Chapter 4
Twenty-Five Years of United States Landscape Ecology: Looking Back and Forging Ahead

Monica G. Turner

Introduction

Looking Back

Landscape ecology is now a mature discipline, and I have been privileged to watch it grow and flourish in the United States during my professional career. It is hard for me to believe that more than 25 years have passed since the first United States Landscape Ecology Symposium was convened in January 1986 at the Institute of Ecology, University of Georgia (UGA). At that time, Ronald Reagan was president, the Soviet Union was intact, incidents including Chernobyl and Challenger were in the news, and world population was a mere 4.8 billion people. Landscape ecology concepts were only emerging, and the technology was nascent. There were relatively few landscape ecology publications (e.g., Forman and Godron 1981; Risser et al. 1984; Naveh and Lieberman 1984; Forman and Godron 1986) and no commercial geographic information systems or digital spatial pattern analysis programs were available. Yellowstone National Park had not yet burned, the oil tanker, Exxon Valdez, had not yet spilled its oil, and most ecologists had heard little about the northern spotted owl (*Strix occidentalis caurina*). Time has indeed marched on, and those earlier days when landscape ecology was little known and not widely accepted seem distant. A quarter century later, it is appropriate to reflect on how landscape ecology and the United States Regional Association of the International Association for Landscape Ecology (USIALE) developed in the United States. In this chapter, I describe how and why the first United States Landscape Ecology Symposium came about, and how it helped to catalyze subsequent progress in the field. Next, I reflect on USIALE during the 2 years (1994–1996) that I chaired the executive committee. Finally, in the spirit of looking forward, I offer a set of questions drawn from active areas of contemporary landscape ecology where I see potential for continued

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progress. This chapter was developed from oral presentations that I delivered at the 2010 25th USIALE Anniversary Symposium, "Is What Humans Do Natural?" held in Athens, Georgia, UGA.

The First United States Landscape Ecology Symposium "The Role of Landscape Heterogeneity in the Spread of Disturbance"

Dr. Frank B. Golley (1930–2006) and I organized that first symposium in 1986, about six months after I completed my PhD in Ecology at UGA under his guidance. Sadly, Frank died in 2006 from illness contracted during his years of fieldwork in the tropics (see Turner et al. 2007), and he was deeply missed at the 25th USIALE Anniversary Symposium. Frank was among a small handful of ecologists representing the United States who were crossing the Atlantic Ocean periodically to participate in landscape ecology meetings in Europe during the early 1980s. He was also among the attendees at the Allerton Park workshop (Risser et al. 1984), who explored the relevance of these new ideas for ecology in the United States. Upon returning from such trips, Frank always shared the new ideas and thinking with students and faculty at the Institute of Ecology. As a young scientist and graduate student, I was intrigued by the new directions that were emerging—notions about spatial pattern in the environment and why it might be important, and about ecological patterns and processes at large scales. These ideas made sense to me and seemed to open a range of new ecological questions waiting to be explored. My graduate training was in ecosystem ecology, not landscape ecology, and I was studying the consequences of interacting disturbances (fire along with grazing and trampling by feral horses) in a salt marsh on Cumberland Island National Seashore, Georgia. Perhaps because disturbances are inherently spatial, or large organisms conspicuously navigate heterogeneous environments and use multiple habitats, the emerging ideas of landscape ecology were appealing to me.

So how did the 1986 symposium develop? As I was completing my PhD in 1985, Dr. Eugene P. Odum (eminent ecologist and a member of my doctoral advisory committee) offered me a 2-year postdoctoral position on an interdisciplinary project focused on understanding social and environmental changes in the state of Georgia. Although relieved to have a position, I was worried about remaining at the same institution and discussed these concerns with Frank. Always the mentor, Frank helped me strategize ways in which to make the most of the opportunity. Given my budding interest in landscape ecology, Frank suggested that remaining at UGA could provide the chance to do something extra—such as organizing a symposium on landscape ecology for United States scientists. Interest in landscape ecology was growing but diffuse, and the time seemed ripe to explore the ideas in an open venue. This seemed like a terrific professional opportunity for me (and it was), though I was completely ignorant about how to proceed. With guidance from Frank and support from Gene Odum, we went about organizing a symposium; there was no a priori plan for it to be an annual event. Frank coached me through

the process but allowed me the freedom (and responsibility) to do it, and we began planning in the late spring of 1985.

The first challenge was to select a theme for the symposium. From my doctoral research, I had a strong interest in disturbance dynamics, and "How does landscape heterogeneity affect the spread of disturbance?" was among the primary research questions identified at the Allerton Park workshop (Risser et al. 1984). Further, there was growing interest in disturbance within ecology, fueled by concepts of the steady-state mosaic (Bormann and Likens 1979), patch dynamics (Paine and Levin 1981), and landscape diversity (Romme and Knight 1982). Disturbance was (and remains) an ideal focal topic in landscape ecology because disturbances both create and respond to landscape heterogeneity. We settled on "The Role of Landscape Heterogeneity in the Spread of Disturbance," as the theme and began to plan in earnest.

Six plenary speakers were invited to the meeting—two from UGA and four from other institutions—and all agreed to attend. I vividly recall sitting at my desk, in front of my phone, gathering my notes and my nerve before calling potential plenary speakers. My own students find it mildly humorous that I was so nervous about contacting these people. However, these were luminaries in ecology—Herb Bormann, Dennis Knight, Paul Risser, and Richard Forman—and I was an unknown 26-year-old just finishing her PhD. Why was each invited? Herb Bormann (Yale University) had originated the steady-state mosaic concept in collaboration with Gene Likens and was a leading thinker in ecosystem ecology. Dennis Knight (University of Wyoming) studied disturbances in western forests and had developed ideas of landscape diversity with his PhD student, Bill Romme. Paul Risser (then at the University of New Mexico) was a leader of the Allerton Park workshop. Richard Forman (then at Rutgers University) was already beginning to conceptualize the discipline. From the UGA campus, Daryl Morrison was head of the School of Environmental Design and working to bridge landscape architecture and ecology, and Gene Odum was an especially holistic-thinking ecologist. To a person, they were gracious to a young scientist and enthusiastic about the symposium.

With speakers lined up, we proceeded to announce the meeting and arrange the logistics. We had no targeted funding, and my husband Michael Turner, a graphic designer, developed the logo and flyer for the meeting (Fig. 4.1). Ultimately, we hosted a 2.5-day conference that included plenary talks (Table 4.1), commentaries on each plenary talk, contributed papers and posters, and a reception at the UGA Botanical Gardens. Frank's secretary liked to do catering on the side, and she prepared the hors d'oeuvres for the reception (though we admittedly underestimated the amount of food that hungry landscape ecologists could consume!). About 90 individuals attended the symposium, representing academic, federal, and state agency scientists. Attendees were from varied disciplines, including landscape architecture, geography, ecology, wildlife, and forestry and included empiricists and modelers. We all fit in one auditorium, there were no concurrent sessions, and there was a wide exchange of ideas. Notably, young scientists (relatively new PhD fellows) were well represented at the meeting, and I think this was key to the rapid subsequent development of the field.

A number of consistent themes emerged during the presentations, and many of those themes remain relevant. For example, disturbance interactions, resilience, and

The Role of Landscape Heterogeneity in the Spread of Disturbance

SYMPOSIUM • JANUARY 15-17, 1986

ANNOUNCEMENT AND CALL FOR PAPERS

Landscape ecology is the synthetic intersection of disciplines that focus on the spatial-temporal pattern of the landscape. Many fundamental questions in basic ecology, geography and land/resource management require a landscape perspective. The purpose of this symposium is to address the role of landscape heterogeneity in the spread of disturbance.

Sessions of contributed papers will focus on:

- Disturbances *directly* affecting the structure of the landscape such as fire and soil erosion.
- Disturbances *indirectly* affecting the structure of the landscape such as exotic species and air pollution.
- Implications for landscape management.

Contributed papers (20 minutes) for these sessions should focus on questions such as: When does landscape heterogeneity enhance the spread of disturbance? When does it retard or stabilize the spread of disturbance? Is the heterogeneity of the landscape at the same scale as the most common types of disturbance in that landscape? Is landscape heterogeneity cause or effect of the disturbance regime? Both theoretical and applied papers that address these and similar questions are welcome. Abstracts should not exceed one page, double spaced. Facilities will also be available for poster presentations.

Schedule and Arrangements:

The symposium will be held at the University of Georgia, Athens, beginning at 8:30 a.m. Wednesday, January 15 and ending at 12:30 p.m. Friday, January 17. Registration fees are $20.00 (regular) and $10.00 (student) and are due by November 15, 1985. Transportation and lodging information will be sent with confirmation of registration.

Deadlines for Contributed Papers and Posters:
Submit title by October 1, 1985.
Submit abstract by November 1, 1985.

To submit abstract or for further information, contact:
Dr. Monica Goigel Turner, Institute of Ecology
University of Georgia, Athens GA. 30602.
(404) 542-2968

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REGISTRATION

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Make checks payable to Institute of Ecology.
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PLENARY SPEAKERS

F. Herbert Bormann Yale School of Forestry and Environmental Studies	Dennis Knight University of Wyoming	Darrel Morrison School of Environmental Design University of Georgia
Eugene P. Odum Institute of Ecology University of Georgia	Paul G. Risser Illinois Natural History Survey	Richard T. T. Forman Harvard University *and others...*
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Organized within the International Association for Landscape Ecology
by Dr. Monica G. Turner and Dr. Frank B. Golley.

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Fig. 4.1 First United States Landscape Ecology Symposium, *The Role of Landscape Heterogeneity in the Spread of Disturbance*, University of Georgia, Athens, Georgia, 1986 Program with logo designed by Michael Turner

Table 4.1 Plenary talks delivered at the first United States Landscape Ecology Symposium held in Athens, Georgia, in January 1986

Plenary speaker	Presentation title
Paul Risser	Landscape Ecology: Sate of the Art
Herb Bormann	Regional Air Pollution and Landscape Heterogeneity
Dennis Knight	Parasites, Lightning and the Vegetation Mosaic in Wilderness Landscapes
Gene Odum	Soil Erosion as Both Input and Output Disturbance
Darrel Morrison	Landscape Restoration in Response to Previous Disturbance
Richard Forman	Landscape Ecology, Disturbance, and the Ethics of Isolation

cumulative effects were considered in detail. Issues of spatial and temporal scale and challenges of extrapolation emerged in a number of presentations. Several presenters addressed water quality, riparian buffers, and nutrient pathways in human-dominated landscapes. Others considered species diversity in fragmented forests, or organisms as agents of spatial pattern. Two studies that subsequently led to very highly cited publications were first presented at the symposium. Jerry Franklin presented the heuristic model for how forest cutting patterns would influence the spread of subsequent disturbances, using Pacific Northwest conifer forests as an example (Franklin and Forman 1987, cited 409 times in ISI Web of Science as of April 2010), and Osvaldo Sala described regional patterns of net primary production in the Great Plains (Sala et al. 1988, cited 359 times as of April 2010). There was a tremendous shared sense of excitement for new ideas, and many hallway conversations focused on questions and methods for tackling more.

The primary product from the symposium was an edited book (Turner 1987; Fig. 4.2); once again, I am indebted to Frank Golley for suggesting the idea and for

Fig. 4.2 Monica G. Turner upon presentation by Terry L. Barrett of the book, *Landscape Heterogeneity and Disturbance*, containing her original inscription, gifted to Eugene P. Odum in 1987. This book was presented to her during the 2010 25th Anniversary Symposium of the United States Regional Association of the International Association for Landscape Ecology, University of Georgia, Athens, Georgia. (Photography by Wingate Downs Photo Courtesy of Terry Barrett)

coaching me through it. Ever the strategic thinker, Frank thought it would be advantageous both to have a product from the symposium and for me to learn how to edit a book (after all, he said, that would be a professional expectation up the road). Always one to embrace a challenge, I eagerly agreed to edit a book. This required developing a prospectus, securing a publisher, inviting contributors, and overseeing the review process. The resulting volume was published by Springer in 2007 and included chapters from each plenary speaker and several additional attendees. The chapter authored by Vern Meentemeyer and Elgene Box on scale effects in landscape ecology was especially influential (Meentemeyer and Box 1987).

Another key outcome from the 1986 symposium was the organizational meeting that led to formation of USIALE. In Europe, IALE had already been organized into regional associations by country, and we followed that model. The inaugural executive committee included Chair David Sharpe, Program Chair Monica Turner; Secretary Joan Nassauer; Treasurer Bill Romme; and Councilors-at-Large John Wiens, Jerry Franklin, and Paul Risser. There was a conscious effort to make the society reflect the interdisciplinary character of the discipline, and thus the officers included representatives from ecology, geography, and landscape architecture. It was also agreed that USIALE symposia would continue annually, and plans began for a 1987 meeting to be held at the University of Virginia in Charlottesville, with Bill Odum serving as local host. Around this same time, Frank Golley had agreed to serve as the first editor-in-chief of the new journal, *Landscape Ecology*, which launched in 1987.

Aside from the birth of USIALE, perhaps the most enduring legacy of the 1986 symposium was the networking, friendships, and collaborations that owe their genesis to that meeting. Cohorts of researchers developed long-term professional relationships that began at the symposium. For me personally, it was at this conference that my long-time collaborator, Bill Romme, and I became acquainted, and where I met the landscape ecology group from Oak Ridge National Laboratory, which I subsequently joined in 1987. Because landscape ecology was not represented at any other professional society meetings, the annual landscape ecology symposia were the best (perhaps only) way to stay abreast of the most innovative research in United States landscape ecology for at least 10 more years.

USIALE from 1994–1996: Reflections of a Past President

After serving USIALE as program chair for 4 years, I was subsequently elected as chair of the executive committee from 1994 to 1996. At that time, we faced three key challenges: membership, institutional memory, and maintaining cutting-edge meetings. I summarize those next, then conclude this section with three recommendations for future presidents of USIALE.

Membership

That first decade of USIALE encompassed a time of rapid growth and high interest in the field of landscape ecology. There was substantial progress in research and a heightened need for interfacing with resource management and planning. However, USIALE experienced relatively slow growth in membership, with low member retention and consequently high turnover. Thus, a USIALE ad hoc membership committee was formed to recommend (1) specific ongoing activities that should be pursued by the executive committee, (2) services or opportunities to enhance the benefits of membership, and (3) targeted one-time activities to enhance membership. The membership committee was chaired by Dave Mladenoff and included Tom Crow, Kathy Freemark, and Joan Nassauer. The committee made a set of excellent recommendations. Recommended ongoing activities included developing a consistent timeline, developing an identity and promotional schedule for the annual symposia (advertise early, widely, and often); a formal guide for the meetings in which the responsibilities of the local host and program chair were clearly demarcated; considering hiring a permanent staff person to facilitate society bookkeeping; and developing mechanisms to ensure inclusion of senior and junior members of the executive committee. All of these were implemented. For member services, the committee recommended development of a USIALE list serve and Web page, and publication of a membership directory; both of these were also implemented. For targeted activities, the committee recommended compiling a membership profile, which was completed by Mike Demers and Louis Iverson, and surveying members for desired services and activities, which also was accomplished.

The membership survey was mailed in the fall of 1994 and distributed at the 1995 symposium, and Eric Gustafson tallied the 82 responses that were received. The most valued aspects of USIALE membership were the personal contacts with colleagues, the newsletter, staying abreast of trends and developments in the field, the annual meetings, and providing a forum for exchanging ideas. Numerous suggestions about the annual symposium were also provided by members, including adding topical workshops; striving to maintain interdisciplinarity; improving professionalism, communication, and organization; minimizing concurrent sessions (no more than three); retaining the mid-meeting field trips; developing more mechanisms to encourage and support student attendees; adding a separate student award for Best Poster; and even adding live music and dancing at the banquet. Many of these suggestions influenced the planning for subsequent meetings and are clearly in evidence today.

Institutional Memory

Another challenge was to maintain institutional memory within USIALE as time passed and executive committee members rotated on and off. USALE operated under bylaws, but there was little continuity of knowledge and no formalized

mechanism for transitioning from one officer to the next. We had no repository for USIALE policy, procedures, responsibilities, or history, and as a result, new officers often felt like they were reinventing the wheel. To address this need, the executive committee produced a handbook to facilitate the workings of USIALE and prevent loss of information as officers changed. In addition, the bylaws (passed initially in 1986) were updated to reflect operational changes that were in place.

Maintaining Cutting-Edge Meetings

The third challenge was to keep the quality of the annual landscape ecology symposia at a high level. During the early years, these symposia were "the" place for the current science; the work presented was creative, novel, and not found at other professional meetings. As time went on, landscape ecology was increasingly represented in other venues, and we recognized the need to avoid just having more of the "same old stuff" presented at USIALE symposia. To some extent, this remains a work in progress because landscape ecology has permeated so extensively within the other disciplines. However, meetings were structured to include symposia or organized sessions that could focus on cutting-edge topics and potentially draw in a new group of attendees. Along with affordability and early advertising, however, these challenges persist and require vigilance from the executive committee.

Recommendations to Future USIALE Presidents

As USIALE sets the course for its second quarter century, I suggest three areas of emphasis. First, the unique niche of USIALE should be enhanced—in the big scheme, we should play to our strengths, particularly with respect to the annual symposia. We have a culture of smallish, friendly, and highly interactive meetings, and we should maintain this strength. The interdisciplinarity and cutting-edge nature of the symposia require ongoing and active planning. Maintaining a strong website is also a must, and the membership survey should be repeated to help position the society to serve its members effectively in the future. Second, we should continue the strong emphasis on and support for student involvement in USIALE. Through the work of many people, USIALE has become one of the best organizations for involving graduate students in many ways. Jack Liu deserves special credit for this, as his long-term commitment to student participation and development through annual awards sponsored by the National Aeronautics and Space Administration (NASA)—Michigan State University (MSU) has made a lasting positive difference for dozens of students. No other society seems so welcoming to students as does ours—USIALE provides an excellent venue for networking, professional development, and linkages between basic and applied landscape ecology. Student involvement should remain a hallmark of the society. Third, USIALE should be a key player in the research and policy issues surrounding sustainability. Tremendous

challenges and opportunities that face our society overlap with landscape ecology. As an interdisciplinary science as well as the branch of ecology that strives to understanding the causes and consequences of spatial heterogeneity, landscape ecology should be "at the table" helping to define our collective future.

Forging Ahead: The Next 25 Years of United States Landscape Ecology

In the 1980s, landscape ecology was sometimes disparaged as a pseudoscience. Some ecologists were skeptical about the rigor of studies conducted over large areas, and some thought landscape ecology largely entailed playing with maps. Twenty-five years later, landscape ecology is mainstream (Turner 2005a, b). Its concepts permeate ecological research across most levels and scales, the methods receive widespread use, approaches are incorporated widely in land management, and landscape ecology is even applied in aquatic and marine ecosystems. In contrast to the ecology of the 1980s, spatial variability and pattern can no longer be ignored; although not requisite in all studies, a conscious rationale and choice about whether to consider space explicitly is expected, and the potential consequences of spatial autocorrelation must be considered in data analyses. The effects of scale are now recognized, even if they are not fully understood, and scaling up and down remain significant challenges. So, what lies ahead?

Contemporary landscape ecology has continued to build on many of the themes touched on at the 1986 symposium, but many interesting questions remain to be answered. Using general phrasing, I list an illustrative set of questions that represent, to me, some of the current frontiers in landscape ecology research (Table 4.2). These questions fall into several general themes. (1) Landscape patterns result from multivariate causes operating over many scales, and they can still be difficult to predict. Much progress has been made in understanding the consequences of single drivers, but elucidating interacting drivers remains a challenge. (2) Disturbance has been a prominent theme in landscape ecology for 25 years, and much has been learned. However, disturbance regimes are changing, and understanding the consequences of such regime shifts is increasingly important. (3) Similarly, much has been learned about the dynamics of single species in heterogeneous landscapes. However, the interactions among species in heterogeneous landscapes, and how spatial patterns influence biotic communities remains a frontier. Landscape genetics also offers exciting new directions for examining within-species variation and bridging to evolution. (4) Despite early representation of ecosystem ecology within landscape ecology, explaining and predicting heterogeneity in ecosystem processes across landscapes remains a challenge. In part, this is because of scaling challenges; many ecosystem processes constitute microbial mediation and operate at very fine scales, yet we may wish to predict the broad scale patterns that result. At the other end of the spectrum, global-scale models do not incorporate the regional variation that is often at the core of landscape studies. (5) Humans have always been recog-

Table 4.2 An illustrative set of research questions that represent some of the current frontiers in landscape ecology

Theme	Questions
Interactions among multiple drivers	What is the relative importance of different factors in producing landscape patterns? How well can we explain the patterns we observe?
	How do relationships among drivers vary with scale?
	How do different causes of pattern (abiotic template, climate, biotic interactions, disturbance, human land use) interact?
Changing disturbance regimes	How will changing disturbance regimes affect landscape patterns and processes? Where are surprises likely?
	How do altered landscapes influence disturbance regimes?
	How will post-disturbance trajectories in the future differ from those of the past?
	How should management anticipate changes in disturbance regimes? Where will changes be of greatest magnitude? How can landscapes be designed or managed to alter susceptibility to disturbance?
Multispecies interactions and within-species variation	How does landscape heterogeneity influence interactions between species? What components of species interactions (e.g., detections, encounter, chase, escape) are affected by pattern?
	Do some landscapes disrupt species interactions?
	How does spatial heterogeneity influence entire biotic communities? How are changes in species assemblages affected by landscape heterogeneity?
	What landscapes promote homogenization versus diversification of community structure?
	How does spatial heterogeneity contribute to microevolution, and what are the implications of rapid changes in landscape pattern for adaptive genetic variation?
Ecosystem processes	How do rates of ecosystem processes vary over space and at different spatial scales, and what controls this variation?
	When must spatial contingencies be considered?
	How can landscape/regional dynamics be captured in global models?
	How can/should models be scaled up or scaled down?
Spatial aspects of social–ecological systems	What spatial patterns enhance resilience in social–ecological systems?
	How do today's land-use decisions constrain future patterns, processes, and options?
	What events or conditions elicit societal (or individual) responses? Do people respond in time to prevent undesirable of irreversible change?
Ecosystem services and sustainability	How does landscape heterogeneity influence the quantity and quality of ecosystem services?
	How can landscapes be designed to sustain production of ecosystem services?

nized in landscape ecology as important components of the system. The emergence of widespread interest in social–ecological systems should provide an opportunity for landscape ecology to contribute in meaningful ways. (6) Ecosystem services, the benefits that people obtain from ecosystems, are often affected by spatial heteroge-

neity. Again, landscape ecology has an opportunity to make important contributions to ongoing research in sustainability science. Thus, while landscape ecology has clearly matured, many exciting challenges and opportunities lie ahead.

Conclusion

The 1986 Landscape Ecology Symposium highlighted the interaction between spatial heterogeneity and disturbance. Twenty-five years later, the reciprocal interactions between landscape heterogeneity and disturbance are still numerous, interesting, complex, sometimes long lasting, reasonably well studied, uncertain in the future, relevant for management, and great topics for continued research (Turner 2010). The 1986 Landscape Ecology Symposium did not provide definitive answers, but rather it opened a new door into a rich area of inquiry. Looking ahead, the many drivers of global change will produce new spatial patterns and new landscape trajectories, and important questions must be addressed (Table 4.2). In the coming 25 years, landscape ecology should refine knowledge of when spatial heterogeneity is fundamentally important, rigorously test the generality of its concepts, and push the frontier of pattern–process interactions. Let us all forge ahead to keep landscape ecology a vibrant and exciting field.

Acknowledgments I am deeply grateful to my PhD advisor, Dr. Frank B. Golley, for having provided such tremendous guidance, encouragement, and support to me as a young scientist, for co-organizing that first United States Landscape Ecology Symposium with me, and for his numerous contributions to the field of landscape ecology. I am also grateful to all who served on the USIALE executive committee during my tenure as chair between 1994 and 1996: Mike Demers (secretary, 1994–1996), Louis Iverson (treasurer, 1993–1995), Sandra Turner (treasurer, 1995–1997), Eric Gustafson (councilor, 1993–1995), Dave Mladenoff (councilor, 1993–1995), Kathy Freemark (councilor, 1994–1996), Marie-José Fortin (councilor, 1995–1997), Joe Means (councilor, 1995–1997), Jeff Klopatek (program chair, 1994–1996), Joan Nassauer (local host 1995, Minneapolis), and Bob Coulson and Robert Giordano (local hosts 1996, Galveston).

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