is attempting to integrate itself with a community of users that is self-defining in terms of geography and interests. In this there is the possibility of expressing values that are counter to mainstream information systems design and practice.

Conclusion: accomplishments, challenges, next steps

The Action Committee's initial task, to build an integrated system of access to distributed environmental information, has shifted away from a focus on electronic on-line resources toward the fostering of partnerships across the region. The approach of advancing participation, distributing responsibility, and promoting the values of citizenship in the region is now regarded as a prerequisite to the development of a sustainable and effective network of information resources.

Discussions about goals and principles have had priority over crafting a particular organizational form. What has emerged could be described as organizational character rather than organizational structure. The most stable indicator of organizational development is the achievement of a regular pattern of quarterly and biennial meetings that have always been held in new locations around the Gulf. These widely distributed meetings allow those who cannot afford to travel to be exposed to GOMINFOEX and, if they wish, the opportunity to participate. In the absence of direct funding this is one way to support the involvement of participants who have very local missions. The 134 individuals who have participated in GOMINFOEX meetings, in the Fundy Forum timed discussion on information exchange (Fundy Forum, 2000), those who have registered on the Participants Map, and the thirteen core individuals who have participated in five or more events are the most definite indication of general interest in this effort and of its potential for success.

The absence of any regular funds has been a defining condition from the start, and this is considered to be as much a benefit as a constraint by most of those who are involved. Owing to lack of funding and institutional support, the creation of a centralized data-driven information system was rejected from the start, and the absence of funding has caused attention to be directed toward creating a more people-centered and project-centered approach to information system development. This said, there is growing awareness that it is unrealistic to expect success in a twenty-year project that has no funding at all. A challenge that the project is approaching with caution is how to devise a more definite structure and fund support staff without compromising the creative character of this voluntary effort to date.

Perhaps the greatest challenge is in actually creating a safe and inclusive information sharing space. Awareness of the need for such a space, a neutral public place for dialogue about multidimensional issues that are often very controversial, is itself an organizing principle for this ongoing activity. The reality of contested facts and conflicting values is a condition that participants have committed themselves to face rather than avoid. This space needs to function at many scales, tapping knowledge and serving needs from the most local watersheds throughout the transborder region. It also must be personally inclusive. Though participation in all events has been in an 8 : 5 male-to-female ratio, a balance acceptable to most participants, critical remarks have been voiced against the 'boys with toys' quality of some of the more technical discussions.

Among ongoing challenges is the need to find a way to keep track of the many partnerships, initiatives, and exchanges that have originated in the GOMINFOEX process, or that have been advanced through it. One suggested approach is to develop a registry that tracks commitments and agreements that have been achieved by project partners, making these visible to all. How to keep the energies of those who have been involved directed toward the benefit of the whole is an open question. One participant asks, "will people come away from meetings without a way to continue their interests, and how can we support the ongoing interactions among thematic groups? We don't yet know how to integrate technology into the Information Exchange AND we don't know if this can be accomplished with a virtual group." Experiments in the direct linkage of distributed data sets are being attempted by partners, including the coordinated development of the Action Items List, People Finder database, and participant and project maps accessible through the e-Atlas. Participants recognize that doing this through participatory process does take time. The '2020 vision' is considered to be realistic to most participants, but working an emergent process with such a long time frame has not been comfortable for all.

Because this is an attempt to define and build a new kind of community, there is a difficulty in defining appropriate indicators for interim and long-term success. Tracking of attendance at meetings is not a sufficient estimate to gauge the relative dynamism of the ongoing interactions which are at the heart of the exchange. The clearest view of the evolution of this project will be seen as the maps of participating projects are developed. Many of the conditions that constrain and enable this effort are changing faster than measures for success can be defined.

The question has been raised, how does this differ from other large regional efforts such as the Southern Appalachian Man and the Biosphere Program, the Chesapeake Bay Program, and the Biscayne Bay Partnership Initiative? It is difficult, in answering this, to assess the value of other existing programs based only upon access to on-line documents, without direct participation in their processes. All of these projects share with GOMINFOEX a goal of making environmental information, especially digital data such as GIS, usefully available within a particular regional focus. GOMINFOEX differs in its goal of building the capacity of its partner projects rather than focusing on building a centralized information resource. It is based on a system of mutual responsibility that is not under the mantle of any existing institution. It is largely self-funded through the commitments of individual participants, whose involvement is based on their own initiative rather than on formal organizational support. It is not based on any existing model but is evolving around the expressed needs and known capacities of its partners.

Two recent comments from participants are characteristic: "What we are doing may not be unique, but we are doing it ourselves", and "What's fascinating is that it does this without any funding!—operating purely on peoples' energy and self-motivation". The best measure of success may be found in the participants' willingness to continue the process. This project, based on shared principles, inclusive process and long-term vision, is now challenged to expand the effort and trust required to approach its overall goal of sustaining coastal communities through the exchange of available environmental information.

Acknowledgements. We thank the Gulf of Maine Council on the Marine Environment for its efforts on behalf of the citizens of the Gulf region over the past ten years, and for its administrative and financial support for the activities of GOMINFOEX over the past two. We thank the New England Aquarium who, with the council, convened the dialogue at which this process began.

We also thank the editors and reviewers who have helped us in presenting this process to a wider audience. We also thank the many unnamed coauthors without whom the ongoing conversation reported here would not be possible.

References

Acheson J M, Steneck R S, 1997, "Bust and then boom in the Maine lobster industry: perspectives of fishers and biologists" *North American Journal of Fisheries Management* **17** 826–847

Aguirre R, Parikh N, 2001, "SPLAT: a spatial planning and analysis tool for collaborative spatial decision-making", National Ocean Service, National Oceanic and Atmospheric Administration, http://spo.nos.noaa.gov/projects/splat/

Alden R, Coon D, Hopkins W, Kearney J, Pendleton C, 2000, "Community-based fisheries management: building the grassroots movement", Maine Fishermen's Forum, Rockport, ME; panel transcript available from Cobscook Bay Resource Center, 4 Favor Street, Eastport, ME 04631

Arctic Sciences Ltd, 1992 *Coastal Information Network, Phase I: Definition, Architecture, and Implementation* (CEF Consultants, Halifax, NS)

Bay of Fundy Fisheries Council, 2000, "Principles of good fisheries management" *Fundy Fisherman* **1** 1

Bigelow H B, Schroeder W C, 1953 *Fishes of the Gulf of Maine* (US Fish and Wildlife Service, Washington, DC)

Boudreau P R, 1999, "A wisdom/willingness/wealth framework for successful integrated coastal zone management: some North American examples", LOICZ Open Science Meeting: Regimes of Coastal Change, Land–Oceans Interactions in the Coastal Zone International Project Office, Netherlands Institute for Sea Research, 1790 AB Den Burg, Texel, pages 29–30

Brown W S, Garrison K M, 1993, "Prototype environmental data and information management system for the Gulf of Maine", Ocean Process Analysis Laboratory, University of New Hampshire, Durham, NH

Castells M, 1996 *The Rise of the Network Society* (Blackwell, Oxford)

Castells M, 1997 *The Power of Identity* (Blackwell, Oxford)

Castells M, 1998 *End of Millenium* (Blackwell, Oxford)

Chaordic Alliance, no date, "The Chaordic design process", http://www.chaordic.org/what_des.html

Coastal Communities Network, 1997, "Community based co-management", East Bay, NS, http://www.coastalcommunities.ns.ca/coman.html

Cody H, 1998, "An east–west highway for a new region state?" *Northeast International Business Journal* **1** 15

Conkling P W, 1995 *From Cape Cod to the Bay of Fundy: An Environmental Atlas of the Gulf of Maine* (MIT Press, Cambridge, MA)

Courchene T J, Telmer C, 1998 *From Heartland to North American Region State: The Social Fiscal and Federal Evolution of Ontario* (Centre for Public Management, University of Toronto, Toronto)

Dobbs D, 2000 *The Great Gulf: Fishermen, Scientists, and the Struggle to Revive the World's Greatest Fishery* (Island Press, Washington, DC)

Ellsworth J, 2000 *Justice Stewardship: The Modern Sustainability Challenge* (International Association for Public Participation, Halifax, Nova Scotia)

Evans A J, Cavanagh T, 1998, "All aboard: networks and networking in the Gulf of Maine", Clean Annapolis River Project, Community Ecosystem Initiatives Workshop, Clementsport, Nova Scotia

Evans A J, Cavanagh T, Rutherford R J, 1999, "Coastal networks working in support of integrated coastal planning and management: a Bay of Fundy case study", Canadian Water Resources Association National Conference, Greenwich, NS; CWRA, PO Box 1329, Cambridge, Ontario N1R 7G6

Evans J, 1997, "Infrastructures for sharing geographic information: lessons from the Great Lakes and Columbia River", in *Geographic Information Research: Bridging the Atlantic* Eds M Craglia, H Couclelis (Taylor and Francis, London) pp 59–70

Evans J D, 1999, "Organizational and technological interoperability for geographic information infrastructures", in *Interoperating Geographic Information Systems* Ed. M F Goodchild (Kluwer Academic, Boston, MA) pp 401–414

Farrey P M, Mooney-Seus M L, Tausig H C, 1999 *Out of the Fog: Furthering the Establishment of an Electronic Environmental Information Exchange for the Gulf of Maine* New England Aquarium, Central Wharf, Boston, MA 02110-3399

Felsenstein L, 1993, "The commons of information", http://is.gseis.ucla.edu/impact/s94/speakers/felsenstein/felsenstein-article.html
Fuller K, Shear H, Wittig J, 1995 *The Great Lakes: An Environmental Atlas and Resource Book* (Environment Canada, Toronto and US Environmental Protection Agency, Chicago)
Fundy Forum, 2000, "Information exchange in the Bay of Fundy and Gulf of Maine region", on-line timed discussion, http://www.fundyforum.com
Geodata Alliance, 2000, "Purpose, principles, participants and organizational concept", Geodata Alliance, Denver, CO, http://www.geoall.net/downloads/Revised_P-P-OC_7-14-00.pdf
GOMINFOEX, 1999, "Terms of reference", Gulf of Maine Environmental Information Exchange, http://www.gulfofmaine.org/gominfoe/terms_of_reference.htm
GOMINFOEX, 2001, "Constituting documentation", Gulf of Maine Environmental Information Exchange, http://www.gulfofmaine.org/gominfoex/pdf/080301report.pdf
Gulf of Maine Council on the Marine Environment, no date, "Our Mission and Primary Focus Areas", http://www.gulfofmaine.org/council/mission.htm
Harris T M, Weiner D, 1996 *GIS and Society: The Social Implications of how People, Space and Environment are Represented in GIS* (National Center for Geographic Information and Analysis, Santa Barbara, CA)
Harris T M, Weiner D, 1998, "Empowerment, marginalization, and 'community-integrated' GIS" *Cartography and Geographic Information Systems* **25** 67 – 76
Harris T M, Weiner D, Warner T A, 1995, "Pursuing social goals through participatory Geographic Information Systems: redressing South Africa's historical political ecology", in *Ground Truth: The Social Implications of Geographical Information Systems* Ed. J Pickles (Guilford Press, New York) pp 196 – 222
Innes J E, 1998, "Information in communicative planning" *Journal of the American Planning Association* **64** 52 – 63
Jordan L, van Tuijl P, 1998, "Political responsibility in NGO advocacy: exploring emerging shapes of global democracy", http://www.oneworld.org/euforic/novib/novib1.htm
Kelly R D, 1991 *Gulf of Maine Watershed, With Major River Basins* (Maine State Planning Office, Augusta, ME)
Kurlansky M, 1997 *Cod: A Biography of the Fish that Changed the World* (Penguin, New York)
Lavigne D M, 1995, "Seals and fisheries, science and politics", paper presented at the Eleventh Biennial Conference on the Biology of Marine Mammals, Orlando, FL, http://www.imma.org/orlando.html
Meyer C A, 1997, "The political economy of NGOs and information sharing" *World Development* **25** 1127 – 1140
Molyneaux P, 1999, "A matter of scale (community-based fisheries management)" *Fishermen's Voice* **4** December, pages 1 – 5
Molyneaux P, 2000, "Local control: advocates say community-based management can ensure the survival of independent fishermen as well as fish" *National Fisherman* **80** (December) 34 – 36
Morris G E (Ed.), 1976 *The Maine Bicentennial Atlas: An Historical Survey* (Maine Historical Survey, Portland, ME)
Nardi B A, O'Day V L, 1999 *Information Ecologies: Using Technology with Heart* (MIT Press, Cambridge, MA)
National Research Council, 1999 *Distributed Geolibraries: Spatial Information Resources: Summary of a Workshop* (National Academy Press, Washington, DC)
Obermeyer N J, 1998, "The evolution of public participation GIS" *Cartography and Geographic Information Systems* **25** 65 – 66
Percy J A, Wells P G, Evans A J (Eds), 1996, "Bay of Fundy issues: a scientific overview", occasional report number 8, Environment Canada, Atlantic Region, Sackville, New Brunswick
Platt D (Ed.), 1998 *Sustaining Island Communities: The Story of the Economy and Life of Maine's Year-round Islands* (Island Institute and Maine Coastal Program, Rockland, ME)
Recchia M, 2000, "Reflections on the international summer institute on community-based management" *Fundy Fisherman* **1** February, page 8
Ricketts P J, 1992, "Current approaches in geographic information systems for coastal management" *Marine Pollution Bulletin* **25** 82 – 87
Saxe J G, 1882, "The blind men and the elephant: a hindoo fable", in *The Poetical Works of John Godfrey Saxe* (Houghton Mifflin, Boston, MA) pp 111 – 112

Schmidt M, 1992, "Gulf of Maine prototype information system user needs assessment and conceptual system design", Gulf of Maine Council Secretariat, Data and Information Management Committee, New Hampshire Department of Environmental Services, PO Box 95, Concord, NH 03302-0095

Schön D A, Rein M, 1994 *Frame Reflection: Toward the Resolution of Intractable Policy Controversies* (Basic Books, New York)

Schroeder P C, 1997, "A public participation approach to charting information spaces", in *ACSM/ASPRS Annual Convention and Exposition Technical Papers volume 5* (ACSM/ASPRS, Seattle, WA) pp 244 – 253, http://www.spatial.maine.edu/~schroedr/autoc13.html

Sheppard E, Couclelis H, Graham S, Harrington J W, Onsrud H, 1999, "Geographies of the information society" *International Journal of Geographical Information Science* **13** 797 – 823

Storm H O, 1953, "Eolithism and design" *Colorado Quarterly* **2** 281 – 291

Toulmin S, 1990 *Cosmopolis: The Hidden Agenda of Modernity* (University of Chicago Press, Chicago, IL)

Wagemakers J, Eddy S (Eds), 1999 *Proceedings of the Great Lakes GIS Online Workshop* (Great Lakes Commission, Ann Arbor, MI)

Widdis R W, 1992, "A Canadian geographer's perspective on the Canada – United States border", in *Geographical Snapshots of North America* Ed. D G Janelle (Guilford Press, New York) pp 45 – 48

Widoff L (Ed.), 1996 *Bridging the Gulf, A Watershed of Watersheds: A US and Canadian Citizen's Conference on Environmental Monitoring in the Gulf of Maine* (The Conference, Portland, ME)

Winograd T, Flores F, 1986 *Understanding Computers and Cognition: A New Foundation for Design* (Ablex, Norwood, NJ)