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A Social Ecology Approach to Understanding Urban Ecosystems and Landscapes

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Introduction

If one's knowledge of one's whereabouts is insufficient, if one's judgment is unsound, then expert advice is of little use

Berry 1990

The shape and dynamics of cities are the result of physical, biological, and social forces. We include the term *dynamic* to emphasize that cities change over time and are the result of both idiosyncratic events and dominant trends. To begin to understand the patterns and processes of cities, we approach the idiosyncratic and dominant—whether it is physical, biological, or social—within an historical context.

To present our approach for understanding urban ecosystems, we separate this chapter into two sections. In Section I, we summarize our social ecology approach—its basis in different social sciences such as geography, history, sociology, and political science—and five concepts or types of analyses that we propose are useful for teaching about urban ecosystems. These five concepts are: (1) the human ecosystem; (2) units of organization and scale; (3) geographic imagination and spatial analyses; (4) linkages between scales and across geography; and (5) examples from everyday life—policies, plans, and management.

In Section II, we assert that a social ecology approach must meet four criteria in order for teachers to adopt it in their existing curriculum. A social ecology approach to the study of urban ecosystems must (1) relate to a teacher's subject matter; (2) be an integral component of their existing curriculum framework; (3) prepare students for achievement in district, state, and national assessments; and (4) be relevant to students' lives while producing significant and enduring learning. We use the activities of Karen Hinson, her students' eleventh grade Advanced Placement United States History course (1998–1999), and the Baltimore Ecosystem Study (BES) as an example to demonstrate the incorporation and application of a social ecology approach in an educational context. As part of the students' year-

long project, and in partnership with the Forest Services of the Maryland Department of Natural Resources and the United States Department of Agriculture, the students were assigned to apply skills learned from their existing curriculum—both knowledge (information) and performance (analytical)—to understand the social history, current status, and future trends of the development of the City of Baltimore's drinking water supply.

Finally, although this course occurred in an academic setting, it is ultimately not an academic exercise. These students might have numerous land management roles in the future: as homeowners, concerned citizens, or professionals offering "expert" advice. In the Summary and Epilogue, therefore, we consider some key points from the course and important issues for the conservation and restoration of urban ecosystems.

A Social Ecology Approach to the Study of Urban Ecosystems

It is increasingly difficult to determine where biological ecology ends and social ecology begins (Golley 1993). Indeed, the distinction between the two has diminished through the convergence of related concepts, theories, and methods in the biological, behavioral, and social sciences. Social ecology may be thought of as a life science focusing on the ecological study of various social species such as ants, bees, wolves, dolphins, or orangutans. In this context, we may study *Homo sapiens*, or human ecology, as an individual social species or comparatively with the ecology of other social species. The subject matter of social ecology, like biological ecology, is of stochastic, historic, and hierarchical systems (Grove and Burch 1997). For instance, because living systems exhibit emergent properties, they cannot be reduced completely to laws of physics (Simpson 1964; Bailey and Mulcahy 1972; Mayr 1982). Further, living systems are not deterministic; they have an historical and contingent dimension that cannot be predicted from physical laws alone (Botkin 1990; Gould 1994).

The underlying basis for this life science approach to the study of human ecological systems depends upon three points (Grove and Burch 1997):

1. *Homo sapiens*, like all other species, are not exempt from physical, chemical, or biological processes. Human characteristics (biophysical and social) are shaped by evolution and, at the same time, shape the environment in which *Homo sapiens* live.
2. *Homo sapiens*, like some other species, exhibit social behavior *and* culture.
3. Social and cultural traits are involved fundamentally in the adaptation of social species to environmental conditions.

In this context, human ecology must address the challenge of reconciling social and biological facts to understand the behavior of *Homo sapiens* over

time (Machlis, et al. 1997). Such a biosocial approach to human ecological systems (Burch 1988; Field and Burch 1988; Machlis, et al. 1997; Wilson 1975, 1998) stands in contrast to others who may adopt either a more traditional geographic or social approach (Hawley 1950, 1986; Catton 1994). This is not to say that social sciences such as psychology, geography, anthropology, sociology, economics, and political science are not important to social ecology. They are, as we will discuss further. Indeed, the most fundamental fact that distinguishes humans and their evolutionary history from other species—both social and nonsocial species—is that human social development has enabled the species to escape local ecosystems to such an extent that local ecosystems no longer regulate human population size, structure, or genetic diversity (Eldredge 1995). This is nowhere more apparent than in urban ecosystems.

The Human Ecosystem

Social scientists have focused on interactions between humans and their environments since the self-conscious origins of sociology, economics, geography, political science, psychology, and anthropology (Hawley 1950, 1986; Burch 1971; Burch, et al. 1972; Young 1974; Micklin and Choldin 1984; Field and Burch 1988; Lee, et al. 1990; Catton 1994; Agnew, et al. 1996). The explicit incorporation of the ecosystem concept within the social sciences dates to Duncan's (1961, 1964) journal articles "From Social System to Ecosystem" and "Social Organization and the Ecosystem." Recently, the social sciences have focused increasingly on the ecosystem concept because it has been proposed and used as an organizing approach for natural resource policy and management (Cortner and Moote 1999).

The ecosystem concept and its application to *Homo sapiens* is particularly important from a research and education perspective because of its utility as an analytical framework for integrating the physical, biological, and social sciences. The ecosystem concept owes its origin to Tansley (1935), in one of modern ecology's clearest yet most subtle founding documents. Tansley noted that ecosystems can be of any size, as long as the concern was with the interaction of organisms and their environment in a specified area. He noted further that the boundaries of an ecosystem are drawn to answer a particular question. Thus, there is no set scale or way to bound an ecosystem. Rather, the choice of scale and boundary for defining any ecosystem depends upon the question asked and is the choice of the investigator. Further, each investigator may place more or less emphasis on the chemical transformations and pools of materials drawn on or created by organisms; or on the flow, assimilation, and dissipation of biologically metabolizable energy; or on the role of individual species or groups of species in the flows and stocks of energy and matter. The fact that there is so much choice in the scales and boundaries of ecosystems, and how to study and relate the processes within them, indicates the profound degree

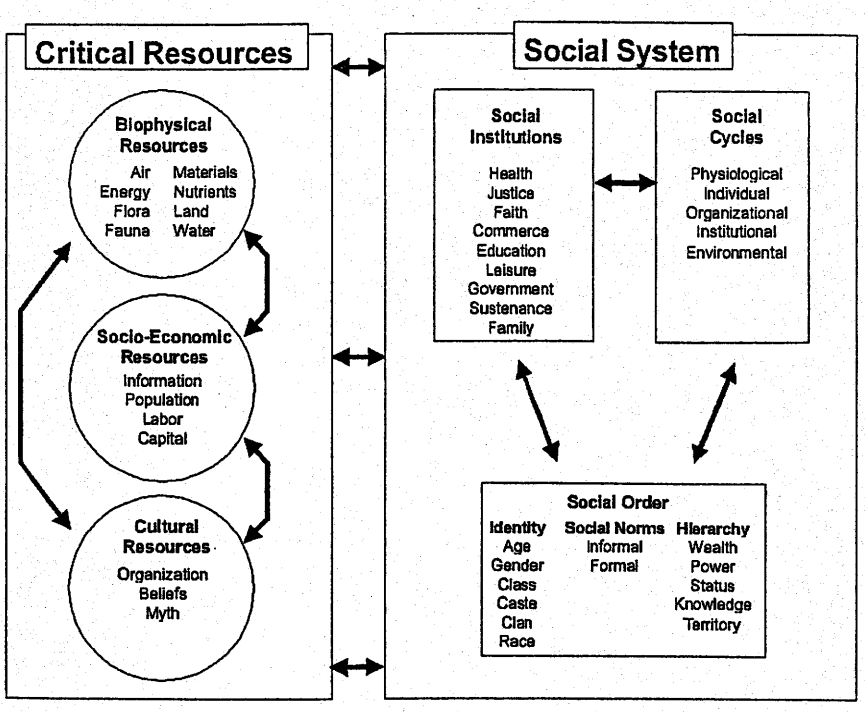

FIGURE 11.1. A framework for human ecological systems. Adapted from Machlis, et al. (1997).

to which the ecosystem represents a research approach rather than a fixed scale or type of analysis.

However, the application of an ecosystem approach to the study of anthropogenic ecosystems requires a revised analytical framework. The analytical framework or parts diagram (Figure 11.1) we identify here and have presented elsewhere (e.g., see Burch and DeLuca 1984; Machlis, et al. 1997; Pickett, et al. 1997) is not a theory in and of itself. As Machlis, et al. (1997) note,

> This human ecosystem model is neither an oversimplification nor caricature of the complexity underlying all types of human ecosystems in the world. Parts of the model are orthodox to specific disciplines and not new. Other portions of the model are less commonplace—myths as a cultural resource, justice as a critical institution. Yet we believe that this model is a reasonably coherent whole and a useful organizing concept for the study of human ecosystems as a life science.

We propose that there are several elements that are critical to the successful application of this framework. First, it is important to recognize that the primary drivers of anthropogenic ecosystem dynamics are both biophysical and social—there is no single, determining driver of anthropogenic ecosys-

tems—and the relative significance of drivers may vary over time. Second, components of this framework need to be examined in the context of each other simultaneously (Machlis 1999). Finally, researchers need to examine how *dynamic biological and social allocation mechanisms*—ecological, exchange, authority, tradition, and knowledge—affect the distribution of *critical resources*—energy, materials, nutrients, population, genetic and non-genetic information, population, labor, capital, organizations, beliefs, and myths—within any human ecosystem (Parker and Burch 1992).

Some readers may examine this parts diagram and wonder if it is complicated with too many terms. However, consider Henderson's (1995) point that,

> . . . trying to run a complex society on a single indicator like the Gross National Product is literally like trying to fly a 747 with only one gauge on the instrument panel. There would be nothing to tell you whether the wing flaps were up or down, whether the fuel tank was full, or what the altitude was. In effect, you'd be flying blind. Or imagine if your doctor, when giving you a checkup, did no more than check your blood pressure!

Henderson's analogies can be taken further. The human ecosystem framework we show here has 45 concepts, which might be represented by one variable per concept, and each variable may be thought of as an "idiot" light or indicator. In contrast, a Cessna airplane may have approximately 50 "idiot" lights that inform the pilot about the status of critical functions of the plane, a Boeing 747 jet has approximately 500 lights, and a NASA Space Shuttle has about 5,000 lights. Given the importance to individuals, groups, and societies of having accurate, timely, and extensive data and understanding about the systems in which they inhabit and on which they depend for life, it may be reasonable some day to strive for at least a Boeing 747–level of "idiot lights" for most human ecosystems (Machlis 1999).

Units of Organization and Scale

Ecologists have a longstanding appreciation for the importance of scale and its associations with different processes. For instance, Urban, et al. (1987) identify different ecological processes/scales and order them by discrete space-time domains. Similarly, one might imagine that the social sciences would be predisposed to a multiscale approach, given that different levels of social organization such as individuals, families, communities, and societies correspond approximately to social science disciplines such as psychology, anthropology, sociology, and political science as well as multiscale disciplines such as geography and economics. Only a few social scientists, however, have explicitly applied scale as an analytical tool to the study of different levels of social organization, particularly as it relates to ecological systems.

Social scientists are increasingly beginning to realize the need for the explicit use of scale as an analytical tool, though it is occurring most frequently in an interdisciplinary context (Grimm, et al. 2000; Pickett, et al. 1999). For instance, the Baltimore Ecosystem Study (BES) has worked to articulate and understand the dynamics of different social scales over time based upon existing social theory. Some examples of issues studied in the BES include:

- Regional variations: urban–rural dynamics (Morrill 1974; Cronon 1991; Rusk 1993);
- Municipal variations: distribution and dynamics of land-use change (Burgess 1925; Hoyt 1939; Harris and Ullman 1945; Guest 1977);
- Neighborhood variations: power relationships between neighborhoods (Shevky and Bell 1955; Timms 1971; Johnston 1976; Agnew 1987; Logan and Molotch 1987; Harvey 1989);
- Household variations: household behavior within communities (Fortmann and Bruce 1988; Fox 1992; Grove and Hohmann 1992; Burch and Grove 1993; Grove 1995).

A Geographical Imagination and Spatial Analyses

All behaviors occur in space and are spatially dependent. For instance, the path an individual walks down a street may depend upon and respond to the path of an approaching person. Changes in one community may depend upon changes in another neighboring community, or the competitive advantage of one port versus another may depend upon their differential access to maritime and land routes for moving goods.

While behaviors occur in space and are spatially dependent, the spatial characteristics of areas frequently are variable or heterogeneous. For instance, the distribution of land uses within the Gwynns Falls watershed, in Baltimore, Maryland varies and has important implications for the economic structure, interactions among neighborhoods, and hydrology of the watershed (Figure 11.2). As we mentioned before, the location of these areas is important. If we took the same land use areas, or patches, and rearranged them like a new puzzle, it is likely that the economic, community, and hydrologic dynamics of the watershed would change.

Crucial to the study of spatial heterogeneity of urban ecosystems is an understanding of underlying processes. Spatial heterogeneity is the combined result of physical, biological, and social processes. An important, underlying driver of patterns of social heterogeneity is social hierarchies. Social hierarchies—or social differentiation—is a significant concept for understanding human ecosystems because it affects the *allocation or flow of critical resources* (re. Figure 11.1: biophysical, socioeconomic, and cultural) and, hence, ecosystem processes. In essence, social differentiation determines "who gets what, when, how, and why."

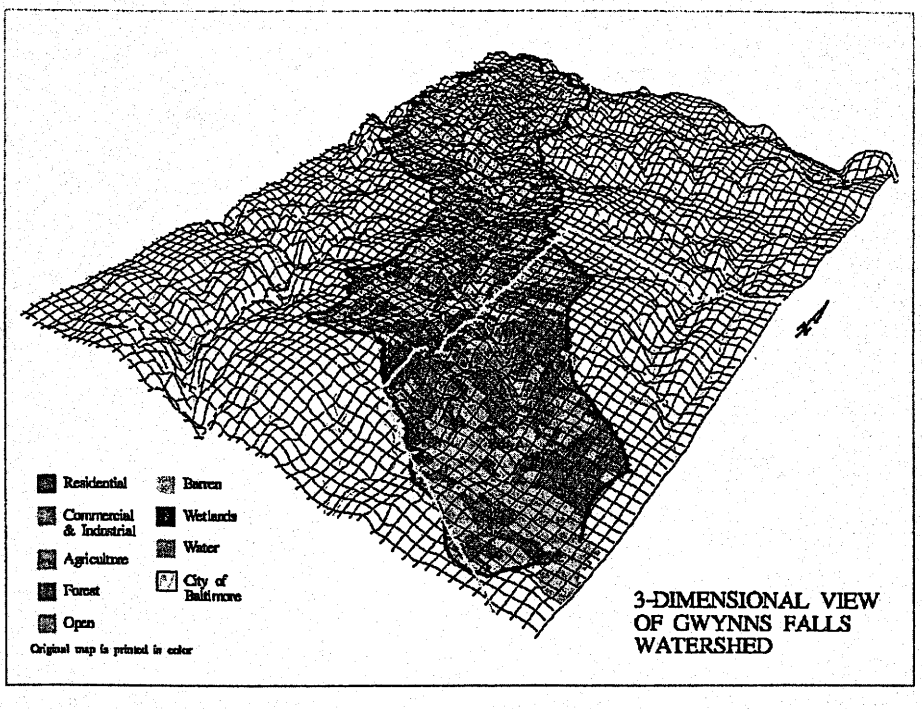

FIGURE 11.2. A three-dimensional view of the Gwynns Falls watershed. From Revitalizing Baltimore Program: Resource Information Systems Component 29 July, 1994.

The allocation of critical resources is rarely equitable and is frequently related to class, race, or ethnicity. As Machlis, et al. (1997) note, unequal access to and control over critical resources is a consistent fact within and between households, communities, regions, nations, and societies. Five types of sociocultural hierarchies are critical to patterns and processes of human ecological systems: wealth, power, status, knowledge, and territory (Burch and DeLuca 1984). *Wealth* is access to and control over material resources in the form of natural resources, capital (money), or credit. The unequal distribution of wealth is a central feature of human ecological systems. *Power* is the ability to alter others' behavior through explicit or implicit coercion (Mann 1984; Wrong 1988). The powerful, often elites with political or economic power, typically have access to resources that are denied the powerless. One example is politicians who make land-use decisions or provide services for specific constituents at the expense of others. *Status* is access to honor and prestige and the relative position of an individual (or group) in an informal hierarchy of social worth (Goode 1978; Lenski 1966). Status is distributed unequally, even within small communities, and high-status indi-

viduals may not necessarily have access to either wealth or power. For instance, a minister or an imam may be respected and influential in a community even though he or she is neither wealthy nor has the ability to alter coercively other people's behavior. *Knowledge* is access to or control over specialized types of information (technical, scientific, religious, and so forth). Not everyone within a social system has equal access to different types of information. Knowledge often provides advantages in terms of access to and control over the critical resources and services of social institutions. Finally, *territory* is access to and control over critical resources through formal and informal property rights (Bromley 1991; Burch, et al. 1972; Fortmann and Bruce 1988).

These processes of social differentiation of human ecosystems frequently have a spatial dimension that is usually characterized by patterns of territoriality and that lead to spatial heterogeneity on many scales. This spatial understanding of social differentiation in an ecological context enables an investigator to ask both "who gets what, when, how, why, and *where*?" and, subsequently, to ask about the relationships among spatial patterns and physical, biological, and social processes of a given area (Grove and Burch 1997).

Linkages Between Scales and Across Geography

Scales and spatial analyses can be linked within the context of hierarchy theory. Hierarchy theory attempts to describe the strong and weak linkages within and between scales of a system in order to understand the ways that components at different scales are related to one another. Thus, lower-level units interact to generate higher-level behaviors and higher-level units control those at lower levels. For instance, a hierarchical approach to urban ecosystems (Figure 11.3) may attempt to understand the ways that the interactions among households within a neighborhood affect the ability of a neighborhood to attract public and private investments in trees, parks, and policing, while the competition among neighborhoods in terms of relative political power subsequently affects the quality of government services that each household receives.

At each scale, there are associated endogenous (internal) and exogenous (external) processes. Examples of endogenous change within a neighborhood may include changes in population structure, housing conditions, or vegetation, whereas exogenous change to a neighborhood may include changes in financial markets, regional transportation, or climate. It is crucial to understand that endogenous change at one level appears as exogenous change to the next, lower level. Further, the links between one scale and another may have variable strength and be spatially-dependent. Understanding these linkages between scale, space, and hierarchy are fundamental to urban ecosystem studies.

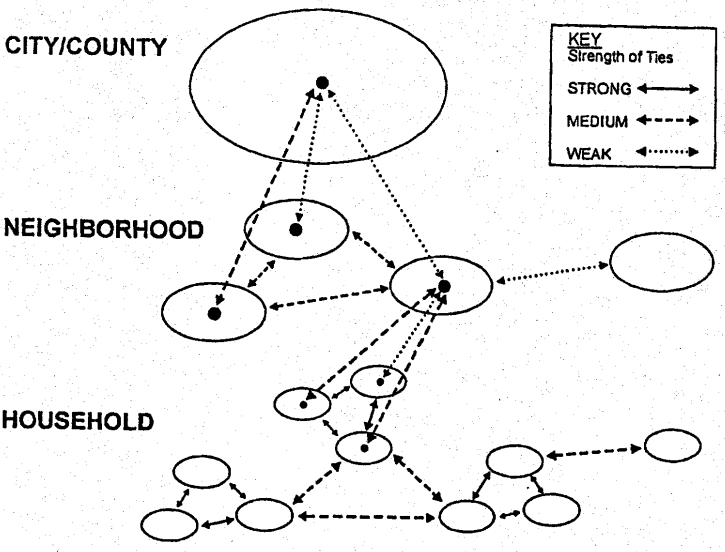

FIGURE 11.3. Example of an urban hierarchical system. Adapted from Urban, et al. (1987).

Learning from Everyday Life: Policies, Plans, and Management as Data

Urban ecosystems are messy systems where controlled experiment often is impossible. For this reason, everyday events—policies, plans, and management activities—represent significant interventions in and powerful means for understanding the dynamics of urban ecosystems. For instance, the Federal Highway Administration's programs of the 1950s significantly affected the settlement and commuting patterns of cities by making it easier for people to travel in and out of cities by car; while the Congressional Fair Housing Act of the 1960s affected the racial and religious composition of cities by removing formal, discriminatory barriers that determined where people could and could not live based only upon their race or religion. Other "everyday" examples include basic means by which cities support their populations with food, water, employment, and leisure.

A Study of Baltimore City's Protected Watershed Forest and Reservoirs

In this section, we use Baltimore City's water supply to illustrate the utility of a social ecology approach for understanding urban ecosystems in general and for education in particular. Our choice to use this example for the class is based upon three points. First, this case study is an appropriate applica-

tion of the knowledge and skills that Karen Hinson expects her students to develop through their Advanced Placement U.S. History course (described later). Second, Rob Northrop and Morgan Grove are working on the development of forest management plans for the city's protected watershed forests and reservoirs and they are familiar with numerous resources that might be useful to the students. Third, the students' involvement in the project might provide them with an appreciation for the relevance of their studies to their day-to-day lives.

Course Description and the Appropriateness of a Social Ecology Approach

Western School of Technology and Environmental Science (Western) is a Baltimore County Public School (BCPS) dedicated to an integrated approach to instruction and 90 minute classes. The focus of the school is on career and technology programs and environmental science. Students choose from a wide range of science and technical courses and as seniors participate in research projects, internships, apprenticeships, and work experiences. Western prepares students for three options after graduation: college, the workplace, or both. Advanced Placement courses are offered to provide interested and motivated students with the opportunity to study materials in more depth.

Advanced Placement (AP) United States History is a course that is based upon the requirements and outline developed by the College Board and the curriculum developed by BCPS. The main purpose of this course is to prepare students for success on the AP United States History exam. The level of achievement required for success on the AP exam necessitates that students be able to analyze and synthesize data and developments in different areas, analyze themes, make comparisons, evaluate and assess verbal, graphic, and pictorial evidence, and demonstrate mastery of a wide range of knowledge (Advanced Placement Course Description, 1999).

The AP curriculum developed by BCPS is designed to increase student achievement throughout the academic year so that students attain a high level of performance on the AP exam. As a result, the BCPS AP United States History curriculum requires students to acquire, integrate, extend, and refine knowledge; use knowledge meaningfully; and think critically and creatively. Students in AP United States History therefore must be curious, independent learners; masters of content; and expressive writers. In turn, AP United States History teachers must use creative, active, dynamic methods of instruction to ensure a high level of success (AP US History Curriculum 1998).

A social ecology approach is one method of instruction that is available to teachers as they implement an AP program. In AP United States History, the Human Ecosystem Framework was one social ecology tool that was

selected as the foundation of the research project. This approach provided a venue for exposing students to collegiate expectations and levels of performance while providing students with the opportunity to use the tools of historians and social scientists in order to find meaning and draw conclusions about the past by analyzing the effects of political, economic, social, and environmental factors throughout history. Social ecology and the Human Ecosystem Framework became the organizing idea around which students constructed meaning and extended their knowledge about the history of the United States.

Project Description and Its Relevance to the Course's Existing Curriculum

The infusion of social ecology and the Human Ecosystem Framework into the AP United States history course resulted in an integrated approach, which required students to investigate biological and human systems in order to identify interactions and patterns throughout history. Students utilized skills of inquiry and learning to answer student-generated questions about United States history. This approach did not require the students to investigate information outside of the realm of the curriculum. Rather it provided a unique opportunity to integrate students' prior learning in other disciplines with the new learnings of the AP United States History curriculum. In this instance students were able to transfer their knowledge from science to history. It is important to note that this project could have been just as successful if students were bringing their knowledge of history into an AP Environmental Science class. For instance, students could have applied their knowledge of civil war history to a discussion of late nineteenth century land use patterns around the Loch Raven Reservoir. As a result of such integration, students were able to process the AP United States history information on a variety of historical and theoretical levels, which prepared them for the higher-level thinking skills required by the AP exam. This process of integration is important because it allows students to apply knowledge meaningfully to address real-world issues, conflicts, and solutions.

Background

In conjunction with the Baltimore Ecosystem Study, the students were teamed with a diverse group of biological and social scientists and professionals in order to delve into Baltimore's and the United States' history and the links among the two. Students were able to explore the history of their local area as it relates to the history of the United States as a whole while at the same time exploring how the biological environment affected the development and needs of the human system. This project had two main objectives for students:

1. To apply primary and secondary research skills in order to determine the effects of political, economic, social, and environmental factors throughout history on the watersheds of Loch Raven Reservoir, Prettyboy Reservoir, and Liberty Reservoir.
2. To research and write a book on the land-use history of Loch Raven Reservoir, Prettyboy Reservoir, and Liberty Reservoir watersheds in order to explain and synthesize how the human ecological system has affected political, economic, social, and environmental history throughout the centuries in these locations.

Students were given the task of developing a historical narrative of the effects of political, economic, social, and environmental factors throughout the entire period of United States history in the study areas that became Loch Raven Reservoir, Prettyboy Reservoir, and Liberty Reservoir in order to provide a forester with the historical basis on which to develop a management plan for the forest ecosystems surrounding the three reservoirs. Students were instructed how to use field research as well as historical research in libraries and historical societies throughout the area in order to accomplish this task.

Approach

The research project was a multitiered approach designed to have the students learn from their own research, from each other, and from professionals in the field.

The first tier related to the organization of the research teams. Students were divided into three research teams, one for each reservoir in the Baltimore area: Loch Raven, Liberty, and Prettyboy. Each team had seven members, each of whom was responsible for researching a specific topic:

- Demographics
- Economic structure
- Political structure
- Transportation
- Class, race, and religion
- Public health
- Leisure and recreation

The topics selected are integral to a social ecology approach and the Human Ecosystem Framework. They also reflect the emphasis placed by the BCPS AP United States History curriculum and the AP United States History exam on "political institutions and behavior and public policy, social and economic change, diplomacy and international relations, and cultural and intellectual developments" (Advanced Placement Course Description 1999). By organizing students into three research teams, they were able to learn from each other about a wider range of topics, to compare results and

synthesize data across topics, and thus to develop a more complete account of the land-use history of the reservoir.

The second tier focused on the learning of historical knowledge. As the class encountered each unit in AP United States History, the students' task was to collect data on her or his topic that corresponded to the unit. Each student was responsible for gathering and analyzing data regarding her or his topic and how the topic affected people's attitudes about and towards the environment throughout each historical period. As a result, students were constantly processing United States history at both a national and local level in regards to trend, events, and issues.

The third tier focused on the biological and social scientists and professionals that interacted with the students throughout their research project. The students' link to the scientists and professionals was a result of the connection between the teacher, Karen Hinson and a main contact, Morgan Grove. Dr. Grove was able to provide the students with the opportunity to meet, discuss, exchange e-mail with, and learn from scientists and professionals. Dr. Grove and Ms. Hinson facilitated the relationship between the students, scientists, and professionals by anticipating the needs and approaches of all those in the network.

Project Results and Preparation for Student Assessments

Many school systems throughout the United States are being confronted with county, state, and national assessments that gauge student achievement and performance in specific disciplines. When students are able to perform at high levels on performance assessments, they are better prepared for traditional assessments such as county, state, and national assessments. This research project was also a performance piece for these students. The performance assessment was the book that they provided to the forester in June 1999.

The ultimate assessment for these students is the AP United States History exam. The AP United States History exam requires students to analyze and synthesize data and developments in different areas, analyze themes, make comparisons, evaluate and assess verbal, graphic, and pictorial evidence, and demonstrate mastery of a wide range of knowledge. This project reinforced these skills by having students discover, assess, evaluate, and synthesize data they collected from primary sources such as journals, census records, letters, artwork, maps, and statistical data in order to make comparisons and analyze themes in the reservoir areas. The transfer of knowledge between the local history of the reservoirs to the national history of the United States allowed them to demonstrate proficiency and mastery of knowledge required for success on the AP United States History exam. In the end, they had to express their findings in a written form as they would on the AP United States History exam. The final result was a 22 percent increase in the students' AP scores from the previous year.

The students summed up the success of this project in the introduction to their book.

Amongst the main objectives through the project we, as a class, hoped to gain knowledge of the correlation between people and their environment. These goals combined knowledge of research experience, observing how our own environment changed over time, to understand that historical trends, research methods, and analysis are important to many people in their daily work, to understand how history is relevant to decisions made about where we live, and to witness how our work will be used to protect and serve the reservoirs and people that are using the reservoir watershed. This was also the first time for many of us to complete a large-scale study that would represent our own work in a usable, real situation.

Finally, the students concluded that:

There were successes, both personal and professional throughout our research exploration. Some personal successes included finding obscure data, completing a difficult portion of research, and working in a group to complete a project of which we are proud. Professional successes included making a reputation for our program, working with professionals throughout the study, and the use of such materials as the Human Ecosystem Framework to produce a complete and well-oriented discussion of our environment and habitat.

Relating to Students' Lives

When instruction relates to students' lives in a meaningful way, students become a part of the learning experience. In our course students felt connected to history and the learning became more enduring. By focusing on the communities in which the students live, they began to see history as a process that affects everyone as opposed to being a subject that is merely learned in high school. Students then began to see the relevance of history to their lives and the importance of their communities. They are then able to become capable and informed citizens and decision makers.

Students also began to see that the information they learn and collect is relevant to the public policy decisions relevant to the areas where they live. Public policy began to take on a new perspective for the students. Such decisions as where to locate a reservoir, which once seemed to be made in isolation, began to be seen as complex, multifaceted, historical decisions that can be influenced by informed citizens.

Students also began to see that for people to do their jobs successfully on a daily basis, knowing and understanding historical trends, research methods, and analysis are important. Students were surprised to hear biological scientists discuss history and social scientists discuss ecology. By interacting with a variety of biological and social scientists and professionals, students became exposed to job possibilities and careers of which they previously may have not been aware. They also became aware of the interdisciplinary nature of many jobs. Thus, the project became a career devel-

opment experience as well as a research experience. Indeed, for several of these students the project became the impetus for senior research internships with the Baltimore Ecosystem Study.

Summary and Epilog

We have tried to provide what we consider to be fundamental concepts to a social ecology approach for teaching about urban ecosystems. Further, we have identified key criteria for a social ecology approach in existing curriculum. Finally, we illustrated this approach using our experience working with Karen Hinson's AP United States History course.

We would like to add another point from our experience during the 1998–1999 school year. We found that this project depended upon process as well as content and was successful because of the network of participants—students, teacher, main science contact, scientists, and professionals. When working with such a diverse population, it is important to:

- Ensure the project is appropriate to the curriculum.
- Make certain the project supports student assessments.
- Ensure the project relates to student lives.
- Anticipate the needs and approaches of all members of the network.

During the past 20 years the human population within the Chesapeake Bay ecosystem has increased from 12.5 million to 16 million. Most of the population growth occurred adjacent to metropolitan areas, where 75–100 percent increases are expected during the next century. This population growth and related land use change within the Chesapeake Bay ecosystem has been linked directly to declining water quality and living resources (US EPA 1983).

The city of Baltimore, Maryland, is representative of the problems and opportunities associated with these expanding metropolitan regions. The city and its sprawling suburbs now constitute a complex urban ecological system, characterized by widespread and substantial forms of human interactions with their biosphere (Pickett 1997). Implementation of conservation and restoration strategies for the sustainable development of these urban ecosystems, which now constitute a significant component of the greater Chesapeake ecosystem, has become an integral part of the interstate Chesapeake Bay restoration program.

Resource issues (e.g., those focused on by Karen Hinson's AP United States History course) ultimately concern human behavior and are similar to those faced by numerous metropolitan areas around the world. Initially developed in the rural hinterlands, Baltimore's three reservoirs now are embedded in rapidly urbanizing watersheds. Eutrophication and sedimentation now jeopardize the long-term ability of the reservoirs to store the quantity and quality of water needed by the 1.5 million residents of the

region that depend on them. On top of the need for water, growing population, affluence, and accessibility have fueled an increased demand from residents throughout the region for public recreation opportunities and conservation of biological diversity.

The protection of important ecological processes such as hydrology, nutrient cycling, and maintenance of biodiversity across these heterogeneous landscapes requires the development of cooperative and collaborative working relationships among individuals, communities, businesses, and government agencies (Sample 1994). Forging and sustaining working partnerships will require a halt to mediating conflicts exclusively through technological fixes and expert advice. Resolving competing issues will need "transformative" processes (Bush and Folger 1994) leading to "a change or refinement in the conscience or character of individual(s) . . ." Such a change will require a willingness and ability to listen and learn and a more empathetic relationship with the environment, other members of the community, and other generations: current, past, and future.

Resource decisions will need to integrate the ecological and social dimensions of landscapes in order to provide a more realistic foundation for the selection of conservation strategies. This will require the ability to "reimagine" the biophysical components of Baltimore's watersheds within a social context that will affect the way we think about the reservoir lands and the questions we ask about them in assessing current conditions and future trends. To achieve this, natural resource managers and local citizens will need to understand how to incorporate social information and understanding into their decision making. They will need to incorporate methods committed to providing simple tools to facilitate the rapid collection and interpretation of relevant social data. Experts will need to make a demystified social science available as everyone's tool (Korten 1984).

The social ecology approach we have described provides a logical framework for interdisciplinary assessment, learning, and communication. It is a guide for identifying data needs and a tool for land managers to use in assessing the human dimensions of alternative conservation activities. It is a model for a curriculum that develops students' skills and insights needed for integrating scientific knowledge of ecological and social relationships. It is a significant initial step in our efforts to develop a unified, holistic approach to the conservation of our ecosphere and prompts us to continue our pursuit of the highest and best ideal of conservation: integrating people and their needs with their environment. Ultimately, we hope we have provided the basis for our students to develop the knowledge and judgment they will need as leaders for the conservation of urban ecosystems in the twenty-first century.

Acknowledgments. Support for this research was provided by the Burlington Laboratory (4454) and Global Change Program; Northeastern

Forest Research Station, USDA Forest Service; the National Science Foundation—NSF Grant #DEB–9714835; the Environmental Protection Agency—EPA Grant #R–825792-01-0; and Western School of Technology and Environmental Science, Baltimore County Public Schools, Baltimore County, Maryland. We would also like to thank the following individuals, who made presentations to the class: Mr. Mike Ratcliffe, Census Bureau, Department of Commerce; Mr. Peter D'Adamo, P.E., Johns Hopkins University; Mr. John C. Moore, P.E., Rummel, Klepper, and Kahl, L.L.P.; Dr. Gary Machlis, National Park Service, Department of the Interior; Mrs. Donna Williams, Maryland Historical Society; and Dr. William R. Burch and the students of his Ecosystem Management Course, School of Forestry & Environmental Studies, Yale University.

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Understanding Urban Ecosystems

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With 49 Illustrations

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Cover illustration: *Long Beach, California*, photograph © 1999 by William W. Fuller of Payson, Arizona.

Library of Congress Cataloging-in-Publication Data

Cary Conference (8th: 1999: Institute of Ecosystem Studies)
Understanding urban ecosystems: a new frontier for science and education/editors, Alan R. Berkowitz, Charles H. Nilon, Karen S. Hollweg.
p. cm.
Includes bibliographical references and index.
ISBN 0-387-95496-1 (alk. paper)—ISBN 0-387-95237-3 (pbk.: alk. paper)
1. Urban ecology—Congresses. 2. Ecosystem management—Congresses. 3. Biotic communities—Study and teaching—Congresses. I. Berkowitz, Alan R. II. Nilon, Charles H., 1956– III. Hollweg, Karen S. IV. Title.
HT241 .C37 1999
307.76—dc21 2002070474

ISBN 0-387-95496-1 (hardcover) ISBN 0-387-95237-3 (softcover) Printed on acid-free paper.

9 8 7 6 5 4 3 2 1 SPIN 10877695 (hardcover) SPIN 10793061 (softcover)

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Springer-Verlag New York Berlin Heidelberg
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